1

GLOSSARY OF TERMS

2	PRIMARY TREATMENT APPROACH – PRESERVATION
3	Preservation standards include measures necessary to sustain the existing form, integrity, and materials of a
4	historic property. Work, including preliminary measures to protect and stabilize the property, generally
5	focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive
6	replacement and new construction. Preservation requires the retention of the greatest amount of historic
7	fabric, including the landscape's historic form, features, and details as they have evolved over time.
8	Limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required
8 9	
	work is permitted.
10	
11	HOW TERMINOLOGY IS USED IN THE PRESERVATION APPROACH
12 13	HOW TERMINOLOGY IS USED IN THE PRESERVATION APPROACH
13 14	Maintain – are those standard maintenance practices that are necessary to retain the features of a property
14	
	as a contributing resource. Maintenance activities are usually not classified as repair, however minor repair
16	such as replacement of posts or railings or segments of paving are included. Limited and sensitive
17	upgrading of building systems (mechanical, electrical, plumbing) and other code related work is
18	appropriate.
19	
20	Plant – the removal and replanting of landscape plantings and vegetation as part of maintenance activities
21	
22	Protect – short term and minimal measures used to stabilize and protect features, such as fencing around
23	landscape features
24	
25	Relocate – the removal and resetting of noncontributing features
26	
27	Remove – the removal of nonhistoric features
28	
29	Repair – features, components of features and materials that require additional work. These may include
30	declining building features (e.g., roofing, foundation, mechanical systems) structures, small-scale features
31	(e.g., repair of a railing) or landscape plantings (e.g., repair mass planting by adding infill plantings).
32	Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive
33	features that are repaired will match the old in design, color, texture, and if possible, material.
34	
35	Retain – are those actions that are necessary to allow for a feature (contributing or noncontributing) to
36	remain in place in its contributing current configuration and condition.
37	
38	Stabilize – immediate measures (more than standard maintenance practices) are needed to prevent
39	deterioration, failure, or loss of features.
40	
41	
42	PRIMARY TREATMENT APPROACH – REHABILITATION
43	Rehabilitation in intended to return a property to a state of utility, through repair or alteration, which makes
44	possible an efficient contemporary use while preserving those portions and features of the property which
45	are significant to its historic, architectural, and cultural values. Rehabilitation allows for repairs, alterations,
46	restoration of missing features, and additions necessary to enable a compatible use for a property as long as
47	the portions or features which convey the historical, cultural, or architectural values are preserved. Limited
48	and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work is
49	permitted.
50	

1 2	HOW TERMINOLOGY IS USED IN THE REHABILITATION APPROACH
- 3 4	Maintain – are those standard maintenance practices that are necessary to retain the features of a property as a contributing resource. Maintenance activities are usually not classified as repair, however minor repair
5 6 7	such as replacement of posts or railings or segments of paving are included. Limited and sensitive upgrading of building systems (mechanical, electrical, plumbing) and other code related work is appropriate.
8	appropriate.
9	Plant – the removal and replanting of landscape plantings and vegetation as part of maintenance activities
10 11	or the restoration of missing features.
12	Reestablish – are those measures necessary to depict a landscape feature as it occurred historically.
13 14	Reestablishment may include the replacement of missing landscape features such as views, planting patterns, spatial relationships, or small scale features.
15 16 17	Relocate – remove and reset noncontributing features
17 18 19	Remove – removal of nonhistoric features
20	Repair – features, components of features and materials that require additional work. These may include
21	declining building features (e.g., roofing, foundation, mechanical systems) structures, small-scale features
22	(e.g., repair of a railing) or landscape plantings (e.g., repair mass planting by adding infill plantings).
23	Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive
24 25	features that are repaired will match the old in design, color, texture, and if possible, material.
26	Restore – are those measures necessary to depict a feature or area as it occurred historically. Restoration
27 28	may include repair of a feature so that it appears as it did historically or it may include replacement of missing features or qualities.
29	$\mathbf{P}_{\mathbf{A}}$
30	Retain – are those actions that are necessary to allow for a feature (contributing or noncontributing) to
31 32	remain in place in its contributing current configuration and condition.
32 33	Stabilize – immediate, more extensive measures (more than standard maintenance practices) are needed to
34 35	prevent deterioration, failure, or loss of features.
36	
37	PRIMARY TREATMENT APPROACH – RESTORATION
38	Restoration standards allow for the accurate depiction of a property as it appeared at a particular time in its
39	history by means of the removal of features from other periods in its history and reconstruction of missing
40	features from the period of significance. The limited and sensitive upgrading of systems (mechanical,
41	electrical, plumbing) and other code related work is appropriate.
42	
43	
44	HOW TERMINOLOGY IS USED IN THE RESTORATION APPROACH
45	
46	Maintain – are those standard maintenance practices that are necessary to retain the features of a property
47	as a contributing resource. Maintenance activities are usually not classified as repair, however minor repair
48	such as replacement of posts or railings or segments of paving are included. Limited and sensitive
49	upgrading of building systems (mechanical, electrical, plumbing) and other code related work is
50	appropriate.
51	

Plant – the removal and replanting of landscape plantings and vegetation as part of maintenance activities 1 2 or the restoration of missing features

- 4 **Relocate** – remove and reset noncontributing features
- 6 **Remove** – removal of nonhistoric features

8 **Reestablish** – are those measures necessary to depict a landscape feature as it occurred historically.

9 Reestablishment may include the replacement of missing landscape features such as views, planting 10 patterns, spatial relationships, or small scale features.

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12 **Repair** – features, components of features and materials that require additional work. These may include 13 declining building features (e.g., roofing, foundation, mechanical systems) structures, small-scale features (e.g., repair of a railing) or landscape plantings (e.g., repair mass planting by adding infill plantings). 14 Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive 15 features that are repaired will match the old in design, color, texture, and if possible, material. 16

- 18 **Restore** – are those measures necessary to depict a feature or area as it occurred historically. Restoration 19 may include repair of a feature so that it appears as it did historically or it may include replacement of 20 missing features or qualities. 21
- 22 **Retain** –are those actions that are necessary to allow for a feature (contributing or noncontributing) to remain in place in its contributing current configuration and condition. 23

24

- 25 Stabilize - immediate, more extensive measures (more than standard maintenance practices) are needed to 26 prevent deterioration, failure, or loss of features.
- 27 28

32

29 CONDITION ASSESSMENT DESCRIPTION LEVELS

- 30 Feature Condition Definitions
- 31 (Note: These terms are also applied to the overall structure/building.)
- 33 The feature is intact, structurally sound and performing its intended purpose. The feature GOOD 34 needs no repair or rehabilitation, but only routine or preventive maintenance.
- 35 FAIR The feature is in fair condition if either of the following conditions is present: 36 37 There are early signs of wear, failure or deterioration though the feature is generally structurally sound and performing its intended purpose - or -38 39 There is failure of a portion of the feature. 40
- 41 POOR The feature is in poor condition if any of the following conditions is present: The feature is no longer performing its intended purpose – or – 42 43 Significant elements of the feature are missing - or -44
 - Deterioration or damage affects more than 25% of the feature or -
 - The feature shows signs of imminent failure or breakdown.
- 47 **UNKNOWN** Not enough information is available to make an evaluation.
- 48 49

45 46

50 **RATINGS OF TREATMENT SEVERITY**

An impact is a detectable result of an agent or series of agents having a negative effect on the significant 51

characteristics or integrity of a structure and for which some form of mitigation or preventative action is 52

GLOSSARY OF TERMS

possible. The assessment should include only those impacts likely to affect the structure within the next
five years.

The Level of Impact Severity and their definitions are given below. For all levels, except UNKNOWN, two
 criteria are given. At least one of the criteria must be met for the declared Level of Impact Severity.

7 8 9	SEVERE	 The structure/feature will be significantly damaged or irretrievably lost if action is not taken within two (2) years. There is an immediate and severe threat to visitor or staff safety. 						
10 11 12 13	MODERATE	 The structure/feature will be significantly damaged or irretrievably lost if action is not taken within five (5) years. The situation caused by the impact is potentially threatening to visitor or staff 						
13 14 15		safety.						
16 17 18	LOW	 The continuing effect of the impact is known and will not result in significant damage to the structure/feature. The impact and its effects are not a direct threat to visitor or staff safety. 						
19 20 21	UNKNOWN	Not enough information is available to make an evaluation.						
22 23 24	DEFINITIONS OF	TERMS						
25 26	<u>A</u>							
20 27 28	AAS: Atomic Absor	ption Spectroscopy						
29 30		rent; the movement of current through an electrical circuit that periodically reverses g current is the form of electric power that is delivered to businesses and residences.						
31 32 33	ACM: Asbestos Con	taining Material						
34	Accessibility: a term	used to describe facilities or amenities to assist people with disabilities and can extend						
35		heelchair ramps, elevators/lifts, walkway contours, reading accessibility, etc.						
36	According to its website, the Park Service is "committed to making all practicable efforts to make NPS							
37	facilities, programs, services, employment, and meaningful work opportunities accessible and usable by all							
38		ose with disabilities. This policy reflects the commitment to provide access to the						
39 40		of the public and to ensure compliance with the Architectural Barriers Act of 1968, the f 1973, the Equal Employment Opportunity Act of 1972, and the Americans with						
41		990. The Park Service will also comply with section 507 of the Americans with						
42		USC 12207), which relates specifically to the operation and management of federal						
43	wilderness areas. Th	e accessibility of commercial services within national parks are also covered under all						
44	applicable federal, st	tate and local laws" (source: http://www.nps.gov/aboutus/eeo.htm).						
45								
46	AES-ICP: Atomic E	Emission Spectroscopy – Inductively Coupled Plasma						
47 48	AIH A. American In	dustrial Hygiene Association						
49		Justifal Hygiche Association						
50 51	<i>Air Terminal:</i> A rod	that extends above a surface to attract lightning strikes.						
52	AL: Action Level	AL: Action Level						

<u>B</u>
Beam : a structural member, usually horizontal, with a main function to carry loads cross-ways to its ongitudinal axis.
Branch Circuit: Insulated conductors used to carry electricity to an associated device or devices that originate from a single circuit breaker.
BTUH: British Thermal Unit per Hour; A traditional unit of energy.
BX Cable: Cable with flexible steel armored outer tube with individual copper conductors insulated with rubber and covered with a cotton braided sheath.
<u>C</u>
<i>Cantilever</i> : refers to the part of a member that extends freely over a beam or wall, which is not supported at ts end.
<i>Cast Iron</i> : a large group of ferrous alloys that are easily cast. Cast iron tends to be brittle and is resistant to destruction and weakening by oxidation. The amount of carbon in cast irons is 2.1 to 4 wt%.
CFR: Code of Federal Regulation
Cistern: An underground receptacle for storage of liquids, usually water.
Clay Sewer: Sewer pipe made from vitrified clay that is highly resistant to corrosion.
<i>Column</i> : a main vertical member that carries axial loads from beams or girders to the foundation parallel to ts longitudinal axis.
<u>D</u>
DC: Direct current; the unidirectional flow of current through an electrical circuit. Direct current is produced through such sources as batteries, thermocouples, or photovoltaic solar cells.
Dead Load: describes the loads from the weight of the permanent components of the structure.
Deflection: the displacement of a structural member or system under a load.
DRO: Diesel-Range Organics
$\underline{\mathbf{E}}$
ELPAT: Environmental Lead Proficiency Analytical Testing
EMT: Electro-metallic tubing; A metallic tube raceway that is used to carry and protect current carrying conductors or cables.
EPA: Environmental Protection Agency

1 2	<u>F</u>
2 3 4	Flue Vent: A duct or pipe conveying combustion by-products from a heater or furnace.
5 6	Fluorescent: A source of light that emits light radiation at longer wavelengths and lower energy.
7 8 9	<i>Footing</i> : a slab of concrete or an assortment of stones under a column, wall, or other structural member to transfer the loads of the member into the surrounding soil.
10	Foundation: supports a building or structure.
11 12	FRP: Fiberglass reinforced plastic
13 14 15	Full Sawn (FS): Lumber cut, in the rough, to its full nominal size.
16 17 18	<u>G</u>
19	Gable: located above the elevation of the eave line of a double-sloped roof.
20 21	Galvanized Steel: Steel coated with zinc carbonate to resist corrosion.
22 23	GPM: Gallon per minute; a standard unit of volumetric liquid flow rate.
24 25	<i>Grade</i> : the ground elevation of the soil.
26 27 28	Gravity Vent: Openings in a roof intended to vent hot air by the action of convection.
28 29 20	Gray Water: Wastewater generated from domestic washing activities and not containing human waste.
30 31 32	GRO: Gasoline Range Organics
33 34	Н
35 36 27	Header: a member that carries joists, rafters or beams and is placed between other joists, rafters or beams.
37 38 39	<i>Hip Roof:</i> a roof sloping from all four sides of a building.
40 41	HUD: Housing and Urban Development
42 43	HVAC: Heating, Ventilation, and Air Conditioning.
44 45 46	Ī
46 47 48	IAQ: Indoor Air Quality
48 49 50	IEUBK: Integrated Exposure Uptake Biokinetic
50 51 52	<i>Incandescent:</i> A source of light that works by incandescence, or works by a heat-driven light emission through black-body radiation.

