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Lighthouses as an overlapping boundary between maritime and terrestrial landscapes : how lighthouses served to connect the growing industries of the Keweenaw Peninsula with the world market

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LIGHTHOUSES AS AN OVERLAPPING BOUNDARY BETWEEN MARITIME AND TERRESTRIAL LANDSCAPES: HOW LIGHTHOUSES SERVED TO CONNECT THE GROWING INDUSTRIES OF THE KEWEENAW PENINSULA WITH THE WORLD MARKET

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This thesis, “Lighthouses as an Overlapping Boundary between Maritime and Terrestrial Landscapes: How Lighthouses Served to Connect the Growing Industries of the Keweenaw Peninsula with the World Market,” is hereby approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE IN INDUSTRIAL ARCHAEOLOGY.

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Table of Contents

List of Figures v

List of Tables vii

Acknowledgements viii

Abstract ix

Chapter I: Introduction 1

Literature Review 4

Research Objectives 15

Chapter II: Background 17

The Early History of Lighthouses 18

Lighthouse Board 18

Lighthouse Construction Practices 19

Lighthouse Contracts and Blueprints 21

Training for American Engineers 28

American Construction Materials 29

Illumination Devices 34

The Industrial History of the Keweenaw 36

Piloting between the Lighthouses 43

Case Study: Copper Harbor Lighthouse 44

Case Study: Manitou Island Lighthouse 49

Case Study: Eagle Harbor Lighthouse 53

Case Study: Ontonagon Lighthouse.....59

Case Study: Portage Lower Entry (Jacobsville) Lighthouse.....64

Case Study: Eagle River Lighthouse.....67

Chapter III: Results and Discussion.....71

Results.....71

Discussion.....86

Chapter IV: Suggestions for Further Work and Concluding Remarks.....92

Suggestions for Further Work.....92

Concluding Remarks.....94

Literature Cited.....97

Appendix A: Contracts.....102

Appendix B: Blank Photo and Survey Sheets.....120

Appendix C: Historic Register Nomination Forms.....122

List of Figures

Figure I.1: Map of the upper part of Michigan 2

Figure I.2: Map of the Keweenaw Peninsula 4

Figure I.3: Photograph of a contract photocopy page received from D.C 13

Figure I.4: Blueprint image from D.C 14

Figure II.1: Blueprint plan drawing for the initial Manitou Island Lighthouse structure 23

Figure II.2: Blueprint plan drawing for the initial Eagle Harbor Lighthouse structure 24

Figure II.3: Blueprint plan drawing for the initial Lower Portage Entry Lighthouse structure 25

Figure II.4: Blueprint plan of the Lower Portage Entry Lighthouse door 26

Figure II.5: Photograph of the third order Fresnel lens on display at the Eagle Harbor Lighthouse museum 35

Figure II.6: Photograph of the 1849 Keeper's Dwelling 47

Figure II.7: Picture of the second Copper Harbor lighthouse structure 48

Figure II.8: Photograph of the second Manitou Island lighthouse structure 52

Figure II.9: Advertisement for the selling of the Manitou Island lighthouse 53

Figure II.10: Photograph of the bay at Eagle Harbor 54

Figure II.11: Representation of the first Eagle Harbor lighthouse structure 56

Figure II.12: Photograph of the second Eagle Harbor lighthouse structure 57

Figure II.13: Photograph of the second Ontonagon lighthouse structure 62

Figure II.14: Picture of second Jacobsville lighthouse structure 66

Figure II.15: Photograph of the second Eagle River lighthouse structure 68

Figure II.16: Photograph of 1998 advertisement for the selling of the second Eagle River Lighthouse structure.....69

Figure III.1: Graph of years of lighthouse use.....73

Figure III.2: Photograph of the current Copper Harbor lighthouse structure with the steel tower out front.....77

Figure III.3: Photograph of the current Manitou Island Lighthouse structure.....79

Figure III.4: Photograph of the current Eagle Harbor lighthouse structure.....80

Figure III.5: Photograph of the wall thickness caused by poured concrete between two layers of brick.....81

Figure III.6: Photograph of the current Ontonagon lighthouse structure.....82

Figure III.7: Photograph of the current Portage Lower Entry Lighthouse.....83

Figure III.8: Photograph of the stamped "Detroit Locomotive Works" on the tower.....84

List of Tables

Table III.1: Chronology of lighthouse construction and use 72

Table III.2: Table summary of case study information.....76

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Abstract

Lighthouses are an important part of the industrial heritage of the Keweenaw Peninsula in Michigan. They functioned as an integrated system that facilitated shipping on Lake Superior and supported the growing industry of the Keweenaw Peninsula. For this reason, lighthouses can be considered as an overlapping boundary between the maritime and terrestrial landscapes. As shipping and industry changed, the lighthouse boundary also changed. Changes to the boundary are reflected in the contractors involved in the construction of lighthouses and the decisions they made with the resources, principally building materials and knowledge, which they had at their disposal. The decline of shipping on the Great Lakes due to the increased use of roads and railroads for commerce and transportation and the decline of industry on the Keweenaw due to the decreasing profitability of the mines are reflected in gradual end of lighthouses functioning as a network.

Chapter I: Introduction

Lighthouses were essential to the industrial and social development of many regions throughout the United States including the Keweenaw Peninsula located on the Upper Peninsula of Michigan as shown in Figure I.1. Lighthouses facilitated shipping networks that removed resources like copper and lumber out of the peninsula to market. Lighthouses aided those same ships in bringing supplies to the local population. Disciplines, like history, historical archaeology, and industrial archaeology may study lighthouses. However, these studies rarely place lighthouses and the process of lighthouse construction into the greater industrial context. This current study purposes to reintroduce lighthouses as an essential part of industrial studies by examining how lighthouses functioned as part of the maritime and terrestrial landscapes to support the growth of industry on the Keweenaw Peninsula. This study will also examine how the lighthouses were constructed by contractors.

Lighthouses are built on rocky coastal areas that are often isolated, stormy, and windy because these are the places where lighthouses are needed to guide ships around reefs and other obstructions in the water. These marginal locations along the shoreline form a boundary comprised of elements of both the terrestrial and maritime landscapes. Given the lack of roads and railroads on the Keweenaw for much of the history of the peninsula, this boundary was the primary means of connecting the local communities to

Figure I.1: Map of the Keweenaw Peninsula on the Upper Peninsula of Michigan. (Michigan Technological University Digital Archives # Book QE75A1pno144-plate2-001, Book QE75A1pno144-plate2-002, Book QE75A1pno144-plate2-003, permission for use from MTU archives)

the rest of the world. The supplies brought via ship ensured the survival of the early communities. Historically, this boundary has been modified by contractors with varying degrees of success. This study addresses the process by which contractors constructed lighthouses by answering a variety of questions including: where would the lighthouse be located, who built the lighthouse, how did materials get to the construction site, how was the structure be built to withstand the elements, and why could the same design not always be reused? All of these questions are part of a larger overarching question: How

did contractors use the resources at their disposal in order to build the lighthouses that guided ships on Lake Superior and aided the burgeoning industry and society of the Keweenaw Peninsula?

This study will answer this question by examining the knowledge and resources contractors used to construct lighthouses on the Keweenaw Peninsula. It will also examine how the lighthouses functioned in connecting the growing needs of industry and population on the Keweenaw with the outside world as a system of communication for shipping on the Great Lakes. In order to do this, the study necessarily discusses the function of lighthouses in terms of their place as an overlapping boundary between the terrestrial and maritime landscapes. The details for this research are derived from information from six lighthouse case studies located on the Keweenaw Peninsula of Michigan, all having initial construction dates circa the 1850s. By location from east to west along the Keweenaw coast, these include Copper Harbor (1849), Manitou Island (1850), Eagle Harbor (1851), Ontonagon (1852), Portage Lower Entry (Jacobsville) (1856), and Eagle River (1857) as shown in Figure I.2. Studying cases restricted to this initial period provides the control for examining the kinds of resources, including building materials and background knowledge, available to lighthouse contractors. This comparison also uses these case studies to provide more information about the relationship between the terrestrial and maritime landscapes.

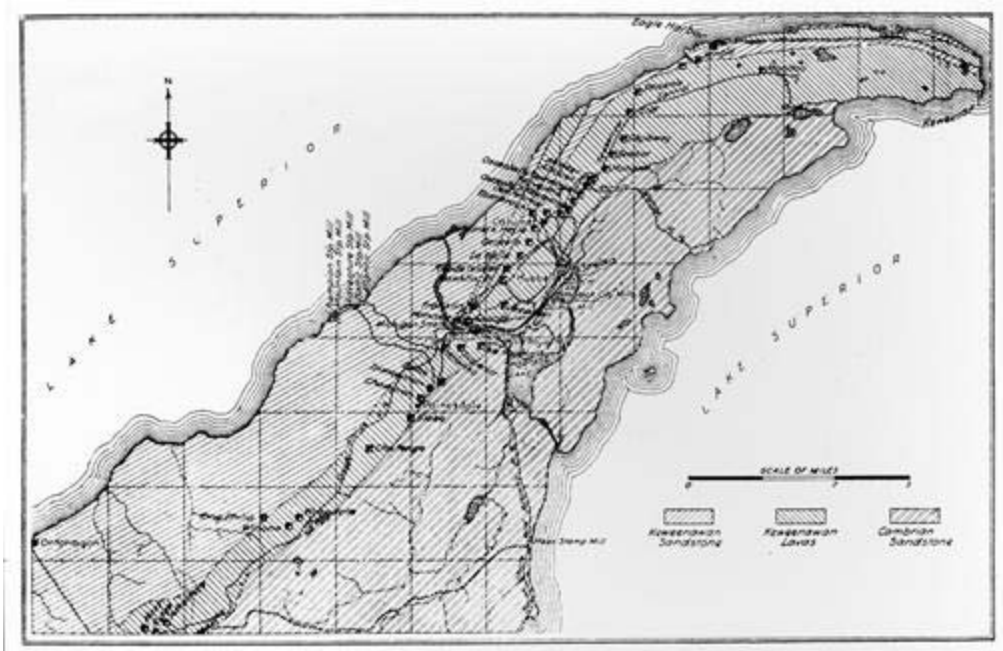

Photo Courtesy Michigan Tech Archives

MAP OF KEWEENAW POINT

Figure I.2: Map of the Keweenaw Peninsula. (Michigan Technological University Archives Image #Book LD3328H3-2-2)

Literature Review

Various kinds of works document lighthouse history. Many are specific to the history of one lighthouse while other works include general descriptions of many lighthouses. This study is unique in its consideration of lighthouses as a system which facilitated both the growth of industry on the Keweenaw Peninsula and shipping on Lake Superior.

One archaeological work which closely relates to this study is Barry C. James's *A History of the Copper Harbor Lighthouse* (1998). His study presents the life history of

the lighthouse from its local context to its condition in 1998 when the work was published. In James's study, the lighthouse is primarily treated as a setting for activities such as the life of a keeper, rather than a dynamic part of the landscape. This work clearly illustrates the approach of an in-depth study of one lighthouse, and it provides useful background information for Copper Harbor Lighthouse case study. The *Ontonagon Light Station Reader: Selections of History & Lore* (2004) by Lighthouse Restoration Committee of the Ontonagon County Historical Society provides background information, including local context and construction details, for the initial Ontonagon Lighthouse structure and the subsequent 1866 structure.

Erie Land Lighthouse: A Microcosm of Nineteenth-Century Great Lakes Maritime History (2007) by Thomas looks at lighthouses as functional components of the maritime landscape and examines archaeological evidence for the materials of construction and the building chronology for the Erie Land Lighthouse. The approach and the analyses included in these studies is relevant to this work in that they discuss lighthouse construction and lighthouses as part of the maritime landscape. They do not, however, consider lighthouses as part of the terrestrial landscape or industrial heritage.

Complimenting these site specific works are a number of volumes about lighthouses that include a wider variety of lighthouses. These include *American Lighthouses: A Pictorial History* (1996) by Jill Caravan and Terry Pepper's website (www.terrypepper.com) *Seeing the Light*. These studies consist of a photograph of the lighthouse, construction dates, location, and a brief description of the history and the physical appearance of the lighthouse. Often general works will include also information

about the lives of the lighthouse keepers, an introduction to lights, and a brief history of the Lighthouse Board (the entity that oversaw the building and maintenance of lighthouses in the United States from 1852 to 1910). The following works are useful examples of this approach: Noble and O'Brien's *Sentinels of the Rocks* (1979); Holden's *Above and Below: A History of Lighthouses and Shipwrecks of Isle Royale* (1985); and Holland's *America's Lighthouses: Their Illustrated History Since 1716* (1972). These sources provide basic historical background for American lighthouses, including some information for lighthouses in this study. For example, in the cases of Eagle River, Eagle Harbor, Lower Portage, and Manitou Island Lighthouses, information about construction dates, location, current condition and function are found within these more general texts.

Another work that closely relates to this study in its attempt to understand the process of building lighthouses is *The Lighthouse Stevensons* (1999). Although closely related to the current study in its emphasis on lighthouse construction, this work falls somewhat outside of the aforementioned categories of lighthouse scholarship. Focusing on the time period between 1790 and 1940, Bella Bathurst reveals the role eight members of the Stevenson family played in the development of lighthouses in Scotland. The Stevenson family not only built lighthouses, but they were also responsible for many innovations related to construction techniques and lighting methods. Bathurst traces the family's involvement in lighthouse construction through time and links the importance of lighthouses to shipping in Scotland. Although not specifically framed as a landscape study, she discusses how the Stevensons adapted lighthouse construction to rocky and isolated terrains. Bathurst also discusses how merchants sending cargo pressed for

lighthouses in the 1780's whereas sailors simply accepted the risks of shipping. The author's description of how building lighthouses progressed is somewhat similar to the current study which also examines what knowledge contractors brought with them to work in an unfamiliar space.

One work that contributed greatly to the theoretical framework used in this study is *The Maritime Cultural Landscape* (1992) by Christer Westerdahl. This work discusses the evolution of the term maritime landscape. In its broadest sense, maritime landscape includes underwater finds, economic activities (such as fishing and shipping), and related land monuments (Westerdahl 1992). This is the definition of the maritime landscape used in this study, and lighthouses are included under "related land monuments" in Westerdahl's framework. The concept of treating the maritime landscape as separate from the terrestrial landscape due to differences in human activities (ie fishing v. farming) is also examined in this work (Westerdahl 1992). In Westerdahl's work, the maritime and terrestrial landscapes are proven to be different. Like this work, the current study treats the maritime and terrestrial landscapes as separate landscapes with an overlapping boundary. In *The Maritime Archaeology and Maritime Cultural Landscapes of Queenscliffe: A Nineteenth Century Australian Coastal Community* (2006), Brad Gregory uses GIS (Geographic Information System) to show the relationship between two overlapping landscapes, the maritime and the terrestrial. His aim was to connect maritime culture to terrestrial archaeological sites by visually connecting them by plotting them on the same map.

Time and Landscape (2002) by Barbara Bender uses three case studies from the United Kingdom to illustrate the subjectivity of landscapes and how they are understood in terms of their prior knowledge. She also connects the chronological development of a landscape to the history of human activities on that landscape. Likewise, the current study examines how contractors built the lighthouse boundary during initial and subsequent interactions with the overlapping landscape based on their changing understanding of that landscape. In *Knowledge and Learning in the Archaeology of Colonization* (2003), Marcy Rockman describes the relationship between human behaviors and the environment as dialectic. She defines locational knowledge as knowledge about a space and its physical characteristics or resources, and she explains that human behaviors changed in response to new environments as well as new understandings about those environments. In other words, as humans learned more about their environment, their behaviors changed in dealing with that environment. This work contributes to the framework for this current study in that it offers a way to look at how lighthouse structures built by contractors changed with their increased understanding of the Keweenaw Peninsula.

There is a wide variety of works about lighthouses that have contributed background information. Other sources have informed the theoretical framework for this study. This study fits in to the rest of lighthouse scholarship by examining lighthouses as a network that functioned together to facilitate shipping on Lake Superior and to support growing industries on the Keweenaw Peninsula.

Theoretical Perspective. The theoretical approach used in this study provides a spatial and chronological framework in order to examine lighthouses as structures that served the needs of the Keweenaw Peninsula by connecting the terrestrial landscape of the peninsula with the maritime landscape of the Great Lakes. As part of this framework, this research considers how contractors have built both initial and subsequent structures based on their understanding and experience of these landscapes. As discussed earlier, works by authors such as Westerdahl (1992) and Thomas (2007) define the maritime landscape as underwater finds, economic activities (such as fishing and shipping), and related land monuments, and explain how lighthouses form an integral part of the maritime landscape due to their primary function as beacons to guide ships. However, the current study proposes that lighthouses should also be described as integral parts of the terrestrial landscape.

Although generally considered coastal rather than terrestrial, the lighthouses of the Keweenaw were constructed in response to the expansion of industry and the needs of the growing population throughout the peninsula. Therefore, it is necessary to view lighthouses as infrastructure created in response to the needs of both the maritime and the terrestrial landscapes. As a consequence, the relationship between the maritime and terrestrial landscapes can best be examined through their common element: the lighthouse. In other words from a spatial perspective, this study is grounded in the idea that maritime and terrestrial landscapes are spaces which must be studied in relation to each other (Gregory 2006). In this case, lighthouses are being considered as the boundary region where the two landscapes intersect. This is not a boundary that

separates two different landscapes, rather (as lighthouses are part of both landscapes) lighthouses illustrate a boundary where the two landscapes meet and overlap.

Important to this research is a consideration of how lighthouses were built with both the maritime and terrestrial landscapes in mind. Space is socially constructed; it does not exist outside of human perception (Bagwell 2006). Bender (2002) discusses how social actors create landscapes based on their prior knowledge, and the evolution of the landscape is a series of changes made by social actors. Although during the initial construction contractors were encountering new areas, they approached their task with knowledge of the importance of lighthouses to shipping and with recognition of the importance of shipping to the local population.

In many instances, it is likely that contractors created the lighthouse boundary with first-hand limited experience of the physical landscape in which they were working since none of the contractors discussed in this study were from the Keweenaw, but they did approach the area with some knowledge of the interplay between the maritime and terrestrial landscapes. Incomplete knowledge of other lighthouse landscapes and designs, limited access to resources, and financial constraints also may have influenced contractors. This state is the incomplete locational knowledge discussed in Rockman (2003). It is possible that it is because of these constraints that the initial six lighthouse structures built between 1849 and 1857 on the Keweenaw lasted only a few years before falling into ruin. As the industry of the Keweenaw was still expanding in the 1870's, contractors built a new generation of lighthouses in roughly the same locations as the original structures. Contractors constructed this second generation of lighthouses based

upon knowledge gleaned from the experience of earlier structures. This process again harkens to the article by Rockman (2003), as the behaviors of the contractors changed in response to their increasing knowledge. In this way, the evolving history of the lighthouse boundary can be traced through time. This theoretical approach provides the framework for considering the question of how lighthouses were built over time to serve the needs of shipping on Lake Superior and the needs of the developing industries and populations of the Keweenaw Peninsula.

Methods. In the current study, information about the physical structure of the extant case study lighthouses of the Keweenaw have been analyzed in order to gain an understanding of the process behind the creation of both the current and former structures. Archival research provided background historical information about period American lighthouse construction practices, building materials, lighthouse contracts and drawings, and the particular history of lighthouses and the Keweenaw Peninsula. Information was also gathered from lighthouse site visits and was recorded on survey forms. Approval was obtained from the Office of Research Integrity and Compliance, protocol #M0618, so that discussions with individuals during the site visits could be used in the study. Survey information was linked to the information from the construction contracts and industrial history of the Keweenaw during the time period of their initial construction events of the 1850s and where applicable reconstruction events in the 1870s. The cumulative result of this research is a more inclusive understanding of how contractors built lighthouses to

suit the needs of shipping on Lake Superior and the needs of the population of the Keweenaw Peninsula.

