OIL STORAGE

Chronology of Alterations and Use

Original Construction

The Outer Island Oil Storage was built in 1895 to provide a safe storage area for the kerosene needed to fuel the lamps. [42]

On file is an undated historic photo that depicts the building in a similar condition to its current appearance. (Historic Image OI-11)

There are no available historic drawings of this building.

Significant Alterations / Current condition

There have been no significant alterations to the Oil Storage. It currently contains an empty steel kerosene storage tank and shelves for general storage.

There have never been electrical or mechanical systems in this building, except for the gravity vent located in the roof.

The Outer Island Oil Storage is in good condition.

[42] "1895 Annual Report of the Lighthouse Board," Outer Island Light in annual reports 1850-1920

Summary of Documented Work on the Building

Date	Work Described	Source of Information
1894, August 7	Steamer "Amaranth" brings brick "for an Oil House."	John Leonard, OI Log, Sept 17, 1874 – Dec 10, 1947, Vol I
Annual Report of 1895 Fiscal Year	"Outer Island, Apostle Group, Lake Superior, Wisconsin. – A brick oil house was erected, with iron roof, door, and shelving, located 60' southwest of the dwelling. *1324. Outer Island, Wisconsin.* - This 10-inch steam whistle was in operation some 478 hours, and consumed about 26 tons of coal."	"1895 Annual Report of the Lighthouse Board," Outer Island Light in annual reports 1850-1920

General Physical Description

This building is a small, one-story, one room, rectangular utilitarian structure with brick bearing walls and foundation, and a sheet metal hipped roof. It has a circular metal vent in the center of the roof and a metal door on the north elevation.

Physical Description -- Architecture

Architecture – Roof
The roofing is sheet metal painted red, with eave molding, and a central vent.

Architecture – Exterior Walls
The exterior walls are three-wythe brick painted. There is stepped brick coursing at the foundation and a brownstone sill at the door. A mortar sample taken indicates that the mortar was composed mostly of sand with minimum lime, the sand was originally dirty, and is extremely fine. The mortar is tan and very soft.

Architecture – Exterior Door
The exterior door is made of steel, has an original lockset, and has two strap hinges. It is 2'7" x 6'10 ½" and is original to the building. (OI-OS-05) There is a painted stone sill at the door.

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

Architecture – Ceiling Finish
There is no ceiling finish as the ceiling is the underside of the original metal roof. It is sheet metal painted yellow.

Architecture – Floor
The floor is concrete slab-on-grade that is painted blue-gray.

Architecture – Casework
There is a metal shelving unit along the entirety of the west wall, painted blue-gray. There is also a wood platform supporting the kerosene tank. It is 4’6” wide, 1’1” tall, and 2’1 ½” deep. Neither shelving unit is historic. (OI-OS-06)

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 7 ½” due to a sill/threshold. The door hardware is not ADA compliant.

Physical Description -- Structural

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

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

Structural – Roof Framing
The roof framing is made up of 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
There are no plumbing systems in the Oil Storage.

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 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 ten bulk samples from a total of ten different types of suspected asbestos containing materials (ACMs) at Outer Island. Of the ten suspect ACMs that were sampled and analyzed, a total of one suspect ACM resulted in a concentration 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. Wall and Ceiling Interiors,
2. Adhesives,
3. Brick and Block Filler (The exterior of the structure is brick and has the potential to have a block filler or grout that is potentially asbestos containing), and,
4. Asbestos-cement (Piping, wall-board, wall interior panels, roof flashing and roofing applications can be constructed of asbestos-cement. This type of application was not observed at the structure but may be present).

The assumed ACMs 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, LCP is assumed to be present throughout the structure. The confirmed LCP was observed to be in poor condition and the assumed LCP was observed to be in poor condition.

Loose/flaking LCP is identified on the exterior walls of the structure. Paint chip debris is noted on localized areas of surface soils surrounding the Oil Storage Building.

Hazardous Materials – Lead Dust

Surface wipe-sampling for lead dust was not conducted in the Oil Storage Building because it in a noninhabited structure.

Hazardous Materials – Lead in Soils

Historical paint maintenance activities such as manual scraping, power-washing, sanding, abrasive blasting or the general poor and peeling condition of exterior LCP may have created the potential to impact the surrounding soil. Areas of the surface soils adjacent to the structure were observed to have LCP debris and additional areas may exhibit LCP debris or lead-contaminated soils, but are not observable due to vegetative cover surrounding the structure.

Preliminary lead-in-soil sampling was not performed to assess whether these near-structure soils contain lead concentrations above applicable soil standards.

Soil Sampling was not conducted around the Oil Storage 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 in the Oil Storage Building.

Hazardous Materials – Petroleum Hydrocarbons

Localized areas of staining were observed on concrete floors in the Oil Storage 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 masonry hipped roof structure.

Exterior Materials. Painted white wood clapboard siding; metal roof shingles painted red.

Openings. One painted metal door painted red to match the painted brick.

Interior Materials. Exposed masonry, concrete floor and galvanized panels at the ceiling.

General Condition Assessment

In general, the Outer Island Oil Storage is in good condition. The original brick walls, concrete floor, and steel door are in good condition.

Structurally, the Oil Storage is in good condition.

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*
This roof is in good condition.

Architecture – Exterior Walls
Condition: *Fair*
The exterior walls are in fair condition, as the walls need repointing and the brick foundation is exposed and weathering at the southwest corner. The paint is peeling severely.

Architecture – Exterior Door
Condition: *Good*
This steel door is in good condition as there is only minor paint peeling. The sill is cracked.

Architecture – Wall Finish
Condition: *Poor*
The wall finish for this building is in poor condition. The paint is peeling badly and an older layer of white paint is visible.

Architecture – Ceiling Finish
Condition: *Good*
The underside of the roof is in good condition.

Architecture – Floor
<u>*Condition:*</u> *Good to Fair*
The concrete floor is in good condition but the blue-gray paint is deteriorated. The concrete is intact. The front stoop, however, is in fair condition as it is cracked.

Architecture – Casework
<u>*Condition:*</u> *Fair*
The metal shelving unit is in good condition with some peeling paint and deflected shelves. The wood platform shelf is in fair condition as it is also deflected and there stains on the wood.

Architecture – Accessibility
<u>*Condition:*</u> *Poor*
This building is currently not accessible.

Condition Assessment -- Structural

Structural – Foundation
<u>*Condition:*</u> *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
<u>*Condition:*</u> *Good*
The concrete slab-on-grade is in good condition.

Structural – Roof Framing
<u>*Condition:*</u> *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
<u>*Condition:*</u> *Good*
The walls are in good condition.

Structural – Lateral System
<u>*Condition:*</u> *Good*
Lateral stability of the building is good.

Structural – Load Requirements
<u>*Condition:*</u> *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
<u>*Condition:*</u> *N/A*

Mechanical – HVAC
<u>*Condition:*</u> *Good*
The original circular metal gravity vent is in good condition, but 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 was constructed in 1895 and served as an oil storage building. Currently, the building is used for secure NPS storage. The proposed use for the Oil Storage is to maintain its existing function as storage with no visitor access.

Preservation, focusing on the exterior, 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*
Strip the existing paint. Repair masonry, repoint as needed and recoat with a proper vapor permeable coating.

Architecture – Exterior Door
Priority: *Low*
Repaint steel door. Epoxy repair the crack at the sill.

Architecture – Wall Finish
Priority: *Low*
Scrape, sand and repaint using the paint analysis to guide the color selection.

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

Architecture – Floor
Priority: *Low*
Repaint the concrete floor to match existing color.

Architecture – Casework
<u>*Priority:*</u> *Low*
No recommendations at this time.

Architecture – Accessibility
<u>*Priority:*</u> *Low*
Provide program access through interpretive exhibits and waysides at the Visitor Center.

Treatment Recommendations -- Structural

Structural – Foundation
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Floor Framing
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Roof Framing
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Wall Framing
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Lateral System
<u>*Priority:*</u> *Low*
No recommendations at this time.

Treatment Recommendations -- Mechanical

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

Mechanical – HVAC
<u>*Priority:*</u> *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 brick and block filler, adhesives, wall and ceiling interiors, and asbestos cement should be sampled.

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*
No recommendations at this time.

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

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.

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

Assessment of Effects for Recommended Treatments

Recommended Treatment	Potential Effects	Mitigating Measures	Beneficial Effects
1. Additional Hazardous Testing and Mitigation	Mitigation of hazardous material may require removal of historic materials.	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

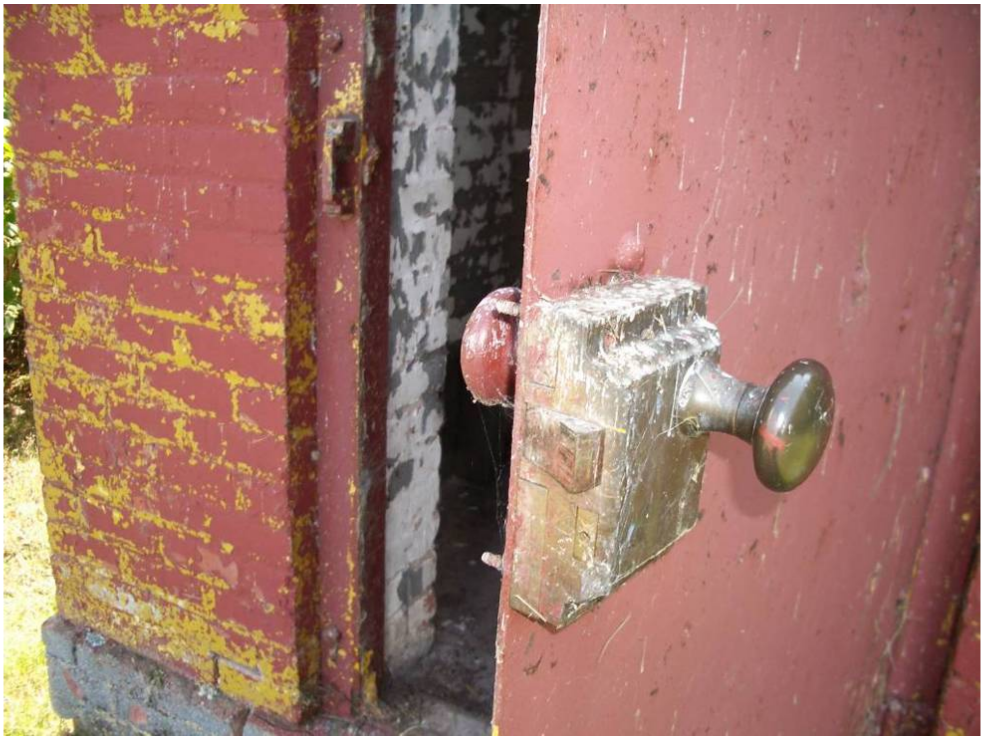
Oil Storage Photographs, 2009

OI-OS-01: North elevation, 2009 (Source: A&A DSC01362)

OI-OS-02: East elevation, 2009 (Source: A&A DSC01364)

OI-OS-03: South elevation, 2009 (Source: A&A DSC01363)

OI-OS-04: North and west elevations, 2009 (Source: A&A IMGP3167)



OI-OS-05: North entry door hardware (Source: A&A IMGP3169)

OI-OS-06: Interior, looking south (Source: A&A DSC01355-A)

1

PRIVY

Chronology of Alterations and Use

Original Construction

The Outer Island Privy was built in 1874, the same year as the Tower.[43]

A photo of the Privy around 1900 roughly illustrates painted brick on the lower half, and unpainted brick on the upper half of the building. (Historic Image OI-04) Today, the Privy is painted.

