OIL BUILDING

Chronology of Alterations and Use

Original Construction

The Sand Island Oil Building was built in 1901. According to the Log Book, on September 11, 1901, "Raspberry Island Light Keeper C. Hendrickson brought the work men over to build the oil house." By November 2, 1901, oil was being stored in the completed building.[40]

The Oil Building is seen in a 1978 photo, much in its current condition. (Historic Image S1-14)

There are no available historic drawings for this building.

Significant Alterations / Current condition

No significant alterations have occurred to the Oil Building. Work completed by the Historic Structure Preservation Team from the NPS between 1998 and 2009 consisted of repointing the masonry, painting the exterior woodwork, repairing the roof, and rehabilitating the brass door latch.

The building is now used for storage and contains no active mechanical systems. The original circular metal gravity vent has a roof cap that renders the vent inoperable.

There are no and were never any electrical systems in the Oil Building.

The Sand Island Oil Storage is in good condition.

[40] E. Luick, Sand Island Log, Oct 1, 1898 - Nov 17, 1907 and June 1, 1914- July 31, 1920

Summary of Documented Work on the Building

Date	Work Described	Source of Information
1901, August 17	"At 7:30 AM the Amaranth crew came a Shore with a load of Brick for the oil house."	E. Luick, SI Log, Oct1, 1898 - Nov 17, 1907 and June 1, 1914- July 31, 1920
1901, September	Sept 11: "At 11:30 AM Raspberry Island Light Keeper C. Hendrickson brought the work men over to build the Oil House." Sept 21: "There are 600 brick left of the Oil house."	E. Luick, SI Log, Oct1, 1898 - Nov 17, 1907 and June 1, 1914- July 31, 1920
1901, November 2	"Keeper finished putting the Oil House in shape and put the Oil in the House.	E. Luick, SI Log, Oct1, 1898 - Nov 17, 1907 and June 1, 1914- July 31, 1920
Annual Report of 1901, Fiscal Year	"*Sand Island, Lake Superior. Wisconsin*. – A crib 16 ' wide, 32 ' long, and 7 ' high was built, placed at the shore line, filled with stones, and connected to the landing wharf by a log bridge, 25 ' long. A walk 16 ' long was built leading from the crib to the top of the bluff. A brick oil house was built, with a capacity for storing 360 gallons of oil."	"1901 Annual Report of the Lighthouse Board," Sand Island Light in annual reports 1870-1910

Notable Actions with Unknown Dates

Date Range	Work Described
1998-2009	Repointed masonry
1998-2009	Painted the exterior woodwork
1998-2009	Repaired the roof
1998-2009	Rehabilitated the brass door latch

General Physical Description

The building is a small, one-story, one room, rectangular brick utilitarian structure with a brick foundation. It has a metal hip roof with a circular metal ridge vent in the center and a metal door located on the north façade.

Physical Description -- Architecture

Architecture – Roof

The roofing is standing seam metal with a metal vent, red color. It was assumed to be prefinished due to the quality of the paint adherence. The ogee cornice trim of the eave extends +/- 6" and is painted wood trim.

Architecture – Exterior Walls

The exterior walls are common bond red brick walls. A mortar sample taken indicates that the composition of the mortar is roughly one part lime to two parts sand, by volume, has a dark tan color, and is moderately hard with fine sand. A mortar sample of a repointing area shows that the mortar contains lime, a small

amount of Portland cement, and sand, which is a typical restoration mixture. The mortar is dark tan in color, moderately soft, and made with relatively coarse sand.

Architecture – Exterior Door
The exterior door is made of plate steel, has the original knob mortise hardware and two surface mounted hinges. It is 2'-7" x 7'-0" x ¼" with 1/8" plate and is original to the building. Its header is cast stone. A sample of the paint of the door trim reveals that the original orange-red layer is a typical color for red lead primer paint. (SI-OB-05 and 06)

Architecture – Wall Finish
The wall finish for this building is the original common bond brick painted white.

Architecture – Ceiling Finish
The ceiling finish is plywood, painted red and supported by metal brackets.

Architecture – Floor
The floor is concrete slab-on-grade, once painted green and is original to the building.

Architecture – Casework
There is a contemporary cabinet, shelving unit, and wood boards for hanging equipment on the south and east walls.

Architecture – Accessibility
This building is currently not accessible. The entry door opening is 2'-7" clear with a grade to finished floor elevation change of 11 ½".

Physical Description -- Structural

Structural – Foundation
The perimeter foundation system consists of brick masonry walls.

Structural – Floor Framing
The floor is a concrete slab-on-grade.

Structural – Roof Framing
The roof framing was metal angles that were not accessible and could not be measured. The angles are covered by metal roof sheathing.

Structural – Wall Framing
The exterior walls are constructed of brick masonry.

Structural – Lateral System
Lateral stability for the building is provided by the brick masonry walls.

Structural – Load Requirements
The required floor load capacity is 125 psf and the required roof snow load capacity is 40 psf.

Physical Description -- Mechanical

Mechanical – Plumbing Systems
None in the building.

Mechanical – HVAC
The original circular metal gravity vent remains on the roof. A roof cap has been put in place above the storage area rendering the vent inoperable.

Mechanical – Fire Suppression
None in the building.

Physical Description -- Electrical

Electrical – System Configuration
None in the building.

Electrical – Conductor Insulation
None in the building.

Electrical – Overcurrent Protection
None in the building.

Electrical – Lighting Systems
None in the building.

Electrical – Telecommunications
None in the building.

Electrical – Fire Alarm System
None in building.

Electrical – Lightning Protection
None on the building.

Physical Description -- Hazardous Materials

Landmark Environmental collected four bulk samples from a total of four different types of suspected asbestos containing materials (ACMs) at Sand Island. Of the four suspect ACMs that were sampled and analyzed, none of the sampled suspect ACMs resulted in concentrations of greater than one percent (positive for asbestos).

Hazardous Materials – Asbestos

The following suspect ACMs were not sampled due to inaccessibility or park limitation regarding potential for damage to structures. Asbestos is assumed to be present in:

1. Block Filler,
2. Wall Interiors, and,
3. Adhesives.

The assumed asbestos containing materials were observed to be in good condition.

Hazardous Materials – Lead Containing Paint

Detectable lead is assumed to be present at the following locations:

1. Interior Painted Surfaces, and,
2. Exterior Painted Surfaces.

Based on the estimated dates of construction of the various structures, intact lead containing paint is assumed to be present throughout the structure. The assumed LCP was observed to be in poor condition.

Paint chip debris was not seen on the ground surface.

Hazardous Materials – Lead Dust

Wipe sampling for lead dust was not conducted in the Oil Building because it is not a residential structure.

Hazardous Materials – Lead in Soils

The historical paint maintenance activities may have the potential to impact the surrounding soil. The surface soils adjacent to the structure were not observed to have lead paint debris. Preliminary lead-in-soil sampling was not performed to assess whether these soils contain lead concentrations above applicable residential soil standards.

Soil Sampling was not conducted around the Oil Building.

Hazardous Materials – Mold

Inspections of the structure were performed to identify the readily ascertainable visual extent of the mold growth. Moisture testing in building materials was not performed nor was sampling of building materials performed for microbial analysis. Mold was not visually identified.

Hazardous Materials – Petroleum Hydrocarbons

Localized areas of staining were observed on concrete floors in the Oil Building. Stained areas are likely associated with fuel oil, diesel or other petroleum hydrocarbons. Tank and piping systems may also contain petroleum hydrocarbons.

Character Defining Features

Mass/Form. A simple utilitarian hipped roof masonry structure.

Exterior Materials. Red brick, wood trim painted red and red metal roofing standing seam panels.

Openings. Steel plate door painted red.

Interior Materials. Exposed masonry painted white and concrete slab.

General Condition Assessment

In general, the Sand Island Oil Building is in good condition.

Structurally, the Oil Building is in good condition.

Mechanically, the circular gravity vent is in good condition but it is not functional. No other mechanical systems exist.

Electrically, the Oil Building has no system.

The following section is a discipline-by-discipline, component-by-component condition assessment of the building. Refer to Volume I, Chapter 2: Methodology for definitions of the condition ratings.

Condition Assessment -- Architecture

Architecture – Roof
Condition: *Good*
The roof and trim are in good condition.

Architecture – Exterior Walls
Condition: *Good*
The exterior walls are in good condition, though there are areas where previous repointing is evident due to variation of color in the mortar joints.

Architecture – Exterior Door
Condition: *Fair to Poor*
The door knob is damaged and does not function.

Architecture – Wall Finish
Condition: *Fair*
The brick is in fair condition with peeling paint.

Architecture – Ceiling Finish
Condition: *Good*
The plywood and metal angles are in good condition.

Architecture – Floor
Condition: *Good*
The floor is in good condition. There are minor cracks from a slight deformation of the floor. The floor also has stains and wear associated with its use as a storage building.

Architecture – Casework
Condition: *Good*
The modern cabinet, shelving unit, and wood boards are in good condition.

Architecture – Accessibility
Condition: *Poor*
This building is currently not accessible.

Condition Assessment -- Structural

Structural – Foundation
Condition: *Good*
The visible portion of the foundation system appears to be in good condition. No obvious signs of distress or damage were observed.

Structural – Floor Framing
Condition: *Good*
The concrete slab-on-grade is in good condition.

Structural – Roof Framing
Condition: *Unknown*
The roof framing could not be observed, thus its condition is unknown. No obvious signs of distress or damage were observed.

Structural – Wall Framing
Condition: *Good*
The walls are in good condition.

Structural – Lateral System
Condition: *Good*
Lateral stability of the building is good.

Structural – Load Requirements
Condition: *Good*
The slab-on-grade has adequate capacity. The roof framing could not be observed, thus its capacity is unknown.

Condition Assessment -- Mechanical

Mechanical – Plumbing Systems and Fire Suppression
Condition: *N/A*

Mechanical – HVAC
Condition: *Good*
The circular gravity vent on the roof is in good condition. A roof cap has been put in place above the storage area rendering the vent inoperable.

Condition Assessment -- Electrical

N/A

Condition Assessment -- Hazardous Materials

Refer to 'Physical Description -- Hazardous Materials' for detailed descriptions of locations and conditions of hazardous materials.

Ultimate Treatment and Use

This building operated as the original oil storage building from 1901 until the Light Station was automated in 1921.

The building is currently used as secure park storage. The use of the Oil Building is proposed to remain as secure park storage.

Preservation is the recommended treatment for the building.

Requirements for Treatment

Compliance requirements for treatment currently include laws, regulations, and standards as outlined by the NPS and listed in Volume I, Administrative Data section of this report.