Iı	<i>averter:</i> A device that converts electrical direct current (DC) to electrical alternating current (AC).
J	
Ja	<i>oist:</i> a horizontal structural load-carrying member which supports floors and ceilings.
K	<u>.</u>
	<i>VA</i> : Kilovolt-ampere equal to 1,000 volt-amperes. kVA is a unit to express the apparent power consume an electrical circuit or electrical device.
	<i>W</i> : Kilowatt equal to 1,000 watts. A kilowatt is typically used to express the output power consumption arge devices or electrical systems.
L	
L	BP: Lead-Based Paint
L	CP: Lead-Containing Paint
L	CS: Lead-Contaminated Soils
	<i>each Field:</i> A drain field used to remove contaminants and impurities from liquid that emerges from a eptic tank.
	<i>ED:</i> Light emitting diode; a semiconductor light source that can emit light in various colors and rightness.
L	<i>ive Load</i> : nonpermanent loads on a structure created by the use of the structure.
L	oad: an outside force that affects the structure or its members.
L	ouver: An opening with horizontal slats angled to allow passage of air while keeping out rain and snow
M	<u>I</u>
M	<i>lg/kg:</i> Milligrams per Kilogram
N	· •
N	EC: National Electric Code.
N	ESHAP: National Emission Standards for Hazardous Air Pollutants
N	<i>Conpotable Water:</i> Water that has not been approved for safe human consumption.
N	VLAP: National Voluntary Laboratory Accreditation Program

1	$\underline{\mathbf{O}}$
23	OSHA: Occupational Safety and Health Administration
4 5 6 7	Overcurrent Protection: A fuse, circuit breaker or relay that will open the electrical circuit when the downstream electrical current exceeds the stated current rating.
8 9 10	<u>P</u>
10 11 12	Passive Ventilation: Ventilation of a building without the use of a fan or other mechanical system.
12 13 14	<i>Pitch</i> : the slope of a member defined as the ratio of the total rise to the total run.
14 15 16	PLM: Polarized Light Microscopy
17 18	PV: Photovoltaic; An array of solar modules or cells that collect solar energy and convert the energy into direct current electricity.
19 20 21 22	PVC: Polyvinyl Chloride; A biologically and chemically resistant plastic widely used for household sewage pipe.
23 24 25	<u>R</u>
26 27	<i>Rafter</i> : a sloped structural load-carrying member which supports the roof.
28 29	RBM: Regulated/Hazardous Material
30 31	<i>Reaction</i> : the force or moment developed at the points of a support.
32 33	RLM: Industrial stem mounted reflector.
33 34 35 36	<i>Romex:</i> Wiring with rubber insulated conductors in an overall sheath of braided cotton fiber.
37	<u>S</u>
38 39 40	Seismic Load: loads produced during the seismic movements of an earthquake.
40 41 42 43	<i>Septic Tank:</i> A sewage tank containing anaerobic bacteria which decomposed waste discharged into the tank.
44 45 46	<i>Shear</i> : forces resulting in two touching parts of a material to slide in opposite directions parallel to their plane of contact.
47 48	Snow Load: loads produced from the accumulation of snow.
49 50	<i>Span</i> : the distance between supports.
50 51 52	<i>Step-down Transformer:</i> A device that converts a high voltage down to a lower voltage through a series of winding coils.

1 2 3	<i>Structural Steel</i> : an iron alloy with a carbon content of 0.16% to 0.29%. Steel is malleable, and easily welded.
4 5	<i>Strut</i> : a structural brace that resists axial forces.
6 7	<i>Stud</i> : a vertical wall member used to construct partitions and walls.
8 9 10	<u>T</u>
11 12 13	<i>Thermal Expansion Tank:</i> A tank used in a closed water heating system to absorb excess water pressure caused by thermal expansion.
14	TSI: Thermal System Insulation
15 16 17	<i>Turbine Vent:</i> Vents utilizing rotating wind vanes to create air flow.
18 19 20	V
21 22 23	<i>Vent Stack:</i> A vertical pipe proving ventilation.
23 24 25	$\underline{\mathbf{W}}$
26 27	<i>WAC</i> : Wisconsin Administrative Code
28 29	WDNR: Wisconsin Department of Natural Resources
30 31 32	<i>Wrought Iron</i> : an iron alloy with very low carbon content, in comparison to steel. Wrought iron is tough, malleable, ductile, and easily welded.
33 34 35	X
36 37 38	<i>XRF:</i> X-ray fluorescence analyzer
39 40	<u>Other</u>
40 41 42	<i>30 μg/m3:</i> 30 micrograms per cubic meter
42 43 44	$\mu g/SF$: Micrograms of Lead Dust per Square Foot of Floor Space
44 45 46	<i>1x:</i> Piece of dimensional lumber 1" (nominal) / $\frac{3}{4}$ " (actual) thick

GLOSSARY OF TERMS

APPENDIX A: MATRIX OF TREATMENT ALTERNATIVE

1

APPENDIX A

Landscape		Accessibility	HazMat	Electrical	Mechanical	Structural	Architecture	Proposed Use of Building	Existing Conditions Site Plan - for reference only		
 Selectively ut and remove trees along bank to open views to Light Station from Lake Statize sidore mohartment with planting and ension control measures where needed Clear trees and brush at Light Station to restore meadow 	Spatial Organization/ Views - Vistas/ Clearing/ Topography	Add a freestanding ramp with guardrais at the west entry door and increase the door opening width as well as openings within the first floor. Accessibility by mechanical means to the 2nd floor and Tower is not included at this time.	Bat guano abatement: water intrusion/mold mitigation; soli dharacterization (lead); asbestos sampling of materials to be rehabilitated; remove stabilize lead paint; remove and replace asbestos roofing.	Provide additional PV power to facilitate running of new ventilation equipment. Remove existing lightning protection system rad, after re-rooffic, replace with new system. Remove lighting fixtures, receptacles and distribution base. If required, provide building power distribution and wiring and connect building to site PV system.	Increase ventilation for moisture control. Remove plumbing piping and fixtures. Remove boiler, boiler piping, and radiators.	Improve basement ventilation or reduce humidity in basement to reduce the moisture content of the first floor framing, properly frame first floor joists at windows and stair	Reroof: add gutler/downspout system; increase basement and tower ventilation; repair rust at walk and lartern walls, repairt; seal joints; replace wood wall shingles at domes; repair windows and repaint; repair doors and hardware and repaint; paint exterior timo in doors and window; repair machiny walls and cellings and paint repair damaged plaster at walls and cellings and paint in interior complete; refinish wood foors; add handralls to statis; repair and paint casework. Add a security gate at of the base of tower that allows for air movement. Remove 1929 alterations as possible.	tion at the interior, or self-guided visitor use	- for reference only	t tool tool tool	Asarah Koga Danar Voorang (2) Pool- Anara Voorang (2) Pool- Nata Voorang
dock in current location railing (west side) (value) ciss to working condition by ris and resetting tracks the walks in current locations in circle stones. circle stones. ble frait onew NPS privy, vy NPS)	Circulation/ Site Accessibility	Program access through interpretive wayside exhibits.	Soli characterization (lead),	Provide additional PV power to facilitate running of new wentiation equipment. Engage an LPI (Lightning Protection Institute) certified inspector to perform an inspection of the lightning protection system and provide findings and recommendators in accordance with LPI- 175.	Increase ventilation for moisture control and visitor comtort.	Investigate cracked column bases to determine the structural significance of the cracks, repair or monitor cracks	crease ventilation; investigate replacing one lower ist on a north window for a secure lowver; replace steing brass intake caps and verify operation of all hers; repair interior plasteripain transge; repair trans at door and pain; verify/provide sealari at all terior joints; design a security point (barrier) at base stairs to prevert unguided visitor access	Rehabilitate for self-guided visitor at 1st; guided to to wer.		Interest Control of the second	The fraction of the fraction o
root cellar (clearing vegetation, repair) titor of non-extant Oil Building with corrier markers. 3 accessible privy (ocation TBD by NPS) 5 accessible privy (ocation TBD by NPS)		Program access through interpretive wayside exhibits.	Water intrusion/mold mitgation; soil characterization (lead); asbestos sampling of materials to be republikated; remove/stadiliza lead paint; remove and replace asbestos roofing.	Remove existing lightning protection system and, after re- roofing, replace with new system. Provide additional PV power to building to accommodate new vertilation equipment and new electric refrigerator and stove.	Clean, inspect, and test seweirseptic system. Repairs as needed for operational system. Increase basement ventilation for missitue control. Replace nusted propane piping. Remove propane piping to refrigerator and stowe.	Properly frame fitst floor joists at windows, replace concrete stari landing, repair masonry walls at rear star, investigate load capacity of roof framing and strengthen if necessary	Rerod: repair guters and downspouts, repaint tim on windows and doors, repair VE staf Janding, repair downs and doors, replace missing hardware: repair cracks at plaster and repaint walls and ceilings; refinish trim and wood foro with alligatored finish cost; repair and paint the casework;	Rehabilitate and maintain current use as seasonal NPS housing and visitor access to 1st floor.			
	Small Scale Features	Program access through interpretive wayside exhibits.	Water intrusion/mold mitigation; remove/stabilize lead paint; remove and replace asbestos roofing.	Provide additional PV power, either PV or generator to facilitate running of new ventilation equipment. Replace existing underground power feed and upgrade building wiring to accommodate new ventilation equipment.	Cap and seal unused plumbing piping. Increase ventilation for moisture control.	Repair damaged area of roof	Reroof; repair gutters; repairt siding and trim; repair windows and doors	Preserve and maintain current use as NPS storage.		The navigation of the archipelago. This t the full historical significance of the syste portions of features that convey the histo Period of Significance: 1856 - 1943 Please refer to the proposed treatments	General Description: This treatment alternative proposes reh: Apostle Islands as a system of light stat
materials from Light Station material removal forest	Reservation Vegetation	Program access through interpretive wayside exhibits.	Asbestos sampling of materials to be rehabilitated; remove/stabilize lead paint; remove and replace asbestos roofing;	Replace existing tram hoist with new as required. Provide site power distribution for other rehabilitated buildings.	Replace tram hoist. Increase basement ventilation for moisture control.	Repair masonry walls below concrete roof slab, protect concrete roof slab from continued deterioration	Rerool; add gutters; repair chimney; repair windows and doors, repaint exerior of windows, doors, and trim	- I maintain current use as NPS storage and		em. Additions that are necessary to ena orical, cultural, or architectural values are below.	abilitating each island's cultural landscap
 Restore orchard planting pattern by planting fruit trees. Prune existing apple tree Restore pine plantings - remove all trees and replant. Restore missing features of OH Michigan Restore missing features of OH Michigan Iendrape to 1928 A restore missing features of Keepers Quarters landscape to 1928 Restore missing features of Keepers Quarters Maintain contributing pine west of Old Michigan Island Lighthouse Remove non-contributing trees in lawn area Remove and replant cedar hedge 	Station Vegetation	Program access through interpretive wayside exhibits.	Remove/stabilize lead paint	No action at this time.	No action at this time.	Construct a concrete foundation, repair and strengthen first floor joists or replace with concrete slab-on-grade, strengthen or reframe walts, strengthen or reframe roof	Reroof: foundation repair, repaint siding and trim; repair windows and doors and repaint; install plexi parel system (operable) to allow visitor to see in but closeable to maintain security and weather tight closure	Preserve for storage for NPS use; possible plexi panel at door to allow visitor visual access.		the navigation of the archipelago. This treatment will reveal this continum by restoring missing historic features, and by repairing or altering others to convey the full historical significance of the system. Additions that are necessary to enable the compatible use of the light stations or islands are allowed as long as period of Significance: 1856 - 1943 Please refer to the proposed treatments below.	PREFERRED ALTERNATIVE: REF
		Program access through interpretive wayside exhibits.	Remove/stabilze lead paint.	No action at this time.	No action at this time.	Repair walls of concrete vault, reset or replace both spot footings	Restore roof shingles: repair foundation: repaint windows, doors, siding, and trim: install plexi panel system (operable) to allow visitor to see in but closeable to maintain security and weather tight closure	Rehabilitate; plexi panel at door to allow visitor visual access.		s or islands are allowed as long as	REHABILITATION A - DUAL PERIOD A NAVIGATIONAL CONTINUUM REVISED 03.08.2011 REVISED 03.08.2011 inted to particular periods of development in

1 APPENDIX B: SUMMARY OF HAZARDOUS MATERIAL FINDINGS

APPENDIX B

Building Number	LCS ID 006371				
Building Name	Old Michigan Island Lighthouse				
>1% Asbestos Confirmed	Heater Component Adhesive				
Asbestos Assumed ⁵¹	Wall/Ceiling Plaster, Wall/Ceiling Interiors, Wall/Ceiling Insulation, Adhesives, Thermal Systems Insulation, Roofing Materials, Flooring, Tar and Tar Paper, Brick/Block Filler, Caulk, and Transite				
Detectable Lead in Paint Confirmed	Window Sashes and Trims and Door and Door Trims				
Detectable Lead in Paint Assumed	Exterior Painted Surfaces and Tower				
Lead Dust on Floors >40 µg/SF Confirmed ⁵²					
Lead Dust on Floors >40 μ g/SF Assumed ²	Throughout				
Lead Dust on Floors <40 µg/SF Confirmed ²					
Visual Mold	Yes				
Lead in Soils >50 mg/kg ⁵³	Roof Drip line				
Lead in Soils <50 mg/kg					
Lead in Soils Assumed					

OLD MICHIGAN ISLAND LIGHTHOUSE 1

< = Greater Than

< = Less Than

k = Less finan µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space mg/kg = Milligrams of Lead per Kilogram of Soil ⁵¹ Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment.

⁵² In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.

⁵³ In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

APPENDIX B

1 **KEEPERS QUARTERS**

Building Number	LCS ID 006389
Building Name	Michigan Island Keepers Quarters
>1% Asbestos Confirmed	Granular Plaster Between Wall Slats
Asbestos Assumed ⁵⁴	Wall/Ceiling Plaster, Wall/Ceiling Interiors, Wall/Ceiling Insulation, Adhesives, Thermal Systems Insulation, Roofing Materials, Flooring, Tar and Tar Paper, Brick/Block Filler, Caulk, and Transite
Detectable Lead in Paint Confirmed	Window Sash and Trims, Doors and Door Trims, Walls and Ceilings
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed ⁵⁵	
Lead Dust on Floors >40 μ g/SF Assumed ²	
Lead Dust on Floors <40 µg/SF Confirmed ²	Living Room Floor
Visual Mold	
Lead in Soils >50 mg/kg ⁵⁶	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	

< = Greater Than

< = Less Than

 $[\]mu$ g/SF = Micrograms of Lead Dust per Square Foot of Floor Space

mg/kg = Milligrams of Lead per Kilogram of Soil

⁵⁴ Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment.