There are no available historic drawings of this building.

Significant Alterations / Current condition

There have been no significant alterations to the Privy.

There have never been electrical or mechanical systems in this building, except for the gravity vent located in the roof.

The Outer Island Privy is in fair to good condition.

[43] List of Classified Structures, National Park Service, 2009.

General Physical Description

This building is a small, one-story, one room, rectangular utilitarian structure with brick bearing walls and foundation. It has a simple gable roof with boxed rafter tails and a square wood vent. The casement window has an arched opening and the door is located on the west elevation.

At the time of this survey, this building was inaccessible. Interior notes were garnered from looking in the window and therefore the overall condition of interior finishes could not be determined from the partial view.

Physical Description -- Architecture

Architecture – Roof
The roofing is metal shingle, painted red, and is original to the building. (OI-P-06) There is a wood fascia, frieze board, and a vent. The eave consists of a closed raked soffit extending approximately 9”. All of the wood is painted and is original to the building. (OI-P-07)

Architecture – Exterior Walls
The exterior walls are made of two-wythe red brick with rowlocks every seventh course (same as the Keepers Quarters – the buildings were built the same year). The foundation is brownstone. A mortar sample from the brick mortar indicates that it was composed of sand and lime, with course sand, tan colored, and very soft.

Architecture – Window
The window is a two-lite (one-over-one) casement or awning with a painted wood frame. There is a painted wood surround and sill. The window is 1’1” x 2’8” and is original to the building. A paint sample taken of the exterior window trim indicated that the original layer was whitewash and the subsequent white layer was impervious to acid, meaning it was a later white paint, not a whitewash. Currently, the trim is painted green.

Architecture – Exterior Door
The door is a five panel wood door, similar to the doors in the house, with original exterior knob (interior inaccessible). The door is 2’4” x 6’7”.

Architecture – Exterior Trim
There is no exterior trim other than the roof elements.

Architecture – Wall Finish
The interior of this building was inaccessible (observations were made through the window). The wall finish for this building appears to be horizontal beadboard, painted, most likely 3 ½” wide.

Architecture – Ceiling Finish
The interior of this building was inaccessible (observations were made through the window). The ceiling finish was not visible from this location.

Architecture – Floor
The interior of this building was inaccessible (observations were made through the window). The floor is concrete.

Architecture – Casework
The interior of this building was inaccessible (observations were made through the window). The Privy contains two adult and one child privy seats, made of wood, painted blue.

Architecture – Accessibility
This building is currently not accessible. The main entry door opening is 2’3” clear with a grade to finished floor elevation change of 5 ½” due to the masonry sill/threshold. There is not an adequate 5’ diameter space within. No accessibility upgrades have been made.

Physical Description -- Structural

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

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

Structural – Roof Framing
The roof framing could not be observed but is believed to be wood framing. The rafters span approximately 3’. The rafters are supported on the exterior wood-framed walls. The rafters are sheathed with solid wood underlayment.

Structural – Wall Framing
The exterior walls are constructed of 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
There are no plumbing systems in the Privy.

Mechanical – HVAC
The original decorative gravity vent for the Privy remains through 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 in the building.

Physical Description -- Hazardous Materials

Landmark Environmental collected ten bulk samples from a total of ten different types of suspected asbestos containing materials (ACMs) at Outer Island. Of the ten suspect ACMs that were sampled and analyzed, a total of one suspect ACM resulted in a concentration 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. Adhesives,
2. Wall Interiors,
3. Brick and Block Filler (Wall interiors may be composed of brick or block and have the potential to have a block filler or grout that is potentially asbestos containing), and,
4. Asbestos-cement (Piping, wall-board, wall interior panels, roof flashing and roofing applications can be constructed of asbestos-cement. This type of application was not observed at the structure but may be present).

The assumed ACMs were observed to be in fair 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, LCP assumed to be present throughout the structure. The assumed LCP was observed to be in poor condition.

Loose/Flaking LCP is identified on the exterior painted surfaces of the structure. Paint chip debris was not seen on the ground surface.

Hazardous Materials – Lead Dust

Surface wipe-sampling for lead dust was not conducted in the Privy because it is an uninhabited structure.

Hazardous Materials – Lead in Soils

Historical paint maintenance activities such as manual scraping, power-washing, sanding, abrasive blasting or the general poor and peeling condition of exterior LCP may have created the potential to impact the surrounding soil. Areas of the surface soils adjacent to the structure were not observed to have LCP debris and additional areas may exhibit LCP debris or lead-contaminated soils, but are not observable due to vegetative cover surrounding the structure. Preliminary lead-in-soil sampling was not performed to assess whether these near-structure soils contain lead concentrations above applicable 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 in the Privy.

Character Defining Features

Mass/Form. A simple small utilitarian masonry gable roof structure with a decorative wood vent painted red.

Exterior Materials. White painted brick with dark grey accents, a metal shingle roof painted red and wood trim painted grey.

Openings. One wood two-lite casement and one five panel door both painted dark green.

Interior Materials. Unknown – no access.

General Condition Assessment

In general, the Outer Island Privy is in good condition on the exterior and the interior condition could not be determined as it was inaccessible. It is a three-seater privy for two adults and one child.

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: *Fair and Poor*
The roof is in fair condition as there is missing trim at the ridge cap and the peeling paint has revealed rust on the metal shingles. The wood elements are in fair condition as they have badly peeling paint. The wood vent with peeling paint shows deteriorated wood.

Architecture – Exterior Walls
Condition: *Fair*
The exterior walls are in fair condition as they have peeling paint and spalling brick, especially on the east and north elevations.

Architecture – Window
Condition: *Fair and Unknown*
This window is in fair condition as the wood frame, surround, and sill have badly peeling paint. The interior condition of the window is unknown.

Architecture – Exterior Door
Condition: *Fair and Unknown*
The door is in fair condition with splitting wood at the panels and separation of stiles and rails. The condition of the interior face of the door is unknown.

Architecture – Exterior Trim
Condition: *N/A*
Refer to roof.

Architecture – Wall Finish
<u>Condition:</u> *Unknown*
The wall finish for this building appears to be horizontal bead board siding, most likely 3 ½" wide. Surveyor was unable to determine the overall condition.

Architecture – Ceiling Finish
<u>Condition:</u> *Unknown*
The ceiling finish could not be identified.

Architecture – Floor
<u>Condition:</u> *Unknown*
The floor is concrete. Surveyor was unable to determine the overall condition.

Architecture – Casework
<u>Condition:</u> *Unknown*
This privy contains two adult and one child privy seats, made of wood, painted blue. Surveyor was unable to determine the overall condition.

Architecture – Accessibility
<u>Condition:</u> *Poor*
This building is not accessible.

Condition Assessment -- Structural

Structural – Foundation
<u>Condition:</u> *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
<u>Condition:</u> *Good*
The concrete slab-on-grade is in good condition.

Structural – Roof Framing
<u>Condition:</u> *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
<u>Condition:</u> *Good*
The walls are in good condition.

Structural – Lateral System
<u>*Condition:*</u> *Good*
Lateral stability of the building is good.

Structural – Load Requirements
<u>*Condition:*</u> *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
<u>*Condition:*</u> *N/A*

Mechanical – HVAC
<u>*Condition:*</u> *Poor*
The original decorative gravity vent on the roof is in poor condition as it needs conservation work.

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

The Privy was constructed in 1874 and most likely was the primary sanitary facility until 1930 when indoor plumbing was installed in the Keepers Quarters. The building is currently vacant and not accessible to the public. The proposed use for the Privy is to retain the structure as an integral component of the site's cultural landscape while precluding public access to its interior.

Preservation, focusing on the exterior, 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: *Moderate*
Replace the missing trim at the ridge cap and any rusted metal shingles in-kind. Scrape, sand and repaint metal shingles and wood elements at eave and rake. Scrape and sand the vent. Epoxy stabilize the wood members and prep and repaint.

Architecture – Exterior Walls
Priority: *Low*
Strip existing paint at brick. Repair spalling brick by flipping the bricks or by replacing in kind. Repaint the exterior walls with a proper coating allowing vapor permeability.

Architecture – Window
Priority: *Low*
Scrape, sand and repaint the exterior window frame, sash and trim. The interior condition of the window is unknown.

Architecture – Exterior Door
Priority: *Low*
Scrape and sand the door and frame. Epoxy stabilize the split wood in the door panels and repair the stiles and rails that are separating from the door face. Paint the door and frame. The condition of the interior face of the door is unknown.

Architecture – Exterior Trim
Priority: *N/A*
Refer to roof.

Architecture – Wall Finish
<u>*Priority:*</u> *Unknown*
The interior condition of the building is unknown.

Architecture – Ceiling Finish
<u>*Priority:*</u> *Unknown*
The interior condition of the ceiling finish is unknown.

Architecture – Floor
<u>*Priority:*</u> *Unknown*
The interior condition of the concrete floor is unknown.

Architecture – Casework
<u>*Priority:*</u> *Unknown*
The interior condition of the wood privy seats is unknown.

Architecture – Accessibility
<u>*Priority:*</u> *Low*
Provide program access through interpretive exhibits and waysides at the Visitor Center.

Treatment Recommendations -- Structural

Structural – Foundation
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Floor Framing
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Roof Framing
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Wall Framing
<u>*Priority:*</u> *Low*
No recommendations at this time.