The recommended treatments are tailored to the Preferred Alternative as the outcome of the Value Analysis/CBA for the project. As individual buildings are rehabilitated, specific alternatives will present themselves during design and construction. The following section is a discipline-by-discipline, component-by-component description of the treatments proposed for the preservation of the building. Refer to Volume I, Chapter 2: Methodology for the priority rating definitions.

Treatment Recommendations -- Architecture

Architecture – Roof
Priority: *Low*
No recommendations at this time.

Architecture – Exterior Walls
Priority: *Low*
No recommendations at this time.

Architecture – Exterior Door
Priority: *Moderate*
Repair the knob and provide operability.

Architecture – Wall Finish
Priority: *Low*
Scrape, sand and repaint interior walls.

Architecture – Ceiling Finish
Priority: *Low*
Scrape, sand and repaint the ceiling.

Architecture – Floor
Priority: *Low*
No recommendations at this time.

Architecture – Casework
Priority: *Low*
No recommendations at this time.

Architecture – Accessibility
Priority: *Low*
Provide program access through interpretive waysides (site map).

Treatment Recommendations -- Structural

Structural – Foundation
Priority: *Low*
No recommendations at this time.

Structural – Floor Framing
Priority: *Low*
No recommendations at this time.

Structural – Roof Framing
Priority: *Low*
No recommendations at this time.

Structural – Wall Framing
Priority: *Low*
No recommendations at this time.

Structural – Lateral System
Priority: *Low*
No recommendations at this time.

Treatment Recommendations -- Mechanical

Mechanical – Plumbing Systems and Fire Suppression
Priority: *N/A*

Mechanical – HVAC
Priority: *Low*
No recommendations at this time.

Treatment Recommendations -- Electrical

N/A

Treatment Recommendations – Hazardous Materials

Hazardous Materials – Asbestos
Priority: *Low*
Recommend sampling of suspect asbestos containing materials, including adhesives, wall interiors, brick and block filler, and asbestos cement.

Hazardous Materials – Lead-Containing Paint and Lead Dust
Priority: *Moderate*
Recommend stabilization or abatement of Lead Containing Paint. Lead dust wipe sampling not recommended.

Hazardous Materials – Lead In Soils
Priority: *Low*
Recommend further soils characterization to confirm applicable regulatory requirements.

Hazardous Materials – Mold/Biological
Priority: *Low*
No action recommended.

Hazardous Materials – Petroleum Hydrocarbons
Priority: *Low*
Recommend further investigation and sampling.

Alternatives for Treatment

One alternative treatment for consideration could be for the use by the park to include this building for interpretive use on the interior as opposed to continued use as park storage. However, due to the limited options for the necessary maintenance functions' storage at this remote site, retaining the storage use on the interior is deemed appropriate.

A second and more extreme alternative would be to remove the structure entirely. This action would be dependent on further definition of the light station's restoration period which has been to date only been defined as pre-1921. Prior to 1901, oil was stored at the separately accessed basement area. However, this alternative is not recommended due to the removal of current historic fabric.

Assessment of Effects for Recommended Treatments

The following table includes an analysis of the major treatment recommendations which affect Section 106 Compliance:

Recommended Treatment	Potential Effects	Mitigating Measures	Beneficial Effects
1. Additional Hazardous Testing and Mitigation	Mitigation of hazardous material may require removal of historic materials and affect the adjacent landscape/fabric.	Any mitigation will need to be evaluated for benefit and implemented sensitively to minimize damage to the resource.	- Improves safety for visitors and staff - Removes hazards from the cultural resource

Oil Building Photographs, 2009

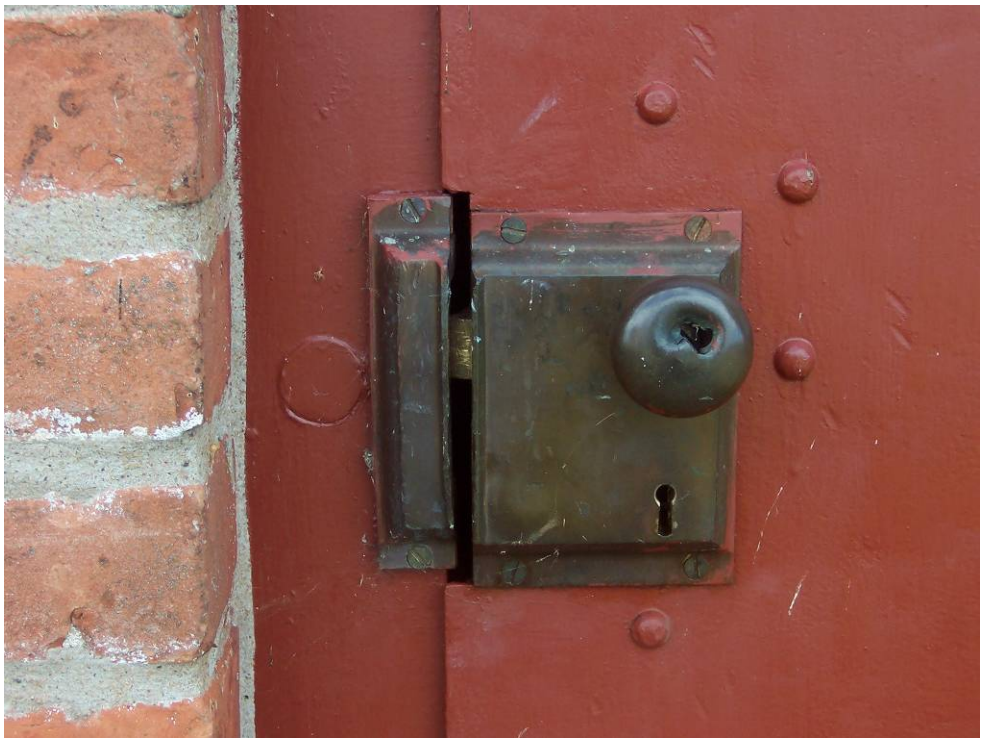
SI-OB-01: North elevation, 2009 (Source: A&A DSC01244)

SI-OB-02: West elevation, 2009 (Source: A&A DSC01245)

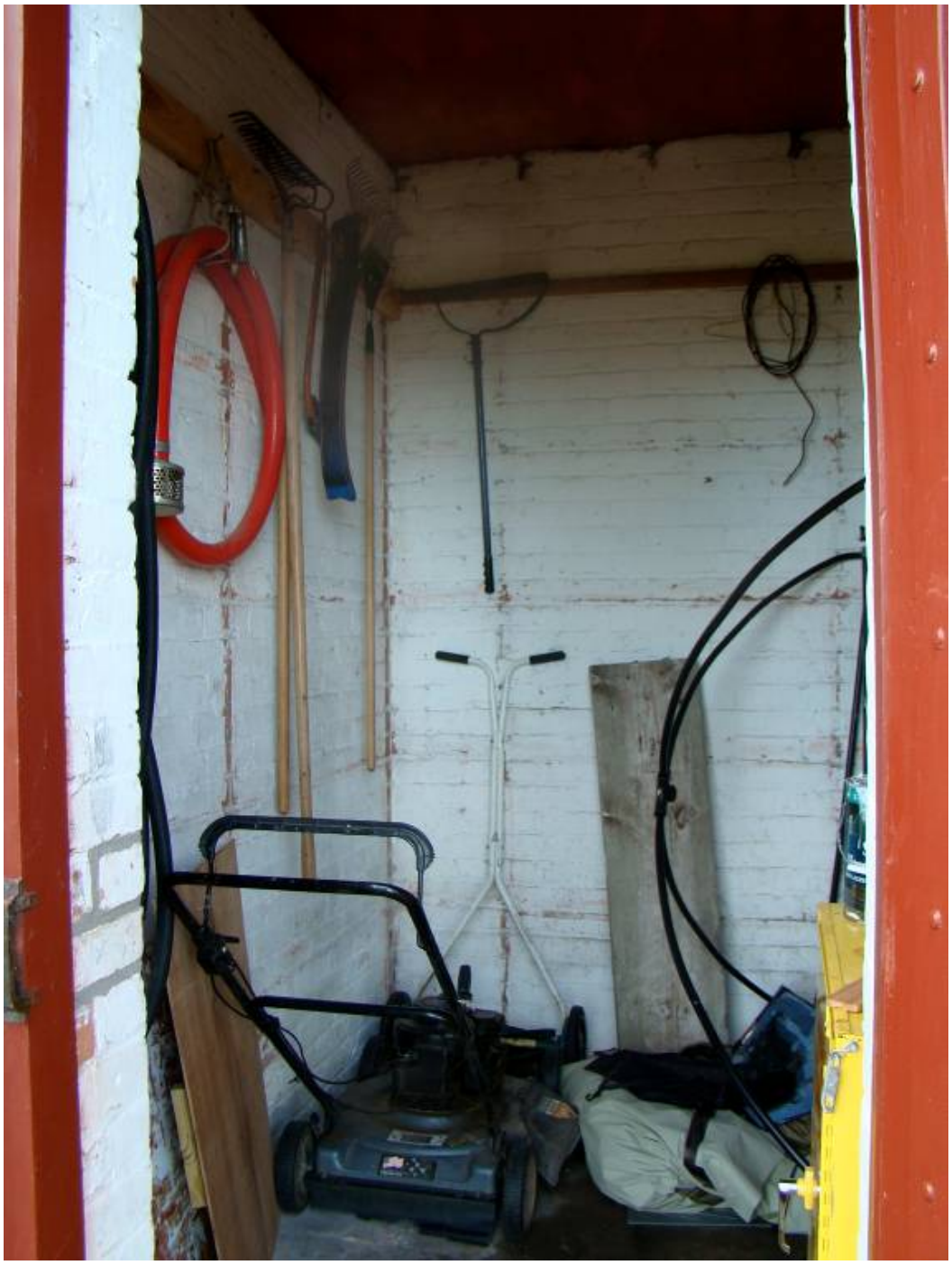
SI-OB-03: South elevation, 2009 (Source: A&A DSC01246)

SI-OB-04: East elevation, 2009 (Source: A&A DSC01247)

SI-OB-05: North entry door (Source: A&A 100_9876)



SI-OB-06: Entry door hardware detail (Source: A&A 100_9880)



SI-OB-07: South elevation, 2009 (Source: A&A CIMG4205)

PRIVY

Chronology of Alterations and Use

Original Construction

The Sand Island Privy was constructed in 1881 along with the Light Station.

The existing Privy is seen in a photo c. 1900, a photo from 1904, an undated photo, a photo from 1978, and a photo from 1979. It is located south of the kitchen and does not appear to have changed significantly, especially from the 1978 photo. (Historic Image S1-15)

There are no available historic drawings for this building.