⁵⁵ In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead

dust per square foot of floor space. ⁵⁶ In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

1 SECOND TOWER

Building Number	LCS ID 006372
Building Name	Michigan Island Second Tower
>1% Asbestos Confirmed	
Asbestos Assumed ⁵⁷	Insulation, Plaster and Adhesives
Detectable Lead in Paint Confirmed	Window Sash and Trims, Doors and Door Trims, Walls and Ceilings
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed ⁵⁸	
Lead Dust on Floors >40 μ g/SF Assumed ²	Throughout
Lead Dust on Floors <40 µg/SF Confirmed ²	
Visual Mold	
Lead in Soils >50 mg/kg ⁵⁹	Roof Dripline and Low Lying Areas Outside of Dripline
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	

2 3

< = Greater Than

< = Less Than

 $[\]mu g/SF =$ Micrograms of Lead Dust per Square Foot of Floor Space

⁵⁷ Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment.

 ⁵⁸ In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.
 ⁵⁹ In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for

⁵⁹ In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

APPENDIX B

1 ASSISTANT KEEPERS QUARTERS AND WORKSHOP

Building Number	LCS ID 006388
Building Name	Michigan Island Assistant Keepers Quarters and Workshop
>1% Asbestos Confirmed	
Asbestos Assumed ⁶⁰	Wall/Ceiling Plaster, Wall/Ceiling Interiors, Wall/Ceiling Insulation, Adhesives, Thermal Systems Insulation, Roofing Materials, Flooring, Tar and Tar Paper, Brick/Block Filler, Caulk and Transite
Detectable Lead in Paint Confirmed	Window Sash and Trims, Doors and Door Trims, Walls and Ceilings
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed ⁶¹	
Lead Dust on Floors >40 μ g/SF Assumed ²	Throughout
Lead Dust on Floors <40 µg/SF Confirmed ²	
Visual Mold	
Lead in Soils >50 mg/kg ⁶²	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

2 3

< = Greater Than

< = Less Than

 $[\]mu$ g/SF = Micrograms of Lead Dust per Square Foot of Floor Space

⁶⁰ Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment.

⁶¹ In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead

dust per square foot of floor space. ⁶² In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

1 **POWER HOUSE**

Building Number	LCS ID 006386
Building Name	Michigan Island Power House
>1% Asbestos Confirmed	
Asbestos Assumed ⁶³	Wall/Ceiling Plaster, Wall/Ceiling Insulation, Adhesives, Thermal Systems Insulation, Roofing Materials, Flooring, Gaskets, Brick Filler and Caulk
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed ⁶⁴	
Lead Dust on Floors >40 µg/SF Assumed ²	Throughout
Lead Dust on Floors <40 µg/SF Confirmed ²	
Visual Mold	
Lead in Soils >50 mg/kg ⁶⁵	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

2 3

< = Greater Than

< = Less Than

 $[\]mu g/SF =$ Micrograms of Lead Dust per Square Foot of Floor Space

⁶³ Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment

⁶⁴ In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.

⁶⁵ In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

APPENDIX B

1 SHED

Building Number	LCS ID 006373
Building Name	Michigan Island Shed
>1% Asbestos Confirmed	
Asbestos Assumed ⁶⁶	Insulation, Plaster, Transite, Roofing Materials and Adhesives
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed ⁶⁷	
Lead Dust on Floors >40 μ g/SF Assumed ²	
Lead Dust on Floors <40 µg/SF Confirmed ²	
Visual Mold	
Lead in Soils >50 mg/kg ⁶⁸	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

2 3

< = Greater Than

< = Less Than

 $[\]mu g/SF =$ Micrograms of Lead Dust per Square Foot of Floor Space

⁶⁶ Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment.

⁶⁷ In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.

⁶⁸ In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

1 **PRIVY**

Building Number	LCS ID 006385
Building Name	Michigan Island Privy
>1% Asbestos Confirmed	
Asbestos Assumed ⁶⁹	Insulation, Plaster, Transite, Roofing Materials and Adhesives
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed ⁷⁰	
Lead Dust on Floors >40 μ g/SF Assumed ²	Throughout
Lead Dust on Floors <40 µg/SF Confirmed ²	
Visual Mold	
Lead in Soils >50 mg/kg ⁷¹	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	

< = Greater Than

< = Less Than

 $[\]mu$ g/SF = Micrograms of Lead Dust per Square Foot of Floor Space

mg/kg = Milligrams of Lead per Kilogram of Soil

⁶⁹ Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment.

⁷⁰ In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.

⁷¹ In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

APPENDIX B

APPENDIX C: MATERIAL ANALYSIS REPORTS, MICHIGAN ISLAND 1

APPENDIX C

1 MICHIGAN ISLAND ACM SAMPLE CHART

Sample #	Sample Date	API ID	Sample Location	Material Description	Laboratory Result
B-MIAKQ-SF-01	9/14/2009	26589	Assistant Keepers Quarters and Workshop	Green pattern sheet flooring	ND
B-MIS-TP-01	9/14/2009	26585	Shed	Tar paper	ND
B-MIKQ-WT-01	9/14/2009	26766	Keepers Quarters	White texture and White/multicolored paint	ND
B-MIKQ-WP-01	9/14/2009	26766	Keepers Quarters	White granular plaster between slats	2% Chrysotile
B-MIOLH-WP-01	9/14/2009	26572	Old Michigan Island Lighthouse	Wall plaster between slats	ND
B-MIOLH-WM-01	9/14/2009	26572	Old Michigan Island Lighthouse	Black/gray fibrous window matting in tower	ND
B-MIOLH-WT1-01	9/14/2009	26572	Old Michigan Island Lighthouse	Thick troweled on wall texture	ND
B-MIOLH-MA1-01	9/14/2009	26572	Old Michigan Island Lighthouse	Silver mastic on heater	ND
B-MIOLH-MA2-01	9/14/2009	26572	Old Michigan Island Lighthouse	Black mastic between heater components	4% Chrysotile
B-MIOLH-WB-01	9/14/2009	26572	Old Michigan Island Lighthouse	Cement wall board with texture	ND
B-MIOLH-WB2-01	9/14/2009	26572	Old Michigan Island Lighthouse	Cement wall board with texture	ND
B-MIOLH-SF1-01	9/14/2009	26572	Old Michigan Island Lighthouse	Blue/tan square sheet flooring with black backing	ND

ND=None Detected

TR=Trace, <1% Visual Estimate

3 4 5

APPENDIX C

MICHIGAN ISLAND LEAD SAMPLE CHART

Sample ID	Sample Type	API ID	Sample Location	Sample Date	Sample Area (sq ft)	Lead (ug)	Repor ting Limit (ug/sq ft)	Lead Concentration (ug/sq ft)
W- 091409- MIKQ- 01	Composite Wipe	26766	Keepers Quarters	9/14/2009	0.33	39	15	119

1	APPENDIX D: FABRIC ANALYSIS
2	

APPENDIX D

5

6

Fabric Analysis Michigan Island Apostle Island National Lakeshore October, 2009

7 On Tuesday, October 6, 2009, David Arbogast, architectural conservator, of Davenport, Iowa, received a 8 large box containing paint and mortar samples from Elizabeth Hallas, AIA, LEED AP. Senior Associate of Andrews & Anderson Architects, PC of Golden, Colorado. She is in the process of preparing Historic 9 10 Structures Reports for the historic lighthouse complexes of the Apostle Islands National Lakeshore, headquartered in Bayfield, Wisconsin. As part of the HSRs paint and mortar/plaster analysis is required in 11 an attempt to ascertain historic finishes, mortars, and plasters for the subject structures. The samples were 12 13 divided into sets contained within large manila mailing envelopes. The analysis follows the order in which the large envelopes have been arranged. The three sets which are contained within this report were from the 14 15 Michigan Island Lighthouse Complex. There were 26 samples in the first set, of which 21 were paint samples and the final five samples were of plaster and mortar, all of which were collected from the Old 16 Michigan Lighthouse. The second set of samples (nos. 27 - 50) contained 24 samples, of which 22 were 17 paint samples and two (nos. 39 and 40) were of plaster and mortar. These were collected from 18 miscellaneous structures at the complex on Michigan Island. The third set of samples (nos. 51 - 63) 19 consisted of ten paint samples and three mortar and plaster samples (nos. 51, 54, and 60). 20 21 During the preceding twenty or more years Mr. Arbogast has performed paint analyses for various structures at the Apostles Islands. Those samples and his reports are in the archives at the headquarters in 22 23 Bayfield and may be examined in relation to the findings from this analysis. 24 The paint samples were visually examined on Wednesday, October 7, using an optical Olympus 25 microscope having magnification between 14 and 80 power. Each layer observed was color matched to the Munsell System of Color using natural north light. Only opaque, pigmented layers (i.e. paint layers) were 26 27 matched. It is impossible to determine colors match for finishes such as metallic paints and leafs and 28 shellacs and varnishes because their color is directly affected by their translucency and reflectance. 29 30 The Munsell System of Color is a scientific system in which colors have been ranged into a color fan based upon three attributes: hue or color, the chroma or color saturation, and the value or neutral lightness or 31 darkness. Unlike color systems developed by paint manufacturers, the Munsell system provides an 32 unchanging standard of reference which is unaffected by the marketplace and changing tastes in colors. 33 34 35 The hue notation, the color, indicates the relation of the sample to a visually equally spaced scale of 100 36 hues. There are 10 major hues, five principal and five intermediate within this scale. The hues are 37 identified by initials indicating the central member of the group: red R, yellow-red YR, yellow-38 green YG, green G, blue-green BG, blue B, purple-blue PB, purple P, and red-purple R. The hues in each

group are identified by the numbers 1 to 10. The most purplish of the red hues, 1 on the scale of 100, is
designated as 1R, the most yellowish as 10R, and the central hue as 5R. The hue 10R can also be expressed
as 10, 5Y as 25, and so forth if a notation of the hue as a number is desired.

42

43 Chroma indicates the degree of departure of a given hue from the neutral gray axis of the same value. It is

the strength of saturation of color from neutral gray, written /0 to /14 or further for maximum colorsaturation.

46

47 Value, or lightness, makes up the neutral gray axis of the color wheel, ranging from black, number 1, to

48 white at the top of the axis, number 10. A visual value can be approximated by the help of the neutral gray

APPENDIX D

1		vals. The color parameters can be expressed with figures			
2	semi-quantitatively as: hue, value/chroma (H, V/C). The color "medium red" should serve as an example				
3	for presentation with the three color attributes, 5R 5.5/6. This means that 5R is located in the middle of the				
4		the middle between light and dark, and 6 is the degree of			
5	the Munsell chroma, or the color saturation, which	is about in the middle of the saturation scale.			
6					
7		ppered plastic bags which were labeled and numbered.			
8	The analysis follows the numbering system used in				
9	ranged from fair to quite excellent. Because of the				
10		s to be missing older layers seen in other, better samples.			
11	The layers are listed from top (most recent) to both	om (oldest). The following results were obtained from			
12	the analysis:				
13					
14					
15	Old Mich	igan Lighthouse			
16	Sample 1	Munsell			
17	Dark green	10GY 3/4			
18	Green	5G 5/2			
19					
20	The first sample was collected from the exterior w	indow shutters. There were only two paint layers on its			
21		prime coat. Both were latex paints and could not date			
22	from the construction of the building.	r			
23	6				
24					
25	Old Mich	igan Lighthouse			
26	Sample 2	Munsell			
27	Dark green	10GY 3/4			
28	Green	5G 5/2			
29	Black	5G 3/1			
30	Dark green	5G 4/2			
31	White	5Y 9/1			
32	() IIIC				
33	The second sample came from the exterior window	v sash. It revealed several additional paint layers not seen			
34	in the first sample, including an oldest layer of whi				
35	in the first sample, meruding an ordest rayer of win	te punt.			
36					
37	Old Mich	igan Lighthouse			
38	Sample 3	Munsell			
39	Dark green	5G 3/4			
40	White	5Y 9/1			
41	White	5Y 9/1			
42	Black	5G 3/1			
43	White	50 5/1 5Y 9/1			
43 44	Black	5G 3/1			
45	Dark green	5G 3/4			
45 46	Black	5G 3/4 5G 3/1			
	White	5Y 9/1			
47 48	W IIIIC	J 1 7/ 1			
	The third sample was removed from the autorier	indow trim Ita lowers although this were easily			
49 50	The third sample was removed from the exterior w				
50 51		e second sample, the oldest layer was white. This was an			
51	oil paint which had yellowed to its present shade b	ut was probably white originally.			