Structural – Lateral System
<u>*Priority:*</u> *Low*
No recommendations at this time.

Treatment Recommendations -- Mechanical

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

Mechanical – HVAC
<u>*Priority:*</u> *Low*
No recommendations at this time.

Treatment Recommendations -- Electrical

N/A

Treatment Recommendations -- Hazardous Materials

Hazardous Materials – Asbestos
<u>*Priority:*</u> *Low*
Recommend sampling of suspect asbestos containing materials, including brick and block filler, adhesives, wall and interiors, and asbestos cement should be sampled.

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

Hazardous Materials – Lead In Soils
<u>*Priority:*</u> *Low*
No recommendations at this time.

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

Hazardous Materials – Petroleum Hydrocarbons
<u>*Priority:*</u> *Low*
No recommendations at this time.

Alternatives for Treatment

The following are several considerations of alternatives for the proposed treatments:

1. An alternative at the exterior walls could be to leave the masonry exposed (if the quality of the brick allowed) or alter the paint pattern vs. what is in situ. The finish of the Privy appeared to have several iterations including that seen in historic photo OI – 04.
2. Another alternative could be, similar to other islands utilitarian structures, allowing a view panel for visitors to experience the interior of the Privy. Given the low visitorship of this island, this is not the currently the recommended treatment.

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

Assessment of Effects for Recommended Treatments

Recommended Treatment	Potential Effects	Mitigating Measures	Beneficial Effects
1. Additional Hazardous Testing and Mitigation	Mitigation of hazardous material may require removal of historic materials.	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

OI-P-01: Aerial, 2009 (Source: A&A DSC01510)

OI-P-02: West elevation, 2009 (Source: A&A IMGP3159)

OI-P-03: North elevation, 2009 (Source: A&A DSC01374)

OI-P-04: East elevation, 2009 (Source: A&A DSC01377)

OI-P-05: South elevation, 2009 (Source: A&A DSC01376)

OI-P-06: Roof and vent details, south elevation (Source: A&A IMGP3163)

OI-P-07: Trim detail, west elevation (Source: A&A IMGP3164)

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

OTHER RESOURCES

Source: Letter from Regional Director of the Midwest Region to Superintendent of Apostle Islands National Lakeshore, June 16, 1977, located at APIS/NPS Business Office File # D3423-Outer

Paint (cheap, fences, etc.) Whitewash	1/2	1/4	1/8	1/16
1 bushel* unslaked lime or Hydrated lime	½ (2 peck)	¼ (1 peck)	1/8 (1 gal)	1/16 (1/2 gal)
20 lbs Spanish Whiting	10 lbs	5 lbs	2 ½ lbs	1 ¼ lbs
17 lbs Rock Salt	8 ½ lbs	4 ¼ lbs	2 1/8 lbs	1 1/16 lbs
12 lbs Brown Sugar	6 lbs	3 lbs	1 ½ lbs	¾ lbs
Slake lime w/ 40 gallons water	20 gals	10 gals	5 gals	2 ½ gals

Apply two coats to wood

Apply three coats to stone or brick

*Bushel = 17 ¾" x 15" x 8" deep = 1 bushel - 4 pecks or 2130 cubic inches
14 1/3" x 10" x 7 ½" = ½ bushel – 2 pecks

Boxes = 8" x 8" x 8 5/12" deep = 1 peck – 2 gallons (8 qts.)
7" x 8" x 4 1/8" = 1 gallon

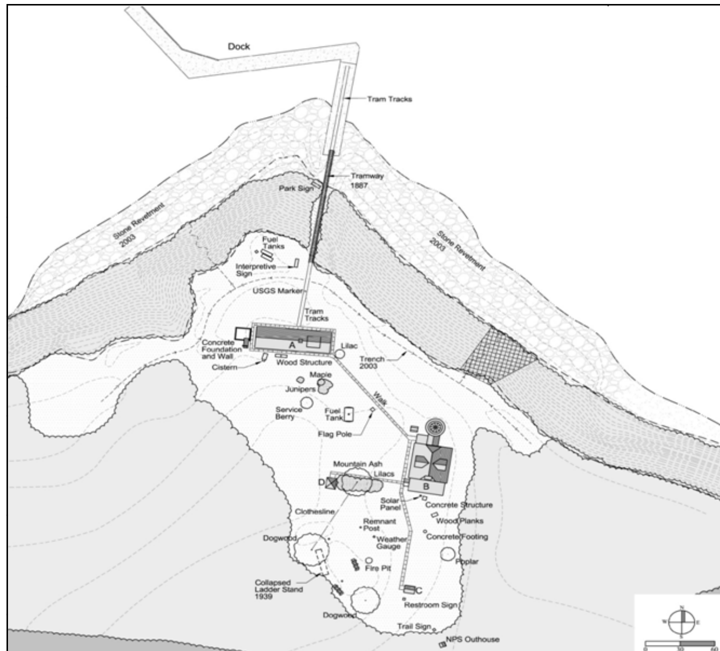
APPENDIX A: MATRIX OF TREATMENT ALTERNATIVE

OUTER ISLAND

PREFERRED ALTERNATIVE: REHABILITATION A

A NAVIGATIONAL CONTINUUM

REVISED 03.08.2011



Existing Conditions Site Plan - for reference only

General Description:
This treatment alternative proposes rehabilitating each island's cultural landscape to best portray the continuum of navigational history that characterizes the Apostle Islands as a system of light stations. Each island (and each light station) conveys specific characteristics related to particular periods of development in the navigation of the archipelago. This treatment will reveal this continuum by restoring missing historic features, and by repairing or altering others to convey the full historical significance of the system. Additions that are necessary to enable the compatible use of the light stations or islands are allowed as long as portions or features that convey the historical, cultural, or architectural values are preserved.

Period of Significance: 1874 - 1961

Please refer to the proposed treatments below.

	Tower	Keepers Quarters	Fog Signal Building	Oil Storage	Privy
Proposed Use of Building	Rehabilitate; guided visitor access.	Rehabilitate as "rustic" for staff housing.	Rehabilitate for limited visitor access to interior; possibly visual only.	Preserve and maintain current use as NPS storage.	Preserve and maintain current use as vacant.
Architecture	Increase tower ventilation; investigate replacing a window sash with a secure louver; repair cracks at masonry; repair rust patches; repaint exterior and interior complete; repaint metal door at base; replace missing access door at walk; replace broken glass and glazing at Lantern; seal all joints	Increase tower: basement ventilation; add gutter and downspout system; reroof the north shed and southwest entry vestibule with materials in kind; repair the rotted siding at the base of the SW entry and paint all siding and exterior trim; repair windows and all doors, repaint; repair masonry walls and chimney; remove non historic ceiling tiles; remove damaged areas of plaster at walls and ceilings, repair in kind and paint; paint all interior trim; repair existing flooring in situ; add handrail at basement stair	Paint fascia, soffit and frieze; repair windows and paint; repair all doors and paint; repair exterior walls and chipped siding; paint interior complete	Repoint masonry at southwest corner; strip paint from brick walls; repaint with permeable coating; repaint door	Replace missing ridge cap pieces, repaint existing metal shingles and soffit/fascia; strip paint from brick walls; repaint with permeable coating; repair window and door and paint
Structural	Monitor existing cracks to verify non-structural	Repoint masonry cracks, repair east framed wall in connection to tower, strengthen roof to properly support dormers	Strengthen ceiling framing over work room	No action at this time	No action at this time
Mechanical	Increase ventilation for moisture control.	Increase ventilation for moisture control. Install chimney liner for heater flue vent. Clean, inspect, and test sewer/septic system. Perform repairs as needed for operational septic system. Remove propane piping to refrigerator and stove.	Replace tram hoist. Clean and repaint fog signal components, piping, and tanks.	No action at this time.	No action at this time.
Electrical	Provide additional PV power to facilitate running of new ventilation equipment. Engage an LPI (Lightning Protection Institute) certified inspector to perform an inspection of the lightning protection system and provide findings and recommendations in accordance with LPI-175.	Remove existing lightning protection system and after re-roofing, replace with new system. Rehabilitate and expand existing PV Array and storage battery system to permit charging of staff radio units, accommodate new ventilation, and provide power for new refrigerator and stove.	Replace broken lighting fixtures and rehabilitate wiring systems. Replace existing tram hoist with new as required.	No action at this time.	No action at this time.
HazMat	Soil characterization (lead); asbestos sampling of materials to be preserved/stabilized; remove/stabilize lead paint	Water intrusion mitigation; soil characterization (lead); asbestos sampling of materials to be preserved/stabilized; remove/stabilize lead paint	Asbestos sampling of materials to be preserved/stabilized; abatement of a few pieces of deteriorating asbestos cement siding; remove/stabilize lead paint	Remove/stabilize lead paint	Remove/stabilize lead paint
Accessibility	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	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. Selectively clear trees along bank to open views to light station from lake 2. Stabilize slope embankment with planting and erosion control measures where needed 3. Maintain all slope stabilization improvements 4. Clear trees and brush at light station to restore meadow 5. Maintain drainage swale and system	1. Retain current boat dock location and configuration 2. Repair tramway to working condition (minor track repair) 3. Add new tramway landings for cart 4. Repair tram tracks to working condition 5. Repair tramway railing (east side) (paint; repair; new handrail) 6. New tramway railing (west side) (paint; repair; new railing and handrail) 7. Repair concrete walks (leveling; replace stones where needed)	1. Mark historic location of well 2. New NPS accessible privy (location TBD by NPS)	1. Remove propane tanks 2. Repair flagpole on bluff - repair pole; paint 3. Maintain concrete foundation west of Fog Signal building 4. Repair cistern - new cover; minor conc repair 5. Retain fuel tank 6. Maintain flagpole (compass) - paint 7. Repair ladder stand 8. Relocate fire pit to west 9. Relocate solar panel to west 10. Remove misc. non-contributing features	1. Remove non-contributing landscape plantings between Fog Signal Building and Oil Storage 2. Maintain landscape plantings south of Oil Storage (pruning)

APPENDIX B: SUMMARY OF HAZARDOUS MATERIAL FINDINGS

1

OUTER ISLAND TOWER

Building Number	LCS ID 006376
Building Name	Outer Island Tower
>1% Asbestos Confirmed	
Asbestos Assumed[44]	Adhesives, Plaster, Brick/Block Filler, Caulk, Transite and Roofing
Detectable Lead in Paint Confirmed	Window Sashes and Window Trims
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	Yes
Lead in Soils >50 mg/kg[46]	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