Significant Alterations / Current condition

No significant alterations have occurred to the Privy. Work completed by the Historic Structure Preservation Team from the NPS between 1998 and 2009 consisted of repointing the masonry, rehabilitating and painting the exterior woodwork, and sanding and refinishing the flooring.

The original decorative gravity vent remains on the roof. There are no other mechanical systems in the building.

There are no and were never any electrical systems in the Privy.

The Sand Island Privy is in good condition.

Summary of Documented Work on the Building

Date	Work Described	Source of Information
1920, June	June 19: "Keeper repaired screens & steps & painted them & the Toilet."	E. Luick, SI Log, Oct1, 1898 - Nov 17, 1907 and June 1, 1914- July 31, 1920
1977	Stabilization of Light Station Quarters and Privy	NPS/APIS Business Office Records D3423 for Sand Island
1978	Repoint brick and paint buildings	NPS/APIS Business Office Records D3423 for Sand Island
1981	Retuckpoint stonework and paint trim on Light Station Quarters and Privy	NPS/APIS Business Office Records D3423 for Sand Island

Notable Actions with Unknown Dates

Date Range	Work Described
1998-2009	Repointed masonry
1998-2009	Rehabilitated and painted the exterior woodwork
1998-2009	Sanded and refinished the flooring

General Physical Description

The building is a small, one-story, one room, rectangular brick utilitarian structure with a brownstone foundation. It has a simple metal gable roof with carved brackets and exposed rafter tails. The Privy is a three-seater (2 adult, 1 child). The door faces north towards the Quarters.

Physical Description -- Architecture

Architecture – Roof
The roofing is red metal shingles (the same used in the main portion of the Light Station Quarters), with a curved trim ridge cap. The roof has decorative rafter tails, gable end fascia board and barge boards similar to the style and era of the Light Station Quarters roof details. (SI-P-01)

Architecture – Exterior Walls
The exterior walls are made of two-wythe red brick running bond with rowlocks every sixth course. The walls have a brownstone foundation and are original to the building.

Architecture – Window
The window is a four-lite casement with a knob slider like the Tower casement. Trim on both the interior and exterior is simple 1x casing. The window is 1'-8" x 2'-0". (SI-P-06 and 07)

Architecture – Exterior Door
The door is two vertical over one horizontal over two vertical wood panels (same look and trim as other exterior doors). The door has a historic ceramic knob, wood threshold, and stone sill. Trim is 1x casing. Above the door is a segmented brick arch. The door measures 2'-8" x 6'-7" x 1 ¾".

Architecture – Exterior Trim
The exterior trim consists of a wood vent that appears to be original. (SI-P-05)

Architecture – Wall Finish
The wall finish is plaster on masonry, painted green, with 1 ¾" wide board wainscot on the east wall and 3 ½" beadboard on the north, south, and west walls. The wall finishes are historic.

Architecture – Ceiling Finish
The ceiling finish is original plaster over lath.

Architecture – Interior Trim
The interior trim consists of a chair rail edge at the top of the wainscot, wood, painted white.

Architecture – Floor
The floor is covered by one sheet of plywood, not original to the building.

Architecture – Casework
The Privy contains two adult (1'-5" tall) and one child (10" tall) wood privy seats, painted gray and white. (SI-P-08)

Architecture – Accessibility
This building is currently not accessible. The main door opening is 2'-8" clear with a grade to finished floor elevation change of 8" due to the stone sill.

Physical Description -- Structural

Structural – Foundation
The foundation of the Privy appears to be stone masonry but was not accessible.

Structural – Floor Framing
The floor appears to be wood framed but was not accessible.

Structural – Roof Framing
The roof framing was measured to be full-sawn (FS) 2x4 rafters spaced at about 24". The rafters span approximately three '. The rafters are supported on the exterior masonry walls. The rafters are sheathed by 1x solid wood underlayment.

Structural – Wall Framing
The walls are brick masonry.

Structural – Lateral System
Lateral stability for the building is provided by the exterior masonry walls.

Structural – Load Requirements
The required floor and roof snow load capacities are 40 psf.

Physical Description -- Mechanical

Mechanical – Plumbing Systems
None in the building.

Mechanical – HVAC
The original decorative gravity vent remains on the roof.

Mechanical – Fire Suppression
None in the building.

Physical Description -- Electrical

Electrical – System Configuration
None in the building.

Electrical – Conductor Insulation
None in the building.

Electrical – Overcurrent Protection
None in the building.

Electrical – Lighting Systems
None in the building.

Electrical – Telecommunications
None in the building.

Electrical – Fire Alarm System
None in the building.

Electrical – Lightning Protection
None on the building.

Physical Description -- Hazardous Materials

Landmark Environmental collected four bulk samples from a total of four different types of suspected asbestos containing materials (ACMs) at Sand Island. Of the four suspect ACMs that were sampled and analyzed, none of the sampled suspect ACMs resulted in concentrations of greater than one percent (positive for asbestos).

Hazardous Materials – Asbestos

The following suspect ACMs were not sampled due to inaccessibility or park limitation regarding potential for damage to structures. Asbestos is assumed to be present in:

1. Plaster,
2. Wall Interiors, and,
3. Adhesives.

The assumed asbestos containing materials were observed to be in good condition.

Hazardous Materials – Lead Containing Paint

Detectable lead is assumed to be present at the following locations:

1. Interior Painted Surfaces, and,
2. Exterior Painted Surfaces.

Based on the estimated dates of construction of the various structures, intact lead containing paint is assumed to be present throughout the structure. The assumed LCP was observed to be in poor condition.

Paint chip debris was not seen on the ground surface.

Hazardous Materials – Lead Dust

Wipe sampling for lead dust was not conducted in the Privy because it is an un-inhabited structure.

Hazardous Materials – Lead in Soils

The historical paint maintenance activities may have the potential to impact the surrounding soil. The surface soils adjacent to the structure were not observed to have lead paint debris. Preliminary lead-in-soil sampling was not performed to assess whether these soils contain lead concentrations above applicable residential soil standards.

Soil Sampling was not conducted around the Privy.

Hazardous Materials – Mold

Inspections of the structure were performed to identify the readily ascertainable visual extent of the mold growth. Moisture testing in building materials was not performed nor was sampling of building materials performed for microbial analysis. Mold was not visually identified.

Character Defining Features

Mass/Form. A simple utilitarian gabled masonry structure with decorative exposed rafter tails that match those at the house.

Exterior Materials. Red brick, wood trim painted white and red metal roofing shingles.

Openings. One covered arched window opening and one five panel wood door, both painted white.

Interior Materials. Plaster, painted wood wainscot and trim.

General Condition Assessment

In general, the Sand Island Privy is in good condition on the exterior and fair condition on the interior. It is a three-seater privy, two adult seats and one child seat. The ceiling and wall finishes made of plaster are in poor condition as pieces of plaster are missing or about to fall off. The original floor is covered or has been removed and a sheet of plywood now covers the floor. The window is blocked on the exterior, but from the interior, it is a good representation of the era. The door is also in good condition.

Structurally, the Privy is in good condition.

Mechanically, the only attribute in the Privy is the decorative gravity vent, which is in good condition.

Electrically, there is no system in the Privy.

The following section is a discipline-by-discipline, component-by-component condition assessment of the building. Refer to Volume I, Chapter 2: Methodology for definitions of the condition ratings.

Condition Assessment -- Architecture

Architecture – Roof
Condition: *Good to Fair*
The shingles have been recently refinished, though there is still a rough edge at the eaves. Also, the ball closures are missing at both ends of the ridge.

Architecture – Exterior Walls
Condition: *Good*
The exterior walls are in good condition.

Architecture – Window
Condition: *Good*
The window is currently boarded up on the exterior. The interior appears to be in good condition.

Architecture – Exterior Door
Condition: *Good to Fair*
This door is in good condition, although the knob is loose and there is no escutcheon.

Architecture – Exterior Trim
Condition: *Good*
The exterior trim is in good condition.

Architecture – Wall Finish
Condition: *Good to Fair to Poor*
The plaster wall finish is in poor condition with pieces missing and large cracks. The east wall wainscot is in fair condition as one board has a large hole, most likely animal made. The beadboard wainscot on the other three walls is in good condition.

Architecture – Ceiling Finish
Condition: *Poor*
The ceiling finish is in poor condition as over half of the plaster is missing and the lath is visible. (SI-P-09)

Architecture – Interior Trim
Condition: *Good*
The trim is in good condition.

Architecture – Floor
Condition: *Good*
The modern plywood is in good condition.

Architecture – Casework
Condition: *Fair*
The privy seats are in fair condition as they have paint peeling and some splitting wood.

Architecture – Accessibility
Condition: *Poor*
This building is currently not accessible.

Condition Assessment -- Structural

Structural – Foundation
Condition: *Good*
The visible portion of the foundation appeared to be in good condition. No obvious signs of distress or damage were observed.

Structural – Floor Framing
Condition: *Unknown*
The floor framing could not be observed, thus its condition is unknown. No obvious signs of distress or damage were observed.

Structural – Roof Framing

Condition: *Unknown*
The roof framing could not be observed, thus its condition is unknown. No obvious signs of distress or damage were observed.

Structural – Ceiling Framing
Condition: *Good*
The ceiling framing is in good condition.

Structural – Wall Framing
Condition: *Good*
The wall framing is in good condition.

Structural – Lateral System
Condition: *Good*
Lateral stability of the building is good.

Structural – Load Requirements
Condition: *Unknown*
The floor and roof framing could not be observed, thus their capacity is unknown.

Condition Assessment -- Mechanical

Mechanical – Plumbing Systems and Fire Suppression
Condition: *N/A*

Mechanical – HVAC
Condition: *Good*
The decorative gravity vent on the roof is in good condition.

Condition Assessment -- Electrical

N/A

Condition Assessment -- Hazardous Materials

Refer to 'Physical Description -- Hazardous Materials' for detailed descriptions of locations and conditions of hazardous materials.

Ultimate Treatment and Use

This building operated as the original privy from 1881 until 1921 when the light was automated. It was most likely still used throughout the tenant years.

The building is currently vacant. The use of the Privy is proposed as passive visitor access by means of visual access only to the interior as seen from the exterior. Various methods of allowing this could be studied and may include a Plexiglas panel (or similar product) that can be in place when the exterior door is open.

Preservation is the recommended treatment for the building.

Requirements for Treatment

Compliance requirements for treatment currently include laws, regulations, and standards as outlined by the NPS and listed in Volume I, Administrative Data section of this report.