General background information concerning the lighthouses, their construction, and the Keweenaw Peninsula was obtained from the Michigan Technological University Archives, the National Archives in Washington, DC, local historical societies, and on-line resources. Communication with the Houghton County, Keweenaw, Ontonagon, and Sandusky Historical Societies, the United States Coast Guard, the Keweenaw Land Trust, the Great Lakes Lighthouse Keeper's Association, and the Maritime Archivist at the National Archives in Washington D.C provided general lighthouse information, including the contracts and building plans for the lighthouses of this study (Figures I.3 and I.4). The Maritime Archivist from the National Archives in Washington D.C. located contracts for the original Copper Harbor, Eagle Harbor, Ontonagon, and Manitou Island Lighthouse structures. Because they were originally handwritten, the photocopied contracts from the National Archives were then transcribed into a word document to make them easier to read. The copies of the original contracts were received at the end of October 2010, and were typed by January 2011. The typed contracts are reproduced in Appendix A. Underlined text or blanks indicate difficulty reading the handwriting. Page numbers refer to the original page number in the hand written text. Once it was realized that contracts for the second lighthouse structures would be important, a request was sent

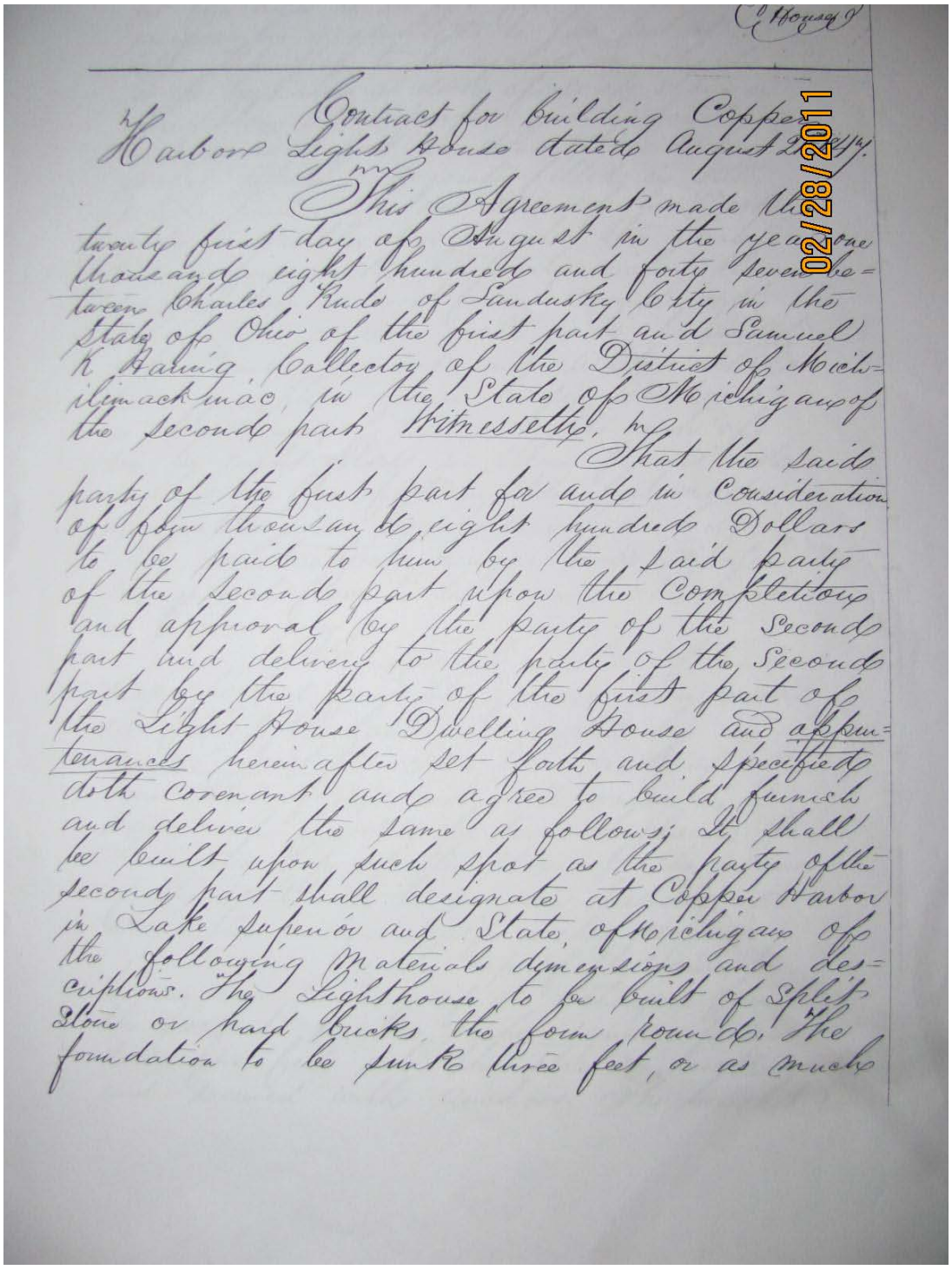

Figure I.3: Page one of the contract for the initial Copper Harbor Lighthouse structure, dated 1847. (The National Archives, Record Group 26, photo by Lisa Gillis, public domain-can be reused)

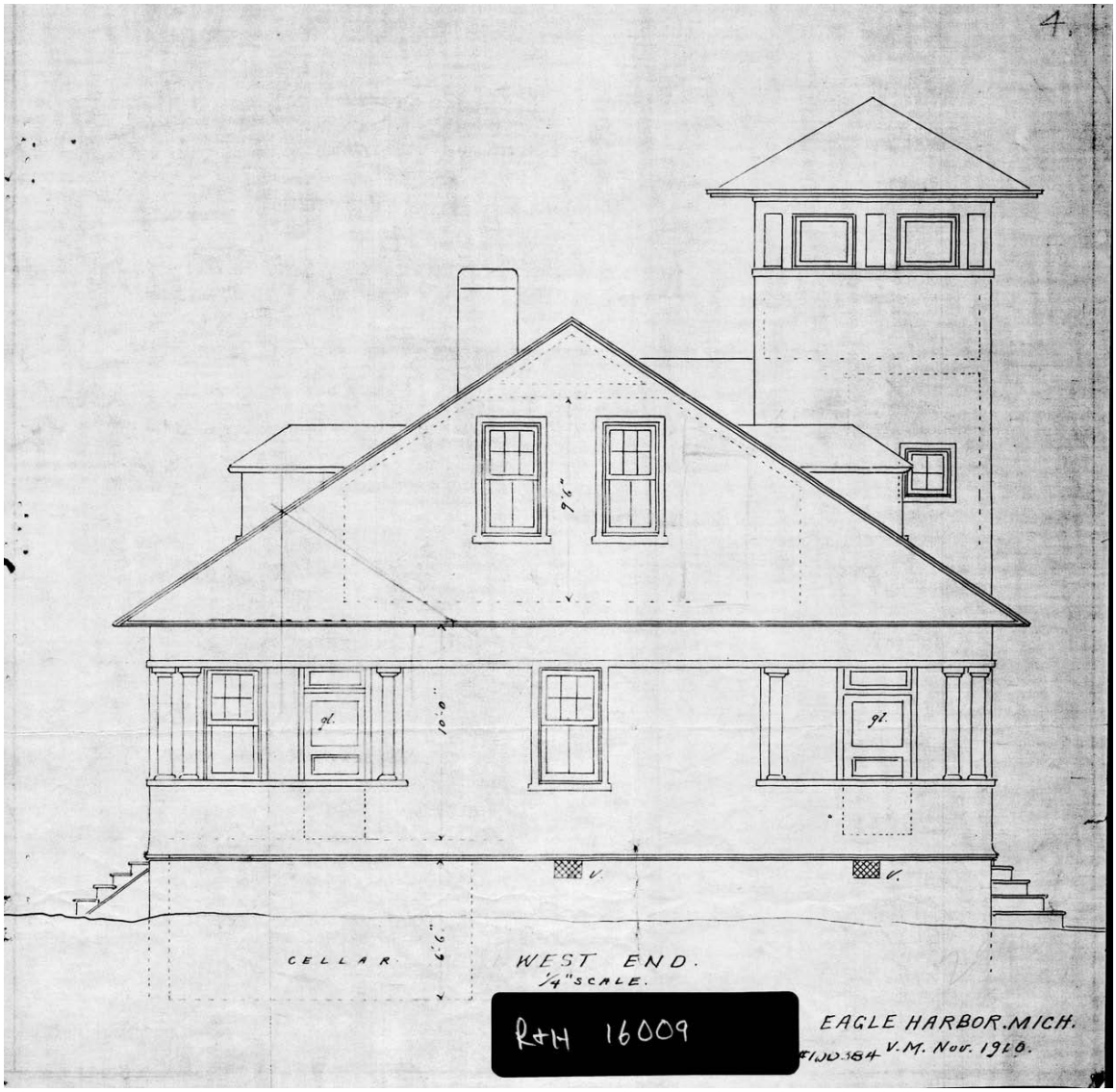

Figure I.4: Blueprint for the second Eagle Harbor Lighthouse structure, dated 1910. (National Archives, Record Group 26, public domain-can be reused)

to the archivist in Washington D.C. for those contracts, but they have not been received at the time of this writing.

Visits were made to each of the lighthouses excluding Manitou Island and Eagle River due to restricted access. Manitou Island is only accessible for a few months each year due to its isolated location, and the author was unable to accompany the preservation team on one of its trips to the island. However, the author and members of the Keweenaw Land Trust preservation efforts met to discuss this study and information that the members might have to contribute to the research. The members of the Keweenaw Land Trust provided photographs and condition reports about the Manitou Island Lighthouse structure. Because the Eagle River lighthouse is in use as a private dwelling, the lighthouse is currently inaccessible. A detailed comparison of a variety of archival sources instead framed much of the analysis of this lighthouse. For the lighthouses visited, information pertaining to the current building materials of the lighthouses and the information present at the site about the history of the lighthouse was collected on the survey forms, Section B-1 Appendix B. Also at this time, photographs were taken, and a photo form, Section B-2 of Appendix B, was filled out. Electronic versions of these forms were created for clarity and for future accessibility.

Research Objectives

This study views lighthouses as important parts of both the maritime and terrestrial landscapes and is concerned with how contractors perceived this dual function and constructed lighthouses accordingly. The primary goal of this study is to present and contextualize the full history and importance of lighthouse landscape of the Keweenaw Peninsula within the industrial heritage of the region. To fulfill this goal, this study

examines how contractors built a series of lighthouses in the 1850's within the context of the rising industries of the Keweenaw, principally mining, quarrying, and lumbering. The second research goal within this study is a consideration of the larger relationship between the maritime and the terrestrial landscapes. In order to do this, the six lighthouse case studies were treated as a common element located at the boundary of both of these landscapes. Traditionally, boundary is a term used to describe the end of one area and the beginning of another. In this study, boundary is treated as an area of overlap between two landscapes. Lighthouses are part of the maritime and terrestrial landscapes and form the overlapping boundary between the two. This perspective allows the function of lighthouses to bridge the gap between these two landscapes. The third goal involves an examination of the process by which contractors created this boundary space. This was accomplished by studying the types of knowledge and resources available to contractors during their initial and subsequent encounters with reserved land parcels for lighthouses and by studying how contractors made meaningful modifications to these spaces in the form of a lighthouse

Chapter II: Background

Lighthouses were essential to the industrial development of the United States. They were built in the original colonies to facilitate trade with Britain. After the War for Independence, the new United States continued to devote resources to lighthouse construction through various bureaucratic systems such as the Lighthouse Establishment (1789-1910) and Lighthouse Board (1852-1910). Lighthouse construction has remained contract work throughout the history of the United States. The materials available to the contractors have varied over time with both the invention of new materials and an increase in the transportation infrastructure of the country. Illumination devices have also evolved through time.

A regional example of these points is the early history of lighthouses on the Keweenaw Peninsula. In the early 1800s, lighthouses aided the arrival of prospectors and supplies into the Keweenaw. Without local farms, early prospectors were completely dependent on supplies brought in by ship. By the middle of the 1800s, lighthouses began to bring more workers for the new industries and to facilitate shipping networks that removed resources such as copper and lumber out of the peninsula to market. As regional industries developed, the workers and their families formed towns throughout the peninsula. As farming on the Keweenaw in many areas is difficult at best due to the soil, these populations relied on the shipping industry to bring supplies for the harsh winters in the region. Everything that could not be grown locally had to be brought in via ship. Without lighthouses to guide them, ships entering the harbors along the peninsula

risked destruction on the rocks of the shallow bays. The six case studies discussed below illustrate these points.

The Early History of Lighthouses in America

In the late 18th century, the King of England, King George III, ordered lighthouses built along the coastline at major ports in the colonies to guide the ships that brought finished goods and colonists into the colonies and raw materials back out. The vast majority of these were neglected and/or destroyed during the War for Independence. Functioning lighthouses helped the British troop ships land but were unnecessary for American troops. However, their importance was not forgotten by the new Continental Congress. At this point, all of the major countries, including France and Britain, which had coastline had lighthouses to facilitate commerce. The Continental Congress (1776) recognized the importance of lighthouses to commerce between the newly formed United States and the rest of the world. Given the industrial history of the United States, it is not surprising then that all but two of the earliest lighthouses ordered by the Continental Congress were located in the northeastern United States close to the rapidly developing textile industry (Hubbell 1988).

Lighthouse Board

The American government created the Lighthouse Establishment on the seventh of August 1789, and it operated until 1910. The head of the Lighthouse Establishment was the Fifth Auditor of Treasury who received his authority from the Secretary of the

Treasury (Weiss 1926). At this time, customs officials were generally used to inspect lighthouses once they were built, and contractors inspected the lighthouse annually for repairs since lighthouse superintendent was not a separate position (Weiss 1926). Only six new lighthouses were built under the Lighthouse Establishment, and contractors had free range in the implementation of designs and in inspections (Weiss 1926). Congress began to question the expenditures of the Lighthouse Establishment that they deemed exorbitant for the few lighthouses built and maintained.

Congress also suspected that the head of the Lighthouse Establishment, the Fifth Auditor, Stephan Pleasanton had an agreement with Winslow Lewis to only use his lamps in lighthouses despite their proven poor performance compared to the Fresnel lens. In fact, the Establishment purchased the patent. The Lighthouse Board was created to investigate this matter. From 1852-1910, the Lighthouse Board, presided over by the Secretary of the Treasury, oversaw the operations of the Lighthouse Establishment. After 1910, the Bureau of Lighthouses took over all lighthouse construction and operation of lighthouses. The current name for the organization under the U.S. Coast Guard is the Lighthouse Service (Strobridge 1974). All of these subsequent changes were simply part of government restructuring.

Lighthouse Construction Practices

Although the organizational names changed, contracts between the government and those contracted to build lighthouses remained essentially the same through the years. Designs, supplies, and building materials were requisitioned and supplied by

contract, and were created without regard for the actual location of the lighthouse structure (Strobridge 1974). In the nineteenth century, the Lighthouse Board advertised projects for bid through local newspapers, and after selecting a winning bid, a non-transferable contract was written although subcontracting was fairly common. Changes during the project in design, materials, or supplies required creation of a new contract by the Lighthouse Board. The Lighthouse Board did not advance money for any project and did not pay the contractor before the District Superintendent or another appointed official had inspected the work. Officially, the Engineer Secretary of the Lighthouse Board was responsible for all lighthouse designs (Strobridge 1974).

The Corps of Topographical Engineers and the Inspector for the Lighthouse District, also known as the District Superintendent, oversaw the implementation of these designs (Strobridge 1974; Weiss 1926). The inspector checked the work after the contractor was finished and checked the lighthouses at least once a year to determine if repairs were needed. Each district includes an engineer, an inspector, and a superintendent (Ontonagon County Historical Society 2004). In 1838 for the first time, the Atlantic and Lake Coast were divided into eight different districts and a naval officer was placed in charge of each district. About this same time, the first engineer was hired to survey the coast to create an actual plan for where to build lighthouses (Weiss 1926). As discussed below, most of the engineers were trained at West Point. Similar designs were often used for multiple lighthouses, especially those built during the same time period, regardless of their location on the coast (Strobridge 1974).

Lighthouse Contracts and Blueprints

The National Archives sent contracts for the initial Copper Harbor, Manitou Island, Eagle Harbor, and Ontonagon Lighthouse structures. Blueprints for the second structure and modifications were also obtained for the Manitou Island, Eagle Harbor, and Portage Lower Entry Lighthouse structures. The blueprints for the rebuilt Portage Lower Entry, Manitou Island, and Eagle Harbor Lighthouse structures were very different from each other, but mostly the same as the actual structures visited, see Figures II.1, II.2, and II.3. The Eagle Harbor blueprint shows a hexagonal tower, but in actuality, the tower is round. The blueprints contain detailed illustrations of walls, doors, stairs, and all other house features including measurements. The rooms on the blueprints are labeled according to their intended purpose as a living room, dining room, etc.

The contract for the initial Copper Harbor Lighthouse structure was drawn up in 1847 between contractor Charles Rude of Sandusky, Ohio and Samuel K. Haring, the Collector of Customs for Michilimackinac. The materials specified were split stone or hard brick with lime mortar for the tower and keeper's house with a three foot foundation. The tower specifications were for a 65 foot high structure with a 25 ft diameter and 5 ft thick wall at the base and 12ft diameter and 2 ft thick wall at the top. The top deck is supposed to be of stone 14.5 ft diameter and 5 inches thick. The scuttle door with an iron frame and copper covering were 24 by 20 inches. The outside wall is coated with Roman cement and then whitewashed twice. The tower was to have six windows with twelve lights. The staircase of yellow pine went to six feet below the lantern and then an iron ladder with 2.5 inch steps to the scuttle. There is a ventilator on

the black dome of the tower with a 3 ft by 20 inch copper vane on the top. The copper electrical line need to be ¾ inches thick and extend 4 feet over the vane and 4 feet deep into the ground. The dwelling requirements were 30x20 feet with an 8 foot high first story and with a cellar of equal width and length to that of the rest of the house. There were supposed to be three windows in each room and four paneled doors. The attached kitchen was supposed to be 14 x 12 ft and 8 ft high with a chimney and an oven. The privy specifications were a stone or brick structure 5 by 4 feet. The well was also supposed to be either stone or brick with a pump or a bucket. All wood should have two coats of paint with plastered interior walls and ceiling. The reflectors should contain six ounces of silver. The keeper should have two spare lamps, an oil canister, a 500 gallon oil container, hand lantern, two pairs of scissors, and two tube cleaners.

The contract for the initial Manitou Island Lighthouse structure written in 1849 was between George Witheril of Cleveland, Ohio and Samuel K. Haring, the Collector of Customs at Michilimackinac. It is almost exactly the same as the contract for the initial Copper Harbor Lighthouse structure. The exceptions are the specifications about the copper conducting wire which is supposed to be 3 ft over the vane and 4 ft into the ground and the keeper's house is supposed to be 34 ft by 20 ft.

The initial Eagle Harbor Lighthouse structure contract is almost the same as those for the Copper Harbor and Manitou Island Lighthouse structure. In fact the contractor is the same, but in 1850 when the contract was written, the Collector of Customs was

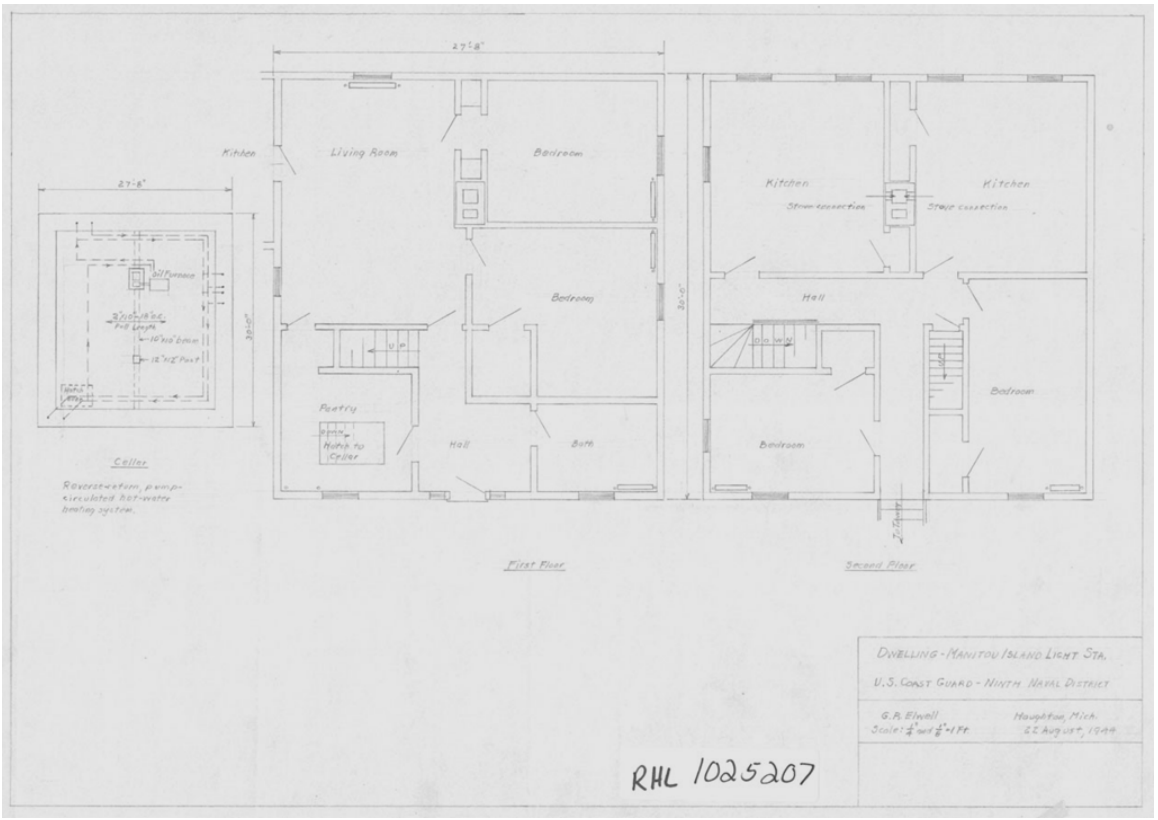

Figure II.1: Blueprint plan drawing for the initial Manitou Island Lighthouse structure. (National Archives, Record Group 26, public domain-can be reused)

Charles E. Avery. Differences include the specifications about the tower which is supposed to be 13 feet above the second floor, the walls were to be 20 inches thick, the attic was to be divided into two chambers, and the floors were to be double flooring.

The contract for the initial Ontonagon Lighthouse structure was the most different of the four but like the contract for Eagle Harbor, was written in 1850. It was drawn up between William Chittenden of Detroit, Michigan and again Charles E. Avery. Unlike the other contracts, this contract started with the keeper's dwelling first and then

Figure II.2: Blueprint plan drawing for the initial Eagle Harbor lighthouse structure. (National Archives, Record Group 26, public domain-can be reused)

went on to describe the specifications for the tower. Throughout the contract it reiterated brick as the building material of choice, and the contract called for hydraulic cement mortar rather than lime mortar. This contract specified different materials such as double floors of "Southern pine" for the keeper's dwelling and glazed French Paris plate glass windows not more than 3/16 inches thick for the tower. The height of the rooms was 9.25 feet, rather than 8 feet. Everything was to have three coats of paint, and floors and stairs were to be treated with linseed oil. Unlike the other lighthouses, the tower was only required to be equipped with six Lewis lamps.