1			
2	Old Michigan Lighthouse		
3	Sa	mple 4	Munsell
4		hite	N 9.5/
5		hite	N 9.5/
6		hite	N 9.5/
7		hite	N 9.5/
8		hite	N 9.5/
9		hite	N 9.5/
10	•••		
11	The fourth sample was from the exte	rior wall There were several la	ayers of stark white paint above multiple
12	layers of whitewash. The whitewash		
13	whitewash does not form distinct lay		
14			and the precise number of hayers.
15			
16		Old Michigan Lighthouse	
17	Sa	mple 5	Munsell
18		rk green	5G 3/4
19		een	5G 5/2
20		hite	5Y 9/1
21		ack	5G 3/1
22		een	5G 5/2
23		hite	5Y 9/1
24			//-
25	The fifth sample was found on the ro	of trim Its oldest white laver	like that of the third sample, was cleanly
26	separated from its substrate.		
27	····		
28			
29		Old Michigan Lighthouse	
30	Sa	mple 6	Munsell
31		rk green	5G 3/4
32		hite	5Y 9/1
33			
34	The sixth sample was collected from	the roof trim of the new additi	on. Like the first sample it retained only
35	two layers of latex paint.		1 5
36	5 1		
37			
38		Old Michigan Lighthouse	
39	Sa	mple 7	Munsell
40		een	5G 5/4
41	Da	rk green	5G 3/4
42	Da	rk green	5G 3/4
43	Ve	ery dark green	5G 3/2
44	Gr	een	5G 5/2
45		ery dark green	5G 3/2
46		rk green	5G 3/4
47		een	5G 5/4
48	Da	rk green	5G 3/4
49		een	5G 5/4
50	Da	rk green	5G 3/4
51		een	5G 5/4
52	Da	rk green	10GY 3/4

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1		Green	5G 5/4
2		White	5Y 9/1
3		White	5Y 9/1
4		Gray	5Y 7/1
5		White	5Y 9/1
6		white	51 9/1
	T1		
7			he Old Michigan Lighthouse. It was
8			arge set of thin, evenly applied paint
9	layers. The gray layer was compl	etely detached from the white laye	er above it. The oldest white layer was
10	very thin and probably served as	a prime coat for the gray layer.	
11	5 1 5		
12			
13		Old Michigan Lighthous	
		Old Michigan Lighthouse	
14		Sample 8	Munsell
15		Off-white	5Y 8.5/1
16			
17	The eighth sample came from the	e new living room trim. It retained	only one paint layer on its wood
18	surface.	-	
19			
20		Old Michigan Lighthouse	
21		Sample 9	Munsell
22		Gray	N 7.0/
23		Gray	N 6.5/
24			
25	The ninth sample was removed fi	rom the living room wall. It retain	ed only two layers of paint. It is quite
26	possible that the wall may have b	been painted with calcimine paint of	originally in light of the fact that the
27			ve been the use of wallpaper on the
28	walls.	interj, antiough possione, inight na	ve been the use of wanpaper on the
29	wuns.		
30		Old Mishigan Lighthama	
		Old Michigan Lighthouse	
31		Sample 10	Munsell
32		Light green	2.5BG 7/4
33		Dark green	5G 3/4
34		White	5Y 9/1
35		Gray	N 6.5/
36			
37	The tenth sample was from the d	ining room wall. It retained four n	aint layers with the oldest of the set
	1	6	and layers with the oldest of the set
38	matching the older of the two pai	int layers of the fiving foom.	
39			
40			
41		Old Michigan Lighthouse	
42		Sample 11	Munsell
43		Tan	2.5Y 7/3
44			
45	The eleventh sample was found o	on the kitchen wall. It retained only	y a single layer of paint on its surface.
46	The eleventh sample was round o	in the literion wall. It founded only	, a single layer of paint on its sarrace.
47			
48		Old Michigan Lighthouse	
49		Sample 12	Munsell
50		Tan	2.5Y 7/3
51		Tan	2.5Y 7/3
52			

The twelfth sample was collected from the dining room/living room/kitchen ceiling. It retained two layers 1 2 of tan paint on its surface in contrast to the single layer seen in sample 11. 3 4 5 **Old Michigan Lighthouse** 6 Sample 13 Munsell 7 Gray N 6.0/ 8 Tan 2.5Y 7/3 9 Off-white 5Y 9/2 10 Red 7.5R 5/6 11 Off-white 5Y 8.5/1 12 13 The thirteenth sample came from the entry wall. It revealed five layers of paint with off-white being the 14 oldest of the set. 15 16 **Old Michigan Lighthouse** 17 18 Sample 14 Munsell 19 Off-white 5Y 8.5/1 20 21 The fourteenth sample was removed from the watchroom wall. It retained a single layer of off-white paint 22 on its surface. 23 24 25 **Old Michigan Lighthouse** 26 Sample 15 Munsell Off-white 27 5Y 8 5/1 White 5Y 9/1 28 29 Tan 2.5Y 7/3 30 Off-white 5Y 8.5/1 31 Off-white 5Y 8.5/1 Light blue 32 7.5B 8/4 33 White N 9.5/ 34 White N 9.5/ 35 The fifteenth sample was from the watchroom ceiling. In contrast with the previous sample, this retained at 36 least eight layers of which the oldest two stark white layers were relatively crumbly and may have actually 37 been whitewash rather than paint. 38 39 40 41 **Old Michigan Lighthouse** 42 Sample 16 Munsell 43 Light green 2.5BG 7/3 44 Off-white 5Y 8.5/1 45 White N 9.5/ 46 White N 9.5/ 47 48 The sixteenth sample was found on the wall/ceiling of bedroom #1. Its oldest pair of stark white layers 49 matched those of sample 15. 50 51 52 **Old Michigan Lighthouse**

APPENDIX D

1	Sample	17	Munsell		
1 2	Light g		2.5G 8/4		
3	Tan	con	2.5Y 7/3		
4	1 411		2.51 115		
5 6 7	The seventeenth sample was collected from under the window seat of bedroom #1. It revealed a pair of paint layers with tan as the older of the two.				
8					
o 9	C	ld Michigan Lighthouse			
10	Sample	0 0	Munsell		
11	White		N 9.5/		
12	White		N 9.5/		
12	White		N 9.5/		
13	winte		IN 9.3/		
14	The eighteenth sample came from the tow	er window. It consisted of	fmultiple layers of whitewash — the		
16	exact number of layers being impossible t				
17	exact number of layers being impossible t	o determine given the nau	are of the material.		
18					
19	ſ	ld Michigan Lighthouse			
20	Sample		Munsell		
20	Off-wh		5Y 8.5/1		
21	White	ite	5Y 9/1		
22	Off-wh	ita	5Y 8.5/1		
23	White	ite	5Y 9/1		
24 25	winte		51 9/1		
23 26	The nineteenth sample was removed from	the window trim of the to	war. It ratained four alternating layers		
20 27	of off-white and white oil-based paint.	the window triff of the t	wer. It retained four alternating layers		
28	of on-white and white on-based paint.				
28 29					
30	ſ	ld Michigan Lighthouse			
31	Sample		Munsell		
32	White	20	N 9.5/		
33	White		N 9.5/		
34	White		N 9.5/		
35	winte		IN 9.3/		
36	The twentieth sample was from the tower	wall Like sample 18 it o	onsisted entirely of multiple layers of		
37	whitewash.	wan. Like sample 18, it e	onsisted entirely of multiple layers of		
38	white wash.				
39					
40	ſ	ld Michigan Lighthouse			
40	Sample	0 0	Munsell		
42	Dark bi		10YR 4/1		
43	Black	own	5Y 2/1		
44	Black		5Y 2/1		
44	Black		5Y 2/1		
46	Black		5Y 2/1		
40	White		N 9.5/		
48	White		N 9.5/		
49	White		N 9.5/		
49 50	vv litte		11 2.01		
50 51	Sample 21 was found on the stair trim of	he tower Reneath multin	le lavers of black paint were multiple		
52	layers of whitewash.	ne to wer. Deneath multip	to age to block punt were multiple		

52 layers of whitewash.

1 2

As noted in the introduction above samples 22 through 26 from the Old Michigan Lighthouse on Michigan
 Island consisted of mortar and plaster samples. These were analyzed on Thursday, October 8 utilizing the
 standard testing procedure developed by E. Blaine Cliver, Regional Historical Architect of the North
 Atlantic Region of the National Park Service.

7 8

9 Sample 22 was from the kitchen plaster. It was off-white in color and consisted of small bits of plaster.
10 There was no reaction with the hydrochloric acid, indicating a mixture of gypsum and sand as opposed to
11 lime and sand. The sand sieve analysis revealed relatively fine sand. The portion which passed all of the

12 sieves was white as opposed to the darker color of the sand. It was probably gypsum powder.

13

14

15 Sample 23 was taken from the watchroom plaster. It was similar to the first sample, but with a very thin 16 skim coat of white plaster on its surface. It also contained a few hairs in the plaster. When tested with hydrochloric acid there was a very miniscule reaction which was not measurable. There is no doubt that, 17 like the first sample, this was composed of gypsum and sand and not lime and sand. The sand sample was 18 19 unusually large. It revealed both sand and gypsum as in the first sample. However, the gypsum appeared at both ends of the spectrum – as white dust passing all of the sieves and as large bits of the white skim coat 20 21 which were unbroken and undissolved by the acid and which did not pass any of the sieves. Discounting for that factor, the sand appeared to be similar, if not the same, as in the first sample. 22

23

24

25 Sample 24 was of the mortar of the light tower. It was tan in color and was moderately hard. It had a very 26 prolonged reaction which produced a thick foam. Interestingly, there was a very low water displacement as 27 a result. These two factors - a prolonged reaction with a very low water displacement are typical of cement 28 and sand mortars. The color is not typical, however, nor is the moderate hardness, as well as the moderate 29 filtering time. Portland cement mortars typically produce gelatinous by-products but none were found here. Likewise, they typically take several days to filter, which was not the case here. It appears, then, that 30 natural cement was used with the sand rather than Portland cement or lime. Natural cement, as its name 31 32 implies, is guarried from the ground and is similar to the cements the Romans used for their construction. 33 Portland cement, named after Portland, England where it was invented and first manufactured, is synthetic 34 cement. The primary difference is that natural cement contains a wider range of possible elements which 35 can affect its performance whereas Portland cement is completely predictable and consistent. As a result, Portland cement is hard, impervious, and brittle. Natural cements tend not to be as hard or impervious or 36 37 brittle, plus their color is different (shades of gray to white for Portland cement and tan or buff for natural cement). Natural cements were overtaken by Portland cement in the later decades of the nineteenth century 38 39 as natural cement quarries played out and production costs for Portland cement became competitive. 40 Generally, if one encounters natural cement it is an indication that it is from a nineteenth century structure. 41 The sand sieve analysis revealed very nicely graded, fine sand of which virtually all passed the largest sieve 42 and less than 4% passed all of the sieves. Almost 60% was trapped in sieve #30. 43 44 45 Sample 25 was collected from the closet plaster. Although of a considerably smaller size than sample 23, it

45 Sample 25 was confected from the closet plaster. Although of a considerably smaller size than sample 25, 46 was virtually identical to it in its other aspects such as a thin white skim coat, tan plaster, miniscule

47 reaction, and an extraordinarily fast filtering speed. There is no doubt that this is also a gypsum and sand

48 plaster. The sand sieve analysis was also roughly similar with a larger proportion of gypsum powder

49 passing all of the sieves and a smaller proportion of bits of skim coat trapped in the largest sieve.

size. Although there was a miniscule amount of fi The sample bore the closest resemblance to sample	tatistical reliability was somewhat hampered by its sines produced, they were not large enough to be weighted by the second samples 23 and 25 it gave clear evidence of the seco
	eve analysis resulted in all of the sand passing the lar
sieve and a relatively high proportion of gypsum of	uust passing all of the sieves.
Mortar/Plaster/S	tucco Analysis Test Sheet
Sample No. 22	
	se, Michigan Island, Apostle Islands NL
Location: Kitchen plaster	
Sample Description: Off-white, very soft, no	reaction, extremely fast filtering time
Test No. 1 – Soluble Fraction	
Data:	
1. <u>185.5</u> Container A weight	8. <u>No</u> Hair or fiber <u></u> type
2. <u>208.6</u> Container A and sample	9. <u>2.7</u> Fines and paper weight
3. 761.24 Barometric pressure	10. <u>2.6</u> Filter paper weight
4. <u>23</u> Temperature	11. 204.3 Sand and Container A weight
5. <u>0.00</u> Liters of water displaced	12. <u>15.0</u> cc. of sand
6. <u>Off-white</u> Filtrate color	13. 47.5 Weight of graduated cylinder and sand
7. <u>Tan</u> Fines color	14. 28.7 Weight of graduated cylinder
Computations:	
15. <u>23.1</u> Starting weight of sample: No. 2	2 – No. 1
16. <u>0.1</u> Weight of fines: No. 9 – No. 10	
17. <u>18.8</u> Weight of sand: No. 11 – No. 1	
18. <u>.80</u> Sand density: No. 12 divided by (1	
19. <u>4.2</u> Weight of soluble content: No. 1	
	0.016 divided by (No. 4 + 273.16 C.)
21. <u>0 00</u> Gram weight of CaCO3: 100 x N	
22. 4.2 Gram weight of Ca(OH)2: No. 1	
23. <u>.0568</u> Mols. of Ca(OH)2: No. 22 divide	
24. <u>4.2</u> Gram total weight of Ca(OH)2: [^]	74 x (No. 20 + No. 23)
25. <u>0.00</u> Gram weight CO2: No. 20 x 44	
26. <u>2.50</u> Gram weight total possible CO2	
27%CO2 gain: No. 25 divided by N	No. 26
Conclusions:	
28. <u>23.10</u> Gram weight of sample:	No. 15 – No. 25
29. <u>0.43</u> Fine parts/volume:	No. 16 divided by No. 28
30. <u>64.94</u> Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31Lime parts/volume:	(No. 24 divided by No. 28) x 1.1
-	· · · · ·
Cement (if present)	
32Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
1	× 2 /