The recommended treatments are tailored to the Preferred Alternative as the outcome of the Value Analysis/CBA for the project. As individual buildings are rehabilitated, specific alternatives will present themselves during design and construction. The following section is a discipline-by-discipline, component-by-component description of the treatments proposed for the preservation of the building. Refer to Volume I, Chapter 2: Methodology for the priority rating definitions.

Treatment Recommendations -- Architecture

Architecture – Roof
Priority: *Low*
Replace the missing metal ball closures at both ends of the ridge.

Architecture – Exterior Walls
Priority: *Low*
No recommendations at this time.

Architecture – Window
Priority: *Moderate*
Remove the board at the window, scrape, sand and repaint.

Architecture – Exterior Door
Priority: *Low*
Repair the loose knob replace the missing escutcheon. Scrape, sand and repaint. Investigate installing a Plexiglas panel (or similar product) inside the door.

Architecture – Exterior Trim
Priority: *Low*
No recommendations at this time.

Architecture – Wall Finish
Priority: *Moderate*
Repair the damaged plaster, repair the east wall wainscot hole and repaint.

Architecture – Ceiling Finish
Priority: *Moderate*
Repair the damaged plaster and repaint.

Architecture – Interior Trim
Priority: *Low*
Repair as needed with wall and finish plaster work. Scrape, sand and repaint.

Architecture – Floor
Priority: *Low*
Remove the modern plywood which may be covering a recently refinished floor per park records.

Architecture – Casework
Priority: *Low*
Scrape, sand and repaint the casework.

Architecture – Accessibility
Priority: *Low*
Provide program access through interpretive waysides (site map).

Treatment Recommendations -- Structural

Structural – Foundation
Priority: *Low*
No recommendations at this time.

Structural – Floor Framing
Priority: *Low*
No recommendations at this time.

Structural – Roof Framing
Priority: *Low*
No recommendations at this time.

Structural – Ceiling Framing
Priority: *Low*
No recommendations at this time.

Structural – Wall Framing
Priority: *Low*
No recommendations at this time.

Structural – Lateral System
Priority: *Low*
No recommendations at this time.

Treatment Recommendations -- Mechanical

Mechanical – Plumbing Systems and Fire Suppression
Priority: *N/A*

Mechanical – HVAC
Priority: *Low*
No recommendations at this time.

Treatment Recommendations -- Electrical

N/A

Treatment Recommendations – Hazardous Materials

Hazardous Materials – Asbestos
Priority: *Low*
Recommend sampling of suspect asbestos containing materials, including adhesives, caulk, and asbestos-cement.

Hazardous Materials – Lead-Containing Paint and Lead Dust
Priority: *Low*
Recommend stabilization or abatement of Lead Containing Paint. Lead dust wipe sampling not recommended.

Hazardous Materials – Lead In Soils
Priority: *Low*
Recommend further soils characterization to confirm applicable regulatory requirements.

Hazardous Materials – Mold/Biological
Priority: *Low*
No recommendations at this time.

Hazardous Materials – Petroleum Hydrocarbons
Priority: *Low*
No recommendations at this time.

Alternatives for Treatment

Although a secondary interior door (Plexiglas panel or similar product) has been proposed, consideration should be given if a physical barrier is required in allowing the Privy to be open to the public during the time of guided use at the light station. Such an addition might be more of a maintenance burden than the risk of the public entering the Privy.

Another alternative could be for the public to only experience the Privy from the exterior.

And finally, reintroducing the glass at the window could be seen as a potential risk. If the glass were to break (either by nature or vandal) it could allow the elements into the interior for a period of time before park staff were able to visit and identify the damage.

Assessment of Effects for Recommended Treatments

The following table includes an analysis of the major treatment recommendations which affect Section 106 Compliance:

Recommended Treatment	Potential Effects	Mitigating Measures	Beneficial Effects
1. Introduce a Plexiglas panel or similar product for visual access by visitors.	- Creates a false atmospheric division at structure. - Installation methods may damage historic fabric.	Study alternative methods for allowing visitors visual access to the structure.	- Improves visitor experience
2. Additional Hazardous Testing and Mitigation	Mitigation of hazardous material may require removal of historic materials and affect the adjacent landscape/fabric.	Any mitigation will need to be evaluated for benefit and implemented sensitively to minimize damage to the resource.	- Improves safety for visitors and staff - Removes hazards from the cultural resource

Privy Photographs, 2009

SI-P-01: North elevation aerial, 2009 (Source: A&A IMGP3061)

SI-P-02: West elevation, 2009 (Source: A&A DSC01258)

SI-P-03: South elevation, 2009 (Source: A&A DSC01259)

SI-P-04: East elevation, 2009 (Source: A&A DSC01260)

SI-P-05: North elevation trim, roof and vent details (Source: A&A IMGP3081)

SI-P-06: East wall and window (Source: A&A 100_9873)

SI-P-07: Window hardware (Source: A&A 100_9874)

SI-P-08: Interior, south elevation (Source: A&A CIMG4191)

SI-P-09: Ceiling and vent detail, looking south (Source: A&A CIMG4203)

1

GLOSSARY OF TERMS

PRIMARY TREATMENT APPROACH – PRESERVATION

Preservation standards include measures necessary to sustain the existing form, integrity, and materials of a historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. Preservation requires the retention of the greatest amount of historic fabric, including the landscape's historic form, features, and details as they have evolved over time. Limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work is permitted.

HOW TERMINOLOGY IS USED IN THE PRESERVATION APPROACH

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 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.

Plant – the removal and replanting of landscape plantings and vegetation as part of maintenance activities

Protect – short term and minimal measures used to stabilize and protect features, such as fencing around landscape features

Relocate – the removal and resetting of noncontributing features

Remove – the removal of nonhistoric features

Repair – features, components of features and materials that require additional work. These may include 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). Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive features that are repaired will match the old in design, color, texture, and if possible, material.

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.

Stabilize – immediate measures (more than standard maintenance practices) are needed to prevent deterioration, failure, or loss of features.

PRIMARY TREATMENT APPROACH – REHABILITATION

Rehabilitation in intended to return a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural values. Rehabilitation allows for repairs, alterations, restoration of missing features, and additions necessary to enable a compatible use for a property as long as the portions or features which convey the historical, cultural, or architectural values are preserved. Limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work is permitted.

HOW TERMINOLOGY IS USED IN THE REHABILITATION APPROACH

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 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.

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

Reestablish – are those measures necessary to depict a landscape feature as it occurred historically. Reestablishment may include the replacement of missing landscape features such as views, planting patterns, spatial relationships, or small scale features.

Relocate – remove and reset noncontributing features

Remove – removal of nonhistoric features

Repair – features, components of features and materials that require additional work. These may include 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). Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive features that are repaired will match the old in design, color, texture, and if possible, material.

Restore – are those measures necessary to depict a feature or area as it occurred historically. Restoration may include repair of a feature so that it appears as it did historically or it may include replacement of missing features or qualities.

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.

Stabilize – immediate, more extensive measures (more than standard maintenance practices) are needed to prevent deterioration, failure, or loss of features.

PRIMARY TREATMENT APPROACH – RESTORATION

Restoration standards allow for the accurate depiction of a property as it appeared at a particular time in its history by means of the removal of features from other periods in its history and reconstruction of missing features from the period of significance. The limited and sensitive upgrading of systems (mechanical, electrical, plumbing) and other code related work is appropriate.

HOW TERMINOLOGY IS USED IN THE RESTORATION APPROACH

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 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.

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

Relocate – remove and reset noncontributing features

Remove – removal of nonhistoric features

Reestablish – are those measures necessary to depict a landscape feature as it occurred historically. Reestablishment may include the replacement of missing landscape features such as views, planting patterns, spatial relationships, or small scale features.

Repair – features, components of features and materials that require additional work. These may include 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). Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive features that are repaired will match the old in design, color, texture, and if possible, material.

Restore – are those measures necessary to depict a feature or area as it occurred historically. Restoration may include repair of a feature so that it appears as it did historically or it may include replacement of missing features or qualities.

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.

Stabilize – immediate, more extensive measures (more than standard maintenance practices) are needed to prevent deterioration, failure, or loss of features.

CONDITION ASSESSMENT DESCRIPTION LEVELS

Feature Condition Definitions

(Note: These terms are also applied to the overall structure/building.)

GOOD The feature is intact, structurally sound and performing its intended purpose. The feature needs no repair or rehabilitation, but only routine or preventive maintenance.

FAIR The feature is in fair condition if either of the following conditions is present:

- There are early signs of wear, failure or deterioration though the feature is generally structurally sound and performing its intended purpose – or –
- There is failure of a portion of the feature.

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 –
- Significant elements of the feature are missing – or –
- Deterioration or damage affects more than 25% of the feature – or –
- The feature shows signs of imminent failure or breakdown.

UNKNOWN Not enough information is available to make an evaluation.

RATINGS OF TREATMENT SEVERITY

An impact is a detectable result of an agent or series of agents having a negative effect on the significant characteristics or integrity of a structure and for which some form of mitigation or preventative action is

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.

SEVERE	1. The structure/feature will be significantly damaged or irretrievably lost if action is not taken within two (2) years. 2. There is an immediate and severe threat to visitor or staff safety.
MODERATE	1. The structure/feature will be significantly damaged or irretrievably lost if action is not taken within five (5) years. 2. The situation caused y the impact is potentially threatening to visitor or staff safety.
LOW	1. The continuing effect of the impact is known and will not result in significant damage to the structure/feature. 2. The impact and its effects are not a direct threat to visitor or staff safety.
UNKNOWN	Not enough information is available to make an evaluation.

DEFINITIONS OF TERMS

A

AAS: Atomic Absorption Spectroscopy

AC: Alternating current; the movement of current through an electrical circuit that periodically reverses direction. Alternating current is the form of electric power that is delivered to businesses and residences.

ACM: Asbestos Containing Material

Accessibility: a term used to describe facilities or amenities to assist people with disabilities and can extend to Braille signage, wheelchair ramps, elevators/lifts, walkway contours, reading accessibility, etc. According to its website, the Park Service is "committed to making all practicable efforts to make NPS facilities, programs, services, employment, and meaningful work opportunities accessible and usable by all people, including those with disabilities. This policy reflects the commitment to provide access to the widest cross section of the public and to ensure compliance with the Architectural Barriers Act of 1968, the Rehabilitation Act of 1973, the Equal Employment Opportunity Act of 1972, and the Americans with Disabilities Act of 1990. The Park Service will also comply with section 507 of the Americans with Disabilities Act (42 USC 12207), which relates specifically to the operation and management of federal wilderness areas. The accessibility of commercial services within national parks are also covered under all applicable federal, state and local laws" (source: http://www.nps.gov/aboutus/eeo.htm).