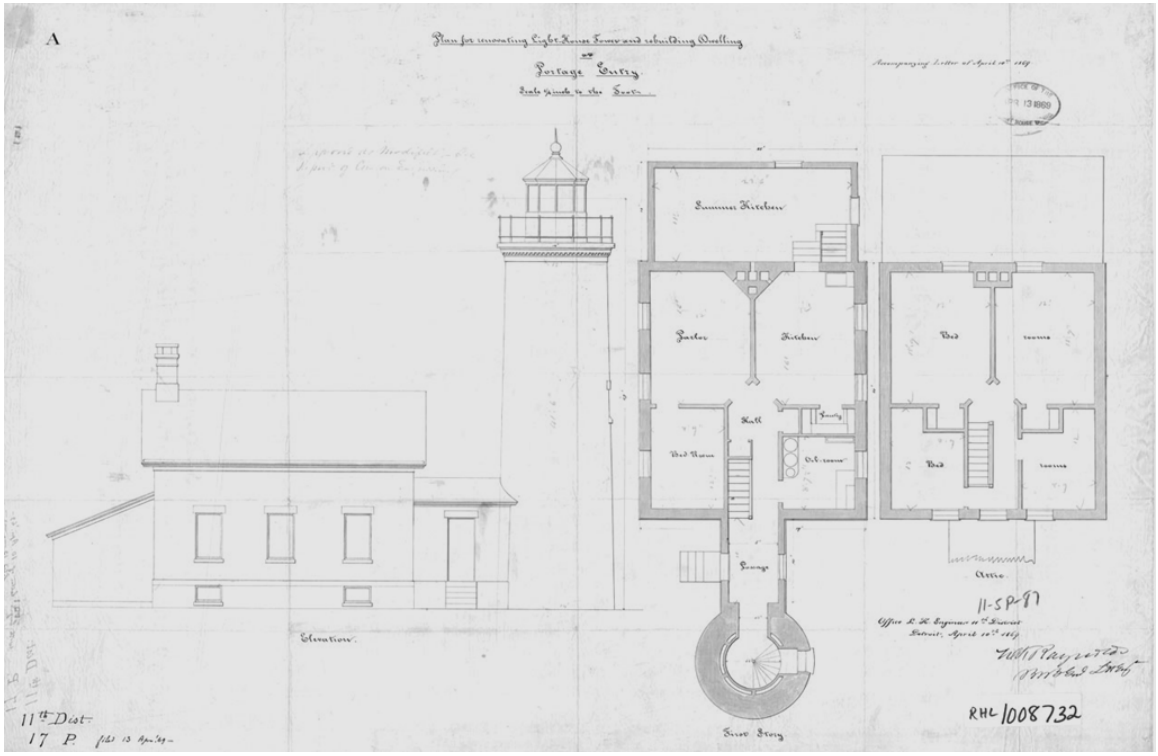

Figure II.3: Blueprint plan for the initial Lower Portage Entry Lighthouse structure. (National Archives, Record Group 26, public domain-can be reused)

Comparing the contracts to the blueprints, it appears that the early contracts detailed verbally for the first generation of lighthouses the same information illustrated in the blueprints for the second generation of lighthouses as shown in Figure II.1, II.2, and II.3. This information includes measurements, room names, detail work for doors, and supporting structures. For example, the contract for the Copper Harbor Lighthouse structure specifies that doors must be four-paneled while the blueprints for the Portage Lower Entry second lighthouse includes a design for the door, see Figure II. 4.

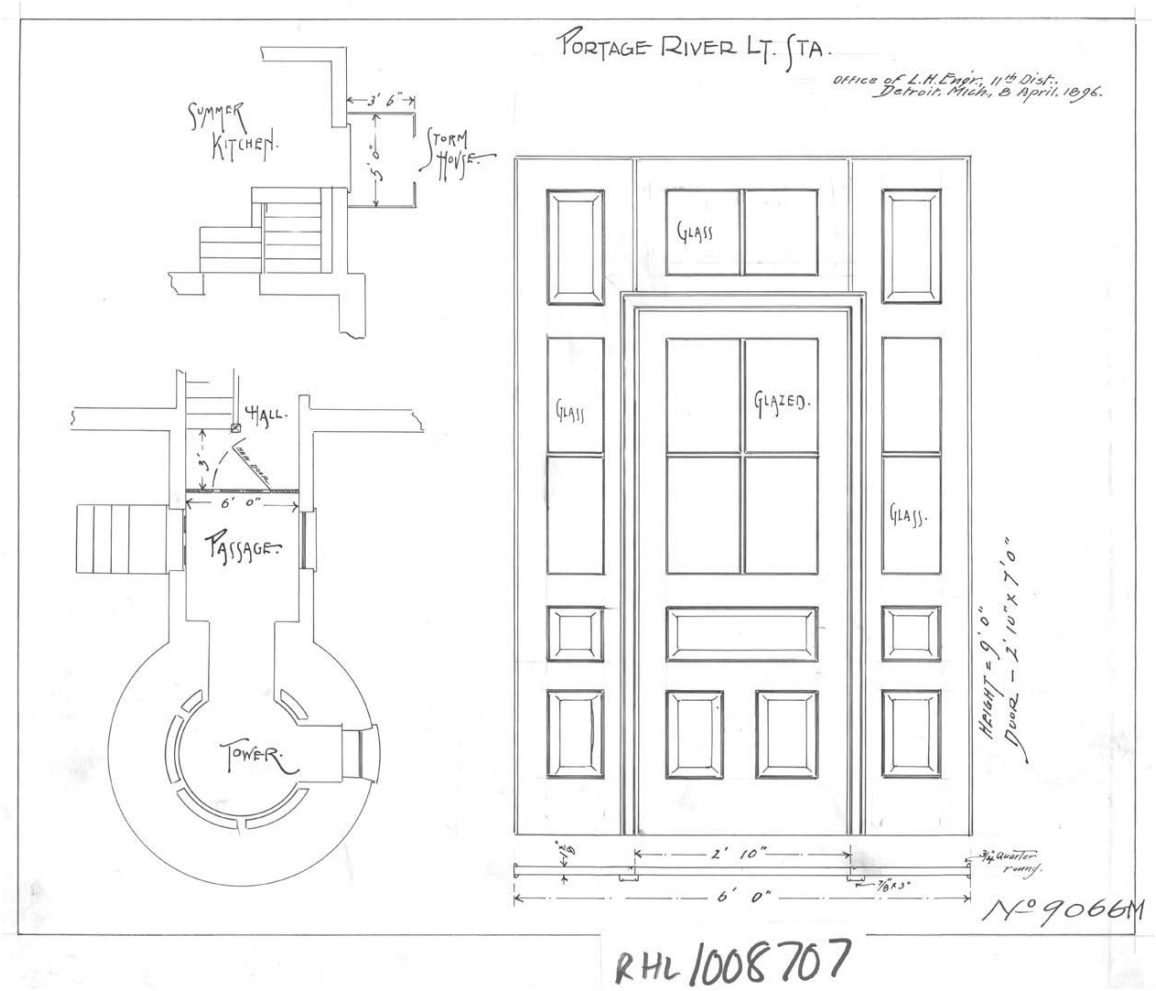

Figure II.4: Blueprint of the Lower Portage Entry Lighthouse door. (National Archives, Record Group 26, public domain-can be reused)

Several components of the contracts for the initial lighthouse structures were the same which indicates that these components were essential for building a lighthouse. Each contract had two main sub topics, the tower and the keeper's dwelling. The tower consisted of a base, the tower walls, a staircase/ladder on the interior, a deck for the lamps, the lamps themselves, windows, and a copper vane and grounding wire. These components are most integral to the function of the tower. The base is necessary for the tower to remain upright, and the actual tower is necessary to shelter the lamps from the elements. The staircase or ladder allows the keeper to make sure that the lamp is still lit and to bring up fuel and wicks for the lamp. The windows as well as the number of lamps affect the range of visibility of the lighthouse. The grounding wire is necessary for a tall structure exposed to stormy weather. The blueprints include the size and shape of the tower but do not include these more particular components which were likely determined during the bidding and contract writing processes.

Both the contracts and the blueprints describe the keeper's dwelling in great detail. All of them include a kitchen, bedrooms, closets, windows, stairs, a hallway, fireplaces, stoves, floors, doors, and a cellar. These are the basic components of a structure designed to be lived in. The contracts also specified the construction of ancillary structures, in particular a privy and well or cistern, on the property. These buildings are absent from the general blueprints, but the list of blueprints sent from the Maritime Archivist at the National Archives in Washington D.C. indicates that these structures were drawn up separately from the main keeper's dwelling and the tower. The

contracts have the added benefit of describing the kinds of building materials to perferred for lighthouses. These materials include hard brick or stone for the tower, the keeper's dwelling, and the ancillary structures, treated pine wood for floors, and glass for windows.

Training for American Engineers

In America, the field of engineering changed over the years from a learn-as-you-go job to a school-taught discipline. Prior to 1870, the vast majority of engineers were not called engineers. They were often employed in other jobs and simply did some engineering on the side. Generally, the vast majority of trained engineers obtained their education from the United States Military Academy at West Point which was established in 1802. However, it was also not until 1879 that West Point graduates started being assigned to schools other than West Point specifically to teach engineering to civilians. The program at West Point was started because during the War for Independence George Washington found that there were not any trained American engineers. Before the war, Britain had sent over its own engineers for select projects (Grayson 1993).

Schools for engineers were slow to spread for a few different reasons. Most of the few schools started before the 1830's were shut down when the economic depression slowed construction projects. Also a standard curriculum for engineering was not created until after World War II. Related to the lack of standardization, individual enterprise was valued to such a high degree that even in 1900 many professional engineering

organizations (mostly established post 1880) only considered a college degree, regardless of the school, the equivalent of about one year of real-world experience (Grayson 1993).

Under the Lighthouse Establishment and Lighthouse Board, trained military engineers drew the lighthouse designs. However, there did not appear to be any engineering experience or training requirements for individuals participating in the bidding process for lighthouse contracts. Lighthouse contractors were not necessarily engineers, and the level of experience and knowledge possessed by lighthouse contractors could have varied considerably.

American Construction Materials

In order to most effectively use building materials, an engineer needed to understand the specific characteristics that determined the limitations of and possible uses of each material. The potential success of a structure built out of particular materials depended on the size and design of the structure and the natural conditions in which it was located. Lighthouses were generally located in remote and often harsh environments. For lighthouse structures, an engineer's knowledge of how water affected each building material would have determined the longevity of his final product. This is particularly true for the lighthouses of the Keweenaw Peninsula where freeze-thaw cycles are a significant weathering process. In the Keweenaw Peninsula, most materials used in the construction of the initial lighthouse structures were found locally because the transportation of materials would have been costly. Much of the second generation of lighthouses was built with brick materials shipped in on the Great Lakes. This was

necessary because the absence of clay on the peninsula made the local manufacture of brick non-existent.

Types of Materials. The major types of building materials included wood, stone, concrete, brick, and metal. Certain materials such as large quantities of steel were not widely available until after the 19th century, and so were impractical to use for early lighthouse construction. Other materials such as wood and stone were used throughout the history of lighthouse construction due to their local availability at most lighthouse sites (Nelson n.d.). Lighthouses built on the rocky mainland differed in construction from those built on the water or in sandy areas. Cribs kept lighthouses built in the water or sandy areas from sinking into the ground by acting as a foundation that kept the lighthouse above the water table. Steel and concrete were often employed to construct these cribs in later years. On solid ground, contractors used many different kinds of materials for lighthouses.

Wood. Many of the earliest lighthouses in the United States were built out of wood and a combination of local or nearby stone (Wermiel 2006). These materials were often convenient and found in large enough quantities for major construction projects. Wooden structures could be rebuilt on the original stone foundation, which saved time and money with regards to the cost of construction. This was particularly important because maritime officials reported to Congress that many of the original lighthouse structures were not the correct height originally. Wooden towers could be rebuilt taller for less expense than brick towers.

Even after other materials became easier to access, most of the interior of lighthouses were still built out of wood. To use wooden materials most efficiently, a contractor would have needed to know the varieties of wood and the methods for using them (Gay and Parker 1943). Whether hard or soft wood, the center of the timber called the heart was the most durable portion of the wood; however, the soft outer wood without its bark could be used with careful preparation (Byrne 1907). Even with paints and sealants, however, wetting and drying affects the expansion and contraction of wood more than any other material (Ransom 1981). Even though moist wood may not decay, it still softens, and episodes of wetting and drying can easily weaken wooden structures (Byrne 1907). Unfortunately, wooden lighthouses usually deteriorated quickly due to the stormy climate of the coastal regions.

Stone. Stone components of lighthouses usually outlasted wooden ones where both materials were used, but the lighthouse often had to be rebuilt anyway once the wooden parts failed. The type of stone determined its durability. As long as the stone is arranged with pressure along the beds, laminated stones are more stress-resistant than non-laminated (Byrne 1907). Additionally, sandstones and limestones absorb more water than granites and marbles, making them less desirable to use in structures; however, many contractors used sandstone and limestone because they are abundant locally (Byrne 1907; Gay and Parker 1943). The Keweenaw Peninsula has an abundance of Jacobsville sandstone which was particularly useful for foundations due to its high compression rate.

Brick. In areas with an abundance of clay, people made bricks by hand or in brickyards by machine. Due to its durability, contractors with reasonable access to these

materials often used bricks in lighthouse construction for all or part of the structure. All brick towers are designed with wide bases that taper towards the top of the tower due to the weight of the bricks (Hubbell 1988). The nature of brick material also posed problems for contractors because the quality of the bricks depended upon the clay and careful attention to the molding and firing of the brick (Byrne 1907). Even properly formed brick often absorbed water and expanded which could weaken the mortar between the bricks and therefore the structure, although the bricks would remain intact and were often reused (Ransom 1981).

Fortunately for contractors working in cold climates, bricks could withstand frost without too much weakening depending upon the finer particles within the clay (Ransom 1981). Mortar between the bricks was comprised of hydrated lime, sand, and water. When mortar between the bricks started to crumble, a new batch of mortar could be made and used to infill the gaps left as the old mortar fell out. Brick lighthouses were very rigid and heavy. This made their use in certain marshy environments impossible without the appropriate foundation. Usually, this foundation was made of stone because common brick is not suitable for underground structures due to the fact that it easily retains moisture causing the bricks to weaken (Gay and Parker 1943). Similarly, contractors also had to account for the fact that interior and exterior brick walls had to have space between them because a solid brick wall absorbs more moisture which also weakens the bricks (Gay and Parker 1943). In lighthouses, ignoring this property of bricks would have been detrimental to the structure due to the constantly wet environment.

Most bricks used for lighthouses were generally of the common red brick variety. To increase visibility, keepers were required to paint the brick lighthouses with whitewash (1847 Copper Harbor Lighthouse Contract, National Archives, Record Group 26). Whitewash is composed of slaked lime and chalk. It often traps moisture against the bricks. This again weakens the bricks and causes the surface of the bricks to slough off hastening lighthouse deterioration (Gay and Parker 1943).

Concrete. Concrete became increasingly important to lighthouse construction in the late 1800's for cribs, for some foundations, and for the general support of the overall lighthouse structure (Gay and Parker 1943). Concrete stabilized lighthouses in sandy or swampy areas. The natural composition of concrete, which is made from cement and water, means that it can withstand great amounts of compression (Gay and Parker 1943). In the open waters or on sandy or swampy shoreline, concrete provided the foundation for the lighthouse and bore most its weight. This material withstood the waves and was often used in conjunction with other building materials such as steel to increase the durability of structures in particularly harsh environments.

Like many other materials, concrete naturally expands and contracts, and contractors had to account for this when using concrete with other materials. Often they chose to completely cover the concrete with another, water tight material, or they used another material to reinforce the concrete during the expansion and contraction (Ransom 1981). Steel could serve in both cases. Conversely, concrete mortar, like bricks, withstood frost much better than lime mortar (Gay and Parker 1943). A contractor also had to consider that concrete is the only building material which is originally liquid

during the construction process, and as a result, concrete is the only material that would have required an external structure to hold it in place until it dried (Gay and Parker 1943).

Metals. As observed from lighthouse visits, cast iron seems to be used in the construction of stairwells in lighthouse towers. Eventually, lighthouse towers were built out of cast iron, the pieces were labeled, and then the tower was shipped to the actual lighthouse site and reassembled. Later contractors used steel alone to create lighthouse cribs where water could pass through the crib, or they used steel to reinforce concrete (Ransom 1981). The former method reduced the impact of the waves on the crib, while the latter design withstood the impact. The steel reinforced the concrete, and the concrete coated the bars of mild steel so that they did not rust (Ransom 1981). After the turn of the century, steel was used to construct the entire tower because steel alloys, as a primary component of the structure, allowed for the creation of taller lighthouses than previously constructed due to their great tensile strength and lightness (Byrne 1907; Gay and Parker 1943; Ransom 1981). The only metal specifically mentioned in the lighthouse contracts included in this study is copper. Copper appears to be used only for vanes and for grounding wires at the top of the lighthouse structures (1847 Copper Harbor Lighthouse Contract, National Archives, Record Group 26).

Illumination Devices

After 1812 when the Lighthouse Establishment bought the patent, all lighthouses in the United States were outfitted with Winslow Lewis lamps which continued to be used into the 1850s as the exclusive means of illumination in lighthouses despite the

widespread use of the superior Fresnel lens in Europe after 1820. Lewis lamps were simple Argand lamps with a parabolic reflector and an extra lens (Weiss 1926). Invented in 1782, the Argand lamp was an oil lamp with a tubular wick and a glass chimney (Elton 2009). The Lewis lamps were thousands of times weaker than the Fresnel and quickly

Figure II.5: Photograph of the third order Fresnel lens on display at the Eagle Harbor Lighthouse museum. (Lisa Gillis, October 11, 2009)

dirtied the glass of the lighthouse towers as the oil fuel burned. Arguably, the reason for the continued use of this method relates to the fact that the head of the Lighthouse Establishment Stephen Pleasanton and Winslow Lewis were close friends (Weiss 1926). Whispers of this corruption were part of the impetus for the establishment of the Lighthouse Board to oversee and to report on the Lighthouse Establishment.

The Fresnel lens design was submitted for use in lighthouses in France in 1819 (Elton 2009). The Fresnel lens differed from the Argand and Lewis lamps in that it had refracting lenses in eight panels arranged in a concentric ring, see Figure II.5 (Elton 2009). Fresnel lenses come in six different orders that vary in physical lamp size. The first order is the largest, and the sixth order is the smallest. The order of the lens also directly relates to its function. The first order is used for seacoast lighthouses, and the second order is really for secondary points along the coast or bays. The third order is also used for coastal areas, but is generally reserved for lakes. The fourth, fifth, and sixth order lenses mark ports, bays, and obstructions in the water (James 1999).

The Industrial History of the Keweenaw Peninsula

The copper mining industry of the Keweenaw spread from the tip of the peninsula in the north to the south of the peninsula in particular Houghton County. In general, the initial construction of lighthouses on the coastline follows this same trend because the lighthouses were deliberately built to facilitate the growth of industry in these areas.

In 1841, geologist Douglass Houghton submitted a report to the state of Michigan indicating that there was native copper on the Keweenaw, but was uncertain about the profitability of mining it because mining native copper had never before been successful (Lankton 1999). In 1843, a land office was placed at Copper Harbor by the Department of War to lease and soon after to sell mineral lands to mining companies (Lankton 1999). By this time, the need for bringing supplies to the early prospectors searching for copper created the need for the Copper Harbor Lighthouse (1849), so a contract was drawn up in 1847 (1847 Copper Harbor Lighthouse Contract, National Archives, Record Group 26). Prior to the development of roads and railways in the area that occurred in the late nineteenth century, land travel on the Keweenaw was incredibly difficult because most early roads were little better than trails and often hard for wagons to use. Water transportation across the Great Lakes was the best way to get supplies and people into the Keweenaw and copper out to the rest of the country. Additionally, the islands at the tip of the Keweenaw Peninsula outside Copper Harbor were shipwreck hazards. With the anticipated opening of the Soo Locks in 1855 and the growth of industry on the tip of the peninsula, the Lighthouse Establishment recognized the need for a lighthouse on Manitou Island, the island closest to the tip of the Keweenaw. As a result, the contract was written for the Manitou Island Lighthouse just two years after the one written for Copper Harbor (1849 Manitou Island Lighthouse Contract, National Archives, Record Group 26).

In the 1850s with the expansion of the copper industry, more people moved to the Keweenaw and towns such as those at Eagle Harbor and Eagle River were established (Lankton 1999). The Eagle Harbor Mining Company brought the first settlers to Eagle

Harbor in 1845, and from then on, the town grew rapidly (Monette 1977). As a result, the Lighthouse Board drew up a contract for a lighthouse at Eagle Harbor in 1850 (1850 Eagle Harbor Lighthouse Contract, National Archives, Record Group 26). Eagle River grew as the nearby Cliff Mine began to operate in 1849. Money was set aside for a lighthouse at Eagle River in 1850, but the lighthouse was not finishing until seven years later (one year after the Manitou Island Lighthouse tower was rebuilt) (Pepper 2006; Pepper 2008). This was due to the government having difficulties purchasing land for the lighthouse in Eagle River and also was due to the lax workmanship of the contractor and construction crew.