1 2	34	Lime with cement parts/v	volume:	(No. 16 x o.2)	divided by No. 28 x 1.1
3 4 5	Test No. 2 – Sa	and Sieve Analysis			
5 6	Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
7	No. 10		<u>106.8</u>	0.0	
8	No. 20	107.3	106.4	0.9	4.84
8 9	No. 30	101.3	99.3	2.0	10.75
10	No. 40	101.5	100.8	7.9	42.47
10	No. 50	99.3	93.2	6.1	32.80
11	Base	72.9	71.2	1.7	9.14
12	Dase		/1.2	1./	9.14
13 14					
14 15					
15 16		Monton/D	lastar/Stugge A	nalysis Test She	at
10 17		Mortar/P	laster/Stucco Al	harysis Test She	el
17					
18 19	Samula Ma	22			
19 20	Sample No.	Old Michigan L	ighthouse Migh	icon Island Ana	stle Islands NI
20 21	Logation:	Watchroom plas	<u>ignulouse, mich</u>	igan Island, Apos	
21	Location.	watchiooni plas	ster		
22	Sample Deserie	ntion: Off white with	yory thin white	alim agat mad	erately hard, extremely minimal
23 24		nely rapid filtering time	very tilli willte	Skilli Coat, Illou	eratery hard, extremely minimar
24 25	<u>reaction, extren</u>				
23 26					
20 27	Test No. 1 – So	Juble Fraction			
28	1031110.1-50				
28 29	Data:				
30	1. 188.9	Container A weight	8 V.	s Hair or fiber	type
31	2. 208.9	Container A and sample		<u>4</u> Fines and pa	
32	3. 761.24			<u>Filter paper v</u>	
33	4. 23			4.5 Sand and Cor	
34	5. 0.00	Liters of water displaced		$\frac{4.5}{2.0}$ cc. of sand	italier A weight
35		Filtrate color			aduated cylinder and sand
35 36	7. Tan	Fines color		<u>.2</u> Weight of grad	
	/. <u> </u>		14. <u>20</u>		
37 38	Computations:				
38 39	15. 20.0	Starting weight of sample	a No 2 No 1		
39 40	15. 20.0 16. 0.1	Weight of fines: No. 9 –			
40 41		Weight of sand: No. 11			
41	17. <u>15.6</u> 18774	Sand density: No. 12 div		No. 14)	
			2 (/	
43		Weight of soluble conten	· ·	· · · · · · · · · · · · · · · · · · ·	272.16C
44 45	20. 0.00	Mols. Of CO2: No. 5 x N		vided by (No. 4 7	- 2/3.10 C.)
45 46	21. 0.00	Gram weight of CaCO3:		21	
46 47	22. 4.3	Gram weight of Ca(OH)2			
47 48	23. <u>.0581</u>	Mols. of Ca(OH)2: No. 2	•		
48 40	24. <u>4.3</u>	Gram total weight of Ca(20 ± 100.23	
49 50	25. 0.00	Gram weight CO2: No. 2		$I_{\rm a} = 20 + N_{\rm c} = 22$	
50	26. <u>2.56</u>	Gram weight total possib		10.20 ± 10.23	
51	27	_%CO2 gain: No. 25 divid	ued by No. 26		
52					

1	Conclusions:				
1 2	28. <u>20.00</u>	Gram weight of sample:		No 15 No 2	5
$\frac{2}{3}$	28. <u>20.00</u> 29. <u>0.50</u>			No. 15 – No. 25 No. 16 divided by No. 28	
3 4		Fine parts/volume: Sand parts/volume:			d by No. 28) x No. 18
4 5	30. <u>60.37</u>				
5 6	31	Lime parts/volume:		(100.24 divide)	d by No. 28) x 1.1
7	Cement (if pre	sent)			
8		Portland cement parts/v	olume:	(No. 16 divide	d by No. 28) x 0.78
9	33.	Natural cement parts/vo	olume:		d by No. 28) x 0.86
10		Lime with cement parts			divided by No. 28 x 1.1
11		1		· · · · · ·	,
12					
13	Test No. $2 - St$	and Sieve Analysis			
14					
15	Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
16	No. 10	115.5	106.8	8.7	8.18
17	No. 20	123.7	106.4	17.3	16.26
18	No. 30	124.9	99.3	25.6	24.06
19	No. 40	145.6	100.8	44.8	42.11
20	No. 50	101.5	93.2	8.3	7.80
21	Base	72.9	71.2	1.7	1.60
22					
23					
24		Martal			
25		Mortar/I	Plaster/Stucco A	nalysis Test She	et
26					
27 28	Sampla No	24			
28 29	Sample No Building:	24 Old Michigan I	ighthouse Mich	icon Island Ano	stle Islands NL
29 30	Location:	Light tower mo		igan Islanu, Apo	
31				d and foamy re	action, moderately slow filtering
32	time	ption. <u>ran</u> , moderate	ry nara, protonge	a and roanny rea	action, moderatery slow intering
33					
34					
35	Test No. 1 – Se	oluble Fraction			
36					
37	Data:				
38	1. 185.1	Container A weight	8. No	<u>Hair or fiber</u>	type
39	2. 205.1	Container A and sample	e 9. <u>4.0</u>	Fines and pa	per weight
40	3. 761.24	Barometric pressure		Filter paper v	
41	4. 23	Temperature	11. 19	7.3 Sand and Cor	ntainer A weight
42	5. 0.10	Liters of water displace	d 12. <u>8</u> .	7 cc. of sand	2
43	6. <u>Yellow-green</u> Filtrate color 13. <u>40.9</u> Weight of graduated cylinder and sand			duated cylinder and sand	
44	7. <u>Tan</u>	Fines color	148	.7 Weight of gra	duated cylinder
45					
46	Computations:				
47	15. 20.0	Starting weight of samp			
48	16. <u>1.1</u>	Weight of fines: No. 9 -			
49	17. <u>12.2</u>	Weight of sand: No. 11			
50	18. <u>.7131</u>	Sand density: No. 12 di			
51	19. <u>6.7</u>	Weight of soluble conte			
52	20. <u>.00041125</u>	Mols. Of CO2: No. 5 x	No. 3. x 0.016 di	vided by (No. 4 -	+ 2/3.16 C.)

1	21. <u>.41</u> Gram weight of CaCO3: 100 x No. 20				
2	22. <u>6.29</u> Gram weight of Ca(OH)2: No. 19 – No. 21				
3	23. <u>.0849831</u> Mols. of Ca(OH)2: No. 22 divided by 74				
4	24. <u>6.59</u> Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)				
5	25. <u>0.18</u> Gram weight CO2: No. 20 x 44				
6					
7	27. 4.59	%CO2 gain: No. 25 divi		(0. 20 + 1(0. 25)	
8	21. <u> </u>		ded by 110. 20		
9	Conclusions:				
10	28. 19.82	Gram weight of sample:		No. 15 – No. 2	5
11	29. <u>5.55</u>			No. 16 divided	
12		Sand parts/volume:			1 by No. 28) x No. 18
13	31	Lime parts/volume:		(No. 24 divided	1 by No. 28) x 1.1
14					
15	Cement (if pres	ent)			
16		_Portland cement parts/ve			l by No. 28) x 0.78
17		_Natural cement parts/vo			d by No. 28) x 0.86
18	34	_Lime with cement parts/	volume:	(No. 16 x o.2) o	divided by No. 28 x 1.1
19					
20					
21	Test No. 2 – Sa	nd Sieve Analysis			
22		-			
23	Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
24	No. 10	107.3	106.8	0.5	0.45
25	No. 20	108.0	106.4	1.6	1.44
26	No. 30	113.0	99.3	13.7	12.36
27	No. 40	166.6	100.8	65.8	59.39
28	No. 50	118.4	93.2	25.2	22.74
29	Base	75.3	71.3	4.0	3.61
30	Dase		/1.5	<u> </u>	
31					
32					
		Montor/D	lastar/Stugas A	nalwaia Taat Cha	-4
33		WIOFtar/P	laster/Stucco Al	nalysis Test Shee	el
34	C	25			
35	Sample No.		· 1.4	· • • • • • •	4 1 1 1 1 1 1
36	Building:			igan Island, Apos	
37	Location:	<u>Closet plaster</u>			erately hard, extremely minimal
38			very thin white	skim coat, mode	erately hard, extremely minimal
39	reaction, extremely rapid filtering time				
40					
41					
42	Test No. 1 – Sc	luble Fraction			
43					
44	Data:				
45	1. 187.8	_Container A weight	8. <u>Y</u> e	s Hair or fiber	type
46	2. 206.8	Container A and sample		.3 Fines and pap	
47	3. 761.24	Barometric pressure		2 Filter paper w	
48	4. 23	Temperature		1.1 Sand and Con	
49	5. 0.00	Liters of water displaced		0.1 cc. of sand	č
50	6. Off-white	Filtrate color			duated cylinder and sand
51	7. Tan	Fines color		<u>8.7</u> Weight of grad	
52	<u></u>		110		

Computations 15. 19.0	: Starting weight of sampl	e: No 2 – No 1		
16. 0.1	Weight of fines: No. 9 –			
17. 13.3		Weight of sand: No. $11 - No. 1$		
187594		Sand density: No. 12 divided by (No. $13 - No. 14$)		
19. 6.6		Weight of soluble content: No. $15 - (No. 16 + No. 17)$		
20. 0.00		Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)		
21. 0.00	Gram weight of CaCO3:			
22. 6.6	Gram weight of Ca(OH)			
23089	Mols. of Ca(OH)2: No. 2	-		
24. 6.6	Gram total weight of Ca(OH)2: 74 x (No. $20 + No. 23$)			
25. 0.00	Gram weight CO2: No. 2			
26. <u>3.92</u> 27	Gram weight total possil		No. $20 + No. 23$)	
21. <u></u>	%CO2 gain: No. 25 divi	ded by No. 26		
Conclusions:				-
28. <u>19.00</u> 20. 0.52	Gram weight of sample:		No. 15 – No. 2	
29. 0.53			No. 16 divided	-
30. <u>53.16</u>	Sand parts/volume: Lime parts/volume:		· ·	d by No. 28) x No. 18 d by No. 28) x 1.1
51			(100. 24 divide	u by No. 28) x 1.1
Cement (if pre				
	Portland cement parts/vo		· ·	d by No. 28) x 0.78
33	Natural cement parts/vol	ume:		d by No. 28) x 0.86
34	Lime with cement parts/	volume:	(No. 16 x 0.2)	divided by No. 28 x 1.1
Test No. 2 – S	and Sieve Analysis			
Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	107.0	106.8	<u> </u>	1.52
No. 20	108.3	106.4	1.9	14.39
No. 30	101.2	99.3	1.9	14.39
No. 40	104.1	100.8	3.3	25.00
No. 50 Base	<u> </u>	<u>93.2</u> 71.2	<u>4.4</u> 1.5	<u>33.33</u> <u>11.36</u>
Dase	12.1	/1.2	1.5	11.50
	Mortar/P	laster/Stucco A	nalysis Test She	et
Court N		laster/Stucco A	nalysis Test She	et
Sample No	26			
Building:	26 Old Michigan L	ighthouse, Mich		et stle Islands NL
Building: Location:	26 Old Michigan L Living room pla	<u>.ighthouse, Mich</u> aster	iigan Island, Apo	stle Islands NL
Building: Location:	26 Old Michigan L	<u>.ighthouse, Mich</u> aster	iigan Island, Apo	stle Islands NL
Building: Location:	26 Old Michigan L Living room pla	<u>.ighthouse, Mich</u> aster	iigan Island, Apo	stle Islands NL
Building: Location: Sample Descr	26 Old Michigan L Living room pla iption: Off-white, soft,	<u>.ighthouse, Mich</u> aster	iigan Island, Apo	stle Islands NL
Building: Location: Sample Descr	26 Old Michigan L Living room pla	<u>.ighthouse, Mich</u> aster	iigan Island, Apo	stle Islands NL

1 2	1. <u>192.0</u> 2.197.7	Container A weight Container A and sample	8. <u>Yes</u> Hair or fiber_ 9. <u>2.7</u> Fines and pap		
3	3. 761.24	Barometric pressure	10. 2.7 Filter paper v		
4	4. 23	Temperature		<u>96.3</u> Sand and Container A weight	
5	5. 0.00	Liters of water displaced	12. 2.7 cc. of sand		
6	6. Off-white	Filtrate color	13. 33.0 Weight of gr	aduated cylinder and sand	
7	7. Tan	Fines color	14. 28.7 Weight of grad		
8					
9	Computations:				
10	15. 5.7	Starting weight of sample: No. 2	– No. 1		
11	16. <u>0.0</u>	Weight of fines: No. 9 – No. 10			
12	17. 4.3	Weight of sand: No. 11 – No. 1			
13	187442	_Sand density: No. 12 divided by			
14	19. <u>1.4</u>	Weight of soluble content: No. 1		272 1(C)	
15	20. 0.00	Mols. Of CO2: No. 5 x No. 3. x		- 2/3.16 C.)	
16	21. 0.00	Gram weight of CaCO3: 100 x N			
17 18	22. <u>1.4</u> 230189	Gram weight of Ca(OH)2: No. 1 Mols. of Ca(OH)2: No. 22 divide			
18	23. <u></u> 24. 1.4	Gram total weight of Ca(OH)2: 7			
20	24. <u>1.4</u> 25. <u>0.00</u>	Gram weight CO2: No. 20 x 44	+ x (100.20 + 100.23)		
20	26. <u>0.83</u>	Gram weight total possible CO2:	$44 \times (N_0 20 + N_0 23)$		
22	27	%CO2 gain: No. 25 divided by N			
23	27				
24	Conclusions:				
25	28. 5.7	_Gram weight of sample:	No. 15 – No. 2	5	
26	29. 0.00	Fine parts/volume:	No. 16 divided	by No. 28	
27	30. 56.14	Sand parts/volume:		l by No. 28) x No. 18	
28	31	Lime parts/volume:	(No. 24 divided	(No. 24 divided by No. 28) x 1.1	
29					
30	Cement (if pres				
31		_Portland cement parts/volume:		d by No. 28) x 0.78	
32		Natural cement parts/volume:		(No. 16 divided by No. 28) x 0.86 (No. 16 x o.2) divided by No. 28 x 1.1	
33	34	Lime with cement parts/volume:	(No. 16 x 0.2)	divided by No. 28 x 1.1	
34					
35 36	Test No. 2 Se	nd Sieve Analysis			
30 37	1 cst N0. $2 - sa$	ind Sieve Analysis			
38	Sieve	Sieve w/ sand weight Sieve w	veight Sand weight	Sand ratio	
39	No. 10	<u>106.8</u> <u>106.8</u>		0	
40	No. 20	106.5 106.4		2.44	
41	No. 30	99.7 99.3	0.4	9.76	
42	No. 40	102.1 100.8		31.71	
43	No. 50	94.9 93.2	1.7	41.46	
44	Base	71.8 71.2	0.6	14.63	
45			_		
46					
47			Privy		
48		Sample 27	Munse		
49		White	5Y 9/1		
50		White	5Y 9/1		
51		White	5Y 9/1		
52		White	5Y 9/1		