AES-ICP: Atomic Emission Spectroscopy – Inductively Coupled Plasma

AIHA: American Industrial Hygiene Association

Air Terminal: A rod that extends above a surface to attract lightning strikes.

AL: Action Level

B

Beam: a structural member, usually horizontal, with a main function to carry loads cross-ways to its longitudinal 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.

C

Cantilever: refers to the part of a member that extends freely over a beam or wall, which is not supported at its end.

Cast Iron: 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.

Column: a main vertical member that carries axial loads from beams or girders to the foundation parallel to its longitudinal axis.

D

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

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

F

Flue Vent: A duct or pipe conveying combustion by-products from a heater or furnace.

Fluorescent: A source of light that emits light radiation at longer wavelengths and lower energy.

Footing: 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.

Foundation: supports a building or structure.

FRP: Fiberglass reinforced plastic

Full Sawn (FS): Lumber cut, in the rough, to its full nominal size.

G

Gable: located above the elevation of the eave line of a double-sloped roof.

Galvanized Steel: Steel coated with zinc carbonate to resist corrosion.

GPM: Gallon per minute; a standard unit of volumetric liquid flow rate.

Grade: the ground elevation of the soil.

Gravity Vent: Openings in a roof intended to vent hot air by the action of convection.

Gray Water: Wastewater generated from domestic washing activities and not containing human waste.

GRO: Gasoline Range Organics

H

Header: a member that carries joists, rafters or beams and is placed between other joists, rafters or beams.

Hip Roof: a roof sloping from all four sides of a building.

HUD: Housing and Urban Development

HVAC: Heating, Ventilation, and Air Conditioning.

I

IAQ: Indoor Air Quality

IEUBK: Integrated Exposure Uptake Biokinetic

Incandescent: A source of light that works by incandescence, or works by a heat-driven light emission through black-body radiation.

Inverter: A device that converts electrical direct current (DC) to electrical alternating current (AC).

J

Joist: a horizontal structural load-carrying member which supports floors and ceilings.

K

kVA: Kilovolt-ampere equal to 1,000 volt-amperes. kVA is a unit to express the apparent power consumed in an electrical circuit or electrical device.

kW: Kilowatt equal to 1,000 watts. A kilowatt is typically used to express the output power consumption of large devices or electrical systems.

L

LBP: Lead-Based Paint

LCP: Lead-Containing Paint

LCS: Lead-Contaminated Soils

Leach Field: A drain field used to remove contaminants and impurities from liquid that emerges from a septic tank.

LED: Light emitting diode; a semiconductor light source that can emit light in various colors and brightness.

Live Load: nonpermanent loads on a structure created by the use of the structure.

Load: an outside force that affects the structure or its members.

Louver: An opening with horizontal slats angled to allow passage of air while keeping out rain and snow.

M

Mg/kg: Milligrams per Kilogram

N

NEC: National Electric Code.

NESHAP: National Emission Standards for Hazardous Air Pollutants

Nonpotable Water: Water that has not been approved for safe human consumption.

NVLAP: National Voluntary Laboratory Accreditation Program

O

OSHA: Occupational Safety and Health Administration

Overcurrent Protection: A fuse, circuit breaker or relay that will open the electrical circuit when the downstream electrical current exceeds the stated current rating.

P

Passive Ventilation: Ventilation of a building without the use of a fan or other mechanical system.

Pitch: the slope of a member defined as the ratio of the total rise to the total run.

PLM: Polarized Light Microscopy

PV: Photovoltaic; An array of solar modules or cells that collect solar energy and convert the energy into direct current electricity.

PVC: Polyvinyl Chloride; A biologically and chemically resistant plastic widely used for household sewage pipe.

R

Rafter: a sloped structural load-carrying member which supports the roof.

RBM: Regulated/Hazardous Material

Reaction: the force or moment developed at the points of a support.

RLM: Industrial stem mounted reflector.

Romex: Wiring with rubber insulated conductors in an overall sheath of braided cotton fiber.

S

Seismic Load: loads produced during the seismic movements of an earthquake.

Septic Tank: A sewage tank containing anaerobic bacteria which decomposed waste discharged into tank.
Shear: forces resulting in two touching parts of a material to slide in opposite directions parallel to their plane of contact.

Snow Load: loads produced from the accumulation of snow.

Span: the distance between supports.

Step-down Transformer: A device that converts a high voltage down to a lower voltage through a series of winding coils.

Structural Steel**:** an iron alloy with a carbon content of 0.16% to 0.29%. Steel is malleable, and easily welded.

Strut: a structural brace that resists axial forces.

Stud: a vertical wall member used to construct partitions and walls.

T

Thermal Expansion Tank: A tank used in a closed water heating system to absorb excess water pressure caused by thermal expansion.

TSI: Thermal System Insulation

Turbine Vent: Vents utilizing rotating wind vanes to create air flow.

V

Vent Stack: A vertical pipe proving ventilation.

W

WAC: Wisconsin Administrative Code

WDNR: Wisconsin Department of Natural Resources

Wrought Iron: an iron alloy with very low carbon content, in comparison to steel. Wrought iron is tough, malleable, ductile, and easily welded.

X

XRF: X-ray fluorescence analyzer

Other

30 µg/m3: 30 micrograms per cubic meter

µg/SF: Micrograms of Lead Dust per Square Foot of Floor Space

1x: Piece of dimensional lumber 1" (nominal) / ¾" (actual) thick

APPENDIX A: MATRIX OF TREATMENT ALTERNATIVE

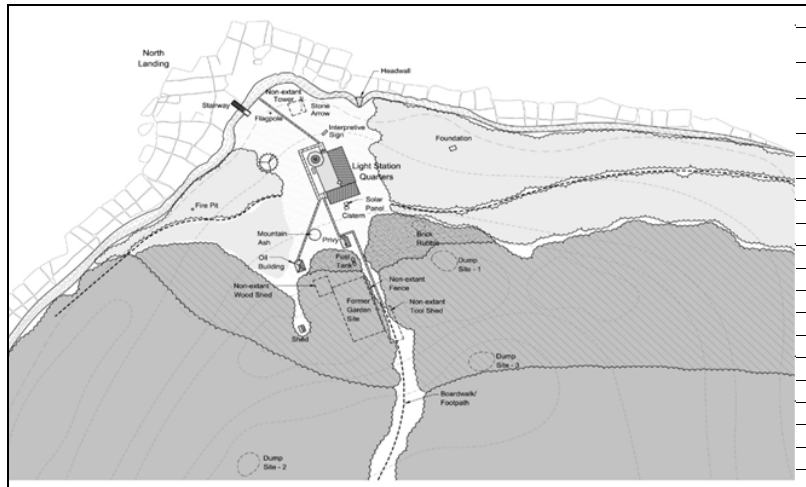
1
2
3

SAND ISLAND

PREFERRED ALTERNATIVE: RESTORATION, LUICK PERIOD (c.1881-1921)

A NAVIGATIONAL CONTINUUM

REVISED 03.08.2011



Existing Conditions Site Plan - for reference only

General Description:
This alternative brings forward the story of navigation of Apostle Islands as a system of six light stations through the rehabilitation of the cultural landscape with an emphasis on restoration. The intent is to rehabilitate individual light stations to best convey the period that is most significant to the island and that most successfully depicts its role in navigation during the period of significance. Restoration of missing features is allowed under this treatment alternative as is removal of non-contributing features, and repair of contributing features. Restoration of missing features may occur where the significance of the feature or space outweighs the loss of extant features, and where substantial physical and documentary evidence exist for the restoration.

Period of Significance: 1881-1921

	Light Station Tower & Quarters	Oil Building	Privy		
Proposed Use of Building	Restore to pre1921 era visitor access for both floors and Tower. "Rustic" housing at second floor.	Preserve and maintain current use as NPS storage.	Preserve; plexi panel at door to allow visitor visual access.		
Architecture	Reroof and correct existing gutter drainage problems; Increase ventilation from basement to tower; repair spot rusting at the Tower; Replace broken/missing glass at the Lantern; Repair access door to walk; add handrails at stairs; Restore openings and closet at front bedroom; Repair plaster/gyp at areas of damage on walls and ceilings; Repaint walls, ceilings, windows, doors and trim on interior; Add ramping at exterior for ABAAS access; Investigate if original flooring is in situ remove newer flooring as possible; Refinish wood floors; investigate adding a guardrail at the Tower walk without compromising historic integrity.	Repair door hardware for operability; repaint at interior	Replace missing ball closures at ridge; Repair hardware and replace missing escutcheon; install plexi panel system (operable) to allow visitor to see in but closeable to maintain security and weather tight closure		
Structural	Reduce the humidity level to reduce the moisture content of the first floor joists, properly frame the first floor joists at the windows, investigate the roof framing of the kitchen and strengthen if necessary	No action at this time	No action at this time		
Mechanical	Increase ventilation for moisture control. Replace rusted propane piping. Drain, clean, and seal cistern under kitchen. Allow for historic rainwater capture system to be interpreted. Remove propane piping to refrigerator and stove.	No action at this time.	No action at this time.		
Electrical	Provide additional PV power to facilitate running of new ventilation equipment and for new refrigerator and stove. Remove existing lightning protection system prior to re-roofing and install new lightning protection system after re-roofing.	No action at this time.	No action at this time.		
HazMat	Water intrusion mitigation; soil characterization (lead); asbestos sampling of materials to be preserved/stabilized; remove/stabilize lead paint; general clean to remove lead dust	Remove/stabilize lead paint	Asbestos sampling of materials to be stabilized, remove/stabilize lead paint		
Accessibility	Add a freestanding ramp with guardrails at the kitchen door and increase the door opening width. Exhibits and media presentation in the kitchen will provide program access to the 2nd floor and tower.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.		
	Spatial Organization/ Views and Vistas/ Clearing/ Topography	**Circulation/ Site Accessibility**	**Structures**	**Small Scale Features**	**Station Vegetation**
Landscape	1. Clear trees to low brush east of the Light Station Quarters 2. Clear trees to lawn at area of non-extant garden (south of Light Station Quarters) 3. Maintain 10-foot width corridor for accessible route to East Bay Landing Dock.	1. Repair wooden staircase north of Light Station Quarters 2. Maintain cleared footpath to Boat House site 3. Surface footpath/boardwalk to Boat House site for accessibility 4. Maintain concrete walks (minor repair) 5. Add width to walks for accessibility (see plan), use precast concrete stones. 6. Provide accessible trail to new NPS privy, location TBD by NPS 7. Repair hiking trail and replace boardwalk to provide accessible route from station to East Bay Landing Dock	1. New NPS accessible privy (location TBD by NPS)	1. Relocate solar panel to east 2. Remove fuel tank 3. Retain and monitor all dump sites 4. Relocate fire pit 5. Maintain flagpole 6. Remove stone north arrow 7. Remove and replace wooden headwall with compatible material 8. Retain stone foundation 9. Restore missing features-fencing at garden	1. Remove non-contributing trees and plantings from cleared area (see plan) 2. Remove invasive vegetation from light station grounds 3. Maintain contributing lilacs at light station grounds

APPENDIX B: SUMMARY OF HAZARDOUS MATERIAL FINDINGS

1

SAND ISLAND LIGHT STATION QUARTERS

Building Number	LCS ID 006381
Building Name	Sand Island Light Station Quarters
>1% Asbestos Confirmed	
Asbestos Assumed[41]	Drywall, Plaster, Adhesives, Wall Interiors, Brick/Block Filler, Roofing Materials and Transite
Detectable Lead in Paint Confirmed	Window Sash and Trims, Doors and Trims, Painted Walls, Ceilings and Tower
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [42]	First Floor and Second Floor Flooring
Lead Dust on Floors >40 µg/SF Assumed [2]	Throughout
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	Yes
Lead in Soils >50 mg/kg[43]	Roof Drip line and 5'-0" from Roof Drip line
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[41] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[42] 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.
[43] 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 non-industrial 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.