Like the early prospectors in Copper Harbor, these early settlers arrived via ship and required supplies, and the increasing production of mines of the peninsula necessitated a way to ship out large quantities of copper. During the winter, piles of copper sat on docks in the harbor waiting for spring and the first ships on Lake Superior to arrive. Since there were no smelters until 1887, all copper mined in the Keweenaw was sent to Detroit, Michigan, Cleveland, Ohio, or Pittsburgh, Pennsylvania for smelting (Hyde 1978). For these reasons, lighthouses in towns such as Eagle Harbor and Eagle River made copper mining both possible and profitable.

During the 1860s, the copper industry continued to expand, particularly in Houghton County. Southeast of Eagle Harbor and Eagle River, the Quincy Mining Company was established in 1846 but was not profitable until 1861 (Lankton 1991). The Pewabic Mining Company was a similar situation. Both of these mines, along with the

dredging of the Portage, created a clear need for a lighthouse where the Portage River meets Lake Superior. As a result, the Lower Portage Entry Lighthouse was built 1856.

An exception to the north to south construction of lighthouses on the Keweenaw was the Ontonagon Lighthouse. The Village of Ontonagon was established in 1843 and rapidly grew due to the copper mines upstream and the local lumber industry (.Ontonagon County Historical Society 2004). The early mines, such as the Victoria mine (1844), Mass mine (1845), and Minesota mine (1847), located upriver from Ontonagon would send their copper out from that port (Hyde 1978). Additionally, the port where the Ontonagon River meets Lake Superior is the safest large port for the fifty miles between the Eagle River Lighthouse to the northeast and Chequamegan Bay, Wisconsin to the southwest. Like Eagle Harbor, the contract for the Ontonagon Lighthouse was drawn up in 1850 (Ontonagon Lighthouse Contract, National Archives, Record Group 26).

Although some early mines like Cliff and Minesota, started in the 1850s, fell into disuse or decline by 1870, the copper industry and local societies as a whole continued to expand until about 1920. The lighthouses, on the other hand, fell into disrepair in less than a decade after construction due to poor maintenance and poor workmanship during construction. As shipwrecks seemingly began to increase with the loss of useful lighthouses, the local population in areas such as Eagle Harbor along with ship captains and sailors began to complain to the Lighthouse Board (Monette 1977). Finally, based on the recommendation of the District Inspector, the Lighthouse Board began setting aside

funds for the reconstruction of certain lighthouses that were considered important (Pepper 2008).

The north to south construction for the intial structures does not hold true for the order of the rebuilt lighthouses. Michigan Senator William Alden Smith began lobbying in 1859 for the lighthouse to be replaced due to its condition, and in 1861, the Manitou Island Lighthouse was completely rebuilt (Pepper 2006). In the time since the opening of the Soo Locks in 1855 and the construction of the first Manitou Island Lighthouse, shipping on Lake Superior had increased as expected, and the shoals around the island were just as dangerous as ever. Therefore the upkeep of this lighthouse was particularly important.

The Copper Harbor and Ontonagon Lighthouses were both rebuilt in 1866, but not entirely for the same reason. Although the copper mines had moved south, the Copper Harbor Lighthouse (like the Manitou Island Lighthouse) was seen as an important location for shipping on Lake Superior. Ontonagon Lighthouse also continued to aid shipping on Lake Superior in general by illuminating a harbor of refuge, but its primary purpose was to facilitate industry. Although the Minesota Mine had closed by this time, other copper mines and the lumber industry continued to grow and made the expense of a new lighthouse at Ontonagon easy to justify (Ontonagon County Historical Society 2004).

Again defying the original north to south pattern, a new lighthouse at Portage Lower Entry was constructed the year before the new lighthouse at Eagle Harbor. As mentioned earlier, the Quincy Mining Company became profitable in 1861 and continued

to be increasingly profitable until 1916 (Lankton 1991). By the 1880s, the Quincy mine was producing fifty million pounds of copper to send out to market (Hyde 1978). Like at Ontonagon, the rapid expansion of nearby industries required a new lighthouse. Also like at Ontonagon, the Lower Portage Entry Lighthouse served to facilitate shipping, in this case by guiding ships into the mouth of the Portage River. The Eagle Harbor Lighthouse differs greatly from the aforementioned cases because it was rebuilt despite the decline of industry in its immediate area and because it is the only one of the rebuilt lighthouses that continues to operate to this day. After it was rebuilt, the Eagle Harbor Lighthouse continued to function to illuminate the bay at Eagle Harbor. Even without mining in the area, ships continued to bring supplies to the Keweenaw using the bay at Eagle Harbor. For example, in the twentieth century, cars were brought into the Keweenaw on ships which docked at Eagle Harbor.

The Eagle River Lighthouse was the last to be rebuilt. Although in 1869 a new lighthouse was discussed, actual construction was postponed until 1884 due to lack of funds (Pepper 2008). Unfortunately, the Cliff Mine ceased operations in 1873, so the Eagle River Lighthouse was unnecessary by the time it was reconstructed (Pepper 2008). As a result, the Eagle River Lighthouse is the first of the six to be decommissioned without a replacement and was sold to a private family in 1908 although the mining industry continued in many parts of the Keweenaw until 1920.

After 1920, decreasing copper prices and increased open pit mining in the west greatly affected industry on the Keweenaw. The copper industry as a whole started to decline as mines became too deep to be profitably mined (Lankton 1999). This decline,

combined with the development of other modes of transportation such as railroads for goods during the early twentieth century, and street cars and automobiles for people, decreased the number of ships needed to supply the Keweenaw Peninsula. As a result, many of the lighthouses became less important as an actual intermediary between the local area and the world arena because of the lack of local demand and the increasing use of the railroad and roads. In fact, the rest of the country was also relying less heavily on shipping on the Great Lakes and more on railroad and road transportation.

The Lower Portage Entry Lighthouse was actually the first of the cases to be decommissioned. The lighthouse was decommissioned in 1900. However, both industry and shipping continued in this area. Quincy Mine reached its peak production in 1916 with two hundred sixty seven million pounds of copper, and shipping on the Portage continued as long as boats were small enough to use the river (Hyde 1978). The Lower Portage Entry Lighthouse was replaced with a series of steel towers (1900, 1920) which were placed increasingly near where the Portage River meets Lake Superior until the Keweenaw Waterway Lighthouse was constructed out in the water. The Copper Harbor Lighthouse was decommissioned in 1933 after the Lower Portage Entry and Eagle River Lighthouses, but like the Portage Entry Lighthouse, it too was replaced by a steel tower. The steel tower serves to mark the tip of the Keweenaw for navigation purposes even though the local mining industry was long since defunct.

The Ontonagon and Manitou Island Lighthouses were the last of these lighthouses which have already been decommissioned. Thanks to a late lumber boom in the twentieth century, Ontonagon Lighthouse continued to serve both local industry and

general navigation interests. For example, by 1920, the Northern Fiber Company had just started using the dock area at Ontonagon to bring in coal ships to supply their papermill (Hitch, Inc. 2003; Hyde 1978). Although the papermill continued to function under various names for the next ninety years, the Ontonagon Lighthouse was decommissioned in 1963. The Manitou Island Lighthouse continued to guide ships around the island shoals until it was finally decommissioned in 2003. With the increase of other navigational aids such as radar and the decline of local industry, fewer lighthouses were needed to mark the peninsula. The decommissioning of the Manitou Island Lighthouse was part of this process.

Today from these six cases, the east of the Peninsula is marked by the Keweenaw Waterway Lighthouse (which replaced the Lower Portage Entry Lighthouse), the tip is marked by the new Copper Harbor steel tower, and the west coast of the peninsula is still marked by the Eagle Harbor Lighthouse.

Piloting between the Lighthouses

Thompson's *Piloting Guide* (1869) indicates how ships used lighthouses to navigate the coastline of the Keweenaw Peninsula. For those piloting on Lake Superior, the lighthouses were an integrated network, and any missing or faulty lighthouses not only made entering a harbor dangerous but also made general navigation on the lake difficult. Evidence for this can be seen in the instructions for shipping on the Lake Superior which describe how ships were to navigate from lighthouse to lighthouse near the coast.

From the Portage Lighthouse to the Manitou Lighthouse, ships were to travel NE1/4E for forty-six miles. The Portage was visible from thirteen miles out, and Manitou was visible from fourteen miles out. From the Manitou Lighthouse to the Copper Harbor Lighthouse, ships were to travel W by N for fourteen miles. Copper Harbor was visible out to ten miles. From Eagle Harbor Lighthouse to Eagle River Lighthouse, ships were to travel SW by W1/2W for seven miles. Eagle Harbor was visible from twelve miles, and Eagle River was visible from eleven miles. From the Eagle Harbor Lighthouse to the Ontonagon Lighthouse, ships were to travel SW by W1/2W for thirteen miles and then SW1/4S for forty-five miles (Thompson 1869). From this guide, it is evident that lighthouses did not exist for the sake of one harbor or a single community. Their function was not limited to the illumination of individual harbors but also entailed guiding ships traveling on Lake Superior. Both of these functions are necessary to connect the local industries and communities of the Keweenaw Peninsula to the rest of the world. This also supports the idea that lighthouses along the coast should be studied as a continuous boundary and not as discreet structures with separate histories.

Case Study: Copper Harbor Lighthouse (Built 1849, Rebuilt 1866, New Tower 1927)

Location and Local History. Copper Harbor is located to the north of the Lower Portage Entry Lighthouse on the tip of the Keweenaw Peninsula. Its location on the top of the peninsula was one of the reasons why early on it was recognized as an important place for a lighthouse. In the mid 1840s, George N. Sanders, who was the assistant

supervisor for the Mining District, wrote to the Secretary of War to tell him that Copper Harbor was a superior harbor, and in 1845, John R. St. John also stressed the need for a lighthouse or beacon at Copper Harbor (James 2000). With the anticipated opening of the Soo Locks in 1855 and an increase in shipping, lighthouses at Copper Harbor and Manitou Island were considered essential guides for increased shipping on Lake Superior.

These lighthouses however were also important for local community and industrial development. In the 1840's prospectors for copper began spending increasing amounts of time on the Keweenaw Peninsula, particularly after 1843 when the land office opened. The work force for the early mining companies such as the Pittsburgh and Boston Company arrived via ships (Hunt 1997). The Pittsburgh and Boston Company had shafts near Ft. Wilkins which produced 70,000 pounds of ore before the company moved further south to start the Cliff mine in the 1840s (James 2000). Additionally, natural topsoil is poor and often not found in much quantity in many parts of the Keweenaw, and early populations relied heavily on provisions shipped across the Great Lakes to feed themselves and their animals (Hunt 1997). The early communities of male miners also counted on these ships to bring their families once the mining companies and towns became more securely established. These ships also brought in new waves of laborers for the expanding mines.

Initial Construction. The contract for the original structure was written on August 21st, 1847 between Charles Rude of Sandusky City, Ohio and Samuel K. Haring, Collector of the District of Michilimackinac (1847 Copper Harbor Lighthouse Contract, National Archives, Record Group 26). The original structure was built in 1849 for

$4800, which in today's dollars with a conversion rate of $28.30 would be $135,840 (1847 Copper Harbor Lighthouse Contract, National Archives, Record Group 26; Mildon 1981; No Author 2011). In one example where local conditions and physical location seems to have been considered by the Lighthouse Board, the initial twenty two foot high tower was declared unsafe due to its proximity to the shore (Hyde 1978; Hyde 1986). The actual structure used was built with a detached tower closer to the shore and the house further back from the tower and coast to avoid the jagged conglomerate ridges of the area. The foundation of the tower for this initial structure was mortared to the ridge on which it was located (James and Day 1995).

Although the contract called for a 65 foot tower, the actual tower was 44 feet high and tapered toward the top. It is unknown if this was done deliberately by the contractor for some functional reason, or was simply a way to cut corners to finish on time by ignoring lighthouse height requirements. In accordance with the contract, it was constructed of stone, and the exterior was painted (1847 Copper Harbor Lighthouse Contract, National Archives, Record Group 26). The one story, four room house was also made from stone, painted white, and had a shingle roof, see Figure II.6 (1847 Copper Harbor Lighthouse Contract, National Archives, Record Group 26). The lamps were made with Lewis dies by Harper and Company of Boston, Massachusetts (1847 Copper Harbor Lighthouse Contract, National Archives Record Group 26). These were replaced with a fifth order Fresnel lens in 1856 (Hyde 1986). In 1863, Joshua Barney, the assistant engineer for the district, recommended that the lighthouse be replaced due to the

amount of standing moisture in the tower and the decay of the watchroom and wooden stairway (James and Day 1995; James 1999).

Rebuilding. The second keeper's house and tower were built to the east of the original structure and out of brick in 1866 (Splake 1984). Some of the rubble stone from the original lighthouse was used for the foundation of the new structure, and the structure was built twenty meters to the east of the initial lighthouse structure, see Figure II.7 (James and Day 1995; Mildon 1981). Despite being located on a more elevated part ofthe land, this tower was actually 62 feet tall which suggests that the reduced height of the first lighthouse tower was not functional. The tower was equipped with a fifth order Fresnel lens used to mark ports. This structure was manned until 1919 when the light

Figure II.6: Photograph of the 1849 Keeper's Dwelling at the Copper Harbor Lighthouse. (Monette Collection Box 32 Folder 1, Michigan Technological University, permission to reuse from MTU archives)

was replaced with acetylene gas (Hyde 1986). These structures are still standing, but in 1933, a 60 foot steel tower was built to guide ships, replacing the 1866 structure (James and Day 1995; Mildon 1981; Splake 1984).

Although the local fishing industry lasted longer than the mining industry, eventually tourism became more important to the economy of the Keweenaw. Currently, the 1866 structures and the fifth order Fresnel lens are part of the Fort Wilkins State Park

Figure II.7: Picture of the second Copper Harbor lighthouse structure. (Michigan Technological University Digital Archives Image #MS044-002-014-005, permission to reuse from MTU archives)

and are open in summer to tourists (Mildon 1981). The report for the Copper Harbor Lighthouse nomination was filed in 1975, see Appendix Section C-1 (Eckert 1975). Nature trails have been added to the area; however access to the site is limited even in summer (Hunt 1997). The cottage association of local home owners which owns the properties surrounding the lighthouse denies land access, so visitors to the lighthouse site must come by boat (Hunt 1997).

Case Study: Manitou Island Lighthouse (Built 1850, Rebuilt Tower 1856, Rebuilt 1861)

Location and Local History. Manitou Island is located off the tip of the Keweenaw Peninsula to the east of Copper Harbor Lighthouse. Although built a year later than Copper Harbor Lighthouse, a lighthouse on Manitou Island was proposed at the same time as Copper Harbor and $7500 was set aside for each of those lighthouses (Nelson 1999). As noted above, Copper Harbor was completed for less than the amount set aside, but Manitou required most of this amount due to the difficulty of building on such an isolated location. The delay in construction was principally due to the difficulty of getting materials to the island (Nelson 1999). Money not used in the construction seems to have been reabsorbed into the Lighthouse Establishment's budget because only the amount in the contract was paid out to the contractor (Hyde 1986).

In 1842, the Chippewa ceded the land between the Chocolate and St. Louis Rivers to the United States government leading to rampant land speculation. In 1843, Michigan Senator DeGarmo Jones took out two mineral leases on Manitou Island. Two years later

the federal government surveyed the island (Deegan et al. 2007). Prospectors tested copper veins on the north side of the island. The copper industry did not impact the island beyond those exploratory endeavors, but the completion of the Soo Locks, scheduled for 1855, justified the cost of putting a lighthouse on Manitou Island due to the expected increase in general shipping (Pepper 2006). The lighthouse would help ships to avoid the shoals around the island (Deegan et al. 2007). However, the fishing industry did develop around the Manitou Island. The American Fur Company organized fishing on Lake Superior in the mid 1830s, and the A. Booth Packing Company took over the industry at the end of the nineteenth century. Assistant lighthouse keeper Henry Corgan started a fishing business in 1883 while tending the Manitou Island Lighthouse (Deegan et al. 2007). Fishermen relied on the safe harbor on the south side of Manitou Island to take refuge from fall storms on Lake Superior during trout season. This fishing boom throughout the Grant Township (this includes Copper Harbor, Bete Grise, and Manitou Island) continued throughout the twentieth century. In fact in 1931, the Lake Superior Fisherman's Association actually took out a five year lease on the island although it only existed for a year after that (Deegan et al. 2007).

Initial Construction. The contract for the first lighthouse was written on May 20th, 1849 between George Witheril of Cleveland, Ohio and Samuel K. Haring, Collector of the District of Michilimackinac (1849 Manitou Island Lighthouse Contract, National Archives Record Group 26). The lighthouse was scheduled to be finished by December 1st of the following year. In 1849, work began on the first Manitou Island lighthouse and keeper's dwelling, and the project was completed the following year for the cost of $7218

(Pepper 2006). In accordance with this contract, the tower was a 60 foot rubble stone structure attached to a rubble stone keeper's dwelling (1849 Manitou Island Lighthouse Contract, National Archives, Record Group 26; Pepper 2006). The tower was equipped with Lewis lamps made by Harper and Company of Boston, Massachusetts (1849 Manitou Island Lighthouse Contract, National Archives, Record Group 26; Pepper 2006). Once completed in July of 1850, the lighthouse was pronounced "good" by Henry B. Miller who at the time served as the District Superintendent of Lights (Pepper 2006). Despite Miller's pronouncement, the Manitou Island Lighthouse rapidly deteriorated, and by 1852, the maritime community began lobbying for a new lighthouse structure due to the dangers of sailing around the island and tip of the Keweenaw (Pepper 2006).

Rebuilding. In 1856, a completely new tower was constructed (Pepper 2006). It was an octagonal structure of cast iron with a flashing white fourth order Fresnel lens used to light ports and bays (Pepper 2006). By 1859, however, Michigan Senator William Alden Smith wanted the lighthouse either repaired or replaced due to its condition (Pepper 2006). As a result of his request, the 11th District Engineer James Duncan Graham drew plans for a new lighthouse structure (Pepper 2006; U.S. Corps of Topographical Engineers 1995-2006).

In 1861, a new 80 foot cast iron skeletal tower was constructed to replace the old tower (Nelson 1999). All of the new towers built on the Great Lakes after this time were the same skeletal design, but the tower built at Manitou Island was the first (Hyde 1986; Nelson 1999). The tower was prefabricated with numbered cast iron sections that were reassembled on the site after being assembled elsewhere first to make sure that the pieces

went together (Pepper 2006). In the center of the tower was a cast iron cylindrical stairwell that was six feet in diameter (Pepper 2006). The interior of this stairwell was wood paneled to decrease condensation inside the structure (Pepper 2006). This tower was equipped with a six bullseyed third order Fresnel lens with oil lamp which was a lens type typical for lighthouses located on coasts or lakes (Hyde 1986; Nelson 1999). The reasons for changing the Fresnel lens itself and for changing its order are unknown, but the third order would have been visible further out into the water than the fourth order.

Figure II.8: Photograph of the second Manitou Island lighthouse structure. (Michigan Lighthouse Conservancy at michiganlights.com ©2001-2010, accessed April 25, 2011, fair use-can be reused)

The stairwell attached the tower to the keeper's dwelling on the second floor rather than running to the ground (Nelson 1999). The second keeper's dwelling was a two story wooden structure, see Figure II.8 (Nelson 1999).

By 1875, fog whistle buildings were added on either side of the lighthouse (Nelson 1999). The fog whistle was used to alert ships who came close to the island. In the 1930's, the lighthouse was equipped with electricity and telephone service, and a boathouse was added to the shore (Nelson 1999). In the 1970's, the light was updated to modern plastic lens and was run by automated twin diesel generators (Nelson 1999). The lighthouse was decommissioned in 2003 and immediately put up for sale by the U.S.

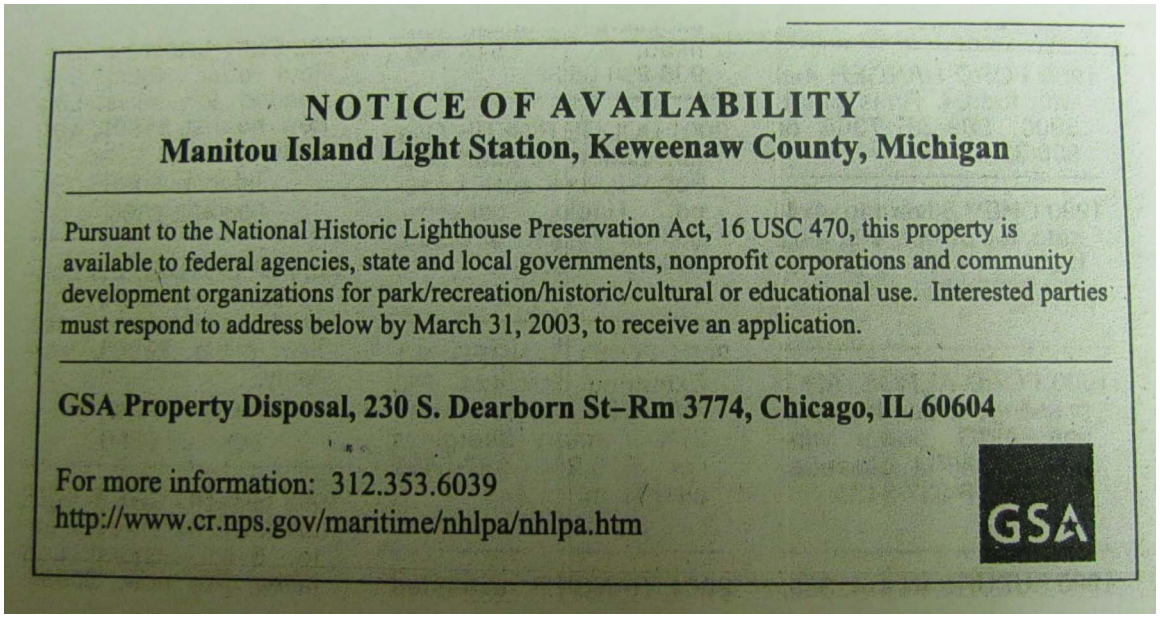

Figure II.9: Advertisement for the selling of the Manitou Island lighthouse. (*Daily Mining Gazette* page 3C Monday, February 3, 2003, photo by Lisa Gillis, permission to reuse from MTU archives)

Coast Guard, and in 2004, the Keweenaw Land Trust received the Manitou Island Lighthouse from the state as part of lighthouse preservation efforts, sees Figure II.9 (Pepper 2006). Since this time, they have been soliciting grants and working with volunteers in order to maintain the lighthouse (Pepper 2006).