[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 nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

KEEPERS QUARTERS

Building Number	LCS ID 101140
Building Name	Outer Island Keepers Quarters
>1% Asbestos Confirmed	Floor Tile
Asbestos Assumed[47]	Adhesives, Plaster, Brick/Block Filler, Caulk, Transite and Wall Interiors
Detectable Lead in Paint Confirmed	Window Sashes and Trims, Doors and Trims, Walls and Ceilings
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	Yes
Lead in Soils >50 mg/kg[49]	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

[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 nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

FOG SIGNAL BUILDING

Building Number	LCS ID 006378
Building Name	Outer Island Fog Signal Building
>1% Asbestos Confirmed	
Asbestos Assumed[50]	Adhesives, Brick/Block Filler, Caulk, Transite and Wall Interiors
Detectable Lead in Paint Confirmed	Window Sashes and Trims, Doors and Trims, and Generators
Detectable Lead in Paint Assumed	Interior and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [51]	
Lead Dust on Floors >40 µg/SF Assumed [2]	
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	
Lead in Soils >50 mg/kg[52]	
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

[50] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[51] 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.
[52] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

OIL STORAGE

Building Number	LCS ID 006379
Building Name	Outer Island Oil Storage
>1% Asbestos Confirmed	
Asbestos Assumed[53]	Adhesives, Brick/Block Filler, Caulk, Transite 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 [54]	
Lead Dust on Floors >40 µg/SF Assumed [2]	
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	
Lead in Soils >50 mg/kg[55]	
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

[53] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[54] 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.
[55] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

PRIVY

Building Number	LCS ID 006380
Building Name	Outer Island Privy
>1% Asbestos Confirmed	
Asbestos Assumed[56]	Adhesives, Brick/Block Filler, Caulk, Transite 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 [57]	
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[58]	
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

[56] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[57] 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.
[58] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

1

APPENDIX C: MATERIAL ANALYSIS REPORTS, OUTER ISLAND

1

OUTER ISLAND ACM SAMPLE CHART

Sample #	Sample Date	API ID	Sample Location	Material Description	Laboratory Result
B-OIKQ-FT1-01	9/14/2009	26768	Keepers Quarters - Second Floor	Brown with black and white steaks floor tile with brown mastic	Trace Chrysotile in Brown mastic, 10% Chrysotile in Brown tile
B-OIKQ-BF1-01	9/14/2009	26768	Keepers Quarters - First Floor	Orange/white plaster block filler	ND
B-OIKQ-BF2-02	9/14/2009	26768	Keepers Quarters - First Floor	White chalky plaster block filler	ND
B-OIKQ-SF1-01	9/14/2009	26768	Keepers Quarters - First Floor	Orange/brown pattern sheet flooring	ND
B-OIKQ-SF2-01	9/14/2009	26768	Keepers Quarters - First Floor	Blue sheet flooring w/ black/tan fibrous backing and White leveler	ND
B-OIKQ-SF3-01	9/14/2009	26768	Keepers Quarters - First Floor	Red sheet flooring w/ black fibrous backing and Tan leveler	ND
B-OIKQ-SF4-01	9/14/2009	26768	Keepers Quarters - First Floor	Green marble sheet flooring with black backing and white leveling compound	ND
B-OIKQ-WT1-01	9/14/2009	26768	Keepers Quarters - First Floor	Thick applied white granular wall texture	ND
B-OIKQ-DW1-01	9/14/2009	26768	Keepers Quarters - First Floor	Pink granular drywall	ND
B-OIKQ-WP-01	9/14/2009	26768	Keepers Quarters - First Floor	Wall plaster patching material	ND

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

OUTER 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-OILH-01	Soil Composite	26768	Outer Island Tower dripline	9/14/2009	16.9	116.5
S-OIKQ-01	Soil Composite	26768	Keepers Quarters dripline	9/14/2009	16.9	794.3

APPENDIX D: FABRIC ANALYSIS

1

Fabric Analysis
Outer Island
Apostle Island National Lakeshore
October, 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 HSRs 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 two sets which are contained within this report were from the Outer Island Lighthouse Complex. There were 30 samples in the first set, of which 21 were paint samples and nine were of plaster and mortar (nos. 4, 8, 17, 22, and 24 – 28) and there were 25 samples in the second set of which one (no. 45) was a plaster sample.

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.

The paint samples were visually examined on Wednesday, October 21, using the same procedures employed for the samples from the previous seven sets from the other lighthouse complexes. Numbering of the samples commenced with one and ended with 55. The quality of the samples ranged from fair to quite excellent. Because of the exposed nature of many of the samples the paint exhibited weathering and appeared in several cases to be missing older layers seen in other, better samples. The layers are listed from top (most recent) to bottom (oldest). The following results were obtained from the analysis:

Oil House

Sample 1	**Munsell**
Dark maroon	7.5R 3/6
Dark maroon	7.5R 3/6
Yellow	2.5Y 8/4
Dark green	5G 4/4
Dark green	5G 4/4
Dark green	5G 4/4
Dark green	5G 4/4
Green	5GY 6/2
Dark maroon	7.5R 3/6
Dark maroon	7.5R 3/6

The first sample was collected from the brick of the oil house exterior. Its analysis revealed a relatively large number of paint layers. Most of the pieces did not reveal the oldest pair of dark maroon layers, but they remained semi-detached on one of the pieces. There was no substrate attached to any of the pieces.

Oil House

Sample 2	**Munsell**
Brown	10YR 6.5/8
Brown	10YR 6.5/8

Brown	10YR 6.5/8
Whitewash	N 9.5/
Whitewash	N 9.5/
Whitewash	N 9.5/

The second sample came from the oil house interior. Its top layer was quite glossy. Beneath the brown layers a minimum of three layers of whitewash were observed.

Oil House

Sample 3	**Munsell**
Green	10G 5.5/1.5
Green	10G 5/2
Light gray-green	10G 8/1
Dark green	10G 4/2
Whitewash	N 9.5/

The third sample was removed from the oil house exterior. Beneath a set of four varying shades of dull green were multiple layers of whitewash as evidenced by its dissolution in hydrochloric acid.

As noted in the introduction above there were nine plaster and mortar samples in the first set of samples from the Outer Island Lighthouse complex. The fourth sample was the first of these samples. It was analyzed on Thursday, October 22 utilizing the standard testing procedure developed by E. Blaine Cliver, Regional Historical Architect of the North Atlantic Region of the National Park Service. The sample was from the mortar of the oil house. It was tan in color and was very soft in consistency. The resultant reaction displaced a minimum amount of water. That fact, coupled with the softness of the sample and its very rapid filtering time leads to the conclusions that it was probably composed of sand and a minimum amount of lime. There were an extremely large proportion of fines in the sample indicating that the sand was originally quite dirty. The sand sieve analysis revealed bits of red brick which were trapped in the two largest sieves. The largest sieve contained only brick bits and the second largest sieve also contain some sand as well. Taking that into account, the sand was extremely fine. At least 42% passed all of the sieves and at least 36% was trapped in the finest sieve.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No.: 4
Building: Oil House, Outer Apostle Islands NL
Location: Mortar
Sample Description: Tan, very soft, small reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 185.5 Container A weight
2. 193.2 Container A and sample
3. 760.22 Barometric pressure

8. No Hair or fiber ______ type
9. 3.8 Fines and paper weight
10. 3.0 Filter paper weight

4. 23 Temperature
5. 0.03 Liters of water displaced
6. Champagne Filtrate color
7. Tan Fines color

11. 190.5 Sand and Container A weight
12. 3.8 cc. of sand
13. 33.8 Weight of graduated cylinder and sand
14. 28.8 Weight of graduated cylinder

Computations:

15. 7.7 Starting weight of sample: No. 2 – No. 1
16. 0.8 Weight of fines: No. 9 – No. 10
17. 5.0 Weight of sand: No. 11 – No. 1
18. .76 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 1.9 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0012321 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. 1.78 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .024 Mols. of Ca(OH)2: No. 22 divided by 74
24. 1.87 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.05 Gram weight CO2: No. 20 x 44
26. 1.11 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 4.5 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 7.65 Gram weight of sample: No. 15 – No. 25
29. 10.46 Fine parts/volume: No. 16 divided by No. 28
30. 49.67 Sand parts/volume: (No. 17 divided by No. 28) x No. 18
31. 26.89 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	107.0	106.7	0.3	6
No. 20	106.6	106.4	0.2	4
No. 30	99.4	99.3	0.1	2
No. 40	101.2	100.7	0.5	10
No. 50	95.0	93.2	1.8	36
Base	73.3	71.2	2.1	42

Outhouse

Sample 5	**Munsell**
Whitewash	N 9.5/

The fifth sample continued the paint series and was from the brick exterior wall of the outhouse. Its relatively thick coating of whitewash layers entirely disappeared in hydrochloric acid.

Outhouse

Sample 6	**Munsell**
Green	10G 5.5/1.5
Dark gray-green	10G 4/1
Gray-green	5G 5/1
White	N 9.5/
Whitewash	N 9.5/

The sixth sample was found on the trim of the outhouse exterior. Interestingly, it retained a stark white paint layer above a set of whitewash layers. The paint was impervious to the acid as opposed to the whitewash which completely dissolved in the acid.

Outhouse

Sample 7	**Munsell**
Green	5G 4.5/4
Dark gray	5Y 4/1
Dark gray	5Y 4/1

The seventh sample was collected from the exterior side of the outhouse door. Its analysis revealed only three paint layers with dark gray being the oldest.