OIL BUILDING

Building Number	LCS ID 006382
Building Name	Sand Island Oil Building
>1% Asbestos Confirmed	
Asbestos Assumed[44]	Block Filler, Adhesives and Wall Interiors
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [45]	
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[46]	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[44] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[45] 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.
[46] 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 non-industrial 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.

PRIVY

Building Number	LCS ID 006383
Building Name	Sand Island Privy
>1% Asbestos Confirmed	
Asbestos Assumed[47]	Wall Plaster, Wall Interiors 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 [48]	
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[49]	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[47] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[48] 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.
[49] 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 non-industrial 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

APPENDIX C: MATERIAL ANALYSIS REPORTS, SAND ISLAND

1

SAND ISLAND ACM SAMPLE CHART

Sample #	Sample Date	API ID	Sample Location	Material Description	Laboratory Result
B-SILH-MA1-01	9/17/2009	25154	Light Station Quarters – Kitchen	Yellow adhesive and Black/multi-colored resinous material	ND
B-SILH-SF1-01	9/17/2009	25154	Light Station Quarters - Kitchen	White/multi-colored sheet vinyl and Brown fibrous backing w/ red resinous material	ND
B-SILH-WT1-01	9/17/2009	25154	Light Station Quarters - Rear hallway to tower	White Plaster wall texture	ND
B-SILH-TP1-01	9/17/2009	25154	Tower	White Plaster over brick	ND

ND=None Detected
TR=Trace, <1% Visual Estimate

SAND ISLAND LEAD SAMPLE CHART

Sample ID	Sample Type	API ID	Sample Location	Sample Date	Reporting Limit (ug/sq ft)	Lead Concentration (ug/sq ft)
S-SILH-01	Soil Composite	25154	Light Station Quarters dripline	9/17/2009	15.7	18.8
S-SIKQ-01	Soil Composite	25154	Light Station Quarters – 5’-0” from dripline	9/17/2009	15.7	139

1

APPENDIX D: FABRIC ANALYSIS

1

Fabric Analysis
Sand Island Lighthouse
Apostle Island National Lakeshore
October 19, 2009

On Tuesday, October 6, 2009, David Arbogast, architectural conservator, of Davenport, Iowa, received a 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 Structures Reports for the historic lighthouse complexes of the Apostle Islands National Lakeshore, headquartered in Bayfield, Wisconsin. As part of the HSR's paint and mortar/plaster analysis is required in an attempt to ascertain historic finishes, mortars, and plasters for the subject structures. The samples were divided into sets contained within large manila mailing envelopes. The analysis follows the order in which the large envelopes have been arranged. The seventh set which is contained within this report was from the set of samples collected from the complex at the Sand Island Light. There were 28 samples in the set, of which 24 were paint samples and seven (nos. 1, 2, 9, 10, 11, 27, and 28) were of plaster and mortar.

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 Bayfield and may be examined in relation to the findings from this analysis.

Samples 1 and 2 from Sand Island consisted of mortar. These were analyzed on Monday, October 19, utilizing the standard testing procedure developed by E. Blaine Cliver, Regional Historical Architect of the North Atlantic Region of the National Park Service.

The first sample was collected from the mortar of the oil house. It was analyzed on Monday, October 19 using the same procedures as with the other mortar and plaster samples of the various lighthouse complexes at the Apostle Islands National Lakeshore. The sand was dark tan in color and was moderately soft. Its analysis produced a substantial quantity of fines relative to the sand. If the fines are considered to be dirt associated with the sand, then an amount of roughly two parts of sand to each part of lime, by volume, was used to produce the mortar. The sand sieve analysis revealed fine sand of which almost 28% passed all of the sieves, over 38% was trapped in the finest sieve and over 23% was trapped in the next finest sieve, #40.

The second sample was found on the mortar patch of the oil house. It was gray and was moderately soft. It created a relatively small water displacement and its fast and bubbly reaction was followed by a prolonged reaction. It appears that the patch was composed of a typical restoration mixture containing lime, a small amount of Portland cement, and sand. The sand sieve analysis produced relatively coarse sand. Although all of it easily passed the largest sieve the remainder was relatively evenly distributed among the four remaining sieves with slightly over 15% passing all of the sieves.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 1
Building: Oil House, Sand Island, Apostle Islands NL
Location: Mortar
Sample Description: Dark tan, moderately soft, fast and bubbly reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 187.8	Container A weight	8. No	Hair or fiber type
2. 198.5	Container A and sample	9. 3.7	Fines and paper weight
3. 761.49	Barometric pressure	10. 2.9	Filter paper weight
4. 23	Temperature	11. 194.2	Sand and Container A weight
5. 0.10	Liters of water displaced	12. 4.7	cc. of sand
6. Yellow-green	Filtrate color	13. 35.1	Weight of graduated cylinder and sand
7. Tan	Fines color	14. 28.7	Weight of graduated cylinder

Computations:

15. 10.7	Starting weight of sample: No. 2 – No. 1	
16. 0.8	Weight of fines: No. 9 – No. 10	
17. 6.4	Weight of sand: No. 11 – No. 1	
18. .73475	Sand density: No. 12 divided by (No. 13 – No. 14)	
19. 3.5	Weight of soluble content: No. 15 – (No. 16 + No. 17)	
20. 0.0041139	Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)	
21. 0 41	Gram weight of CaCO3: 100 x No. 20	
22. 3.09	Gram weight of Ca(OH)2: No. 19 – No. 21	
23. .0417	Mols. of Ca(OH)2: No. 22 divided by 74	
24. 3.39	Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)	
25. 0.18	Gram weight CO2: No. 20 x 44	
26. 2.02	Gram weight total possible CO2: 44 x (No. 20 + No. 23)	
27. 8.91	%CO2 gain: No. 25 divided by No. 26	

Conclusions:

28. 10.52	Gram weight of sample:	No. 15 – No. 25
29. 7.60	Fine parts/volume:	No. 16 divided by No. 28
30. 44.70	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. 35.45	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32.	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33.	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34.	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.7	0.1	1.54
No. 20	106.6	106.4	0.2	3.08
No. 30	99.7	99.3	0.4	6.15
No. 40	102.2	100.7	1.5	23.08
No. 50	95.7	93.2	2.5	38.46
Base	73.0	71.2	1.8	27.69

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 2
Building: Oil House, Sand Island, Apostle Islands NL
Location: Mortar patch
Sample Description: Gray, moderately soft, fast and bubbly reaction followed by prolonged reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 191.9	Container A weight	8. No	Hair or fiber type
2. 205.8	Container A and sample	9. 3.4	Fines and paper weight
3. 761.49	Barometric pressure	10. 3.0	Filter paper weight
4. 23	Temperature	11. 203.1	Sand and Container A weight
5. 0.20	Liters of water displaced	12. 9.9	cc. of sand
6. Yellow-green	Filtrate color	13. 39.9	Weight of graduated cylinder and sand
7. Tan	Fines color	14. 28.7	Weight of graduated cylinder

Computations:

15. 13.9	Starting weight of sample: No. 2 – No. 1	
16. 0.4	Weight of fines: No. 9 – No. 10	
17. 11.2	Weight of sand: No. 11 – No. 1	
18. .5893	Sand density: No. 12 divided by (No. 13 – No. 14)	
19. 2.3	Weight of soluble content: No. 15 – (No. 16 + No. 17)	
20. 0.082278	Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)	
21. 0 82	Gram weight of CaCO3: 100 x No. 20	
22. 1.48	Gram weight of Ca(OH)2: No. 19 – No. 21	
23. .01997	Mols. of Ca(OH)2: No. 22 divided by 74	
24. 7.57	Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)	
25. 0.36	Gram weight CO2: No. 20 x 44	
26. 4.50	Gram weight total possible CO2: 44 x (No. 20 + No. 23)	
27. 8.00	CO2 gain: No. 25 divided by No. 26	

Conclusions:

28. 13.54	Gram weight of sample:	No. 15 – No. 25
29. 2.95	Fine parts/volume:	No. 16 divided by No. 28
30. 48.75	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31.	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32.	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33.	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34. 3.25	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0

No. 20	108.6	106.4	2.2	19.82
No. 30	101.5	99.3	2.2	19.82
No. 40	103.4	100.8	2.6	23.42
No. 50	95.6	93.2	2.4	21.62
Base	72.9	71.2	1.7	15.32

Analysis of the paint samples began on Monday, October 19, following the same procedures used for the previous sets of samples. Numbering of the samples began with number 3 and ended with number 28. The following results were obtained from the analysis:

Oil House

Sample 3	**Munsell**
Dark maroon	7.5R 3/4
Dark maroon	7.5R 3/4
Orange-red	10R 6/8
Charcoal	N 2.0/
Orange-red	10R 6/8

The third sample was collected from the oil house trim. Beneath the pair of dark maroon paint layers was a mixture of orange-red and charcoal paints. The orange-red is a typical color for red lead prime paint for ferrous metals.

Privy

Sample 4	**Munsell**
White	N 9.5/

The fourth sample came from the privy interior trim. It retained a single layer of stark white paint on its sound wood substrate.