3 White $5Y 9/1$ 3 Sample 27 was the first of the second set of samples. Analysis of this set began on Friday, October 9. The 5 Sample 27 was the first of the second set of samples. Analysis of this set began on Friday, October 9. The 6 sample of form the interior of the privy. Beneath multiple layers of oil-based white paint were 7 remnants of silver paint which was probably used to enhance the low light levels of the interior. Silver paint is made using powdered aluminum. In light of the fact that commercial aluminum production did not commence until the 1930's, this paint cannot predate that decade. 10 Privy 13 Sample 28 14 White 5Y 9/1 15 White 5Y 9/1 16 White 5Y 9/1 17 Sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely weathered wood, indicating paint loss through weathering if, indeed, it was painted. If it was painted there is a strong possibility that it was whitewasher ather than painted. Hore by 5Y 9/1 18 Old Michigan Lighthouse Tower Sample 29 Munsell 19 White N 0.5/ White N 0.5/ 19 Gray Sy 7/1 Sample 29 was removed from the exterior window of the Old Michigan Lighthouse tower. It revealed three widely-diver	1		White	5Y 9/1
3 Silver 4 Sample 27 was the first of the second set of samples. Analysis of this set began on Friday, October 9. The sample was collected from the interior of the privy. Beneath multiple layers of oil-based white paint were remanants of silver paint which was probably used to enhance the low light levels of the interior. Silver paint is made using powdered aluminum. In light of the fact that commercial aluminum production did not commence until the 1930's, this paint cannot predate that decade. 10 Privy 13 Sample 28 Munsell 14 White 5Y 9/1 15 White 5Y 9/1 16 White 5Y 9/1 17 Sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely weathered wood, indicating paint loss through weathering if, indeed, it was painted. If it was painted there is a strong possibility that it was whitewashed rather than painted, thereby explaining the loss of the finish as whitewash is considerably less durable than paint. 23 Old Michigan Lighthouse Tower 24 Old Michigan Lighthouse tower. It revealed three widely-divergent paint layers with gray being the oldest known layer. 25 Sample 30 Munsell 26 Black N 0.5/ 27 Brack Sample 30 28 Gray 2.56 3.5/2 <tr< td=""><td></td><td></td><td></td><td></td></tr<>				
4 Sample 27 was the first of the second set of samples. Analysis of this set began on Friday, October 9. The sample was collected from the interior of the privy. Beneath multiple layers of oil-based white paint were remnants of silver paint which was probably used to enhance the low light levels of the interior. Silver paint is in adde using powdered aluminum. In light of the fact that commercial aluminum production did not commence until the 1930's, this paint cannot predate that decade. Privy Sample 28 Munsell White Sample 28 Munsell White Sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely weathered wood, indicating paint loss through weathering if, indeed, it was painted. If it was painted there is a strong possibility that it was whitewashed rather than painted, thereby explaining the loss of the finish as whitewash is considerably less durable than paint. Old Michigan Lighthouse Tower Sample 29 Munsell Black N 0.5/ White N 9.5/ Sample 29 was removed from the exterior window of the Old Michigan Lighthouse tower. It revealed three widely-divergent paint layers with gray being the oldest known layer. Sample 29 was removed from the exterior sindow of the Old Michigan				
5 Sample 27 was the first of the second set of samples. Analysis of this set began on Friday, October 9. The sample was collected from the interior of the privy. Beneath multiple layers of oil-based white paint were remnants of silver paint which was probably used to enhance the low light levels of the interior. Silver paint is made using powdered aluminum. In light of the fact that commercial aluminum production did not commence until the 1930's, this paint cannot predate that decade. 11 Privy 12 Privy 13 Sample 28 Munsell 14 White SY 9/1 15 White SY 9/1 16 White SY 9/1 17 Sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely 9 weathered wood, indicating paint loss through weathering if, indeed, it was painted. If it was painted there is a strong possibility that it was whitewashed rather than painted, thereby explaining the loss of the finish as whitewash is considerably less durable than paint. 23 Old Michigan Lighthouse Tower 24 Old Michigan Lighthouse Tower. 25 Sample 29 Munsell 26 Black N 0.5/ 27 White N 9.5/ 28 Gray SY 7/1 39 Gray SY 7/1				
12Privy13Sample 28Munsell14WhiteSY 9/115WhiteSY 9/116WhiteSY 9/117WhiteSY 9/118Sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely19weathered wood, indicating paint loss through weathering if, indeed, it was painted. If it was painted there18sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely19weathered wood, indicating paint loss through weathering if, indeed, it was painted. If it was painted there19is a strong possibility that it was whitewashed rather than painted, three by explaining the loss of the finish21Old Michigan Lighthouse Tower23Sample 2924Old Michigan Lighthouse Tower25Sample 2926Black27White28Gray29was removed from the exterior window of the Old Michigan Lighthouse tower. It revealed three29widely-divergent paint layers with gray being the oldest known layer.29Sample 30Munsell29Gray-2.5G 5.5/220Dark green2.5G 3/439Maroon7.5R 3/440Maroon7.5R 3/441Sample 30 was from the privy roof. Three finish layers of green survived, which is comparable in number42tobse of the exterior sample, no. 28. The oldest maroon layer was probably a red lead prime coat.43Sample 31Mun	5 6 7 8 9	sample was collected from the in remnants of silver paint which w is made using powdered aluminu	terior of the privy. Beneath multip as probably used to enhance the lo m. In light of the fact that commen	le layers of oil-based white paint were w light levels of the interior. Silver paint
13Sample 28Munsell14White $5Y$ 9/115White $5Y$ 9/116White $5Y$ 9/117Sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely18Sample 28 came from the exterior of the privy. Beneath three layers of white paint was extremely19weathered wood, indicating paint loss through weathering if, indeed, it was painted. If it was painted there20is a strong possibility that it was whitewashed rather than painted, thereby explaining the loss of the finish21Old Michigan Lighthouse Tower22Sample 2923Munsell24Old Michigan Lighthouse Tower25Sample 2926Black27White28Gray29Sample 29 was removed from the exterior window of the Old Michigan Lighthouse tower. It revealed three29widely-divergent paint layers with gray being the oldest known layer.29Sample 29 was removed from the exterior window of the Old Michigan Lighthouse tower. It revealed three34Green25Sample 3036Green37Gray-green38Dark green39Maroon39Maroon30Sample 30 was from the privy roof. Three finish layers of green survived, which is comparable in number41tobse of the exterior sample, no. 28. The oldest maroon layer was probably a red lead prime coat.4214441445Sample 31 <tr< td=""><td></td><td></td><td></td><td></td></tr<>				
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38 Dark green 2.5G 3/4 39 Maroon 7.5R 3/4 40 7.5R 3/4 41 Sample 30 was from the privy roof. Three finish layers of green survived, which is comparable in number to those of the exterior sample, no. 28. The oldest maroon layer was probably a red lead prime coat. 42 to those of the exterior sample, no. 28. The oldest maroon layer was probably a red lead prime coat. 43 44 45 Shed 46 Sample 31 Munsell 47 White N 9.5/ 48 White N 9.5/ 49 White N 9.5/ 50 White N 9.5/				
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43 1 1 1 44 45 Shed 46 Sample 31 Munsell 47 White N 9.5/ 48 White N 9.5/ 49 White N 9.5/ 50 White N 9.5/				
44 Shed 45 Sample 31 Munsell 46 Sample 31 Musell 47 White N 9.5/ 48 White N 9.5/ 49 White N 9.5/ 50 White N 9.5/		to those of the exterior sample, h	0. 28. The oldest maroon layer wa	s probably a red lead prime coat.
45 Shed 46 Sample 31 Munsell 47 White N 9.5/ 48 White N 9.5/ 49 White N 9.5/ 50 White N 9.5/				
46 Sample 31 Munsell 47 White N 9.5/ 48 White N 9.5/ 49 White N 9.5/ 50 White N 9.5/				
47 White N 9.5/ 48 White N 9.5/ 49 White N 9.5/ 50 White N 9.5/				
48 White N 9.5/ 49 White N 9.5/ 50 White N 9.5/				
49 White N 9.5/ 50 White N 9.5/				
50 White N 9.5/				
51			White	N 9.5/
	51			

Sample 31 was found on the exterior of the shed. Beneath a layer of white paint were multiple layers of 1 2 whitewash which dissolved readily in hydrochloric acid, leaving the paint layer behind. 3 4 5 Shed 6 Sample 32 Munsell 7 Blue-green 10BG 5/4 8 Paper _____ 9 Blue-green 10BG 5/4 10 11 Sample 32 was collected from the interior of the shed. It consisted of a very thick and stiff layer of paper, or cardboard, with paint on both sides. The paint was probably applied during the manufacturing process of 12 13 the paper. 14 15 New Tower 16 Sample 33 17 Munsell 18 Tan 10YR 8.5/4 19 N 9.5/ White 20 White 5Y 9/1 21 22 Sample 33 was collected from the interior wall of the new tower light base. It consisted of three layers of 23 latex paint. 24 25 26 New Tower 27 Sample 34 Munsell Black N 0.5/ 28 29 Charcoal N 2.0/ 30 White N 9.5/ 31 White N 9.5/ N 1.0/32 Black 33 7.5YR 5/6 Brown 34 Sample 34 came from the exterior of the new tower light base. At the bottom of a series of black and white 35 layers were remnants of a coat of brown paint. 36 37 38 **New Tower** Sample 35 39 Munsell 40 White N 9.5/ 41 Clear varnish _____ N 9.5/ 42 White 43 44 Sample 35 was removed from the exterior of the new tower light base. Its upper white coat was very shiny. 45 Beneath it was a very glossy coat of clear varnish. Beneath the varnish was a layer of stark white paint. 46 47 48 **Power House** 49 Sample 36 Munsell 50 White 5Y 9/1 51 White 5Y 9/1

1		White	5Y 9/1	
2		a		
3	-	the interior trim paint of the power	house. It revealed three layers of identical whit	ie
4 5	oil-based paint.			
6				
7		Power He	nuse	
8		Sample 37	Munsell	
9		Blue-gray	5BG 4/1	
10		Gray	5Y 7/1	
11		White	5Y 9/1	
12				
13			Like its counterpart, sample 36, it revealed thr	ee
14	paint layers of which	the oldest was white.		
15				
16				
17		Power He		
18		Sample 38 Yellow	Munsell 2.5Y 8/4	
19 20		Yellow	2.5Y 8/4 2.5Y 8/4	
20 21		Yellow	2.5Y 8/4	
22		I Chow	2.51 0/7	
23	Sample 38 was colle	cted from the interior of the power h	nouse. It revealed three identical layers of yello	W
24	paint.			
25	1			
26				
27			e mortar samples. These were analyzed on	
28	Saturday, October 10).		
29				
30				
31			ver house. It was dark gray in color and gave m	
32			nd. It was hard and brittle and had a very small	i
33			size probably accounts for the relatively rapid lays to filter) and the absence of gelatinous by-	
34 35			The sand sieve analysis revealed fine sand of	
35 36		largest sieve sieves and 14% passed		
37	which an passed the	largest sieve sieves and 1470 passed	an of the sleves.	
38				
39	Sample 40 was taken	from the exterior mortar of the kee	per's house. It was gray in color and was	
40	moderately soft. Its s	oftness in conjunction with a fast ar	d bubble reaction, a relatively large water	
41			of a lime and sand composition with	
42		arts of lime to seven parts of sand, b		
43	Revealed typical san	d of which virtually all passed the la	argest sieve and almost 7% passed all of the sie	ves.
44				
45				
46			A	
47 48		Mortar/Plaster/Stucco	Analysis Test Sheet	
48 49				
49 50	Sample No	39		
51	Building:	Power House, Michigan Island	, Apostle Islands NL	
52	Location:	Exterior brick mortar		

1 2 3	Sample Descrip <u>filtering time</u>	otion: Dark gray, har	d and brittle, j	prolonged and b	bubbly reaction, extremely fast
4 5	Test No. 1 – So	Juble Fraction			
6	1031110.1 50				
7	Data:				
8	1. 185.5			<u>Hair or fiber</u>	type
9	2. <u>193.1</u>		9. <u>2.7</u>	Fines and pap	ber weight
10	3. 769.88	Barometric pressure	10. <u>2.6</u>	Filter paper v	veight
11	4. 23	Temperature		0.5 Sand and Con	tainer A weight
12	5. 0.10	_Liters of water displaced		<u>8</u> cc. of sand	
13		n Filtrate color			duated cylinder and sand
14	7. <u>Light gray</u>	Fines color	14. <u>28</u>	<u>.7 Weight of grad</u>	duated cylinder
15					
16	Computations:	~ · · · · · ·			
17	15. 7.6				
18	16. <u>0.1</u>	_Weight of fines: No. 9 –			
19	17. 5.0	_Weight of sand: No. 11			
20	18. <u></u>	_Sand density: No. 12 div			
21	19. <u>2.5</u>	Weight of soluble conten			272 1(())
22	20. 0.00416			vided by (INO. 4 +	- 2/3.10 C.)
23	21. <u>042</u> 22.2.08	_Gram weight of CaCO3:		51	
24 25	22. <u>2.08</u> 23028	_Gram weight of Ca(OH) _Mols. of Ca(OH)2: No. 2			
23 26	23. <u></u>	Gram total weight of Ca			
20 27	24. 2.39 25. 0.18	Gram weight CO2: No. 2		$.20 \pm 100.23)$	
28	26. 1.42	Gram weight total possil		(0.20 + No.23)	
29	27. 12.68			0.20 + 10.23)	
30	27. 12.00		ded by 110. 20		
31	Conclusions:				
32	28. 7.42	Gram weight of sample:		No. 15 – No. 2	5
33	29. 1.35	Fine parts/volume:		No. 16 divided	
34	30. 51.21			(No. 17 divided by No. 28) x No. 18	
35	31.	Lime parts/volume:		(No. 24 divided by No. 28) x 1.1	
36				(
37	Cement (if pres	ent)			
38		Portland cement parts/vo	olume:	(No. 16 divided	l by No. 28) x 0.78
39	33.	Natural cement parts/vol	ume:	(No. 16 divided by No. 28) x 0.86	
40	34	_Lime with cement parts/	volume:	(No. 16 x o.2) divided by No. 28 x 1.1	
41					
42					
43	Test No. 2 – Sa	nd Sieve Analysis			
44					
45	Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
46	No. 10	106.8	106.8	0.0	0
47	No. 20	106.7	106.4	0.3	6.00
48	No. 30	100.0	99.2	0.8	16.00
49	No. 40	102.5	100.8	1.7	34.00
50	No. 50	94.7	93.2	1.5	30.00
51	Base	71.9	71.2	0.7	14.00
52					