The eighth sample continued the series of mortar and plaster samples. It was collected from the outhouse mortar. It was tan in color and was very soft with large, visible sand grains. It had a fast and bubbly reaction with a relatively small water displacement. That, along with a rapid filtering time indicated a composition of sand and lime. There were a relatively small proportion of fines, indicating a level of care initially taken to clean the sand. As anticipated, the sand sieve analysis revealed coarse sand. Over 5% failed to pass any of the sieves, which was a large amount than that which passed all but the finest sieve and all of the sieves, combined. Almost 2/3 was trapped in the second largest sieve.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 8

Building: Outhouse, Outer Island, Apostle Islands NL

Location: Mortar

Sample Description: Tan, very soft, large sand grains, fast and bubbly reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 188.9 Container A weight	8. No Hair or fiber ____ type
2. 203.8 Container A and sample	9. 3.3 Fines and paper weight
3. 760.22 Barometric pressure	10. 3.0 Filter paper weight
4. 23 Temperature	11. 199.8 Sand and Container A weight
5. 0.18 Liters of water displaced	12. 6.9 cc. of sand
6. Clear Filtrate color	13. 39.7 Weight of graduated cylinder and sand

7. Tan Fines color

14. 28.8 Weight of graduated cylinder

Computations:

15. 14.9 Starting weight of sample: No. 2 – No. 1
16. 0.3 Weight of fines: No. 9 – No. 10
17 10.9 Weight of sand: No. 11 – No. 1
18. .633 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 3.7 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0073925 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 74 Gram weight of CaCO3: 100 x No. 20
22. 2.96 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .04 Mols. of Ca(OH)2: No. 22 divided by 74
24. 3.51 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.33 Gram weight CO2: No. 20 x 44
26. 2.09 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 15.79 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28.	14.57	Gram weight of sample:	No. 15 – No. 25
29.	2.06	Fine parts/volume:	No. 16 divided by No. 28
30.	47.36	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31.	26.50	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	107.4	106.8	0.6	5.55
No. 20	113.4	106.4	7.0	64.81
No. 30	101.1	99.3	1.8	16.67
No. 40	101.4	100.7	0.7	6.48
No. 50	93.5	93.2	0.3	2.78
Base	71.6	71.2	0.4	3.70

Fog Signal

Sample 9	**Munsell**
Black	N 0.5/
Dark gray	N 2.0/
Black	N 0.5/
Gray-green	10 G 6/1
Dark gray	N 4.0/
Dark gray-green	10G 4/1
White	N 9.5/

The ninth sample was collected from the fog signal exterior. Its analysis revealed a set of gray and greenish gray layers. The oldest white layer appeared on only one end of one of the pieces.

Fog Signal

Sample 10	**Munsell**
Light green	7.5G 7/2

The tenth sample came from the workroom wall of the fog signal. It consisted on a single layer of light green paint without any substrate.

Fog Signal

Sample 11	**Munsell**
White	N 9.5/
White	N 9.5/
White	N 9.5/
Tan	2.5Y 6/5
Tan	2.5Y 7/4
Tan	2.5Y 7/4
Tan	2.5Y 7/4
Tan	2.5Y 7/4
Gray-tan	2.5Y 7/2

The eleventh sample was removed from the workroom ceiling of the fog signal. Beneath a set of three stark white layers was a relatively consistent set of tan layers with the oldest being somewhat grayer than the others. No substrate remained.

Fog Signal

Sample 12	**Munsell**
Gray	N 6.0/
White	5Y 9/1

The twelfth sample was from the workroom trim of the fog signal. The white layer on its wood surface was extremely thin and probably served as a prime coat for the gray finish coat.

Fog Signal

Sample 13	**Munsell**
Light green	7.5G 7/2
Cream	2.5Y 8.5/2
Light brown	10YR 6/4
Light brown	10YR 6/4
Light brown	10YR 6/4
Light brown	10YR 6/4
Black	N o.5/

The thirteenth sample was found on the storage wall of the fog signal. The substrate was a thick paper. On its surface was a very glossy, flaky, black substance which readily delaminated from the light brown paint on its surface. It is unlikely that the black layer was an applied finish.

Fog Signal

Sample 14	Munsell
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/

The fourteenth sample was collected from the interior trim of the storage of the fog signal. Its top layer was a stark white, high-gloss paint. All of the layers were extremely thin and evenly applied.

Fog Signal

Sample 15	Munsell
Dark maroon	2.5R 3/4
Gray	5Y 7/1
Light green	7.5G 7/2
Light gray	5Y 8/1
Gray	5Y 6/1
Dark gray	5Y 4/1
White	5Y 9/1

The fifteenth sample came from the battery storage wall of the fog signal. It was in excellent condition, clearly revealing a set of evenly applied, thin layers with white being the oldest color. The sample was detached from its substrate.

Fog Signal

Sample 16	Munsell
Dark maroon	2.5R 3/4
Dark maroon	2.5R 3/4
Gray	5Y 6/1
Gray	5Y 6.5/1
Gray	5Y 6/1
Light gray	5Y 8/1
Green	5G 4/4
Charcoal	5Y 3/1
Light gray	5Y 8/1
Gray	5Y 7/1
Gray	5Y 7/1
Gray	5Y 7/1
White	5Y 9/1
Gray	5Y 6.5/1
Charcoal	5Y 3/1
Gray	5Y 5/1
White	5Y 9/1
White	5Y 9/1

The sixteenth sample was removed from the equipment room wall of the fog signal. It was truly outstanding in its quality, revealing a very large set of evenly-applied paint layers, but without attached substrate. The oldest pair of white layers was relatively thick indicating that they were probably not prime coats, but were finish coats.

The seventeenth sample continued the plaster and mortar samples. It came from the equipment room chimney mortar of the fog signal. It was tan in color and was very soft. With a very fast reaction and a small water displacement it was evident that this was composed of a relatively small part of lime in relation to its sand content. The sand sieve analysis revealed fine sand of which well over one-fifth passed all of the sieves and almost one-third was trapped in the finest sieve.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 17
Building: Fog Signal, Outer Island, Apostle Islands NL
Location: Equipment Room Chimney Mortar
Sample Description: Tan, very soft, speedy reaction, extremely fast filtering time

Test No. 1 – Soluble Fraction

Data:

1. 185.1 Container A weight	8. No Hair or fiber ______ type
2. 201.0 Container A and sample	9. 3.6 Fines and paper weight
3. 760.22 Barometric pressure	10. 3.0 Filter paper weight
4. 23 Temperature	11. 197.9 Sand and Container A weight
5. 0.05 Liters of water displaced	12. 7.6 cc. of sand
6. Champagne Filtrate color	13. 41.6 Weight of graduated cylinder and sand
7. Brown Fines color	14. 28.87 Weight of graduated cylinder

Computations:

15. 15.5 Starting weight of sample: No. 2 – No. 1
16. 0.6 Weight of fines: No. 9 – No. 10
17. 12.8 Weight of sand: No. 11 – No. 1
18. .59375 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 2.1 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0020535 Mols. Of CO_2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 20 Gram weight of $CaCO_3$: 100 x No. 20
22. 1.9 Gram weight of $Ca(OH)_2$: No. 19 – No. 21
23. .0256 Mols. of $Ca(OH)_2$: No. 22 divided by 74
24. 1.74 Gram total weight of $Ca(OH)_2$: 74 x (No. 20 + No. 23)
25. 0.09 Gram weight CO_2: No. 20 x 44
26. 1.04 Gram weight total possible CO_2: 44 x (No. 20 + No. 23)
27. 8.65 %CO_2 gain: No. 25 divided by No. 26

Conclusions:

28. 15.41 Gram weight of sample:	No. 15 – No. 25
29. 3.89 Fine parts/volume:	No. 16 divided by No. 28
30. 49.32 Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. 12.42 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	107.3	106.8	0.5	3.97
No. 20	107.3	106.4	0.9	7.14
No. 30	100.3	99.3	1.0	7.94
No. 40	104.3	100.8	3.5	27.78
No. 50	97.2	93.2	4.0	31.75
Base	73.9	71.2	2.7	21.43

Fog Signal

Sample 18	**Munsell**
Gray	N 7.0/
Dark gray	N 5.5/
Gray	N 7.0/
Light gray	N 8.0/
Gray	N 7.0/
Gray	N 6.5/

The eighteenth sample resumed the paint analysis. The sample was from the second floor wall of the fog signal. It consisted of a palette of layers in varying shades of gray.

Fog Signal

Sample 19	**Munsell**
White	5Y 9/1
White	5Y 9/1
Light gray	5Y 8/1
Gray	5Y 6/1
Dark gray	5Y 4/1
Gray	5Y 6/1
Off-white	5Y 8.5/1
Dark gray	5Y 4/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1

The nineteenth sample was found on the second floor trim of the fog signal. It began with a pair of white layers and ended with a pair of white layers with a set of varying gray layers between them.

Fog Signal

Sample 20	**Munsell**
Red	7.5R 3/12
Gray	N 6.5/
Gray	N 6.5/

Charcoal	N 1.5/
Dark gray	N 4.0/
Dark gray	N 4.0/
Gray	N 7.0/
Dark gray	N 5.0/
Dark gray	N 5.0/
Gray	N 6.5/
Gray	N 6.5/
Gray	N 6.5/
Light gray	N 8.0/
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1

The twentieth sample was collected from the equipment room of the fog signal. It was in excellent condition with numerous layers beneath a bright red top layer of paint. At the base of the sample, beneath the oldest white layer, was a thin layer of black and dark maroon which may have been a ferrous metal substrate. It did not appear to be an applied paint.

Fog Signal

Sample 21	**Munsell**
Gray	N 7.0/
Dark gray	N 5.5/
Gray	N 7.0/
Light gray	N 8.0/
Gray	N 7.0/
Gray	N 6.5/

Sample 21 came from the exterior baseboard trim of the fog signal. It retained a set of varying shades of gray paint.

Sample 22 resumed the mortar and plaster sample analysis. It was from the exterior mortar of the fog signal. Its attributes of color (gray), hardness, brittleness, very small water displacement, and lengthy filtering time pointing toward a mixture of Portland cement and sand. The sand sieve analysis revealed very moderate sand of which virtually passed the largest sieve and less than 3% pass all of the sieves. Almost half was trapped in sieve #40 and almost 30% was trapped in sieve #30.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 22
Building: Fog Signal, Outer, Island, Apostle Islands NL
Location: Exterior brick mortar
Sample Description: Gray, hard and brittle, small reaction followed by prolonged reaction, slow filtering time

Test No. 1 – Soluble Fraction

Data:

1. 187.8 Container A weight
2. 227.2 Container A and sample
3. 760.22 Barometric pressure
4. 23 Temperature
5. 0.08 Liters of water displaced
6. Yellow-green Filtrate color
7. Brown Fines color
8. No Hair or fiber ______ type
9. 4.1 Fines and paper weight
10. 3.1 Filter paper weight
11. 216.6 Sand and Container A weight
12. 19.3 cc. of sand
13. 57.5 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 39.4 Starting weight of sample: No. 2 – No. 1
16. 1.0 Weight of fines: No. 9 – No. 10
17. 28.8 Weight of sand: No. 11 – No. 1
18. .67 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 9.6 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0032856 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 33 Gram weight of CaCO3: 100 x No. 20
22. 9.27 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .1253 Mols. of Ca(OH)2: No. 22 divided by 74
24. 9.51 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.14 Gram weight CO2: No. 20 x 44
26. 5.66 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 2.47 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28.	39.26	Gram weight of sample:	No. 15 – No. 25
29.	2.55	Fine parts/volume:	No. 16 divided by No. 28
30.	49.15	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.	1.99	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	106.9	106.7	0.2	0.70
No. 20	109.0	106.4	2.6	9.12
No. 30	107.8	99.3	8.5	29.82
No. 40	114.6	100.7	13.9	48.77
No. 50	95.7	93.2	2.5	8.77
Base	72.0	71.2	0.8	2.81

Lighthouse

Sample 23	**Munsell**
White	N 9.5/
White	N 9.5/

White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/

Sample 23 continued the paint layers. It was removed from the exterior siding of the lighthouse. Its analysis revealed eight layers of stark white paint.