Case Study: Eagle Harbor Lighthouse (Built 1851, Rebuilt 1871)

Location and Local History. Prospectors initially came to the Eagle Harbor area in the early 1800s in search of copper (Monette 1977). The first Europeans to arrive at Eagle Harbor originally came by ship singularly or in groups, and they brought very little equipment with them. In some instances, however, these explorations led to more permanent residences later on. For example, Edward Taylor, after his original visit to the area in 1842, built a tavern. Officially though, the Eagle Harbor Mining Company brought in the first real influx of men in 1845 via ship (Monette 1977). By 1859, the little village had expanded to include multiple taverns, a hotel, a store, houses, a post office, and even a jeweler (Monette 1977). The town expanded as the copper and lumber industries flourished (National Park Service n.d.). Supplies came in and copper left on ships through the harbor.

Although the only transportation method for large quantities of copper available at the time was shipping, the natural harbor was shallow, rocky, and narrow, see Figure II.10. These conditions posed an obvious hazard for people on the ships, but it also adversely affected the people living in Eagle Harbor. Without roads or railroads, the

population relied upon supplies from ships to survive each winter, as winter weather cut them off entirely from the rest of country. An early winter meant that the inhabitants might not have enough supplies to make it through the season, or an especially long winter could hinder spring supply ships and leave the inhabitants without food and other essentials until shipping was restored. Additionally, accidents, such as a fire that destroyed one of the local warehouses, could leave the inhabitants without provisions (Monette 1977). These difficulties were aggravated by the shape of the natural harbor (Monette 1977). Demands for a lighthouse then were related to the dangerous nature of the harbor and from the local population's dependence on external provisions.

Figure II.10: 1898 Photograph of the bay at Eagle Harbor. (Michigan Technological University digarch #F572-S9-A7-pt 2-3, permission to reuse from MTU archives)

Initial Construction. On March 3, 1849, the Lighthouse Board approved a budget of $4,000 for the construction of a lighthouse at Eagle Harbor in response to the demands from the Eagle Harbor inhabitants (Kordes n.d.). In contract drawn up between George Witheril of Cleveland, Ohio and Charles E. Avery, Collector of the Customs for the District of Michilimackinac on July 11, 1850, the cost for the actual construction was $3895. The official completion date was scheduled for October 15, 1850 (1850 Eagle Harbor Lighthouse Contract, National Archives, Record Group 26). The lighthouse was located on the main Keweenaw Peninsula near the town Eagle Harbor (Monette 1977).

Figure II.11: Representation of the first Eagle Harbor lighthouse structure. (Michigan Technological University digarch #AP2H2v6-442-A, permission to reuse from MTU archives)

The contract called for the tower and keeper's house to be built out of hard bricks or stone. The tower was required to be thirteen feet above the second story of the house (1 (1850 Eagle Harbor Lighthouse Contract, National Archives Record Group 26). However, the lighthouse finished in 1851 was constructed using stone for the keeper's house and wood for the tower, see Figure II.11 (Anderson n.d.; Lenz 2002; No Author 1973).

According to the contract, the tower was to be equipped with eight Winslow Lewis lamps made from dies by Harper and Company of Boston, Massachusetts (1850 Eagle Harbor Lighthouse Contract, National Archives, Record Group 26). These lamps were replaced with a third order Fresnel lens (Hyde 1986). The weather from Lake

Figure II.12: Photograph of the second Eagle Harbor lighthouse structure. (Michigan Technological University digarch #NARA 42-200, permission to reuse from MTU archives)

Superior quickly deteriorated the initial structure, and on July 15, 1870, the Lighthouse Board awarded a private contractor $14,000 to rebuild the lighthouse at a time which in today's dollars would be approximately $406,000 (Kordes n.d.; No author 2011).

Rebuilding. This second lighthouse differed greatly from the first. The contractor used bricks to build an eighteen feet by thirty feet keeper's house and a forty-four feet tall hexagonal tower on an eighteen inch thick rock foundation, see Figure II.12 (Anderson n.d.; Lenz 2002). The tower was equipped with a fourth order Fresnel lens, used to mark ports. In 1871, a separate brick structure was built to serve as an oil house (Hyde 1986).

To ensure the lighthouse's durability, the contractor made the interior and exterior walls of the lighthouse out of brick and then filled the space between them with concrete, an unusual practice for the time; this created eighteen inch thick walls (Kordes n.d.). The contractor also constructed a red brick outhouse since the lighthouse did not have indoor plumbing (Lundstrom 2004). When finished in 1871 the lighthouse had a parlor, kitchen, pantry, and four bedrooms for the keeper's family as well as fully plastered interior walls. The well-designed structure and the lighthouse's proximity to town made it a popular keeper's post (Drake n.d.). Around the same time, the whale oil lamp was replaced with a fourth order Fresnel lens due to the rising cost of sperm oil and the inadequate supply of colza or rapeseed oil (Clemensen and Howell 1986).

Later, a woodshed was added which the family converted into a kitchen in 1907 so that they could have a dining room, and they used a coal-fired boiler for central

heating (Kordes n.d.). In 1925, the outside of the lighthouse was covered in white stucco to promote visibility (Mildon 1981). The 1930's saw new hardwood floors, electricity, and an incandescent lamp for the lighthouse (Kordes n.d.). In 1962, the fourth order Fresnel light was replaced with an aircraft beacon light, and by 1980, the Lighthouse Service under the United States Coast Guard had completely automated the lighthouse with two rotating red and white lights, phasing out the need for a lighthouse keeper (Anderson n.d.; Kordes n.d.). The Keweenaw County Historical Society repurposed the Eagle Harbor Lighthouse as a museum in 2001 and hired David T. Bimel of Boston, Massachusetts to repair the lighthouse bricks (Bruce Johanson, personal communication 2010). This maintenance was crucial because by this time the white stucco paint, used to make the lighthouse more visible, had caused the bricks on the east facade to deteriorate (Anderson n.d.; Jordon n.d.).

Case Study: Ontonagon Lighthouse (Built 1852, Rebuilt 1866)

Location and Local History. The port where the Ontonagon River meets Lake Superior is the safest large port for the fifty miles between the Eagle River Lighthouse to the northeast and Chequamegan Bay, Wisconsin to the southwest. The Village of Ontonagon was founded in 1843 when James Kirk Paul opened a tavern and a hotel for mine prospectors in the area (Ontonagon County Historical Society 2004). As a result, the Ontonagon Lighthouse has been an important guide for ships from its construction in 1852 through 1963 when it was decommissioned. The late lumber boom of the 20th

century continued to make the Ontonagon Lighthouse an important guide until it was decommissioned (Hunt 1997). Initially, the lighthouse was constructed to facilitate ships taking copper out to market. The early mines, such as the Victoria mine (1844), Mass mine (1845), and Minesota mine (1847), located upriver from Ontonagon would send their copper out from that port (Hyde 1978).

As a result of the shipping, mining, and lumber industries in the area, the Village of Ontonagon developed rapidly. By 1856, it was the busiest port on Lake Superior (Ontonagon County Historical Society 2004). At this time, the Ontonagon Harbor was dredged to allow larger ships access to the port. The fifth order Fresnel lens was installed only a year later. Even after the town was destroyed by fire in 1896, the lighthouse remained intact, and continued to serve the community into the 21st century with the aforementioned logging boom supplying the local paper mill (Ontonagon County Historical Society 2004). One of the ships burned in the fire was the City of Straits lumber schooner which was carrying 50,000 board feet of lumber at the time (Hitch, Inc. 2003). The late lumber boom of the twentieth century continued to make the Ontonagon Lighthouse an important guide until it was decommissioned (Hunt 1997). In 1920, the Northern Fiber Company started using the dock area to bring in coal ships to supply their paper mill. This company changed names to the Ontonagon Fiber Company and then the Smurfit Stone Container Corporation, but operated until 1953 (Hitch, Inc. 2003; Hyde 1978).

Initial Construction. The contract for the Ontonagon Lighthouse was drawn up on July 21, 1850 between William Chittenden of Detroit, Michigan and Charles E.

Avery, Collector of the Customs for the District of Michilimackinac (Ontonagon Lighthouse Contract, National Archives, Record Group 26). The sum of $4800 was appropriated for the first lighthouse in 1850, and construction began in 1851 on lot 7 West of the Ontonagon River which was already owned by the government (Hitch, Inc. 2003). According to the contract, the keeper's house and the lighthouse tower were supposed to built out of rubble masonry or hard brick. The lamps were to be made in using a Winslow Lewis patented die by Harper and Co and Hamminway of Boston.

In actuality, the structure was made of wood, and the tower was equipped with a Winslow Lewis lamp. The lighthouse was supposed to be completed by October 1st, 1852. In 1852, the contractor F. W. Chittenden from Detroit was paid upon the completion of the satisfactory lighthouse (Ontonagon Lighthouse Contract, National Archives, Record Group 26). The lighthouse, the local church, and the west pier are all located at approximately 323 degrees from true North, which made the harbor easily navigable for ships even at night. In 1857, the Lewis lamp was replaced with an 125 pound fifth order Fresnel lens for $600 (Hyde 1986; Ontonagon County Historical Society 2004).

Rebuilding. The second lighthouse structure, built in 1866 for $14,000, was made of yellow brick and designed in the "schoolhouse" fashion with a thirty-four foot tall square tower in the middle of the front of the house, see Figure II.13 (Hyde 1986). It was built next to the first structure, which was not torn down until the completion of the second lighthouse structure. The second structure was one and a half stories and built of

cream brick. The tower, attached to the west end of the house, was square and had a fifth order Fresnel lens, for marking ports. The entire house was on an elevated basement; this design was geared towards keeping water out of the living quarters of the house. In 1890, a square kitchen was added at the opposite end of the house from the tower, a woodshed was built behind it, and an iron gallery was added around the tower to facilitate the cleaning of the windows (Hyde 1978; Ontonagon County Historical Society 2004). In 1919, the barn was converted to a garage, and after 1945, the kitchen and bathroom were modernized (Hitch, Inc. 2003).

Figure II.13: Photograph of the second Ontonagon lighthouse structure. (Michigan Technological University Digital Archives Image #MS044-005-082, permission to use from MTU archives)

The Coast Guard decommissioned the lighthouse in 1963 and turned it over to the Army Corps of Engineers. Two years later, the coast guard gave the Fresnel lens to the Ontonagon County Historical Society. In 1975, the lighthouse was placed on the National Register of Historic Places, a move that has ultimately been problematic for the lighthouse, see Appendix Section C-2 (Hitch, Inc. 2003; Torma and Lowery 1975). Rules requiring lighthouse repairs to be historically accurate to the 1866 period of construction make the repairs far more costly than simply fixing or replacing materials with modern equivalents or methods. For example, a slate/asbestos roof was put on the lighthouse in the 1920's. However, when the roof finally required repairs, the National Register would have required the Army Corps of Engineers to put on a cedar shake roof with copper flashing. The expense was prohibitive as the Ontonagon Lighthouse did not receive preservation funds from the federal government. Therefore, the Army Corps of Engineers did not replace the roof (Ontonagon County Historical Society 2004).

In 1992, the Army Corps of Engineers put in a new boiler system that exploded because draft control was not required by law and therefore not put in. For the next seven years, the building was without heat causing a great deal of damage to the brickwork. Finally in 1999, the Ontonagon County Historical Society, with the permission of the Army Corps of Engineers, reinstalled heat in the lighthouse and added insulation (Ontonagon County Historical Society 2004). After several years of negotiations and legislation, the Ontonagon County Historical Society finally obtained the lighthouse in 2000 and used a grant from the Michigan State Historic Preservation office to continue repairs. At this time the lighthouse is open to tourists through the historical society, but

access is limited due to the paper mill located next to the lighthouse (Ontonagon County Historical Society 2004).

Case Study: Portage Lower Entry (Jacobsville) Lighthouse (Built 1856, Rebuilt 1870)

Location and Local History. The Portage Lower Entry Lighthouse is located near the Jacobsville sandstone quarry that would have required supplies and workers when it started in the 1880s. The Pewabic and Quincy mines also required supplies and workers, but the Portage Lower Entry lighthouse was not thought of as immediately important because the Portage itself was not entirely useful until the bottom had been dredged because it was so shallow. One of the closest large mining companies, the Quincy Mining Company was established in 1846 but was not profitable until 1861. After this point however, the mine continued to be profitable until 1920 (Lankton 1991).

By the 1880s, the Quincy mine was producing fifty million pounds of copper to send out to market, and in 1916, the mine reached its peak production with two hundred sixty seven million pounds of copper (Hyde 1978). However, the mine's actual share of the market decreased steadily from 1885 until the 1960s when it finally closed (Hyde 1978). The Pewabic mine also became successful at the same time as Quincy, and the Quincy mine later absorbed the Pewabic mine. It was largely due to the success of these mines that the towns Houghton and Hancock began to prosper and ship travel on the Portage became increasingly common.

The initial Portage Lower Entry Lighthouse structure was built shortly before the mines were profitable, but the second structure was built at a time when shipping on the lake would have been very important for the mines. The second lighthouse structure was actually decommissioned while the Portage was still in use due to the placement of a new lighthouse called the Keweenaw Waterway Lighthouse which was located out in the waters of Lake Superior closer to the actual entryway. This lighthouse was not decommissioned until the 1970s when many ships became too large to travel on the Portage. After the decline of the mines, this lighthouse mostly served to mark the entry for ships caught in storms on Lake Superior. In this particular case, the actual decommissioning of the lighthouse appears to be more closely aligned with changes in ship design although its function changed with the decline of mines after 1920.

Initial Construction. The initial structure built in 1856 was a wooden tower with an oil lantern (Salmen 2004). This structure was meant to be somewhat temporary for two reasons. First many were still unconvinced that a lighthouse was necessary, and second, there was difficulty in determining where to place the lighthouse (Mike Ditty, personal communication 2010). For visibility, lighthouses are typically placed on higher ground. In the case of the Jacobsville area, the terrain is mostly flat, and the most elevated part of the landscape is not actually next to the portion of the Portage that needs illumination. The contractor mistakenly built the first lighthouse on land not actually purchased by the government for the lighthouse, but on land adjacent to their properties. As a result, the government purchased the actual lighthouse grounds after the lighthouse had been built (Mike Ditty, personal communication 2010). The miscommunication in

this case may have stemmed from the contractor's lack of familiarity with this area of the Keweenaw Peninsula.

Rebuilding. In 1870, a new structure was built to replace the deteriorating initial lighthouse structure (Salmen 2004). The house was built with a 45 feet high attached tower with a fifth order Fresnel lens, commonly used in lighthouses functioning to illuminate ports (Salmen 2004). Both the lighthouse tower and the keeper's dwelling were made of brick, see Figure II.14 (Salmen 2004). The lighthouse tower cast iron lantern room was fully constructed elsewhere to ensure that the parts matched and were all there. Then the tower was disassembled, shipped to the actual location of the

Figure II.14: Picture of the second Jacobsville lighthouse structure. (Michigan Lighthouse Conservancy at michiganlights.com, accessed April 28, 2011, fair use-able to reuse)

tower twice as high (Mike Ditty, personal communication, 2010; Salmen 2004). lighthouse, and reassembled on the appropriate site. In 1900, a detached four story steel tower located about a mile south of the 1870 structure, closer to the entryway, replaced the 1870 tower for guiding ships, and in 1920, that tower was replaced with a new steel These towers were octagonal, 8 feet in diameter, and were situated on a 20 square feet concrete base (Mildon 1981). As mentioned previously, the lighthouse was deactivated when the Keweenaw Waterway Lighthouse was lit. The 1870s Portage Lower Entry lighthouse structure is now privately owned and operated as a bed and breakfast. In the 1970s, major additions were made to the keeper's dwelling.

Case Study: Eagle River Lighthouse (Built 1857, Rebuilt 1884)

Location and Local History. Eagle River was a port for the Cliff Mine and home to supporting businesses such as a fuse factory (Beaderstadt n.d.). In the 1840s, ships brought supplies and manpower into the mine long before enough copper had been located to make exporting a major concern. However by the 1850s, the Cliff Mine had become well established and was producing large enough quantities of copper to send to market. This led to the establishment of the town of Eagle River and the need for a lighthouse at that port. The Cliff Mine closed in 1873 and the town declined so that by the time the lighthouse was repaired in 1884, it was no longer needed for the industrial development of the Keweenaw Peninsula (Pepper 2008). The decrease in shipping from the area with the decline of the Cliff Mine, along with an increase in sand and silt

blocking the port discouraged use of the port (Salmen n.d.). In this particular case the lighthouse was then only important for guiding ships along the coast and did not assist the town or mark a safe harbor for ships on Lake Superior. This may be the reason it was never automated or had a new steel tower built. Instead it was sold to a private owner as soon as it was decommissioned in the early twentieth century.

Figure II.15: Photograph of the second Eagle River lighthouse structure. (Michigan Technological University Digital Archives Image #MS-042-Z421, permission to reuse from MTU archives)

Initial Construction. Although money was appropriated for the lighthouse in 1850, it took three years for the state of Michigan to obtain the rights to the land, and then it took an additional four years, until 1857, for the contractor to produce work that was considered "sufficient." The keeper's house was one and a half stories, and the tower was attached in the northeast corner of the structure. Both were made of stone. Due to its location on a bluff, this tower was only 24 feet tall. Even once the lighthouse was finished, it was evident that the workmanship was poor because by 1867 there were already large cracks in the base of the tower (Pepper 2008).

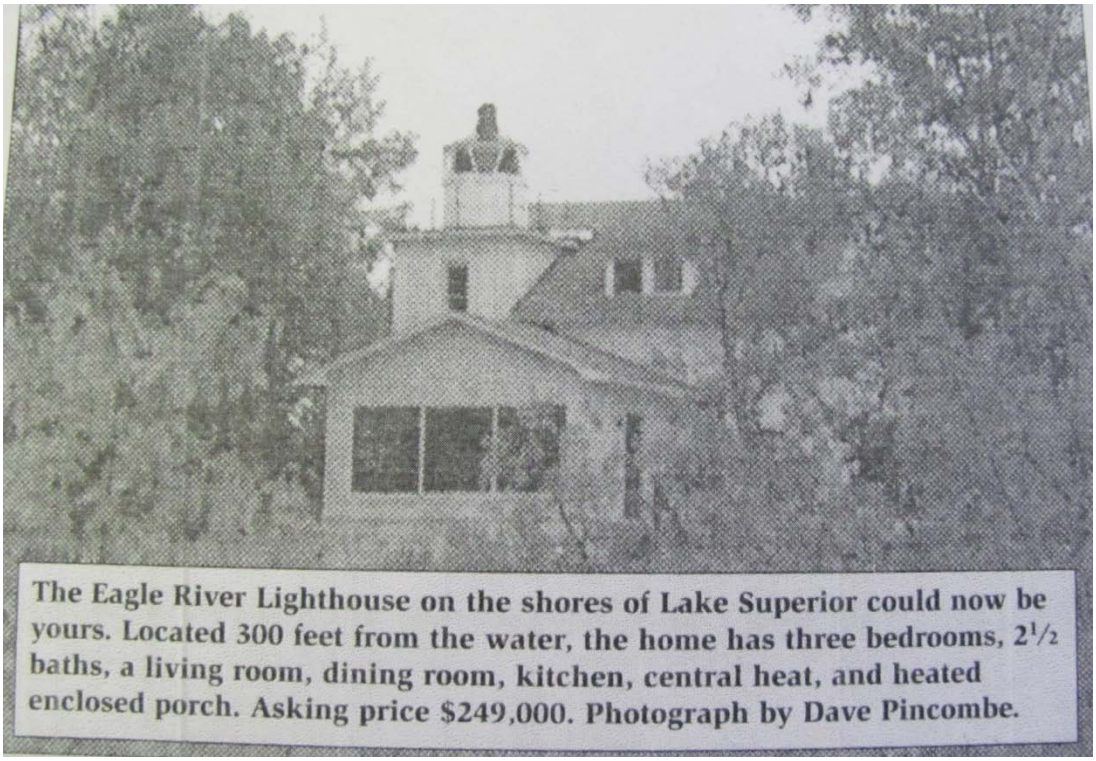

Figure II.16: Photograph of 1998 advertisement for the selling of the second Eagle River lighthouse structure. (Monette Collection Box 40 Folder 2 at the Michigan Technological University archives, photo by Lisa Gillis, permission to reuse from MTU archives)

Rebuilding. Although technically funds were set aside for a new lighthouse in 1869, the renovation of the lighthouse was postponed until 1884 when funds were actually obtained (Pepper 2008). This is likely due to the decreasing importance of the Eagle River Lighthouse as the copper mines in the area closed. The keeper's house and tower are mostly stone although the second floor has white wooden siding, see Figure II.16. The tower is a small extension that is located forward on the roof of the house with a sixth order Fresnel lens which is the smallest order light that marks ports (Chamberlin n.d.). The height of the tower and small lens may also indicate the degree to which the Eagle River Lighthouse was decreasing in importance.