Sample No. 40 Building: Keeper's House, Michig	an Island, Apostle Islands NL
Location: Exterior mortar	
	fast and bubbly reaction, extremely rapid filtering
Test No. 1 – Soluble Fraction	
Data:	
1. <u>188.9</u> Container A weight	8. <u>No</u> Hair or fiber type
2. <u>208.9</u> Container A and sample	9. <u>3.2</u> Fines and paper weight
3. <u>769.88</u> Barometric pressure	10. <u>2.7</u> Filter paper weight
4. <u>23</u> Temperature 5. 0.56 Liters of water displaced	11. <u>202.7</u> Sand and Container A weight
5. <u>0.56</u> Liters of water displaced 6. <u>Yellow-green</u> Filtrate color	12. <u>8.0</u> cc. of sand 13. <u>42.5</u> Weight of graduated cylinder and sand
7. Tan Fines color	14. <u>28.7</u> Weight of graduated cylinder
. <u> </u>	14. <u>20.7</u> Weight of graduated cynnaer
Computations:	
15. 20.0 Starting weight of sample: No. 2	– No. 1
16. 0.5 Weight of fines: No. $9 - No. 10$	
17. <u>13.8</u> Weight of sand: No. 11 – No. 1 18. <u>.5797</u> Sand density: No. 12 divided by (1	N_{0} 12 N_{0} 14)
19. <u>5.7</u> Weight of soluble content: No. 12	
20. <u>0.02329</u> Mols. Of CO2: No. 5 x No. 3. x (
21. 2.33 Gram weight of CaCO3: 100 x N	
22. <u>3.37</u> Gram weight of Ca(OH)2: No. 19	
23. <u>.04555</u> Mols. of Ca(OH)2: No. 22 divide	
24. <u>5.09</u> Gram total weight of Ca(OH)2: 7	•
25. <u>1.02</u> Gram weight CO2: No. 20 x 44	
26. <u>3.03</u> Gram weight total possible CO2:	
27. <u>33.66</u> %CO2 gain: No. 25 divided by N	lo. 26
Camalaniama	
Conclusions:	No. 15 No. 25
28.18.98Gram weight of sample:29.2.63Fine parts/volume:	No. 15 – No. 25 No. 16 divided by No. 28
30. <u>42.15</u> Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. 31.94 Lime parts/volume:	(No. 24 divided by No. 28) x 1.1
	(10. 2) arried by 10. 20) A 1.1
Cement (if present)	
32. Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78 (No. 16 divided by No. 28) x 0.86
33. Natural cement parts/volume: 34. Lime with cement parts/volume:	(No. 16 divided by No. 28) x 0.86 (No. 16 x o 2) divided by No. 28 x 1 1
14 Lime with cement narts/volume.	(No. 16 x o.2) divided by No. 28 x 1.1

1	Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
2	No. 10	106.9	106.8	0.1	0.35
3	No. 20	109.7	106.4	3.3	11.46
4	No. 30	107.5	99.3	8.2	28.47
5	No. 40	111.2	100.8	10.4	36.11
6	No. 50	98.0	93.2	4.8	16.67
7	Base	73.2	71.2	2.0	6.94
8					
9					
10			Keeper's H		
11		Sampl	e 41	Munse	
12		White		5Y 9/1	
13		White		5Y 9/1	
14					
15				from the exterior	window trim of the keeper's
16	house. It retaine	ed two layers of white oil-	based paint.		
17					
18			17 1 11		
19		G	Keeper's H		
20		Sampl	e 42	Munse	
21 22		Black		N 0.5/ 5Y 7/1	
22		Gray Black		N 0.5/	
23 24		DIACK		IN 0.5/	
24 25	Sample 12 was	removed from the exterio	r window sash of	f the keeper's hou	se. It revealed a gray layer
26					al sash color used in the late
27		early twentieth centuries.	r oldek pullit, will	ien is a very typic	ar sush color used in the late
28					
29					
30			Keeper's H	ouse	
31		Sampl	-	Munse	ell
32		White		5Y 9/1	
33		White		5Y 9/1	
34		White		5Y 9/1	
35		White		5Y 9/1	
36		Gray		5Y 7/1	
37		Gray		5Y 7/1	
38					
39					air of oldest gray layers are
40	typical exterior	colors commonly used in	the early twentie	eth century.	
41					
42					
43		~ .	Keeper's H		
44		Sampl	e 44	Munse	
45		White		5Y 9/1	
46		White		N 9.5/	
47		White		N 9.5/	
48		White		N 9.5/	
49 50		Gray		5Y 7/1	
50	Sample 11	found on the out-rise 1	r trim of the - 1	or'a have the	a similar to its sourt
51 52	Sample 44 was	iound on the exterior doc	a unit of the keep	ber s nouse. It wa	s similar to its counterpart,

52 sample 43.

1			
2 3		V	
3 4		Keeper's House Sample 45	Munsell
5		White	N 9.5/
6		White	N 9.5/
7		Light gray	5Y 8/1
8		Light gray	5Y 8/1
9		Yellow	2.5Y 8/4
10		I Chow	2.51 0/4
10 11 12	Sample 45 was collected from the color.	kitchen wall of the keeper's hous	se. Its oldest layer was a rich yellow
13 14			
15		Keeper's House	
16		Sample 46	Munsell
17		White	5Y 9/1
18		White	5Y 9/1
19		White	5Y 9/1
20		White	5Y 9/1
21		White	5Y 9/1
22		White	5Y 9/1
23			
24		kitchen door trim of the keeper's	house. It retained at least six layers of
25	white, oil-based paint.		
26			
27			
28		Keeper's House	
29		Sample 47	Munsell
30		Light yellow-green	7,5Y 8/2
31		Dark gray	5Y 5/1
32			
33			er's house. Beneath the upper light
34	yellow-green paint was a distinct,	but thin layer of dark gray paint.	
35			
36			
37		Keeper's House	
38		Sample 48	Munsell
39		White	5Y 9/1
40		White	5Y 9/1
41		Gray	5Y 7/1
42			
43	-	-	eeper's house. Beneath a pair of white
44	layers was a gray layer matching	those of its counterparts, samples	43 and 44.
45			
46 47		V	
47 48		Keeper's House	Mangoll
48		Sample 49	Munsell
49 50		Light yellow-green	7,5Y 8/2
50 51 52	Sample 49 was found on the wall single layer of light yellow-green		the keeper's house. It revealed only a s counterpart, sample 47.

1 2						
3	Keeper's House					
4	Sample 50		Munsell			
5	Pastel blue-	green	5BG 9/1			
6 7 8 9	Sample 50 was collected from the second floor of pastel blue-green paint on its surface.	r wall of the k	eeper's house. It retained only a very thin layer			
10 11 12 13 14 15 16 17 18	Sample 51 was the first sample of the third set Taken from the second floor plaster of the keep bits of plaster. There was a miniscule reaction and sand as opposed to lime and sand. The san $37 \frac{1}{2}\%$ was trapped in sieve #20 and, in a statis #40, and #50.	per's house, i with the hydr id sieve analy	t was off-white in color and consisted of small ochloric acid, indicating a mixture of gypsum sis revealed surprisingly coarse sand of which			
18 19 20	Mortar/Plaste	r/Stucco Ana	lysis Test Sheet			
21						
22	Sample No. 51					
23		<u>chigan Island,</u>	Apostle Islands NL			
24	Location: Second floor plaster					
25 26	Sample Description: Off-white, soft, mini	scule reaction	, extremely fast filtering time			
27 28 29 30 31 32 33 34	Test No. 1 – Soluble Fraction Data: 1. <u>185.1</u> Container A weight 2. <u>195.2</u> Container A and sample 3. <u>761.24</u> Barometric pressure	9. <u>2.7</u> 10. <u>2.6</u>	_Hair or fibertype _Fines and paper weight _Filter paper weight			
35	4. <u>23</u> Temperature		5 Sand and Container A weight			
36	5. <u>0.00</u> Liters of water displaced		cc. of sand			
37	6. <u>Off-white</u> Filtrate color		_Weight of graduated cylinder and sand			
38	7. <u>Dark gray</u> Fines color	14. <u>28.7</u>	Weight of graduated cylinder			
39						
40	Computations:					
41	15. <u>10.1</u> Starting weight of sample: No					
42	16. 0.1 Weight of fines: No. $9 - No.$					
43	17. <u>6.4</u> Weight of sand: No. 11 – No		J- 14)			
44 45	18. <u></u>					
45 46	19. 3.6 Weight of soluble content: No 20. 0.00 Mols. Of CO2: No. 5 x No. 3					
46 47			$100.4 \pm 2/3.10$ C.)			
47 48	21. 0.00 Gram weight of CaCO3: 100 22. 3.6 Gram weight of Ca(OH)2: No					
40 49	23. <u>.0486</u> Mols. of Ca(OH)2: No. 22 div					
49 50	24. <u>3.6</u> Gram total weight of Ca(OH)		$20 + N_0 (23)$			
51	25. <u>0.00</u> Gram weight CO2: No. 20 x 4		20 • 110. 23)			
52	26. 2.14 Gram weight total possible C		. 20 + No. 23)			

27	_%CO2 gain: No. 25 div	ided by No. 26		
29. 0.99	Fine parts/volume:	:		
32 33	_Portland cement parts/v _Natural cement parts/vo	olume:	(No. 16 divide	d by No. 28) x 0.78 d by No. 28) x 0.86 divided by No. 28 x 1.1
Test No. 2 – Sar	nd Sieve Analysis			
Sieve No. 10 No. 20 No. 30 No. 40 No. 50 Base	Sieve w/ sand weight <u>107.2</u> <u>108.8</u> <u>100.3</u> <u>101.8</u> <u>94.2</u> <u>71.8</u>	Sieve weight <u>106.8</u> <u>106.4</u> <u>99.3</u> <u>100.8</u> <u>93.2</u> <u>71.2</u>	Sand weight 0.4 2.4 1.0 1.0 1.0 0.6	Sand ratio <u>6.25</u> <u>37.50</u> <u>15.625</u> <u>15.625</u> <u>15.625</u> <u>9.375</u>
	~			
	White White Yellow inued the paint sample se	v ries. The sample	5Y 9/1 5Y 9/1 2.5Y 8 was collected fro	l 3/4 m the second floor hallway
		Veener's H		
three layers of p Sample 54 conti house. It was qu evidence of beir	White Off-wl Pink e from the second floor be aint with pink being the finued the plaster and mor ite similar to the first san ag a gypsum and sand pla	e 53 nite athroom wall of t oldest of the three tar samples. It wa nple but with bits ister. Its sand siev	Muns 5Y 9/1 2.5Y 8 10R 8 he keeper's hous e. as a plaster samp of a very thin why re analysis reveal	l 3.5/2 /3 e. Like sample 52, it revealed le from the stair of the keeper's hite skim coat. It also gave every ed moderately coarse sand of
	Conclusions: 28. 10.10 29. 0.99 30. 53.47 31. Cement (if prese 32. 33. 34. 34. 34. 34. 34. 35. 35. 35. 35. 35. 35. 35. 35. 35. 35	Conclusions: 28. 10.10 Gram weight of sample 29. 0.99 Fine parts/volume: 30. 30. 53.47 Sand parts/volume: 31. 31. Lime parts/volume: 31. Cement (if present) 32. Portland cement parts/volume: 31. Natural cement parts/volume: 33. Natural cement parts/volume: 34. Lime with cement parts Test No. 2 – Sand Sieve Analysis Sieve Sieve w/ sand weight No. 10 107.2 No. 20 108.8 No. 30 100.3 No. 40 101.8 No. 50 94.2 Base 71.8 Sample 52 continued the paint sample se ceiling of the keeper's house. It retained White White Vellow Sample 53 came from the second floor be three layers of paint with pink being the off-wheele second floor be three layers of paint with pink being the off-wheele second floor be three layers of paint with pink being the off-wheele second floor be three layers of paint with pink being the off-wheele second floor be three layers of paint with pink being the off-wheele second floor be three layers of paint with pink being the off-wheele second floor be three layers of paint with pink being the off-wheele second floor be three layers of paint with pink being the off-wheele second floor be three layeres of paint with pink being the off-wheele second flo	28. 10.10 Gram weight of sample: 29. 0.99 Fine parts/volume: 30. 53.47 Sand parts/volume: 31. Lime parts/volume: 32. Portland cement parts/volume: 33. Natural cement parts/volume: 34. Lime with cement parts/volume: 34. Lime with cement parts/volume: 34. Lime with cement parts/volume: Test No. 2 – Sand Sieve Analysis Sieve Sieve w/sand weight Sieve weight No. 10 107.2 106.8 No. 20 108.8 106.4 No. 30 100.3 99.3 No. 40 101.8 100.8 No. 50 94.2 93.2 Base 71.8 71.2 Keeper's He Sample 52 White White White Vellow Sample 53 Sample 53 Sample 53 came from the second floor bathroom wall of t White Pink Sample 54	Conclusions: 28. 10.10 Gram weight of sample: No. 15 - No. 2 29. 0.99 Fine parts/volume: No. 16 divided 30. 53.47 Sand parts/volume: (No. 17 divided) 31.