Sample 24 continued the mortar and plaster sample analysis. The sample was collected from the exterior block mortar of the lighthouse. It proved to be a classic Portland cement and sand mortar. It was gray and hard. It had a very low water displacement. Its filtering was a matter of almost two days time. It produced gelatinous byproducts with the reaction which dried to a very large quantity of fines. There is no doubt that a large proportion of Portland cement was used in the mortar in relation to the sand content. The sand sieve analysis was unusually interesting in that the sand proved to be virtually identical to that analyzed from the kitchen plaster (sample 22) from the Michigan Island Light. All of it easily passed the largest sieve and almost 10% passed all of the sieves. One-third was trapped in the finest sieve, #50, and over 42% was trapped in the next finest sieve, #40.

Analysis of sample 25 and the subsequent four other plaster and mortar samples were undertaken on Friday, October 23. The sample 25 came from the exterior brick mortar of the lighthouse. It was tan in color and was moderately soft. With a very low water displacement and a relatively large amount of fines it appears that the mortar consisted of sand and cement. With its color (tan) this was probably natural cement and not Portland cement, which is typically gray. The relatively small sample size probably accounts for the fairly fast filtering time. Cement samples normally filter slowly. Natural cement, as its name implies, is quarried from the ground and is similar to the cements the Romans used for their construction. Portland cement, named after Portland, England where it was invented and first manufactured, is a synthetic cement. The primary difference is that natural cement contains a wider range of possible elements which can affect its performance whereas Portland cement is completely predictable and consistent. As a result, Portland cement is hard, impervious, and brittle. Natural cements tend not to be as hard or impervious or brittle, plus their color is different (shades of gray to white for Portland cement and tan or buff for natural cement). Natural cements were overtaken by Portland cement in the later decades of the nineteenth century as natural cement quarries played out and production costs for Portland cement became competitive. Generally, if one encounters natural cement it is an indication that it is from a nineteenth century structure. The sand sieve analysis revealed fine sand which easily passed the largest sieve. Well over one-quarter of it passed all of the sieves and well over one-third was trapped in the finest sieve, #50.

Sample 26 was removed from the brick mortar patch of the lighthouse. It was brown in color and was moderately hard. It had a very modest water displacement. Its hardness and water displacement coupled with a slow filtering time and a relatively large proportion of fines points toward a mixture of sand and cement. The brown color of the sample points toward a natural cement rather than a Portland cement, which is typically gray. The sand sieve analysis was quite interesting. It revealed moderately coarse sand. Identical amounts were trapped in sieves #40 and #50 (both over 25%) and in the base and in sieve #20 (both almost 15%). The sand in sieve #30 was almost the same in weight as the latter two from the base and sieve #20.

Sample 27 was from the brick mortar patch of the lighthouse. It was gray in color and was relatively soft. That softness, coupled with a fast and bubbly reaction, a fair amount of water displacement, as well as a rapid filtering time points toward a mixture of approximately five parts of sand to two parts of lime, by volume. The sand sieve analysis produced a moderate sand which easily passed the largest sieve, but less than 7% passed all of the sieves. Almost one-fifth was trapped in the finest sieve, #50, and well over 58% was trapped in the next finest sieve, #40.

Sample 28 was taken from the mortar of the lighthouse. It was tan in color and moderately soft. Its minimal reaction is typical of a lime and cement mortar. The speed of the reaction coupled with its foaminess, in addition to the relatively large proportion of fines indicates a high probability that the cement was not Portland cement, but natural cement. In addition, natural cement yields a tan color whereas most Portland cement is gray in color. The sand sieve analysis revealed very moderate sand. Over 18% of it passed all of the sieves whereas only slightly over 1% was trapped in the largest sieve. In a curious turn of events equal portions were trapped in sieves #20 and #30 (both 13%) and in #40 and #50 (both over 27%). This was extremely similar to the sand of sample 25 above.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 24
Building: Lighthouse, Outer Island, Apostle Islands NL
Location: Exterior block mortar
Sample Description: Gray, very hard, small reaction followed by prolonged reaction, gelatinous by-products, extremely slow filtering time

Test No. 1 – Soluble Fraction

Data:

1. 192.0 Container A weight
2. 208.6 Container A and sample
3. 760.22 Barometric pressure
4. 23 Temperature
5. 0.05 Liters of water displaced
6. Off-white Filtrate color
7. Gray Fines color
8. No Hair or fiber______type
9. 8.8 Fines and paper weight
10. 3.4 Filter paper weight
11. 200.3 Sand and Container A weight
12. 6.0 cc. of sand
13. 37.1 Weight of graduated cylinder and sand
14. 28.8 Weight of graduated cylinder

Computations:

15. 16.6 Starting weight of sample: No. 2 – No. 1
16. 5.4 Weight of fines: No. 9 – No. 10
17. 8.3 Weight of sand: No. 11 – No. 1
18. .7229 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 2.9 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.002 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 20 Gram weight of CaCO3: 100 x No. 20
22. 2.7 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0364 Mols. of Ca(OH)2: No. 22 divided by 74
24. 2.84 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.09 Gram weight CO2: No. 20 x 44
26. 1.69 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 5.33 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28.____16.51___Gram weight of sample: No. 15 – No. 25
29.____32.71___Fine parts/volume: No. 16 divided by No. 28
30.____36.34___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.____25 51___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
No. 20	106.7	106.4	0.3	3.61
No. 30	100.2	99.3	0.9	10.84
No. 40	104.3	100.8	3.5	42.17
No. 50	96.0	93.2	2.8	33.73
Base	72.0	71.2	0.8	9.64

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 25
Building: Lighthouse, Outer Island, Apostle Islands NL
Location: Exterior brick mortar
Sample Description: Tan, moderately soft, fast and bubbly reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:
1. __185.5__ Container A weight
2. __193.8__ Container A and sample
3. __763.02__ Barometric pressure
4. __23__ Temperature
5. __0.08__ Liters of water displaced
6. Yellow-green Filtrate color
7. Light brown Fines color
8. __No__ Hair or fiber_____type
9. __3.7__ Fines and paper weight
10. 2.9__ Filter paper weight
11. 190.7 Sand and Container A weight
12. _3.4__ cc. of sand
13. _34.0 Weight of graduated cylinder and sand
14. _28.8 Weight of graduated cylinder

Computations:
15.____8.3____Starting weight of sample: No. 2 – No. 1
16.____0.8____Weight of fines: No. 9 – No. 10
17.____5.2____Weight of sand: No. 11 – No. 1
18.___.653846__Sand density: No. 12 divided by (No. 13 – No. 14)
19.____2.3____Weight of soluble content: No. 15 – (No. 16 + No. 17)
20._0.0032977_Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21.____0 33____Gram weight of CaCO3: 100 x No. 20

22. 1.97 Gram weight of $Ca(OH)_2$: No. 19 – No. 21
23. .0266 Mols. of $Ca(OH)_2$: No. 22 divided by 74
24. 4.41 Gram total weight of $Ca(OH)_2$: 74 x (No. 20 + No. 23)
25. 0.15 Gram weight CO_2: No. 20 x 44
26. 2.62 Gram weight total possible CO_2: 44 x (No. 20 + No. 23)
27. 5.73 %CO_2 gain: No. 25 divided by No. 26

Conclusions:

28. 8.15	Gram weight of sample:	No. 15 – No. 25
29. 9.81	Fine parts/volume:	No. 16 divided by No. 28
30. 41.72	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. 8.44	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	107.0	106.7	0.3	5,56
No. 20	107.2	106.4	0.8	14.81
No. 30	99.9	99.2	0.7	12.96
No. 40	102.1	100.7	1.4	25.93
No. 50	94.6	93.2	1.4	25.93
Base	72.0	71.2	0.8	14.81

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 26
Building: Lighthouse, Outer Island, Apostle Islands NL
Location: Brick mortar patch
Sample Description: Brown, moderately hard, fast and bubbly reaction, slow filtering time

Test No. 1 – Soluble Fraction

Data:

1. 188.9 Container A weight
2. 199.4 Container A and sample
3. 763.02 Barometric pressure
4. 23 Temperature
5. 0.08 Liters of water displaced
6. Yellow-green Filtrate color
7. Tan Fines color
8. No Hair or fiber ____ type
9. 3.8 Fines and paper weight
10. 3.1 Filter paper weight
11. 193.8 Sand and Container A weight
12. 3.1 cc. of sand
13. 33.7 Weight of graduated cylinder and sand
14. 28.8 Weight of graduated cylinder

Computations:

15. 10.5 Starting weight of sample: No. 2 – No. 1
16. 0.7 Weight of fines: No. 9 – No. 10
17. 4.9 Weight of sand: No. 11 – No. 1
18. .632653 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 4.9 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0033 Mols. Of CO_2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 33 Gram weight of $CaCO_3$: 100 x No. 20
22. 4.57 Gram weight of $Ca(OH)_2$: No. 19 – No. 21
23. .0618 Mols. of $Ca(OH)_2$: No. 22 divided by 74
24. 4.81 Gram total weight of $Ca(OH)_2$: 74 x (No. 20 + No. 23)
25. 0.15 Gram weight CO_2: No. 20 x 44
26. 2.86 Gram weight total possible CO_2: 44 x (No. 20 + No. 23)
27. 5.24 %CO_2 gain: No. 25 divided by No. 26

Conclusions:

28.	10.35	Gram weight of sample:	No. 15 – No. 25
29.	6.76	Fine parts/volume:	No. 16 divided by No. 28
30.	29.95	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.	5.82	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
No. 20	106.7	106.4	0.3	6.12
No. 30	99.7	99.3	0.4	8.16
No. 40	101.9	100.8	1.1	22.45
No. 50	94.9	93.2	1.7	34.69
Base	72.6	71.2	1.4	28.57