By 1908, the lighthouse had been decommissioned. The Coast Guard then sold the lighthouse to the Vertin family who used it as a private residence until selling it to Jim Vivian, see Figure II.11 (No Author n.d.). The lighthouse is still in use as a private residence today (No Author n.d.).

As discussed above, the case study lighthouses resulted from the needs of ships in the Great Lakes and from the needs of the immediate area. The initial lighthouse structures were built during the prospecting and early mining years of the 1840s and 1850s. With the exception of Eagle River, the second generation of lighthouses was built in the 1860s and 1870s at a time when industry in their specific areas was expanding. The mines started during the first generation of lighthouses were becoming profitable during this time. Early lighthouses were built with limited budgets and using local materials, such as wood and stone. The second generation of lighthouses was built out of

mostly brick building materials. As seen in the contracts, the contractors who built the lighthouses were not from the Keweenaw.

Chapter III: Results and Discussion

The six case studies outlined above provide insight into how the initial and subsequent generations of lighthouses fit into the industrial history of their local areas. The site visits confirmed a great deal of the background information although there was a much greater variety of building materials apparent during the site visit than was discussed in the background.

Results

Case Studies. The following tables were created from the historic information for each lighthouse case study as a tool for comparing them. Table III.1 provides a chronology for the lighthouse construction and modifications. As a general rule, the lighthouses were built during early prospecting on the Keweenaw Peninsula and the actual start up of mines. The lighthouses were initially constructed based on the rise of shipping and the local industries. For example, the Copper Harbor and Manitou Island Lighthouse structures were built primarily due to their location at the tip of the Keweenaw and the anticipated increase in shipping on Lake Superior with the opening of the Soo Locks in 1855. With the exception of the Eagle River Lighthouse which was rebuilt after the Cliff Mine closed in 1871 and did not serve to aid general navigation, the lighthouses were rebuilt either to continue to aid local industries (Ontonagon, Lower Portage Entry) or to continue functioning as aids to navigation on Lake Superior (Copper

Table III.1
This table illustrates the chronology of lighthouse construction and use. This table provides a general time line for the six case study lighthouses.

Chronology of Lighthouse Building and Use	
Date	Lighthouse
1849	Copper Harbor Initial Construction
1850	Manitou Island Initial Construction
1851	Eagle Harbor Initial Construction
1852	Ontonagon Initial Construction
1856	Portage Lower Entry Initial Construction
1857	Eagle River Initial Construction
1858	Manitou Island New Tower
1861	Manitou Island Rebuilt
1866	Ontonagon Rebuilt
1866	Copper Harbor Rebuilt
1870	Portage Lower Entry Rebuilt
1871	Eagle Harbor Rebuilt
1884	Eagle River Rebuilt
1900	Portage Lower Entry Decommissioned
1908	Eagle River Decommissioned
1927	Copper Harbor Steel Tower Constructed
1933	1866 Copper Harbor Structure Deactivated
1963	Ontonagon Decommissioned
2003	Manitou Island Decommissioned
2011	Eagle Harbor Still Active

Harbor, Manitou Island, Eagle Harbor). After 1900, all of the lighthouses except Eagle Harbor were deactivated. The Copper Harbor and Portage Lower Entry Lighthouses were deactivated and replaced with steel towers. The Eagle River, Ontonagon, and Manitou Island Lighthouses were deactivated without replacements. As discussed earlier, three of the six case studies serve to outline the coastline of the Keweenaw Peninsula. The east of the Peninsula is marked by the Keweenaw Waterway Lighthouse

(which replaced the Lower Portage Entry Lighthouse), the tip is marked by the new Copper Harbor steel tower, and the west coast of the peninsula is still marked by the Eagle Harbor Lighthouse.

Figure III.1 illustrates the points that the use lives of the lighthouses varied considerably based on local circumstances. The Copper Harbor, Lower Portage Entry, and Eagle River Lighthouses were in use for significantly less time than the other lighthouses. As previously mentioned, the Copper Harbor Lighthouse was replaced with a steel tower which still functions to illuminate the tip of the Keweenaw Peninsula. Similarly, the Lower Portage Entry was replaced with steel towers and then the

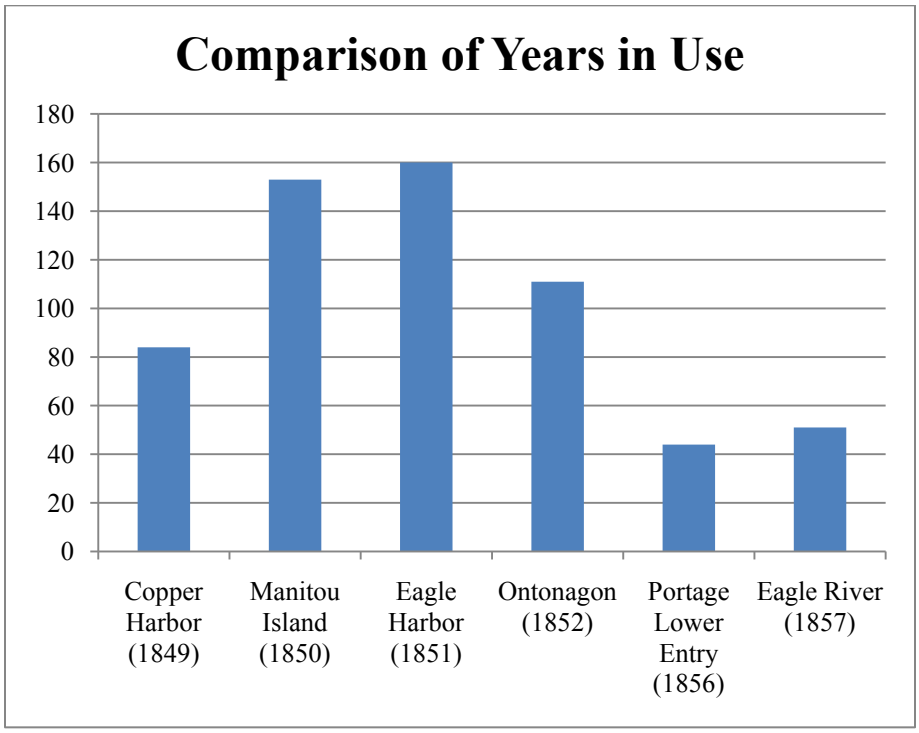

Figure III.1: Comparison of Years in Use. This graph compares how long the case study lighthouses were in use.

Keweenaw Waterway Lighthouse to illuminate the meeting of the Portage River and Lake Superior. The lighthouse structures serving to illuminate these two areas changed, but the importance of having lighthouse in those areas did not. In the case of the Eagle River Lighthouse however, the industry of the area went into decline starting with the close of the Cliff Mine in 1871, and as a result, having a lighthouse quickly became unnecessary.

In contrast to this, the Manitou Island, Eagle Harbor, and Ontonagon Lighthouses were used for a longer period of time. The Manitou Island Lighthouse was important to general shipping on Lake Superior and so was not decommissioned until recently. Likewise, the Ontonagon Lighthouse served to aid navigation by illuminating a harbor of refuge. However, the local lumber industry also continued to use the harbor until the mid twentieth century when the lighthouse was decommissioned. Eagle Harbor Lighthouse continues to be important for navigation to this day although the industry of the area has been in decline for over a century.

Table III.2 summarizes the construction information for the six case studies. The construction dates illustrate that generally the lighthouses were built starting with the northern part of the peninsula and moving to the south in the same way that the copper mining industry developed. The dates of rebuilding reflect the fact that the lighthouse rebuilding did not follow this same pattern. The construction costs for the initial lighthouse structures range from Eagle Harbor which cost below $4000 up to Manitou Island which cost more than $7000. Although Eagle Harbor was built with a stone keeper's dwelling and a wooden tower and Manitou Island was made entirely from stone,

it seems unlikely, since the other lighthouses were built from the same materials, that the difference in construction costs is due to materials. It is more likely that the difference in cost stems from the difficulty of building on their respective locations. From this table, it is also evident that the materials for the initial structure are stone and wood which would have been available locally, and the building material for the second set of structures is brick which would have been shipped in from elsewhere.

Table III.2
This table includes a summary of case study information. This table summarizes dates for construction and use, construction costs, and building materials.

Lighthouse	Dates			Cost		Building
	Built	Rebuilt	Deactivated	Built	Rebuilt	
Copper Harbor	1849	1866, 1927 (steel tower)	1933	$4,800	Unknown	44 ft tower taper toward the top, stone, exterior paint, one story 4 room keeper house, stone, painted, shingle roof; brick, stone foundation, 62 ft tower, 5th order Fresnel
Manitou Island	1850	1858 (tower), 1861	2003	$7,218	Unknown	stone house, wooden tower; new tower with 4th order Fresnel lens, octagonal, cast iron; cast iron tower with wooden panel interior, 3rd order Fresnel lens, 2 story wooden house
Eagle Harbor	1851	1871	N/A	$3,895	$14,000	stone 1.5 story keeper's house and 24 ft tower in the northeast corner; keepers house and tower brick, concrete infilled house walls, 4th order Fresnel
Ontonagon	1852	1866	1963	$4,800	$14,000	60 ft tower, rubble stone tower and dwelling; yellow brick schoolhouse 1.5 story, 5th order Fresnel, elevated basement
Portage Lower Entry	1856	1870	1900	Unknown	Unknown	wood tower and house, Lewis lamp; 45 ft attached tower, 5th order Fresnel, brick
Eagle River	1857	1884	1908	Unknown	Unknown	wooden tower, oil lantern; stone house and tower, wooden siding, tower small extension to front of house, 6th order Fresnel

Figure III.2: Photograph of the current Copper Harbor lighthouse structure with the steel tower out front. (Lisa Gillis, June 1, 2010.)

Site Visits. As mentioned previously in addition to collecting historic information, visits were made to the current Copper Harbor, Eagle Harbor, Ontonagon, and Portage Lower Entry Lighthouse structures. Members of the Keweenaw Land Trust were also questioned about the current Manitou Island Lighthouse structure. The four lighthouses visited for this study were constructed using very similar materials although only Copper Harbor and Ontonagon were the same design.

Site Visit to Copper Harbor Lighthouse. The active steel lighthouse tower is located closer to the coastline and in front of the 1866 structure. The walls of the keeper's house and attached tower for the 1866 structure are brick, see Figure III.2. Wood can be found in the roof supports, window frames, and shutters. There is a course of limestone between the Jacobsville Sandstone foundation and the brick walls of the keeper's house. Metal is used for water drains from the roof and the roof of the lighthouse tower. Overall, the 1866 lighthouse is in excellent condition although some of the bricks on the front of the tower are spalling off.

Personal Communications about Manitou Island Lighthouse. Manitou Island Lighthouse has wooden siding and window frames. The roof is asphalt tile, and the house has a brick chimney. The tower located out in front of the lighthouse is metal. The foundation for the keeper's house is stone, see Figure III.3. The tower connects to the keeper's house only on the second floor. Work has been done by the members of the Keweenaw Land Trust and other volunteers to seal the roof and windows to protect theinterior, and to clean up the floors of the keeper's house and tower. They intend to restore the entire structure, but as of now, their efforts are concentrated in reducing the chance of further damage to the lighthouse and writing a nomination for the National Register.

Site Visit to Eagle Harbor Lighthouse. The wall, chimney, and tower of the current Eagle Harbor Lighthouse structure are comprised of brick, see Figure III.4. The foundation of

Figure III.3: Photograph of the current Manitou Island Lighthouse structure. (courtesy of the Keweenaw Land Trust, permission to use from Joe Kaplan)

there is a layer of limestone between the foundation and walls similar to Copper Harbor and Lower Portage Entry. The roof and window frames are made of wood. The only concrete visible is the poured concrete front steps, and as mentioned in the Keweenaw County Historical Society museum tour, there is also concrete poured between the exterior and interior brick walls to keep the walls from retaining moisture, see Figure III.5. The Keweenaw County Historical Society keeps the keeper's house in good condition as a museum, but the tower is maintained by the U.S. Coast Guard. The tower seems in good condition except for a few spalling bricks. Sheet metal is present on one of the basement windows, and the railing and lighthouse tower stairs are cast iron.

Figure III.4: Photograph of the current Eagle Harbor lighthouse structure. (Lisa Gillis, October 11, 2009.)

Figure III.5: Photograph of the wall thickness caused by poured concrete between two layers of brick. (Lisa Gillis, October 11, 2009.)

Site Visit to Ontonagon Lighthouse. Like the Eagle Harbor Lighthouse, the walls of the current Ontonagon Lighthouse are made of brick, see Figure III.6. The interior walls, roof, roof supports, and window frames for the keeper's house are wood. The steps are poured concrete. The railing and steps in the lighthouse tower are cast iron. The foundation is Jacobsville Sandstone, and there is a layer of limestone between the stone foundation and the brick wall. This lighthouse is now in excellent condition due to the efforts of the Ontonagon County Historical Society.

Figure III.6: Photograph of the current Ontonagon lighthouse structure. (Lisa Gillis, June 14, 2010.)

Site Visit to Portage Lower Entry Lighthouse. The walls of the Portage Lower Entry Lighthouse are mostly brick. The 1970s addition to the house has wooden siding, see Figure III.7. The steps are poured concrete. The foundation is Jacobsville Sandstone, and there is a layer of limestone between the foundation and wall. One panel of the metal on the tower outside landing is stamped with "Detroit Locomotive Works," see Figure III.8.

The tower was constructed elsewhere with numbered pieces, taken down, and reassembled at the lighthouse site (Mike Ditty, personal communication 2010). The modifications made in the 1970s are clearly distinct from the historic parts of the

Figure III.7: Photograph of the current Portage Lower Entry Lighthouse. (Lisa Gillis, June 25, 2010.)

lighthouse. Many features such as the staircase railing remain the same as they were when the current house was originally built in 1870. According to the current owner, the tower has not really been modified at all as funding for repairs is not available. This is in that lighthouse is now run as a business and very few visitors come to pay for a tour (Mike Ditty, personal communication 2010).

Figure III.8: Photograph of the stamped "Detroit Locomotive Works" on the tower. (Lisa Gillis, June 27, 2010.)

Discussion

Overall, the building materials, if not the actual design, of the lighthouses appear fairly uniform for the second generation of lighthouses just as they were for the first generation. Contractors for the first generation relied heavily on local stone and wood. Once shipping became easier, contractors increasingly used brick for lighthouses. The decline of shipping on the Great Lakes and the decline of the mining industry on the Keweenaw Peninsula is the principle reason for the break up of the lighthouse boundary. The wide variety of uses and owners after the lighthouses were decommissioned causes differences in the care and/or accessibility of these structures.

By integrating the previously discussed background research with lighthouse contracts and site visits, it is possible to address how lighthouses functioned as an overlapping boundary between the maritime and terrestrial landscapes. Lighthouses facilitated the connection between the growing industries of the Keweenaw Peninsula and the shipping networks of Lake Superior. This connected the local companies to a pool of workers and to the larger market; both of which were necessary for continued mining, lumber milling, and in the case of Jacobsville, quarrying. The changes in the construction of the lighthouse boundary correspond directly to the rise and fall of the local industries.

Lighthouses as a Boundary. Lighthouses were used to illuminate the coastal area of the Keweenaw Peninsula. This can be seen in the physical placement of the lighthouses on

the landscape. Lighthouses were placed on elevated lands located close to the coast. In other words, they were located where the land meets the water, where the Keweenaw Peninsula meets Lake Superior. From the subsection on piloting, this boundary of lighthouses can be seen as continuous. In other words, lighthouses should be discussed as one continuous boundary rather than as discreet structures illuminating individual "areas" of the coast. For example, in addition to illuminating the bay at Eagle River, the Eagle River Lighthouse also functioned as a waypoint between the Ontonagon Lighthouse and the Eagle Harbor Lighthouse. This continuous lighthouse boundary lies in an area of overlap between the maritime and terrestrial landscapes.

Lighthouses such as Copper Harbor and Manitou Island were constructed due to the anticipated increase in shipping on the Great Lakes with the opening of the Soo Locks in 1855. Lighthouses were built to facilitate entry of ships into safe harbors on the Great Lakes. Without lighthouses, ships traveling on Lake Superior had difficulties and faced many dangers before reaching their appointed destination or a port of any kind. The piloting guide suggests how the ships used the lighthouses (Thompson 1869). Originally ships brought in settlers and necessities. Later ships carried a wider variety of goods and building materials. For example, they brought in the bricks used to construct the second generation of lighthouses. After the turn of the twentieth century, shipping declined with the increase in the use of railroads and roads for travel and commerce. As a result, the importance of many lighthouses declined. Only a few lighthouses in harbors of refuge such as Ontonagon continue to remain important.

Lighthouses are also part of the terrestrial landscape. Lighthouses were necessary for the establishment of industry and towns on the Keweenaw Peninsula. Without a complete network of roads or railroads, shipping was the easiest means of reaching the Keweenaw Peninsula and for receiving supplies. With the establishment of mines and logging companies on the Keweenaw Peninsula and their associated towns, new needs arose. Growing industries required an increase in workers and supplies, such as metal machine parts, to operate. The workers in town also relied on lighthouses to guide ships carrying animals and essential supplies such as food. The loss of a delivery was disastrous for a community due to the difficulty of farming in the poor soils of the Keweenaw. Once the mining companies started producing copper, they also relied on lighthouses to aid ships on their way from the Keweenaw Peninsula to market. Without this system, it would not have been possible for the companies to make a profit. With the decline of industry on the Keweenaw Peninsula, the lighthouses also declined because there was less of a need for exports of copper and less of a need for importing supplies and goods as the population left the area to find other work. For these reasons then it is evident that the lighthouses were a critical component of the terrestrial landscape.

The Changing Lighthouse Boundary. Period lighthouse contracts in conjunction with site visits to contemporary lighthouse structures illustrate how the lighthouse boundary changed over time. The contracts for Copper Harbor, Manitou Island, Eagle Harbor, and Ontonagon called for the lighthouses to be constructed from "split stone or hard bricks." However, all of the lighthouses from the 1850s on the Keweenaw were built out of some

combination of stone rubble or wood as those were locally available materials. Bricks were not available locally due to the lack of clay on the Keweenaw Peninsula, and it was still not cost effective to bring bricks in by ship. As a result, although the contractors from Ohio would probably have been quite familiar with the durability of brick and the construction methods for brick lighthouses, they were limited to using other materials available locally for the initial lighthouse structures. Later contractors did not face such limitations. Of the four second generation lighthouses visited for this project (Portage Entry, Copper Harbor, Eagle Harbor, and Ontonagon), all were constructed of brick. Ships most likely brought bricks to the sites when new lighthouse structures became necessary. The bricks for the Copper Harbor and Ontonagon lighthouses are Milwaukee Cream City bricks that are only manufactured in the Milwaukee area. The use of Milwaukee bricks might suggest that the same contractor was responsible for the construction of both lighthouses, although the contracts for the second generation of lighthouses still need to be reviewed in order to confirm this fact. The other two lighthouses are built out of common red brick. Common red brick was manufactured in a variety of areas across the United States wherever red clay was present.

The materials were not the only part of the boundary to change over time. The location of the lighthouses also changed. According to the contracts, the Collector of Customs in Michilimachinac designated the land upon which the lighthouses were to be built. The contractors themselves were not from the Keweenaw Peninsula and possibly not familiar with the local area prior to the contract work. Charles Rude, who built the Copper Harbor Lighthouse, was from Sandusky, Ohio (1847 Copper Harbor Lighthouse

Contract, National Archives, Record Group 26). George Witheril, who built the Manitou Island and Eagle Harbor Lighthouses, was from Cleveland, Ohio (1849 Manitou Island Lighthouse Contract, National Archives, Record Group 26; 1850 Eagle Harbor Lighthouse Contract, National Archives, Record Group 26). William Flehittenden, who built the Ontonagon Lighthouse, was from Detroit, Michigan (Ontonagon Lighthouse Contract, National Archives, Record Group 26). It is uncertain the degree of experience the contractors had with lighthouse construction prior to their building lighthouse structures on the Keweenaw. As previously mentioned, the contractor for the Portage Lower Entry Lighthouse mistakenly built the lighthouse structure on land not owned by the government (Mike Ditty, personal communication 2010). The government usually purchased lands for lighthouses ahead of advertising for bids, so this example may suggest the contractor's lack of familiarity with the landscape or simply the complexities of having so many different parties involved in the lighthouse construction process.

The second generation of lighthouses has probably weathered better at least in part due to the difference in their locations when compared to the first structures. Many of the initial lighthouse structures began to crack or lean due to problems with sinking foundations. This occurred because the lighthouses were located too close to the shoreline. Most of the later lighthouse structures were built farther back from the coast than the initial structures although the Ontonagon Lighthouse was simply built beside the original structure (Ontonagon County Historical Society 2004). In this case, the new construction location also had the added benefit of allowing the old lighthouse to continue functioning until the new lighthouse was completely finished. It is possible that

this also gave the contractors for the second lighthouses more time, as well as easier access to materials, which allowed for the construction of better lighthouses the second time around.