Privy

Sample 5	**Munsell**
Pastel green	5G 9/2
Pastel green	5G 9/2
Gray-green	5G 6/1
Light gray-green	5G 7/1
Light gray-green	5G 7/1
Light gray-green	5G 7/1
Green	5G 6/2
Dark green	5G 4/2

The fifth sample was removed from the privy interior. It revealed a set of eight paint layers on its plaster substrate with dark green being the oldest surviving layer.

Lighthouse and Keeper's Quarters

Sample 6	**Munsell**
White	N 9.5/

White	N 9.5/
White	N 9.5/

The sixth sample was from the exterior shutter of the lighthouse and keeper's quarters. Its analysis revealed three white paint layers on a sound wood substrate.

Lighthouse and Keeper's Quarters

Sample 7	**Munsell**
White	N 9.5/
White	N 9.5/
White	N 9.5/
Black	N 1.0/
Gray	N 6.0/

The seventh sample was found on the exterior window of the lighthouse and keeper's quarters. In addition to the three white paint layers observed in the previous sample there was an older layer of black paint with a layer of gray paint beneath it.

Lighthouse and Keeper's Quarters

Sample 8	**Munsell**
White	N 9.5/
White	N 9.5/
White	N 9.5/

The eighth sample was collected from the exterior siding of the lighthouse and keeper's quarters. It revealed the three white layers seen in its two predecessors. The substrate was sound wood.

The ninth sample was a mortar sample taken from the exterior mortar patch of the lighthouse and keeper's quarters. It was tan in color and relatively hard and brittle. Its reaction was quite prolonged which is typically indicative of Portland cement content. Its very small water displacement is also typical of Portland cement. However, it filtered rapidly, which may be more of a factor of its small size than of lime content. It also had a very small amount of fines which is not typical of Portland cement which frequently generates gelatinous by-products which results in a large amount of fines. Thus, it may be a standard restoration mortar using lime, Portland cement, and sand. Its sand sieve analysis revealed average sand. In an interesting anomaly equal amounts were trapped in sieves #30, #40, and #50.

The tenth sample was of the mortar of the lighthouse and keeper's quarters. It was moderately hard and grayish-tan in color. A fast and bubbly reaction was followed by a prolonged reaction which produced a relatively large water displacement. Those indicators point toward a mixture of lime, Portland cement, and sand. The sand sieve analysis revealed fine sand of which all passed the largest sieve. Interestingly, equal amounts were trapped in sieves #40 and #50.

The eleventh sample was collected from the new entry mortar of the light keeper's quarters. It was gray in color and was moderately soft, but brittle. It had a fast and bubbly reaction which was followed by a prolonged reaction. There was a significant water displacement. Its filtering was quite slow, requiring over a day as opposed to an hour for samples with very rapid filtering. These aspects point toward a mortar composed of lime, Portland cement, and sand. The sand sieve analysis used a large sample weighing 35.9

grams, which provides greater statistical reliability than most of the other sand samples in this report. As such, virtually all of it passed the largest sieve and well over 11% passed all of the sieves. Almost exactly 30% was trapped in the finest sieve and almost 38% was trapped in sieve #40.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 9
Building: Lighthouse and Keeper's Quarters, Sand Island, Apostle Islands NL
Location: Exterior mortar patch
Sample Description: Tan, moderately hard and brittle, prolonged reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1.	185.5 Container A weight	8. No	Hair or fiber type
2.	192.5 Container A and sample	9. 3.1	Fines and paper weight
3.	761.75 Barometric pressure	10. 2.9	Filter paper weight
4.	23 Temperature	11. 191.2	Sand and Container A weight
5.	0.03 Liters of water displaced	12. 3.6	cc. of sand
6.	Champagne Filtrate color	13. 34.6	Weight of graduated cylinder and sand
7.	Tan Fines color	14. 28.8	Weight of graduated cylinder

Computations:

15. 7.0 Starting weight of sample: No. 2 – No. 1
16. 0.2 Weight of fines: No. 9 – No. 10
17. 5.6 Weight of sand: No. 11 – No. 1
18. .642857 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 1.2 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0012346 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0.12 Gram weight of CaCO3: 100 x No. 20
22. 1.08 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0145 Mols. of Ca(OH)2: No. 22 divided by 74
24. 1.17 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.05 Gram weight CO2: No. 20 x 44
26. 0.69 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 7.25 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 5.83	Gram weight of sample:	No. 15 – No. 25
29. 3.43	Fine parts/volume:	No. 16 divided by No. 28
30. 61.75	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31.	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32.	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33.	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34.	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	107.2	106.4	0.8	14.04
No. 30	100.6	99.3	1.3	22.81
No. 40	102.1	100.8	1.3	22.81
No. 50	94.5	93.2	1.3	22.81
Base	72.2	71.2	1.0	17.54

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 10
Building: Lighthouse and Keeper's Quarters, Sand Island, Apostle Islands NL
Location: Mortar
Sample Description: Gray-tan, moderately hard, fast and bubbly reaction followed by prolonged reaction, moderate filtering time

Test No. 1 – Soluble Fraction

Data:

1.	188.9 Container A weight	8. No	Hair or fiber type
2.	203.6 Container A and sample	9. 4.0	Fines and paper weight
3.	761.75 Barometric pressure	10. 3.0	Filter paper weight
4.	23 Temperature	11. 197.4	Sand and Container A weight
5.	0.46 Liters of water displaced	12. 7.0	cc. of sand
6.	Yellow-green Filtrate color	13. 37.3	Weight of graduated cylinder and sand
7.	Tan Fines color	14. 28.8	Weight of graduated cylinder

Computations:

15. 14.7 Starting weight of sample: No. 2 – No. 1
16. 1.0 Weight of fines: No. 9 – No. 10
17. 8.5 Weight of sand: No. 11 – No. 1
18. .82353 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 5.2 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.01893 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 1.89 Gram weight of CaCO3: 100 x No. 20
22. 3.31 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0447 Mols. of Ca(OH)2: No. 22 divided by 74
24. 4.71 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.83 Gram weight CO2: No. 20 x 44
26. 2.80 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 29.64 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 13.87 Gram weight of sample: No. 15 – No. 25

29. 7.21 Fine parts/volume: No. 16 divided by No. 28
30. 50.47 Sand parts/volume: (No. 17 divided by No. 28) x No. 18
31. _____ Lime parts/volume: (No. 24 divided by No. 28) x 1.1

Cement (if present)
32. _____ Portland cement parts/volume: (No. 16 divided by No. 28) x 0.78
33. _____ Natural cement parts/volume: (No. 16 divided by No. 28) x 0.86
34. 1.59 Lime with cement parts/volume: (No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	106.6	106.4	0.2	2.33
No. 30	100.1	99.2	0.9	10.47
No. 40	104.0	100.8	3.2	37.21
No. 50	96.4	93.2	3.2	37.21
Base	72.3	71.2	1.1	12.79

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 11
Building: Light keeper's Quarters, Sand Island, Apostle Islands NL
Location: New entry mortar
Sample Description: Light gray, brittle, moderately soft, fast and bubbly reaction followed by prolonged reaction, slow filtering time

Test No. 1 – Soluble Fraction

Data:
1. 185.1 Container A weight
2. 206.1 Container A and sample
3. 761.75 Barometric pressure
4. 23 Temperature
5. 0.46 Liters of water displaced
6. Yellow-green Filtrate color
7. Off-white Fines color
8. No Hair or fiber _____ type
9. 3.0 Fines and paper weight
10. 2.9 Filter paper weight
11. 200.6 Sand and Container A weight
12. 9.3 cc. of sand
13. 44.3 Weight of graduated cylinder and sand
14. 28.8 Weight of graduated cylinder

Computations:
15. 21.0 Starting weight of sample: No. 2 – No. 1
16. 0.1 Weight of fines: No. 9 – No. 10
17. 15.5 Weight of sand: No. 11 – No. 1
18. .60 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 5.4 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.01893 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 1.89 Gram weight of CaCO3: 100 x No. 20
22. 3.51 Gram weight of Ca(OH)2: No. 19 – No. 21

23. .0474	Mols. of Ca(OH)2: No. 22 divided by 74	
24. 4.91	Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)	
25. 0.28	Gram weight CO2: No. 20 x 44	
26. 2.92	Gram weight total possible CO2: 44 x (No. 20 + No. 23)	
27. 9.59	%CO2 gain: No. 25 divided by No. 26	

Conclusions:

28. 20.72	Gram weight of sample:	No. 15 – No. 25
29. 0.48	Fine parts/volume:	No. 16 divided by No. 28
30. 44.88	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. 27.36	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32.	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33.	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34. 1.06	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	107.0	106.8	0.2	0.56
No. 20	108.7	106.4	2.3	6.40
No. 30	104.1	99.2	4.9	13.65
No. 40	114.4	100.8	13.6	37.88
No. 50	104.0	93.2	10.8	30.08
Base	75.3	71.2	4.1	11.42

Lighthouse and Keeper's Quarters

Sample 12	**Munsell**
White	N 9.5/
Gray	5Y 6/1
Gray-green	10G 6/1
Gray-green	10G 6/1
Gray-green	10G 6/1
Dark green	10G 5/2
Gray	5Y 7/1

The twelfth sample continued the paint sample series. It was collected from the kitchen wall. It revealed seven paint layers of which the oldest gray layer was relatively thick.

Lighthouse and Keeper's Quarters

Sample 13	**Munsell**
Navy blue	10B 3/6
Off-white	2.5Y 9/3
Cream	2.5Y 8.5/2

The thirteenth sample was from the interior side of the summer kitchen window. The navy blue top layer was easily disengaged from the off-white layer beneath it. Cream was the oldest color observed on the sound wood substrate.

Lighthouse and Keeper's Quarters

Sample 14	**Munsell**
Navy blue	10B 3/6
Navy blue	10B 3/6
Navy blue	10B 3/6
Gray	5Y 7/1
Gray	5Y 6/1
Gray	5Y 7/1
Gray	5Y 7/1
Gray	5Y 7/1
Gray	5Y 6/1
Gray	5Y 7/1
Gray	5Y 6/1
Gray	5Y 7/1
Dark gray	5Y 4/1
Dark gray	5Y 4/1
Gray	5Y 6/1
Gray	5Y 6/1
Dark gray	5Y 4/1
Dark gray	5Y 4/1
White	5Y 9/1
Warm gray	5Y 7/2

The fourteenth sample was removed from the summer kitchen stair. Its quality was quite remarkable with clearly distinguished paint layers. All the layers beneath the navy blue paint layers exhibited yellowing which is a characteristic of oil-based paints. Warm gray (probably originally just gray) is the oldest surviving color.