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 27
Building: Lighthouse, Outer Island, Apostle Islands NL
Location: Brick mortar patch
Sample Description: Gray, soft, fast and bubbly reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 185.1 Container A weight
2. 203.1 Container A and sample
3. 763.02 Barometric pressure
4. 23 Temperature
5. 0.12 Liters of water displaced
6. Yellow-green Filtrate color
7. Off-white Fines color
8. No Hair or fiber______type
9. 3.7 Fines and paper weight
10. 3.1 Filter paper weight
11. 199.0 Sand and Container A weight
12. 8.4 cc. of sand
13. 42.7 Weight of graduated cylinder and sand
14. 28.8 Weight of graduated cylinder

Computations:

15. 18.0 Starting weight of sample: No. 2 – No. 1
16. 0.6 Weight of fines: No. 9 – No. 10
17. 13.9 Weight of sand: No. 11 – No. 1
18. .6043 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 3.5 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0049466 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 49 Gram weight of CaCO3: 100 x No. 20
22. 3.01 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0406 Mols. of Ca(OH)2: No. 22 divided by 74
24. 3.37 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.22 Gram weight CO2: No. 20 x 44
26. 2.00 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 11 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 17.78 Gram weight of sample: No. 15 – No. 25
29. 3.37 Fine parts/volume: No. 16 divided by No. 28
30. 47.24 Sand parts/volume: (No. 17 divided by No. 28) x No. 18
31. 20.85 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
No. 20	106.6	106.4	0.2	1.44
No. 30	101.4	99.3	2.1	15.11
No. 40	108.7	100.7	8.0	57.55
No. 50	95.9	93.2	2.7	19.42
Base	72.1	71.2	0.9	6.47

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 28
Building: Lighthouse, Outer, Island, Apostle Islands NL
Location: Brick mortar
Sample Description: Tan, moderately soft, fast and foamy reaction, slow filtering time

Test No. 1 – Soluble Fraction

Data:

1. 187.8	Container A weight	8. No	Hair or fiber ______ type
2. 201.4	Container A and sample	9. 4.1	Fines and paper weight
3. 763.02	Barometric pressure	10. 3.0	Filter paper weight
4. 23	Temperature	11. 195.6	Sand and Container A weight
5. 0.03	Liters of water displaced	12. 5.9	cc. of sand
6. Yellow-green	Filtrate color	13. 36.5	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. 1.1	Weight of fines: No. 9 – No. 10
17. 7.8	Weight of sand: No. 11 – No. 1
18. .7564	Sand density: No. 12 divided by (No. 13 – No. 14)
19. 4.0	Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0012366	Mols. Of CO_2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 12	Gram weight of $CaCO_3$: 100 x No. 20
22. 3.88	Gram weight of $Ca(OH)_2$: No. 19 – No. 21
23. .0524	Mols. of $Ca(OH)_2$: No. 22 divided by 74
24. 3.97	Gram total weight of $Ca(OH)_2$: 74 x (No. 20 + No. 23)
25. 0.05	Gram weight CO_2: No. 20 x 44
26. 2.36	Gram weight total possible CO_2: 44 x (No. 20 + No. 23)
27. 2.12	%CO_2 gain: No. 25 divided by No. 26

Conclusions:

28. 13.86	Gram weight of sample:	No. 15 – No. 25
29. 7.94	Fine parts/volume:	No. 16 divided by No. 28
30. 42.60	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. 6.83	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	106.9	106.8	0.1	1.23

No. 20	107.4	106.4	1.0	12.99
No. 30	100.3	99.3	1.0	12.99
No. 40	102.9	100.7	2.1	27.27
No. 50	95.3	93.2	2.1	27.27
Base	72.6	71.2	1.4	18.18

Lighthouse

Sample 29	**Munsell**
White	N 9.5/
White	N 9.5/

Sample 29 resumed the paint layers and was from the lighthouse exterior trim. It retained only a pair of stark white paint layers.

Lighthouse

Sample 30	**Munsell**
Off-white	N 8.5/
Cream	2.5Y 8/3
White	N 9.5/
Tan	2.5Y 7/5
Tan	2.5Y 7/5
Tan	2.5Y 7/5
Tan	2.5Y 7/4
Tan	2.5Y 7/4
Tan	2.5Y 7/4
Tan	2.5Y 7/5
Light brown	10YR 6/4
Cream	2.5Y 8/2
Cream	2.5Y 8/2

Sample 30 was found on the entry wall of the lighthouse. A set of tan-colored paint layers represented a consistent history of that color. However, the oldest cream layers were lighter and grayer than the tan layers.

Lighthouse

Sample 31	**Munsell**
Yellow	2.5Y 8/8
White	N 9.5/
White	N 9.5/
Light brown	10YR 7.5/5
Blue-green	5G 8/1
Blue-green	5G 8/1
Gray	5Y 6/1
Very dark brown	2.5Y 3/2
Gray	5Y 6/1
Gray	5Y 7/1
Very dark green	5G 3/4
Gray	5Y 7/1

Whitewash	N 9.5/

Sample 31 commenced the second set of samples from the Outer Island Light Complex. Analysis of this set commenced on Monday, October 27, 2009. Sample 31 was collected from the kitchen of the lighthouse. It was in excellent condition. Beneath a set of a dozen paint layers was a relatively thick set of ill-defined whitewash layers.

Lighthouse

Sample 32	**Munsell**
Green	5G 6.5/3
Dark brown	.5YR 4/4
White	5Y 9/1
Pastel blue-green	5BG 9/1
Peach	10YR 8/5

Sample 32 came from the living room wall of the lighthouse. There was a complete cleavage between the peach and the pastel blue-green layer. The peach-colored paint was firmly adhered to its paper substrate. The cleavage may indicate that the peach layer was incompatible with the pastel blue-green layer or that a thin film of dirt had built up over time resulting in the weak adhesion between the layers

Lighthouse

Sample 33	**Munsell**
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Gray	5Y 6/1
Black	N 1.5/
Dark gray	5Y 4/1
Gray	N 6.75/
Gray	5Y 5/1
Gray	5Y 6/1
Gray	5Y 5/1
Gray	5Y 6/1
Gray	5Y 5/1
Cream	2.5Y 8/2
Dark brown	7.5YR 4/2
Gray	5Y 7/1

Sample 33 was removed from the interior door trim of the lighthouse. Its quality was quite excellent with clearly observable paint layers. Despite a very lengthy history of white paint the older layers were primarily gray with a few exceptions. The oldest layer was gray.

Lighthouse	
Sample 34	**Munsell**
Pastel blue-green	5BG 9/1
Whitewash	N 9.5/
Light blue-green	5BG 8/1
Peach	7.5YR 7/4
Peach	7.5YR 7/4
Peach	7.5YR 7/4
Blue-green	5BG 8/1
Blue-green	5BG 7.5/1
Blue-green	5BG 8/1
Brown	7.5YR 5.5/4
Blue-green	5BG 6/1
Blue-green	5BG 6/1
Blue-green	5BG 7/2
White	5Y 9/1

Sample 34 was from the wall of bedroom 1 in the lighthouse. Its quality was excellent, revealing a large array of paint layers. The oldest white layer was extremely thin and probably served as a prime coat for an original finish coat of blue-green paint.

Lighthouse	
Sample 35	**Munsell**
White	5Y 9/1
Brown	7.5YR 4/4
Brown	7.5YR 5/4
Blue-green	5BG 5/2
Blue-green	5BG 5/2
Blue-green	5BG 5/2
White	N 9.5/

Sample 35 was found on the wall of bedroom 1 of the lighthouse. Its paint layers were extremely thin and evenly applied. The oldest white layer was exceptionally thin and probably served as a prime coat for an original finish layer of blue-green.

Lighthouse	
Sample 36	**Munsell**
White	N 9.5/
Whitewash	N 9.5/
Tan	10YR 8/4
Blue-green	5BG 5/2
Peach	10YR 8/5
White	5Y 9/1
Rose	10R 7/5
Tan	10YR 8/4
Blue-green	5BG 6/2
Blue-green	5BG 6/2
Gray	5Y 6.5/1

Sample 36 was collected from the wall of bedroom 2 of the lighthouse. Its analysis revealed a set of paint layers beneath a relatively thick layering of whitewash with a white paint layer on their surface. The oldest surviving paint layer was gray which may have served as a prime coat for a finish layer of blue-green.

Lighthouse

Sample 37	**Munsell**
Light yellow	5Y 8.5/4
Light rose	5YR 8/4

Sample 37 was collected from the wall of the first floor hallway of the lighthouse. It retained only two layers of paint on its paper substrate.

Lighthouse

Sample 38	**Munsell**
White	5Y 9/1
Warm gray	5Y 8/2
Light yellow	5Y 8.5/4
Light green	2.5G 7/2
Green	2.5G 5/4

Sample 38 came from the first floor main stair of the lighthouse. It revealed five paint layers on its paper substrate.

Lighthouse

Sample 39	**Munsell**
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Tan	10YR 7/4
Tan	10YR 7/4
Tan	10YR 7/4

Sample 39 was removed from the wall of the first floor storage room of the lighthouse. Beneath the oldest tan layer was a translucent (roughly off-white – 5Y 8.5/1) layer which may have been a sizing or a glue probably used for wallpaper. The layers were quite thin and no substrate remained.

Lighthouse

Sample 40	**Munsell**
White	5Y 9/1
Tan	10YR 8/4
Tan	10YR 8/3
Tan	10YR 8/3
Tan	10YR 8/3
Gray	5Y 7/1
Light blue-green	5BG 8/2
Light blue-green	5BG 8/2
Rose	10R 6/4
Rose	10R 6/2

Light rose	10R 7/2
Light blue-green	5BG 8/1
Light blue-green	5BG 8/1
Light blue-green	5BG 8/1
Dark gray	5Y 4/1
Blue-green	5BG 5/4
Blue-green	5BG 5/4

Sample 40 was from the wall of the hall of the lighthouse. It was excellent in quality, revealing a large array of paint layers with blue-green being the oldest observed color on the plaster substrate.

Lighthouse

Sample 41	**Munsell**
Dark gray	N 4.0/
Gray	N 5.0/
Dark gray	N 4.0/
Gray	N 5.0/
Dark gray	N 4.0/
Dark gray	N 4.0/
Dark gray	N 4.0/
Whitewash	N 9.5/

Sample 41 was collected from the entry stair of the lighthouse. Beneath a set of dark gray and gray paint layers was a relatively thick set of ill-defined whitewash layers.