Chapter IV: Suggestions for Further Work and Concluding Remarks

Suggestions for Further Work

This study could be furthered by more detailed work about the lives of the different contractors and companies that would provide more information for the specific case of the Keweenaw Peninsula. It would also be interesting to know how similar kinds of studies would play out in other regions of the country, throughout America, or in other countries.

An attempt was made in this study to locate personal histories for the individual contractors mentioned in the contracts from the National Archives in Washington D.C. This information would have added more detail to the construction histories of the specific case studies and possibly have provided a clearer connection between contractors and engineers. Internet research and contact with the local historical societies in Sandusky, Ohio and Detroit, Michigan (selected because the contracts mention those locations in association with the contractors) produced inconclusive results. Although in one case an individual of the same name was located (Charles Rude), no mention was found of his actual work on lighthouses. The Sandusky Historical Society found an obituary in which the deceased was the son of Charles Rude. The obituary mentions that Charles Rude owned a hotel. No further information could be obtained on this individual, including any role he might have played in lighthouse construction or his knowledge of construction in general.

Once it was realized that contracts for the second lighthouse structures would aid this study, a request was filed with the National Archives in Washington D.C. for these contracts. However, the contracts were never received. The second series of contracts would have allowed for a more complete integration of the site visits into the idea of construction practices and the changing lighthouse boundary. An attempt was also made to contact a private researcher who worked previously with the Keweenaw Land Trust on the Manitou Island Lighthouse. Because a visit to the National Archives was not feasible due to lack of funding, it was hoped that the researcher would be able to locate the actual letters to the Lighthouse Board about lighthouse construction and/or drafts of the bids which the Lighthouse Board sent to newspapers. The letters would provide further insight into the actual process of construction, and the bids would illustrate who was being targeted for lighthouse construction and where and how bids were called for. The present study would benefit from such information, and any further study would need to include this information.

An attempt was also made to research the Detroit Locomotive Works using online resources. Although information was found regarding the history of the works, no further information regarding their work on metal for lighthouses was discovered. It would be of interest to discover the kind of connection, if any, between specific companies that manufactured lighthouse parts and materials and the individual contractors. It is possible that this information would be located in company records of transactions or could be found in information about the work of the individual contractors.

Concluding Remarks

Although general coffee table books of lighthouses and specific case study books of lighthouses provide information about individual lighthouses, this study pulls six lighthouses built in a similar location at a similar time into one framework. As the excerpts from the piloting guide demonstrate lighthouses must be understood as a unified boundary. This perspective more accurately mirrors the historic perception of lighthouses than studying them as individual landscapes. Considering lighthouses as individual sites is a more modern perspective possibly caused by the variety of uses for lighthouses after being decommissioned. In other words, the lighthouses have changed from being viewed as an overlapping boundary to being isolated locations. Understanding the lighthouses as they functioned between industry and shipping requires reconsidering lighthouses as a unified boundary that linked coastal margins as a continuous band that integrated maritime and terrestrial landscapes.

A detailed look at the importance of lighthouses for bringing in people and supplies to support the industries and their importance for removing the copper to market demonstrates that lighthouses were essential to the development of industry on the Keweenaw Peninsula. Therefore, the lighthouse boundary is an important part of the industrial heritage of the Keweenaw. The decline in shipping on the Great Lakes after about 1910 coincides with the increased use of railroads for interstate commerce. This general decline was aggravated by the decreasing profitability of mining in the area due to the difficulties of getting copper out of the deep mines. The interplay between

shipping on the Great Lakes and the industry of the Keweenaw ultimately led to changes in the lighthouse boundary.

Once other construction materials such as brick could be easily brought to the lighthouse sites at a lower cost by ship, it seems from the lighthouse visits and background information that the contractors favored this material for the main lighthouse structure although cast iron (for pieces of the tower like the stairs) and wood (for the house interior) were still important materials. The use of local materials for the construction of the original lighthouse structures as noticed from the historic background research was primarily due to convenience and cost to the detriment of permanence. The contractors for all structures regardless of the time they were working were restricted to the design, created by the Lighthouse Board engineers, which was drawn without regard for the actual area in which the lighthouse was to be placed. Although modifications to construction technically required a new contract, it appears that the contractors modified the terms of the actual contract at times during the actual construction of the first generation of lighthouse structures by reducing the height of the tower or by using wooden materials for either the tower or the keeper's dwelling.

Lighthouses are an important part of the industrial heritage of the Keweenaw Peninsula. Their decline marks the decline in shipping Lake Superior and the decline of industry on the Keweenaw. Treating lighthouses as an overlapping boundary between the maritime and terrestrial landscapes shows the interplay between the decline of industry on the peninsula and the reduction of shipping in the area. Looking at this interplay also allows us to examine how the lighthouse boundary changed and explains

how lighthouses eventually came to be considered as separate entities rather than one single system. This study provides a framework for reintegrating lighthouses into their original system. Discussing the contractors and the building materials ties the construction of the lighthouses themselves back into the history of the Keweenaw and allows one to examine lighthouses as ever dynamic components of the Keweenaw Peninsula.

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Appendix A

Section A-1: Transcript of Contract for First Copper Harbor lighthouse structure.

Contract for building Copper Harbor Light House dated August 21st 1847.

This Agreement made the twenty first day of August in the year one thousand eight hundred and forty seven between Charles Rude of Sandusky City in the State of Ohio of the first part and Samuel K. Haring, Collector of the District of Michilimachinac, in the State of Michigan of the Second part Hitnessetty,

That the said party of the first part for and in consideration of four thousand eight hundred Dollars to fee paid to him by the said party of the second part upon the Completion and approval by the party of the second part and delivery to the party of the second part by the party of the first part of the Light House Dwelling House and appurtenances herein after set forth and specified doth covenant and agree to build, furnish, and deliver the same as follows: It shall be built upon such spot as the party of the second part shall designate at Copper Harbor in Lake Superior and State of Michigan of the following materials, dimensions, and descriptions. The Lighthouse to be built of split stone or hard bricks, the form round, the foundation to be sunk three feet, or as much *(end page 105)* deeper as may be necessary to make the fabric secure to be built up solid, and laid in good lime mortar. The Tower to be sixty five feet high from the surface of the ground, the diameter of the base to be twenty five feet and that of the top twelve feet, the thickness of the walls at the base to be five feet and to be uniformly graduated to two feet at the top. The top to be arched on which is to be laid a deck of soap stone or other stone of a proper quality fourteen and a half feet in diameter and five inches thick and joints filled in with white lead. On one side of the Deck to be a scuttle door to enter the lantern twenty four inches by twenty inches, the scuttle door an iron frame covered with Copper, the outside wall is to be powted with Roman Cement and Whitewashed twice over there are to be six windows in the Tower, of twelve lights each of ten by eight glass in strong frames and a door of five feet by three feet made of double inch boards cross nailed with substantial hinges, lock and latch the ground floor to be paved with brick or stone.

A sufficient number of circular steps to lead from the ground floor to within six feet of the lantern connected by a center sash the stairs to be made of yellow Pine clear of Sap and well seasoned, the stairs and floor to be two inch plank (planed). From the top of the stairs to the entrance of the scuttle to be an iron ladder with steps two and a half inches square.

On the top of the tower to be an iron lantern of an Octagon form the posts to be two inches square, to run down five feet into the stone or brick work and secured with Anchors. The height and *(end of page 106)* diameter of the lantern to sufficient to admit an iron sash in each octagon to contain fifteen lights fifteen by twenty four glass with a tier of Copper panes at bottom the rabbets of the sashes to be three quarters of an inch deep and glazed with double plate glass. On one of the octagons to be an iron framed door covered with copper four feet by two in the clear, to be shut tight into the rabbets with a strong twined button, The top to be a dome formed by sixteen iron rafters concentrating in an iron hoop five inches wide nine inches diameter, covered with copper thirty two ounces to the square foot which is to come down and rivet in the piece that forms the top of the sash which is to be three inches wide. On the Dome to be a traversing ventilation two and a half feet long and fifteen inches diameter to which is to be secured a copper vane three feet long and twenty inches wide. The ventilation and pane to be framed with iron covered with Copper and painted black.

Around the lantern to be an iron railing, the frosts of which to be one and three eights of an inch square connected by three railings three quarters of an inch square the upper one to be four feet from the deck. The lantern and wood work of the Tower to be painted twice over with white lead except the dome which is to be black, lantern white inside.

The Light House to have a complete electrical conduction made of Copper three quarters of an inch in diameter with an improved electrical point to be substantially secured with proper bolts and stays to base tower and dome to extend in height at least four feet above the top of the ventilation or vane, and in depth at least four feet into the

earth forming an oblique angle from the perpendicular of the foundation of the Lighthouses.

The Dwelling House to be of split *(end of page 107)* stone or hard brick thirty four feet by twenty from out to out one story of eight feet in the clean divided into two rooms with an entry between, the stairs to lead to the chambers and the cellar to be in entry. A Chimney with a fire place in each room with iron or stone backs or sides, a cellar under the whole of the house, with sufficient walls of stone to support the walls of the house which are to be twenty inches thick the whole laid up in strong lime mortar and to be well painted. The roof to be rectangular, the boards of which to be jointed and halved, the roof joists to be not less than eight inches by three at the ridge and three inches by seven at the foot with collar beams seven inches by three, the joists to be placed not over two feet apart to be well secured and covered with first quality shingles. There are to be three windows in each room, of sixteen lights of eight by ten glass each, and one of the same dimensions in each Chamber. The Doors to be four paneled with first quality hinges and thumb latch to each a good lock on the outside Door with a bolt and thumb latch to the back passage Door. A closet in each room with a good lock on it, all the floors to be doubled and well nailed. The joists of the first floor to be twelve by three inches, and of the second to be ten by three inches square to be laid not exceeding two feet apart.

Also a kitchen attached to the Dwelling House fourteen feet by twelve in the clear the walls of stone or brick eight feet high with double floors the joists of the first floor to be twelve by two inches and of the second two by three inches square, two windows and one *(end of page 108)* Door besides a door to communicate with the dwelling house a chimney with a fireplace and sizeable oven with an iron door, iron crane, trammel and hooks in the fire place and on one side of the chimney a sink with a spout leading through the wall.

Also an out house or privy at a convenient distance from the dwelling of stone or brick five feet by four in the clear, with a well at least eight feet deep, walled up with stone or brick, the roof to be well shingled.

Also a well to be sunk of such depth as to procure good water, at a convenient distance from the house to be stoned or bricked up and furnished with a pump or with a curb, windlass and an iron chain, and a strong iron hooped bucket.

All the wood work of the Dwelling house, kitchen and outhouse to be painted with two coats of good paint exclusive of priming.

The inside walls and ceilings to be lathed and plastered and furnished in a plain neat style gutters of double tin to lead round the dwelling house and kitchen with shouts of same material to carry off the rain water. All the lumber used to be of well seasoned heart pine, consequently entirely free from sap.

Above and below each window from of the Light House must be single stone of sufficient dimensions to reach from out to out of the frame and extend inwards the whole thickness of the wall. And in building up the walls if of stone there must be an entire range of thorough stones every three feet besides that in the intermediate space the stones must tie.

The Light House is also to be fitted up in the same manner that the Light-houses of the United States have been fitted up by Winslow Lewis with thirteen patent lamps, and thirteen fourteen inch reflectors. Reflectors to be *(end of page 109)* made in dies or moulds as done by Winslow Lewis and by Hooper and Co of Boston Massachusetts each reflector to have six ounces pure silver and to furnish two share lamps and reflectors double tin oil baths to hold five hundred gallons of oil one lantern canister and an iron rivet, one stove and one funnel one tin wicks box one tin tube one oil carrier one oil feeder six wicks formers one hand lantern aid lamp two tube cleaners one glaziers diamond, two files and two pair of scissors.

The whole to be completed in a workman like manner by the first day of July next, subject to the approval of the Collector of Michilimackinac or of such persons as he shall appoint for that purpose.

And the said party of the second part as Collector as aforesaid does covenant and agree for himself and his successors in office to pay to said party of the first part upon the

completion approval and delivery of all the works specified the sum of four thousand eight hundred Dollars aforesaid.

In Witness where of the parties to these presents have hereinto set their hands and seals the day and year first above writing.

In the presence of Clinton Haring as to Charles Rude. *Signed* Sam K Haring and Charles Rude *(end of page 110)*

Section A-2: Transcript of Contract for First Manitou Island lighthouse structure.

Contract for Building Light House on Manitou Island Lake Superior.

This agreement made this twentieth of May in the year one thousand eight hundred and forty nine between George Metherell of Cleveland in the state of Ohio of the first part and Samuel K. Haring Collector of the District of Michilimackinac, in the State of Michigan of the Second part witnesseth:

That the said party of the first part for and in consideration of the sum of Seven thousand two hundred and eighteen Dollars to be paid to him by the said party of the second part upon the completion and approval by the party of the second part and delivery to the party of the second part by the party of the first part of the Light House Dwelling House and appurtenances hereinafter set forth and specified doth covenant and agree to build furnish and deliver the same as follows. It shall be built upon such spot as the party of the second part shall decynate at Manitou Island. Lake Superior in the state of Michigan of the following materials dimensions and description to ___. The Light House to be build of split stone or hard bricks, the former round, the foundation to be sunk three feet deep or as much deeper as may be necessary to make the fabric secure to be built up solid and laid in good lime mortar. The Tower to be sixty five feet high from the surface of the ground, the diameter of the base to be twenty five feet and that of the top twelve feet, the thickness of the walls at the base to be five feet and to be uniformly

graduated to two feet at the top, the top to be arched on which is to be laid a deck of soap stone or other stone of a proper quality fourteen and a half feet in diameter and five inches thick and joists filled in with white lead on one side of the deck to be a scuttle door to enter the lantern twenty four inches by twenty inches, the scuttle door an iron frame covered with copper the outside wall is to be painted with Roman cement and white washed twice over there are to be six windows the Tower of twelve lights each of ten by eight glass strong frames and a door of five feet by three feet made of double inch boards nailed with substantial hinges *(end of page 340)* hinges lock and latch the ground floor to be paved with brick or stone. A sufficient number circular steps to lead from the ground floor to within six feet of the lantern connected by a center part, the stairs to be made of yellow pine clear of sap and well seasoned the stairs and floors to be two inch plank (planed) from the top of the stairs to the entrance of the scuttle to be an iron ladder with steps two and a half inches square.

On the top of the tower to be an iron lantern of an Octagon form the gaists to be two inches square to run down five feet into the stone or brick work and secured with anchors the height and diameter of the lantern to be sufficient to admit an iron sash in each Octagon to contain fifteen lights fifteen by twenty four glass with a tier of copper panes at bottom, the rabbets of the sash to be three quarter of an inch deep and glazed with double plate of glass.

In one of the Octagons to be an iron framed door, covered with copper, four feet by two in the clear, to be shut tight into the rabbets with a strong turned button. The top to be a dome formed by sixteen iron rafters concentrating in an iron hoop five inches wide, nine inches diameter, covered with copper thirty two ounces to the square foot, which is to come down and rivet into the piece that forms the top of the sash, which is to be three inches wide.

On the dome to be a traversing ventilator two and a half feet long and fifteen inches diameter to which is to be secured a copper vane three feet long and twenty inches wide. The ventilator and vane to be vane framed with iron, covered with copper and painted black. Around the lantern to be an iron railing, the parts of which to be one and

three eights of an inch square, connected by three railings three quarters of an inch square the upper one to be four feet from the deck. The lantern and wood work of the tower to be painted twice over with white lead, except for the dome, which is to be black; lantern white inside.

The light house to have a complete electrical conductor, made of copper, three quarter of an inch in diameter, with an improved electrical point=to be substantially *(end of page 341)* substantially seemed with proper bolts and stasys to base tower and dome-to extend in height at least four feet above the top of the ventilation on vane, and in depth at least four feet into the earth, forming an obtuce angle from the perpendicular of the foundation of the light House. The dwelling house to be split stone or hard brick thirty four feet by twenty from out to out, one story of eight feet in the clear, divided into two rooms with an entry between the stairs to lead to the chambers and the cellar to be in the entry. A chimney with a platform in each room, with iron on stone backs and sides. A cellar under the whole of the house, with sufficient walls fo stone to support the walls of the house which are to be twenty inches thick; The roof to be rectangular, the boards of which to be jointed and halved, the roof joists to be not less than eight inches by three at the ridge and three inches by seven at the foah with collar beams seven inches by three; the joists to be placed not over two feet apart, to be well secured, and covered with first quality shingles. There are to be three windows in each room, of sixteen lights of eight by ten glass each and one of the same dimensions in each chamber. The doors to be four paneled, with first quality hinges and thumb latch to each, a good lock on the outside door, with a bolt and thumb latch to the back passage door; a closet in each room with a good lock to it.-All the floors to be doubled and well nailed-the joists of the first floor to be twelve by three inches and of the second to be ten by three inches square, to be laid not to exceed two feet apart. Also a kitchen attached to the dwelling house, fourteen feet by twelve in the clear, the walls of stone or brick eight feet high, with double floors the joists of the first floor to be twelve by two inches and of the second ten by three inches square two windows and one door besides a door to communicate with the dwelling house, a chimney with a fire place, and sizable oven with an iron door, iron crane,

trammel and hooks in the fire place, and on one side of the chimney a sink with a spout leading through the wall.

Also an out house or privy, at a convenient distance from the dwelling, of stone or brick five feet by four in the clear, with a well at least eight *(end of page 342)* eight feet deep, walled up with stone or brick: the roof to be well shingled.

Also a well to be sunk of such depth as to procure good water, at a convenient distance from the house; to be stoned or bricked up and furnished with a pump, or with a curb windlass and an iron chain: and a strong iron hooped bucket.

All the woodwork of the dwelling house kitchen and outhouse to be painted with two good coats of paint, exclusive of pruning. The inside walls and ceilings to be lathed and plastered and finished in a neat plain style. Gutters of double tin to lead round the dwelling house and kitchen, with spouts of same material to carry off the rain water. All the lumber used to be of well seasoned heart pine, consequently free from sap.

Above and below each window frame of the light house must be single stone of sufficient dimensions to reach from out to out of the frame, and extend inwards the whole thickness of the wall. And in building up the walls, if of stone, there must be an entire range of thorough stones every three feet, besides that in the intermediate spaces the stone must tie.

The Light House is also to be fitted up in the same manner that the Light houses of the United States have been fitted up by M. Winslow Lewis with thirteen patent lamps and thirteen fourteen inch reflectors-reflectors to be made in dies or moulds as done by Winslow Lewis or by Hooper and company of Boston Massachusetts,-each reflector to have six ounces pure silver and to furnish two spare lamps and reflectors double tin oil butt to hold five hundred gallons of oil-one lantern canister and an iron trivet one stone and one funnel, one tin nick box, one tin tube box, one oil carrier and oil feeder, six nick famers, one hand lantern and lamp two tube cleaners, one glaziers diamond two files and two pair of scissors.-The whole to be completed in a good and nonkmanlike manner by the first day of December next subject to the approval of the Collector of Michilimackinac or of such person as he shall appoint for that purpose. And *(end of page*

343) And the said party of the second part as Collector of Customs and Superintendent of Sights as aforesaid does covenant and agree for himself and his successor in Office to pay said party of the first part upon the completion approval and delivery of all the will specified within the time above specified the sum of Seven thousand two hundred and eighteen Dollars aforesaid.

In witness whereof the parties have hereunto set their hands and seals the day and year first above written. In presence of C. E. Avery. Samuel K. Harind Sup. Of Lights, George Witherall. *(end of page 344)*

Section A-3: Transcript of Contract for first Eagle Harbor lighthouse structure.

Eagle Harbor. Michigan.