Lighthouse and Keeper's Quarters

Sample 15	**Munsell**
White	5Y 9/1
White	5Y 9/1
Gray	5Y 7/1

The fifteenth sample was taken from the interior door trim. It revealed three paint layers of which gray was the oldest. Its apparent oil content had caused it to yellow over time.

Lighthouse and Keeper's Quarters

Sample 16	**Munsell**
Light blue	5B 9/2
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Beige	7.5YR 7.5/3

The sixteenth sample was collected from the parlor wall. It did not retain any substrate and revealed five layers of paint with beige as the oldest of the set.

Lighthouse

Sample 17	**Munsell**
White	N 9.5/
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Warm gray	5Y 7/2

The seventeenth sample came from the interior window trim of the lighthouse. Although it revealed only five paint layers on its sound wood substrate, the oldest warm gray matched the oldest layer observed in sample 14 above.

Lighthouse and Keeper's Quarters

Sample 18	**Munsell**
Light blue	5B 8/2
White	N 9.5/

The eighteenth sample was removed from the entry. It was somewhat enigmatic. The two paint layers listed above were adhered to a thick paper layer beneath which was a relatively thick (for paint) or extremely thin (for plaster) layer of lime-based (reactive with hydrochloric acid) yellow layers (5Y 8/4) beneath which was a stark white (N 8.5/) layer of lime. These could represent either the very thin skim coat of plaster or a layer of whitewash with a layer of yellow calcimine paint on its surface.

Lighthouse and Keeper's Quarters

Sample 19	**Munsell**
Whitewash	N 9.5/

The nineteenth sample was from the light tower. It consisted of a relatively thick accumulation of whitewash layers. These dissolved entirely in hydrochloric acid.

Lighthouse and Keeper's Quarters

Sample 20	**Munsell**
White	5Y 9/1
Green	10G 6/2
Light blue	10B 9/2

The twentieth sample was found on the kitchen chase. Although it only retained three finish layers, the oldest layer appeared to be calcimine paint because it reacted with hydrochloric acid.

Lighthouse and Keeper's Quarters

Sample 21	**Munsell**
White	N 9.5/

Sample 21 was taken from the basement brick wall. It consisted of a thick accumulation of whitewash layers which reacted completely with hydrochloric acid.

Lighthouse and Keeper's Quarters

Sample 22	**Munsell**
Light green	5G 8/1
Light green	5G 8/1
Gray-green	5G 7/1
Gray-green	5G 7/1
Gray-green	5G 7/1

Sample 22 was collected from the wall of bedroom 1. It retained five distinct layers of paint on its plaster substrate of which the three oldest were all gray-green.

Lighthouse and Keeper's Quarters

Sample 23	**Munsell**
Light blue	2.5B 8/2

Sample 23 came from the wall of the second floor hallway. There was only a single layer of light blue paint on its plaster substrate.

Lighthouse and Keeper's Quarters

Sample 24	**Munsell**
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1

Sample 24 was found on the baseboard trim of bedroom 2. The four layers of white paint on its wood substrate appear to have been oil-based and to have yellowed as a result of the oil content.

Lighthouse and Keeper's Quarters

Sample 25	**Munsell**
Khaki	7.5Y 7/4

Sample 25 was taken from the closet of the second floor. There was a single finish layer on its surface which was extremely thin.

Lighthouse and Keeper's Quarters

Sample 26	**Munsell**
Navy blue	10B 3/6
Gray	N 5.0/
Dark gray	N 3.75/
Gray	N 5.0/
Dark gray	N 3.75/
Gray	N 6.5/
Charcoal	N 1.5/

Gray	N 5.0/
Charcoal	N 1.5/

Sample 26 was collected from the floor of bedroom 1 on the second floor. Relative to the wall and baseboard samples, this revealed an extraordinary number of layers. Floors tend to get painted more frequently because their finishes are more prone to abrasion and loss.

Sample 27 continued the mortar and plaster samples. It was a plaster sample taken from the second floor closet. It was tan in color with bits of stark white plaster having paint on their surface. The white bits were probably the skim coat. There was a relatively small water displacement. Interestingly, the filtrate was quite clear although the acid is has a natural yell-green color prior to filtering. The white portion completely disappeared and did not reappear as fines as was the case with gypsum plaster. The fines were quite minimal and consisted of bits of paint and a very small amount of hair. It can be assumed that the skim coat was pure lime, but the brown coat beneath it was probably gypsum. Its sand sieve analysis revealed very fine sand of which all passed the largest sieve, over 9% passed all of the sieves, well over half of it was trapped in the finest sieve and almost 30% was trapped in sieve #40.

Sample 28 was of the mortar from the west entry. It was tan in color and was moderately soft. It had a minimal reaction with a very low water displacement. The initial fast reaction was followed by a prolonged reaction. There were minimal fines produced, indicating a relatively clean sand was initially used. It appears that this mortar was composed of small amounts of lime and Portland cement relative to the sand. The sand sieve analysis revealed very fine sand of which all easily passed the largest sieve. 28% passed all of the sieves, 36% was trapped in the finest sieve and 26% was trapped in sieve #40, the second finest sieve.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 27
Building: Second Floor Closet, Sand Island, Apostle Islands NL
Location: Plaster
Sample Description: Tan with very thin white skim coat and paint coat, soft, fast reaction, extremely rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1.	187.8 Container A weight	8. Yes	Hair or fiber ____ type
2.	196.7 Container A and sample	9. 2.9	Fines and paper weight
3.	761.75 Barometric pressure	10. 2.8	Filter paper weight
4.	23 Temperature	11. 194.4	Sand and Container A weight
5.	0.16 Liters of water displaced	12. 3.8	cc. of sand
6.	Clear Filtrate color	13. 35.3	Weight of graduated cylinder and sand
7.	Brown Fines color	14. 28.7	Weight of graduated cylinder

Computations:

15. 8.9 Starting weight of sample: No. 2 – No. 1

16. 0.1 Weight of fines: No. 9 – No. 10
17. 6.6 Weight of sand: No. 11 – No. 1
18. .5758 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 2.2 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0065845 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0.66 Gram weight of CaCO3: 100 x No. 20
22. 1.54 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0208 Mols. of Ca(OH)2: No. 22 divided by 74
24. 2.03 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.29 Gram weight CO2: No. 20 x 44
26. 1.21 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 23.97 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 8.61	Gram weight of sample:	No. 15 – No. 25
29. 1.16	Fine parts/volume:	No. 16 divided by No. 28
30. 44.13	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. 25.93	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32.	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33.	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34.	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	106.5	106.4	0.1	1.563
No. 30	99.6	99.3	0.3	4.688
No. 40	102.7	100.8	1.9	29.688
No. 50	96.7	93.2	3.5	54.688
Base	71.8	71.2	0.6	9.375

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 28
Building: West Entry, Sand Island, Apostle Islands NL
Location: Mortar
Sample Description: Tan, moderately soft, fast reaction followed by prolonged reaction, moderate filtering time

Test No. 1 – Soluble Fraction

Data:

1. 192.0	Container A weight	8. No	Hair or fiber type
2. 199.2	Container A and sample	9. 3.2	Fines and paper weight

3. 761.75	Barometric pressure	10. 3.1	Filter paper weight
4. 23	Temperature	11. 196.9	Sand and Container A weight
5. 0.05	Liters of water displaced	12. 3.0	cc. of sand
6. Yellow-green	Filtrate color	13. 34.9	Weight of graduated cylinder and sand
7. Off-white	Fines color	14. 28.8	Weight of graduated cylinder

Computations:

15. 7.2	Starting weight of sample: No. 2 – No. 1
16. 0.1	Weight of fines: No. 9 – No. 10
17. 4.9	Weight of sand: No. 11 – No. 1
18. .6122	Sand density: No. 12 divided by (No. 13 – No. 14)
19. 2.2	Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.002076	Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0.21	Gram weight of CaCO3: 100 x No. 20
22. 1.99	Gram weight of Ca(OH)2: No. 19 – No. 21
23. .02695	Mols. of Ca(OH)2: No. 22 divided by 74
24. 2.15	Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.09	Gram weight CO2: No. 20 x 44
26. 1.28	Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 7.03	%CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 7.11	Gram weight of sample:	No. 15 – No. 25
29. 1.41	Fine parts/volume:	No. 16 divided by No. 28
30. 42.19	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31.	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32.	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33.	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34. 0.31	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0
No. 20	106.5	106.4	0.1	2
No. 30	99.7	99.3	0.4	8
No. 40	102.0	100.7	1.3	26
No. 50	95.0	93.2	1.8	36
Base	72.6	71.2	1.4	28

A number of conclusions can be drawn from the analysis, as follow:

1. There was a low degree of consistency between the samples, making it difficult to draw any firm conclusions.

2. A number of samples had so few layers that one of the following conclusions can be reached:

a. The oldest layers had either weathered away over time, which is probable with exterior paint.

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.

c. The element itself had been replaced or is of recent date.

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.

e. Because very little is known today about calcimine paint a few comments are in order to explain it, as follow:

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.

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.

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.

2. At least two of the samples (nos. 19 and 21) from the lighthouse and keeper's quarters were whitewashed as their probable original finish.

3. Of the other samples, sample 14 revealed an extraordinary number of layers which is quite amazing given its location in a relatively insignificant location. It is mere speculation as to why this sample would have so many layers and other samples from more prominent locations would have so relatively few layers.

4. 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 for those samples composed of sand and lime. For samples containing Portland cement, the best this form of testing can do is to indicate the presence of Portland cement and the sand itself.

The primary goal in repointing is to achieve a compatible mortar. This can be done for lime and sand samples that were analyzed. It can also be done for Portland cement samples with a bit of trial and error. If the mortar is very hard then a higher ratio of Portland cement to sand will work. One must take into consideration any deterioration of the masonry as a result of the mortar. If this has been the case it may be advisable to use a softer mortar for repointing.

The other primary mode of mortar analysis is spectrographic testing. Unfortunately, it also cannot accurately determine exact ratios of Portland cement to sand and/or to lime.

The secondary goal is to match the appearance of the mortar, which depends to a very large extent on the sand. This is where acid reduction testing shines. It provides and exact calculation of the sand grain sizes as well as a sample of the sand for matching of color. If the sand is carefully matched then the appearance will be successful. This is especially critical in partial repointing and patching.

5. There are instances where the narrative of the mortar make up refers to Portland – but the data sheet following does not include it in line #32. The reason for this is that rather than a number for lime content, the calculation is made for lime with Portland cement content. If the sample merely had Portland cement and sand there would be a number for Portland cement.

1

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.

NPS D-633/106,232 / March 2011