1		Mortar/P	laster/Stucco A	nalysis Test She	et	
2 3						
4	Sample No	54				
5	Building:		, Michigan Islan	d, Apostle Island	s NL	
6	Location:		<u> </u>	···, _ · · · · · · ·	~	
7			very thin white	skim coat, mod	erately hard, extremely minima	al
8	reaction, extrem	nely rapid filtering time	-			_
9						
10						
11	Test No. 1 – Sc	luble Fraction				
12						
13	Data:	~	0.01			
14	1. <u>187.8</u>			Hair or fiber		
15	2. 205.4	_Container A and sample		<u>7</u> Fines and paper		
16	3. 761.24			<u>6</u> Filter paper v		
17	4. 23	Temperature Liters of water displaced		2.0 Sand and Cor	itainer A weight	
18 19	5. <u>0.00</u> 6. Off-white			0.4 cc. of sand	aduated cylinder and sand	
19 20	6. <u>Off-white</u> 7. Tan	Fines color		8.7 Weight of gra		
20 21	/. <u> </u>		14. <u>20</u>	<u></u> weight of grad		
21	Computations:					
23	15. <u>17.6</u>	Starting weight of sampl	e: No. 2 – No. 1			
24		Weight of fines: No. 9 –				
25		Weight of sand: No. 11				
26		Sand density: No. 12 divi		- No. 14)		
27	19. 3.3					
28	20. 0.00	Mols. Of CO2: No. 5 x 1			- 273.16 C.)	
29	21. 0.00	Gram weight of CaCO3			,	
30	22. 3.3	_Gram weight of Ca(OH)	2: No. 19 – No.	21		
31	2300446	_Mols. of Ca(OH)2: No. 2				
32	24. 3.3	_Gram total weight of Ca		. 20 + No. 23)		
33	25. 0.00	_Gram weight CO2: No. 2				
34	26. <u>1.96</u>	_Gram weight total possi		10.20 + No.23		
35	27	_%CO2 gain: No. 25 divi	ded by No. 26			
36						
37	Conclusions:				c .	
38	28. 17.60	Gram weight of sample:		No. 15 – No. 2		
39 40	29. <u>0.57</u>	Fine parts/volume:		No. 16 divided		
40 41	30. <u>59.09</u> 31.	Sand parts/volume:			1 by No. 28) x No. 18	
41	51	Lime parts/volume:		(100.24 uivided)	1 by No. 28) x 1.1	
42	Cement (if pres	(ent)				
44		Portland cement parts/vo	lume.	(No. 16 divided	1 by No. 28) x 0.78	
45	33	Natural cement parts/vol	lume.		1 by No. 28) x 0.86	
46	34.				divided by No. 28 x 1.1	
47	51		volume.	(110. 10 X 0.2)		
48						
	Test No. 2 – Sa	nd Sieve Analysis				
50						
51	Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio	
52	No. 10	107.3	106.8	0.5	3.60	
49 50 51	Sieve	•	-	-		

APPENDIX D 25.90 No. 20 110.0 1 106.4 3.6 2 No. 30 102.6 99.3 3.3 23.74 3 No. 40 105.5 100.7 4.8 34.53 No. 50 4 94.6 93.2 1.4 10.07 5 Base 71.5 0.3 2.16 71.2 6 7 8 **Power House** 9 Sample 55 Munsell White 5Y 9/1 10 White 5Y 9/1 11 12 White 5Y 9/1 13 14 Sample 55 continued the paint sample series. It was removed from the exterior window of the power house. 15 Its analysis revealed three layers of white paint atop a putty substrate. 16 17 18 **Assistant Keeper's House** 19 Sample 56 Munsell 20 White 5Y 9/1 21 White 5Y 9/1 22 White 5Y 9/1 23 24 Sample 56 was from the exterior siding of the assistant keeper's house. It retained three layers of white 25 paint over an extremely weathered wood substrate. 26 27 28 **Assistant Keeper's House** 29 Sample 57 Munsell 30 White 5Y 0/1 5Y 9/1 31 White White 5Y 9/1 32 33 34 Sample 57 was found on the exterior trim of the assistant keeper's house. Like its counterpart, sample 56, it 35 retained three layers of white paint, but the wood substrate was unweathered. 36 37 38 **Assistant Keeper's House** 39 Sample 58 Munsell Off-white 5Y 8.5/2 40 41 White 5Y 9/1 5Y 7/1 42 Grav 43 44 Sample 58 was collected from the stair well wall of the assistant keeper's house. Its analysis showed three 45 layers of paint, of which the oldest was a typical gray paint. 46 47 48 **Assistant Keeper's House** 49 Sample 59 Munsell 5Y 9/1 50 White Gray 5Y 7/1 51 52 Yellow 2.5Y 8/4

	Gray	5Y 7/1
	ellected from the second floor wal at, of which a typical gray was the	l and ceiling of the assistant keeper's house. It revealed e oldest layer.
assistant keeper's is open to question each, by volume.	house. The sample size was quite n. It showed characteristics of a li The sand sieve analysis revealed	es. It was collected from the chimney mortar of the e small with the result being that its statistical reliability me and sand sample with approximately equal parts of very fine sand of which over 30% passed all of the ver half was trapped in the finest sieve.
	Mortar/Plaster/Stu	acco Analysis Test Sheet
Sample No Building: Location: Sample Description	Assistant Keeper's House Chimney mortar	e, Michigan Island, Apostle Islands NL pubbly reaction, extremely rapid filtering time
Test No. 1 – Solu	ble Fraction	
2. <u>198.7</u> 0 3. <u>761.24</u> 1 4. <u>23</u> 7 5. <u>0.10</u> 1 6. <u>Off-white</u> 1	Container A weight Container A and sample Barometric pressure Femperature Liters of water displaced Filtrate color Fines color	 8. Yes Hair or fiber type 9. 2.8 Fines and paper weight 10. 2.7 Filter paper weight 11. 196.3 Sand and Container A weight 12. 2.5 cc. of sand 13. 33.0 Weight of graduated cylinder and sand 14. 28.7 Weight of graduated cylinder
16. 0.1 17. 4.3 18. .5814 19. 2.3 20. 0.0041125 21. 0.41	Starting weight of sample: No. 2 - Weight of fines: No. 9 – No. 10 Weight of sand: No. 11 – No. 1 and density: No. 12 divided by (N Weight of soluble content: No. 15 Mols. Of CO2: No. 5 x No. 3. x 0 Gram weight of CaCO3: 100 x No Gram weight of Ca(OH)2: No. 19 Mols. of Ca(OH)2: No. 22 divided	No. 13 – No. 14) – (No. 16 + No. 17) .016 divided by (No. 4 + 273.16 C.) b. 20 – No. 21

Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)

Gram weight total possible CO2: 44 x (No. 20 + No. 23)

No. 15 – No. 25

Gram weight CO2: No. 20 x 44

Gram weight of sample:

%CO2 gain: No. 25 divided by No. 26

2.19

0.18

1.30

13,85

1 2 3

4

5 6 7

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11

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27.____

Conclusions:

28. 6.52

Appendix D: Fabric Analysis

1 2 3 4	29. 1.53 30. 38.34 31. 36.95	Fine parts/volume: Sand parts/volume: Lime parts/volume:			by No. 28 d by No. 28) x No. 18 d by No. 28) x 1.1
5 6 7 8 9	33	sent) Portland cement parts/vo Natural cement parts/vo Lime with cement parts/	lume:	(No. 16 divided	d by No. 28) x 0.78 d by No. 28) x 0.86 divided by No. 28 x 1.1
10 11	Test No. 2 – Sa	and Sieve Analysis			
12 13 14 15 16 17 18 19 20 21	Sieve No. 10 No. 20 No. 30 No. 40 No. 50 Base	Sieve w/ sand weight <u>106.8</u> <u>106.4</u> <u>99.4</u> <u>101.4</u> <u>95.4</u> <u>72.5</u>	Sieve weight <u>106.8</u> <u>106.4</u> <u>99.3</u> <u>100.7</u> <u>93.2</u> <u>71.2</u>	Sand weight <u>0.0</u> <u>0.1</u> <u>0.7</u> <u>2.2</u> <u>1.3</u>	Sand ratio 0.00 0.00 2.33 16.28 51.16 30.23
22 23		ł	Assistant Keepe	r's House	
24 25		Sampl Gray		Muns 5Y 7/1	
26 27 28 29		tinued the last three paint s . It retained only a single l			garage wall of the assistant wood substrate.
30 31		A	Assistant Keepe	's House	
32		Sampl		Muns	ell
33		Dark g		N 4.0/	
34		Gray	-	N 5.75	5/
35		Gray		N 5.75	5/
36		-			
37	Sample 62 was	removed from the interior	trim of the assis	tant keeper's hou	se. Its gray paint was darker
38	than the typical gray paint seen elsewhere and was not yellowed.				
39	· · · · · · · · · · · · · · · · · · ·	8 9 1			
40					
41		A	Assistant Keepe	·'s House	
42		Sampl		Muns	ell
43		Off-wh		5Y 8.5	
44		White		5Y 9/1	
45		Gray		5Y 7/1	
46		Gray		51 //1	
47	Sample 63 was	from the first floor entry	stair wall of the a	ssistant keener's	house. It revealed a relatively
48		ree paint layers with the o			nouse. It revealed a relatively
48 49	cypical set of th	nee punt layers with the 0	a stal	iaura gray.	
49 50					
	A number of -	analyziana aan ka draver f	om the analysis	as follow:	
51 52	A number of c	onclusions can be drawn fr	om the analysis,	as follow:	
72					

1 2 3	1.	There was a low degree of consistency between the samples, making it difficult to draw any firm conclusions.		
4 5	2.	A number of samples had so few layers that one of the following conclusions can be reached:		
6 7		a. The oldest layers had either weathered away over time, which is probable with exterior paint.		
8 9 10 11 12 13 14		b. They may have been stripped. This would be especially true if the older finish was a calcimine paint, which is impossible to cover with any coating, including calcimine paint itself. It was an extremely popular paint for interior plaster surfaces during the nineteenth and early twentieth centuries. In light of the use of whitewash, which is a related waterborne paint, the probability of calcimine paint here is very high.		
15 16		c. The element itself had been replaced or is of recent date.		
17 18 19		d. Other coverings such as wallpaper or calcimine paint may have preceded the paint and were removed prior to painting. Wallpaper was a popular covering, especially for damaged plaster.		
20 21 22 23		e. Because very little is known today about calcimine paint a few comments are in order to explain it, as follow:		
24 25 26 27 28 29 30		It was immensely popular throughout the nineteenth century and into the early twentieth century. It was cheap, easily applied and removed, had a very soft and lustrous sheen, and could be mixed and used by the average homeowner who could not afford a painter. In this case it could have been applied by Coast Guard personnel rather than painters. Decorative painters frequently used it because of its sheen. It is still in production to this day, although it is very rarely used.		
31 32 33 34 35 36 37		It is waterborne glue distemper paint which, unlike its cousin, whitewash, must be entirely removed prior to repainting. The difference between calcimine paint and whitewash is in the formulation. Calcimine paint was developed for interior use only and was developed to carry a pigment whereas the high lime content of whitewash prevented it from taking on a pigment. Whitewash was primarily used for exteriors and for dark service areas of interiors.		
38 39 40 41 42		Nothing will stick to it, including calcimine paint. Its absence, therefore, is about the only means of its detection. This is a real Catch-22. Because it was typically removed prior to repainting its presence is usually indicated either through historic documentation (which is very rare) or the very small number of layers where many would normally be found or where other, similar surfaces retain considerably more.		
43 44 45 46	3.	There is no doubt that many of the tower elements were whitewashed as their probable original finish.		
47 48 49	4.	Of the other samples, only sample 7 appears to have the most complete, by far, stratigraphy. It was truly excellent in its quality leaving little doubt that gray was the original color in that situation.		
50 51 52	5.	As can be seen with many of the mortar sample discussions no relative ratios of sand to Portland cement or sand to Portland cement and lime has been stated. The acid reduction method which was used is better than other methods for determining lime to sand ratios. Hence, they were provided		

1		for those samples composed of sand and lime. For samples containing Portland cement, the best
2		this form of testing can do is to indicate the presence of Portland cement and the sand itself.
3		
4		The primary goal in repointing is to achieve a compatible mortar. This can be done for lime and
5		sand samples that were analyzed. It can also be done for Portland cement samples with a bit of trial
6		and error. If the mortar is very hard then a higher ratio of Portland cement to sand will work. One
7		must take into consideration any deterioration of the masonry as a result of the mortar. If this has
8		been the case it may be advisable to use a softer mortar for repointing.
9		
10		The other primary mode of mortar analysis is spectrographic testing. Unfortunately, it also cannot
11		accurately determine exact ratios of Portland cement to sand and/or to lime.
12		
13		The secondary goal is to match the appearance of the mortar, which depends to a very large extent
14		on the sand. This is where acid reduction testing shines. It provides and exact calculation of the
15		sand grain sizes as well as a sample of the sand for matching of color. If the sand is carefully
16		matched then the appearance will be successful. This is especially critical in partial repointing and
17		patching.
18		
19	6.	There are instances where the narrative of the mortar make up refers to Portland – but the data
20		sheet following does not include it in line #32. The reason for this is that rather than a number for
21		lime content, the calculation is made for lime with Portland cement content. If the sample merely
22		had Portland cement and sand there would be a number for Portland cement.

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As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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