Lighthouse

Sample 42	**Munsell**
Red	5R 4/14
Cream	2.5Y 8.5/3
Cream	2.5Y 8.5/3
Cream	2.5Y 8.5/3
Cream	2.5Y 8.5/3

Sample 42 was collected from the wall of the entry of the lighthouse. Between a striking red surface layer of paint and the wood substrate were four layers of cream-colored paint.

Lighthouse

Sample 43	**Munsell**
Black	N 0.5/
White	5Y 9/1
Off-white	5Y 8.5/1

Sample 43 came from the window trim of the lighthouse tower. There were but three paint layers on the wood substrate of white the oldest off-white layer was extraordinarily thin and probably served as a prime coat for the white layer.

Lighthouse

Sample 44	**Munsell**

Brown	2.5YR 4/6
Gray	N 6.0/
Black	N 0.5/
Gray	N 6.0/
White	5Y 9/1
Gray	5Y 6/1
Dark gray	N 4.0/
Gray	5Y 5/1
Dark gray	N 4.5/
Gray	N 5.5/
Light gray	N 7.5/
Gray	N 5.5/
Dark gray	N 4.5/
Dark gray	N 4.5/
Gray	N 5.5/
Dark gray	N 4.5/
Black, glossy varnish	---------

Sample 44 was removed from the kitchen stair of the lighthouse. It proved to be particularly challenging, although it did reveal a large number of finish layers on its wood substrate. The oldest layer was a very glossy, very dark varnish.

Sample 45 was from the hall plaster of the lighthouse. It was warm gray in color and was very soft. It gave every evidence of having been composed of lime and sand with an approximate ratio of one part of lime to three parts of sand, by volume. The sand sieve analysis revealed very fine sand. 22 ½% passed all of the sieves whereas only 1% was trapped in the largest sieve. Moreover 46 ½% was trapped in the finest sieve.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 45
Building: Lighthouse, Outer Island, Apostle Islands NL
Location: Hall plaster
Sample Description: Warm gray, very soft, fast and fizzy reaction, extremely slow filtering time

Test No. 1 – Soluble Fraction

Data:

1. 187.5 Container A weight
2. 212.1 Container A and sample
3. 763.02 Barometric pressure
4. 23 Temperature
5. 0.25 Liters of water displaced
6. Off-white Filtrate color
7. Warm gray Fines color
8. No Hair or fiber ______ type
9. 3.4 Fines and paper weight
10. 3.0 Filter paper weight
11. 207.8 Sand and Container A weight
12. 12.2 cc. of sand
13. 49.1 Weight of graduated cylinder and sand
14. 28.8 Weight of graduated cylinder

Computations:

15.	24.6	Starting weight of sample: No. 2 – No. 1
16.	0.4	Weight of fines: No. 9 – No. 10
17.	20.3	Weight of sand: No. 11 – No. 1
18.	.60	Sand density: No. 12 divided by (No. 13 – No. 14)
19.	3.9	Weight of soluble content: No. 15 – (No. 16 + No. 17)
20.	0.0103	Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21.	1 03	Gram weight of CaCO3: 100 x No. 20
22.	2.87	Gram weight of Ca(OH)2: No. 19 – No. 21
23.	0.0387763	Mols. of Ca(OH)2: No. 22 divided by 74
24.	3.63	Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25.	0.45	Gram weight CO2: No. 20 x 44
26.	2.16	Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27.	20.83	%CO2 gain: No. 25 divided by No. 26

Conclusions:

28.	24.15	Gram weight of sample:	No. 15 – No. 25
29.	1.66	Fine parts/volume:	No. 16 divided by No. 28
30.	50.43	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31.	16.53	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	107.0	106.8	0.2	1.0
No. 20	107.2	106.4	0.8	4.0
No. 30	100.6	99.3	1.3	6.5
No. 40	104.7	100.8	3.9	19.5
No. 50	102.5	93.2	9.3	46.5
Base	75.7	71.2	4.5	22.5

Lighthouse

Sample 46	**Munsell**
Dark gray	N 4.5/
Gray	5Y 5/1
Dark gray	N 4.5/
Gray	5Y 5/1
Light gray	N 7.5/
Gray	N 5.0/
Gray	N 5.0/
Charcoal	5Y 3/1
Tan	7.5YR 7/2
Gray	N 6.5/
Gray	N 6.5/
Dark gray	5Y 4/1
Light gray	5Y 8/1

Dark gray	5Y 4/1
Dark green	5G 4/4
Whitewash	N 9.5/

Sample 46 resumed the paint analysis. The sample was from the basement stair wall of the lighthouse. It was excellent in its quality. Beneath a very large number of paint layers was a thick accumulation of whitewash layers of which at least six layers were visible.

Lighthouse

Sample 47	**Munsell**
White	N 9.5/
Whitewash	N 9.5/

Sample 47 was found on the basement wall of the lighthouse. Beneath a layer of white paint was a very thick set of whitewash layers which were virtually indistinguishable from each other.

Lighthouse

Sample 48	**Munsell**
Pastel blue-green	5G 9/1
Dark green	5G 3/4
Gray	5Y 7/1
Pastel peach	5YR 9/2
Pastel peach	5YR 9/2
Light peach	7.5YR 8/3
Pastel peach	5YR 9/2
Light peach	7.5YR 8/3
Off-white	5Y 8.5/1
Gray	5Y 5/1
Green	10GY 7.5/4
Pale green	2.5G 9/3

Sample 48 was collected from the wall of bedroom 3 of the second floor of the lighthouse. Its quality was excellent. The oldest pale green layer may have served as a prime coat for a finish coat of green.

Lighthouse

Sample 49	**Munsell**
Blue-green	5BG 5,5/2
White	N 9.5/
Tan	7.5YR 7/2
Light green	10G 7/2
Light green	10G 7/2
Light green	10G 7/2
Dark green	10G 3/4

Sample 49 came from the wall of the closet of bedroom 3 on the second floor of the lighthouse. It retained a relatively large number of paint layers considering its location with dark green being the oldest observed layer on its white plaster substrate.

Lighthouse

Sample 50	**Munsell**
White	5Y 9/1

Sample 50 was removed from the trim of bedroom 4 of the second floor of the lighthouse. It retained a single layer of dirty white paint on its wood substrate.

Lighthouse

Sample 51	**Munsell**
Light blue-green	5BG 8/1
White	N 9.5/
Tan	7.5YR 7/3
Tan	7.5YR 7/3
Tan	7.5YR 7/3
Light green	10G 7/2
Light green	10G 7/2
Gray	10YR 7/1
Gray	5Y 7/1
Dark gray	5Y 3/1
Dark green	10G 3/4

Sample 51 was from the wall of the closet of bedroom 4 of the second floor of the lighthouse. Like its counterpart, sample 49, it revealed a surprisingly large number of paint layers in light of its location. The oldest apparent finish layer was dark green.

Lighthouse

Sample 52	**Munsell**
Light green	7.5GY 7.5/2
White	N 9.5/
Warm gray	5Y 7/2
Warm gray	5Y 7/2
Warm gray	5Y 7/2
Warm gray	5Y 7/2
Tan	10YR 8/5
Tan	10YR 8/2
Tan	10YR 8/2
Tan	10YR 8/2
Tan	10YR 8/2
Tan	10YR 8/2
Tan	10YR 8/2
Tan	10YR 8/2
Blue-green	5BG 6/1
Blue-green	5BG 6/1
Light blue-green	5BG 8/1
Dark green	10G 3/4

Sample 52 was found on the wall between bedrooms 1 an 2 on the second floor of the lighthouse. The white and warm gray layers were quite thick and filled with microbubbles, which is typical of some early forms of latex paint. The oldest dark green layer was firmly adhered to its plaster substrate.

Lighthouse

Sample 53	**Munsell**
Pastel blue-green	5G 9/1

Sample 53 was collected from the wall of bedroom 1 of the second floor of the lighthouse. It revealed a single layer of pastel blue-green paint on its very brittle paper substrate.

Lighthouse

Sample 54	**Munsell**
Brown	5YR 6/4
Brown	5YR 6/4
Brown	5YR 6/4
Brown	5YR 6/4
Brown	5YR 6/4
Warm gray	5Y 7/2

Sample 54 came from the wall of the third floor stair of the lighthouse. It was challenging as the paint beneath the four brown layers appeared unevenly with only warm gray as the layer that could be exactly identified.

Lighthouse

Sample 55	**Munsell**
Brown	5YR 6/4
Brown	5YR 6/4
Brown	5YR 6/4
Brown	5YR 6/4
Brown	5YR 6/4
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Tan	10YR 8/3
Blue-green	5BG 6.5/1
Blue-green	5BG 6.5/1
Dark gray	5Y 4/1
Blue-green	5BG 6.5/1
Blue-green	5BG 6.5/1
Blue-green	5BG 6.5/1
Blue-green	5BG 5/1
Blue-green	5BG 6.5/1
Dark blue-green	5BG 4/1

Sample 55 was removed from the trim of the third floor of the lighthouse. It was excellent in its quality. Beneath the same five layers of brown paint seen in the previous sample was a large array of additional paint layers with dark blue-green as the oldest observed color.

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

1. There was a relatively high degree of consistency between the samples so that comparisons could easily be made between the samples.

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.

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

    d. Other coverings such as wallpaper may have preceded the paint and were removed prior to painting. Wallpaper was a popular covering, especially for damaged plaster.

3. There is no doubt that several of the buildings had various elements which were whitewashed as their probable original finish.

4. Many of the samples revealed lengthy sequences of layers so that positive conclusions can be reached for those samples and other samples can be evaluated in relation to them

5. When it is states “sample detached from substrate” (sample #15 for example) there is not necessarily an implication that can be directly drawn. It simply means that there was no substrate or indication of a substrate beneath the oldest layer. There may be any number of reasons for this, as follow:

    a. The substrate may have been hard and impervious such as metal or stone so that it was impossible to remove the substrate with the sample.

    b. There may have been a natural cleavage between the substrate and the oldest finish layer. This is typical found when linseed oil was used as a prime coat on wood or when calcimine paint remains on the surface of plaster.

    c. There may have been cleavage between layers so that only those layers above that cleavage survived the sampling process.

    It does mean that it is impossible to identify a prime coat so that one is left to speculate as to the relative age of the oldest layer. It also means that older finish layers may have been left behind in the sampling process.

6. 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.

7. 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

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

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