George Witheril-Contract for building Lt. House
This agreement made this eleventh day of July in the year one thousand eight hundred and fifty between George Witheril of Cleveland, Cuyahuga County Sate of Ohio of the first part and Charles E. Avery Collector of the Customs for the District of Michilimackinac in the State of Michigan, of the part and behalf of the United States of America of the second part. Witnesseth, that the said party of the first part, for and in consideration of the sum of Three thousand Eight hundred and ninety five dollars, to be paid to him, the said party of the first part, by the said party of the second part, upon the completion and approval by the said party of the second part, and delivery to the said party *(end of page 47)* of the second part by the party of the first part of the light house and dwelling, and appurtenances herein after set-forth and specified doth covenant-and agree to build furnish and deliver the same as follows: It shall be built-upon such spot, as the party of the second part shall designate at Eagle Harbor, Lake Superior, of the materials dimensions and description. The dwelling to be of hard bricks or stone, thirty six feet by twenty feet; one-story, eight-part-in the clear divided into two rooms with an

entry between eight feet wide; walls to be twenty inches thick, and laid strong lime mortar. A cellar to be under the entire house, six feet in the clear; walls of the same to be twenty thick built of stone and wall laid in strong lime mortar. Roof to be rectangular, covered with good seasoned boards, and shingled with shingles of the best quality. Two center rafters to be timbers seven inches by seven inches square for the posts of the tower to barbon; The remainder three inches by six inches----A chimney at each end of the house, fireplaces in each parlor. Three windows in each parlor sixteen lights ten by eight-in each. One in each gable and window lights each eight-by ten. The attic to be divided into two chambers with a space between eight feet wide, chambers to be finished lathed and plastered, parlors to be lathed and plastered, stairs to lead from the entry into the chambers, closet in each parlor back of the stairs. All the floors to be laid double and wall nailed to be four windows in the cellar, six lights, eight by ten each and a door to lead out side; stair to lead from the cellar into one of the rooms. Attached to the house to be a kitchen, fourteen feet by twelve feet in the clear, floor to be on a level with the floor of the house to be two doors, one to lead outside, and one to lead into one of the rooms in the house; two windows twelve lights each eight-by ten inches lathed and plastered; floor laid double. A chimney with a suitable fireplace, Crane, trammel and hooks; A chimney with a suitable fireplace Crane, trammel and hooks on one side of the chimney to be an oven with an iron door: On the other side a sink with a trunk to lead through the wall to carry off the water closets in the rooms to be lathed and plastered, with sheves and locks on the doors; all the doors to be four panels; the front door is to have frieze lights; all the doors to have good hinges and Ruog locks.-steps to lead from the ground to under the sill of front door, with a railing on each side: the kitchen door to open on a platform twenty feet by thirteen feet, supported by twelve pieces of timber five inches square set in to *(end of page 48)* the ground, on the head of which to be laid four by four prists, covered with two inch mauk spiked down, the top of the peak to be on level with the under part of the sill of door, Around the platform to be railings, six inches wide, and three feet high, except a space of three feet wide, in which to to be a gate hung with hinges and a latch; steps to lead from the gate to the ground with a railing. On the center of the house, to be

an Octagon tower thirteen feet high above the walls of the house, Eight feet diameter the posts to be seven inches square, tenonad into the beams of the house which are to be eight inches square, wall secured with girths and braces the former to be four inches by six inches: to be brief pillars under the beams of the tower floor and joists four by four framed into the buance of the lower floor to those of the upper to support the tower; the outside of the tower to be boarded and shingled, above the roof round the tower where it connects with the roof of the House, to be well evllure with lead; One window in the tower, nine lights eight by ten inches On the top of the tower to be a framed Octagon deck Three feet diameter timbers six by seven inches square, secured to the top of the post by mortice and tanoris, the havie of the deck to be covered with two inch plank spiked down, the joints wall eaulkad with oakurn and covered with white lead. The deck coppered with twenty two ounce copper wall nailed down. On one side of the deck to be a scuttle to enter the lantern as large as the space between the timbers of the deck will admit, scuttle door and rabbits to be covered with copper source as the deck. Stairs to lead from the attic story of the house, to the entrance of the scuttle. The inside of the tower to be either lathed or plastered, or lined up with boards primed and jointed tongue and piowad.

On the tower to be an iron lantern of an Octagon form, the height and diameter sufficient to admit six lights, twenty four by fifteen inches in each Octagon. A post one and one half inches square to pass through the deck three feet and bottad on the post of the tower. Rabits of the sashes to be three quarters of an inch deep, glazed with the best French plate glass, be fastened to the sash with strong lead pines, except the tower tie which is to be filled in with copper, with ventilator and slides to close in each Octagon, in one of the Octagons to be an iron frame door four feet by two covered with copper to shut tight into the rabbits with two strong turn buttons. The dorm to be formed by sixteen iron rafters concentrating into an iron hoop five inches wide, nine inches diameter, covered with copper thirty ounces to the foot which is to come down and rivet to the piece that forms the top of the sash. On the top of the Dorm to be a traversing ventilator fifteen inches high and twelve inches Diameter on which is to be secured a raw two feet long

and one foot wide—Ventilator and Vane covered with *(end of page 47)* covered with copper, round the lantern to be an iron railing, posts one and one fourth inch square, three rails three quarters of an inch square. The house to have one electrical rod made of copper. Three fourths inch bolt, to run up the foot above the vane, and two feet down into the ground secured to the building with copper staples. All the wood work of the house including floors, roof And tower, and the iron and copper work of the lantern to be painted three coats. The lantern to be fitted up with eight lamps and Eight fourteen inch reflectors made in mould or die as done by Winslow Lewis and by Mesus. Hooper Meo of Boston, in the same manner and the reflectors to be of the same form and focus as the United States lighthouses have been fitted……by Winslow Lewis: Each reflector to have on it six ounces of silver—The light House to be furnished with two spare lamps four double tin oil canisters to hold Eighty gallons each painted two coats. Lantern, canister and trivet, tin wick box, tin tube box, hand lantern and lamp oil feeder Torch, six wick formers, two pair Seipors, two files and one glaziers diamond. Also a privy six four feet boarded, clap-boarded battened door with hinges and latch—With suitable vault and woodwork chepad for painting and well finished inside.

No pay must to be made to the party of the first part until the whole is completed and the same inspected and approved by the party of the second part, or such person as be the said party of the second part may appoint for the purpose. The Whole to be completed in a good and workmeanlike manner by the fifteenth day of October next.--- And the party of An Second part-as Collector and As aforesaid does covenant and agree for himself, And his Successors in Office, to pay the said party of the first part upon the completion approval and delivery of all the work Specified within the time above specified the sum of three Thousand Eight-hundred and ninety five dollars.----

In Witness Whereof the…….parties have here unto set their hands, the day and year first above written.

In presence of T. J. Birehard

George Witherell, Charles E. Avery Collector District of Michilimacinac Office of Sup. of Light, April 11, 1857.

This certifies that the written contract has been substantially and faithfully fulfilled on the part of the contractor. Charles E. Avery Sup. of Lights *(end of page 50)*

Section A-4: Transcript of Contract for first Ontonagon lighthouse structure.

Contract Wm. Flhittenden Light-House and dwelling, conjoint, Ontonagon River, Lake Superior

This Agreement made this twenty first day of July in the year of our thousand eight between William Flehittenden of Detroit in the state of Michigan of the first part-and Charles E. Avery, Collector of the Customs for the District of Michilimackinac in the State of Michigan of the Second Part:

Witnesseth, That the said party of the first part for and in consideration of the sum of Four thousand Eight hundred dollars to be paid to him by said party of the second part upon the Completion, and approval by the party of the second part and delivery to the party of the second part, by the party of the first part, of the Light House and dwelling House, united, and appurtenances hereinafter setforth and specified, doth covenant and agree to build, furnish, and deliver the same as follows, It shall be built upon such spot as the party of the second part shall designate at Ontonagon River, on Lake Superior, of the following materials, dimensions and Specifications towith, The building is to be thirty Eight by twenty on the outside. The exterior walls of the House are to be constructed in the rubble masonry, of the Stone of the lcountry or of hard brick, and the interior walls and walls of the Tower of hard brick all laid in the best hydraulic cement mortar.

Under the whole house is a cellar, if of stone, are to be sixteen inches thick; bur if of hard brick only twelve inches thick The cellar floor is to be paved with best quality hard paving brick Door may to enter the cellar from the out-side of the building with Steps to go down, a stone curb around it, and bulkhead oven *(end of page 167)* to protect

it against storms. There will be two windows of six lights each, Eight by ten glass in the Cellar.

The walls of the House are to be carried up 9 ¼ feet above top of entrance Story floor, when the flooring timbers of of the Attic flooring will be laid on, then carried up three feet to the plates where irovill aceive the rafters. Chimneys of each and are of M luck to have a fireplace, the outer hearth and flue with proper funnel pipe for a cooking stove in the entrance Story; One fireplace in one attic chamber, and a funnel pipe for a stove in the other.

The entrance Story is divided into two rooms with an entrance, vestibule, Stairing of Eight feet between them. The Stairs lead from the entrance vestibule to the Attic and Lantern; And under them are the stairs leading from the kitchen to the Cellar. The pace back of the Stairway is divided into two Closets, One opening to each room and to be finished, with shelves and other necessary conveniences.

The Attic is divided into two Chambers, with the Tower and Stairway between them. In front of the Stair way is a Closet opening into it, and in rear are two recesses, one opening into Each chamber. The lower flooring joists are to be three by Eight inches, fifteen inches apart, and doubled as trimmers and as trimming joist-at-the sides of the hearths and other openings, the attic flooring to be the same.

The ridge of the roof to receive the upper and of the rafters is to be a cruss of seven by seven inches timber of sufficient depth and strength to support the roof.

The roof is to be rectangular and have one third fertich, the rafters are to be three by four inches, two feet apart rising on the plates and ridge, covered with good seasoned inch boards, milled, jointed, and matched, and well nailed on. It is to be covered with the best quality of Warrantent Jaine shingles, nailed on, secured by the best copper or composition nails. The Centre of the building is to be a Circular Tower Eight feet in diameter on the inside built and a proper foundation twenty inches wide and two deep below the Cellar floor, and up to three above the ridge of the House, and there received Stone coping of one foot rise and ten inches projection of proper width. Its walls are to

be one foot thick, and connected with the other walls by brick partition walls eight inches thick.

In the walls to be proper openings for doorways And for one window in front above the roof of six Lights *(end of page 168)* _____ by twelve inches. The openings will have to be secured by arches turned over them, and extra Security given to the walls by the insertion of nail plate in the joints of the Masonry at proper intervals and paces.

The upper end of the Tower forming a deck for the Lantern to rest apron, is to be arched over leaving a proper sized opening for a Scuttle to enter the Lantern. The arch is to be a domical arch of twenty inches rise its thrust to be fully counteracted by an iron bar loop 1 ¾ inches square, let into the brickwork at a proper height. The arch is to be right eight inches thick at the crown, and the deck is to have a pitch of six inches from the center down to the front edge of the coping or cornice of the Tower.

The deck is to be covered with twenty ounce copper sheathing, laid on a proper surface prepared by covering the brick work with boarding 1 ¼ inch thick nailed to the timbers let into the brickwork of the Tower and secured to it.

This boarding to be covered with sheathing paper thoroughly saturated with and laid down in Tar, on this the copper sheathing is to be secured in a thorough manner with copper or composition nails, And also to the front edge of the stone coping in the most efficient manner, the Scuttle door to be covered with copper sheathing and made tight and secure.

The Tower and Chimney will be collared with lead and properly secured with lead or zinc fastenings. There will be three windows in each room of the entrance Story, and one in each of the Chambers, twelve lights each of nine by twelve Cylender glass, the outside door in front will be three feet four inches, by seven feet, 1 ¼ inch thick four panels. In the entrance Story are five inside doors, two feet eight inches by seven feet 1 ¼ inch thick four panels. In the Attic Story are two doors two feet six inches, by six feet six inches, one inch thick four panels, and one to Closet, two feet four inches wide, and as high as roof will admit, on the front door will be a Lock, and on all the doors good hinges Latches, bolts and fastenings. The stair way and eropwalls above the cellar are to

be fastened on the walls; and the use of the building above the cellar; together with the porch, is to be furred, lathed and plastered, and finished in a decent manner, all the floors to be laid double, the upon one of the Southern pine, Stems of Southern pine, are to be constructed from the entrance to the Lantern, and from the Kitchen to the cellar in a proper manner. There are *(end of page 169)* to be stone steps to the front door, also to the outside door of porch Attached to the back of the House is a frame porch ten by twelve feet with a lean roof boarded and shingled.

There are to be gutters to all the eaves, with trunks to lead the water into the Cisterns.

All the woodwork of the House except the floors, to be painted-three coats best quality of paint; floor and stairs oiled with linseed oil. On the top of the Tower is to be wrought iron Lantern, sufficient-in height-and diameter to contain Sixty Lights in each Octagon Sixteen by twenty four inches, and two copper panes, twelve by sixteen inches. The four of the copper panes, Ventillators are to be constructed to adjust the Air, when required and to keep out the water. There are to be Lantern posts 1 ½ inches square, to run down through the deck and arch to be lightly secured by bolts to the inside of the Tower. To these are secured in a proper manner the iron sash with rebates of three fourths of an inch in depth. A door two by four feet is to be made on one side of the Octagon, and which is to be glazed Tpartly covered with copper if required, and made to shut-tight into rebates, having two strong turn buttons and handle.

The top of the Lantern is a dome formed by sixteen rafters of iron concentrating into an iron loop, twelve inches diameter five inches and one half inch thick at top, and at the bottom secured to top rail of Lantern, which is covered with thirty two ounce copper coming down and witting to the top rail of Lantern or sashes which is three inches wide and forms a favorable termination treit. On the top of this dome is a traversing ventilation and vane covered with copper. Ventillation fifteen inches diameter, twenty inches high, vane thirty inches long twelve inches wide. Around the Lantern are to be eight iron railing posts, one and one eight, standing off twenty two inches from the outside of the post of the Lantern; the tower end to be fastened securely to the deck and at the top secured to the Lantern, two railings, three fourths inch round iron, are to go quite

around through these posts. Aerop the base of the dome is to be an iron bar one inch square; riveted to the copper bar of Sash. The Lantern to be glazed with best French Paris made plate glass, one fourth of an inch thick. No pane less than three sixteenths of an inch thick allowed to be put in. *(end of page 170)* The lantern to be painted, three coats black outside and white inside.

A copper electrical rod five eights of an inch diameter is in sun up two feet above vane and from thence down to, and two feet into the ground. To construct an out-House five by four feet, walls to be inch boards milled jointed and matched, the roof boarded and shingled, The inside furnished with proper seals __. If good water cannot be conveniently obtained by means of a well, a brick cistern to be built to hold not less than Eight-hundred gallons; the sides and bottom to be one foot thick inside courses to be laid in Roman Cement, and the whole inside surface of the Cistern to be Plastered with the same.

The Light House is to be fitted up with six Lamps, ___ six fourteen inch reflectors, on two circulars made in a mould or die, such as made by Mesers Harper and Co and Hamminway of Boston, in the same manner and of the same form and focus, each reflector to have on it six ounces of pure silver. The Light-House to be furnished with four double tin oil butts, to hold Eighty gallons each; Two spare Lamps, spare inside iron tubes, lantern canister and iron trivet; tin wick and tube boxes, three gallon oil carrier, oil feeder and hand Lantern and lamp wick trimmer six wick formers, two pan Scepors, two plyers, two files and glaziers diamond. The whole to be approved by the superintendent.

No payment to be made until the whole is completed in a good workmanlike manner, of best materials, and the entire work to be completed by first day of October next, subject to the approval of the Collector of Michilimackinac, or such person as he shall appoint for the purpose. And to be constructed in accordance with the plan and drawing of the same, on file in this office.

And the said party of the Second part as Collector as aforesaid does covenant and agree for himself and his Successors in office to pay said party of the first part upon the completion approval and delivery of all the work specified the sum of Four thousand

Eight hundred dollars. In Witness whereof the said parties have hereunto set their hands and seals the day and year first above written.

In presence of J.T. Burchard, John M. Reynolds; Charles E. Avery Sup. Of Lights, Wm F. Lhittenden.

District of Michilimackinac, Collectors office December 1, 1807. This certifies that the foregoing contract has been substantially fulfilled on the part of the contractor. Charles E. Avery Supr. Of Lights.

Appendix B

Section B-1: Blank survey sheet.

Lighthouse Site Survey Form
Last Update: 10-4-09
By: Lisa Gillis

LIGHTHOUSE SITE SURVEYED:
DATE OF SURVEY: **SURVEYOR:**
LIGHTHOUSE LOCATION:

DATES OF BUILDING AND REBUILDING:

EXTANT BUILDING MATERIALS:

-WOOD:__YES/NO
-WHERE:

-BRICK:__YES/NO
-WHERE:

-CONCRETE:__YES/NO
-WHERE:

-STEEL:__YES/NO
-WHERE:

-OTHER:

HISTORIC BUILDING MATERIALS:

CONTEXT INFORMATION:

RECONSTRUCTION/PRESERVATION:__YES/NO
-WHERE:

Section B-2: Blank photo notes sheet.

Photo Number	Site	View/Description	Flash	Number of Takes

Eagle Harbor Photo Notes
Date:
Photographer:
Recorder:

Appendix C

Section C-1: Copper Harbor Lighthouse State Historic Register Form (permission to use from MTU archives)**.**

County Keweenaw

MICHIGAN HISTORY DIVISION
Michigan Department of State

Theme(s) EC TECH: Tran

INVENTORY FORM

X STATE REGISTER SITES
~~(Michigan Historical Commission Meeting)~~

____ NATIONAL REGISTER NOMINATION REPORT
(State Historic Preservation Review Board Meeting)

Name of Site (Common) Copper Harbor Lighthouse

(Historic) ~~Copper Harbor Lighthouse~~

Address: Street and Number Fort Wilkins State Park

City/Town Copper Harbor Zip

Significant Dates (construction, cornerstone event, etc.) 1866-1867, 1933

Significance/Description
The Copper Harbor Lighthouse, built of brick with a square tower attached at the front, stands on a point of land which forms the sheltered bay at the east end of the harbor.

Present Owner ~~Michigan Department of~~ Public Natural Resources

Address: Street and Number Mason Building

City/Town Lansing Zip 48918

Present Use Museum

State Register: ~~Marker~~ Local Site No. 275 To Be State Site No.

Date Listed 2-22-74 Marker

National Register Level of Significance: Local ____ State ____ National ____

Date Nominated ____ Date Sent ____ Date Listed ____

Date of: Commission Meeting ____ Review Board Meeting ____

Prepared by Kathryn Eckert Date 1/15/75

Source(s) County sites file

MH-84 - 10/74

Section C-2: Ontonagon Lighthouse State Historic Register Form (permission to use from MTU archives)

9 MAJOR BIBLIOGRAPHICAL REFERENCES

Lighting up the Past. Ontonagon: Ontonagon County Historical Society, 1966.

Lake Superior Journal (Sault Ste. Marie). July 20, October 15, 1851, May 22, 1852.

Annual Report of the Secretary of the Treasury, 1866, Washington, D. C., 1867, p. 223.

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY: less than 1 acre

UTM REFERENCES

	ZONE	EASTING	NORTHING
A	16	323030	5193050
B			
C			
D			

VERBAL BOUNDARY DESCRIPTION

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE	CODE	COUNTY	CODE
Michigan	26	Ontonagon	131

11 FORM PREPARED BY

NAME / TITLE: Carolyn Torma, Historian, Historic Sites
William Lowery, Historian, Historic Sites

ORGANIZATION: Michigan History Division

DATE: August 1975

STREET & NUMBER: Department of State

TELEPHONE: (517) 373-0510

CITY OR TOWN: Lansing

STATE: Michigan

12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS:

NATIONAL ___ STATE ___ LOCAL X

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

STATE HISTORIC PRESERVATION OFFICER SIGNATURE

TITLE: State Historic Preservation Officer DATE: 8/7/75

FOR NPS USE ONLY

I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

DATE

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST: DATE

KEEPER OF THE NATIONAL REGISTER

GPO 888-4

Form No. 10-301
(Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
PROPERTY MAP FORM

FOR NPS USE ONLY
RECEIVED
DATE ENTERED

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- ENCLOSE WITH MAP

1 NAME

HISTORIC Ontonagon Lighthouse

AND/OR COMMON

2 LOCATION

CITY, TOWN Ontonagon ___VICINITY OF COUNTY Ontonagon STATE Michi

3 MAP REFERENCE

SOURCE United States Geological Survey

SCALE 1:62500 DATE 1955

4 REQUIREMENTS

TO BE INCLUDED ON ALL MAPS
1. PROPERTY BOUNDARIES
2. NORTH ARROW
3. UTM REFERENCES

INT: 3

Form No. 10-301a
(Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
PROPERTY PHOTOGRAPH FORM

FOR NPS USE ONLY
RECEIVED
DATE ENTERED

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES ENCLOSE WITH PHOTOGRAPH

1 NAME

HISTORIC Ontonagon Lighthouse

AND/OR COMMON Ontonagon Lighthouse

2 LOCATION

CITY, TOWN Ontonagon Light ___VICINITY OF COUNTY Ontonagon STATE Michi

3 PHOTO REFERENCE

PHOTO CREDIT Gagon, Daily Mining Gazette, Houghton, Michigan
DATE OF PHOTO 1975
NEGATIVE FILED AT Michigan History Division
Daily Mining Gazette

DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	__UNALTERED	__ORIGINAL SITE
X GOOD	__RUINS	X ALTERED	X MOVED DATE 1884
__FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

Located at the mouth of the Ontonagon River, which flows into Lake Superior, the Ontonagon Lighthouse is a simple rectangular, cream-colored brick building, with a square light tower on the west end.

Although the structure is only one-and-one-half stories, it gives the impression of more, because of the extremely high basement. This stone foundation was built far above ground to protect the living areas from inundation.

The lake or north facade is three bays wide, and has three double hung, sash windows on the main story level. Each window is six over six panes, with rectangular cut stone lintels and sills. The single window on the basement level is located just above the cut stone water table and has three panes of glass. On the south facade, there are two windows on both stories, but in similar positions at the north side. The basement story windows, however, are larger and descend into the water table.

The east facade has two windows in the second story level, each with nine panes of glass and rectangular lintels and sills.

The medium gable roof has a plain boxed cornice. Two windows, one each on the north and south sides, form hipped dormers. An internal chimney rises through the east end of the roof, and has simple horizontal bands of molded brick, one of the few ornamental details on the lighthouse.

The light tower is three stories high, or 26 feet, 10 inches from ground to focal plane, and is surmounted by an iron polygonal beacon, which housed the light. In contrast to the rest of the building, the window in the tower is located at the normal first story level. Around the polygonal beacon is a square light iron gallery, consisting of a platform and rail, which was added to aid in the cleaning of the windows.

The lighthouse has gone through an evolution of change to most effectively meet its functions. The earliest structure was erected in 1852; this lighthouse replaced it in 1866. In 1884 it was moved 865 feet to the end of the west pier extension for better visibility. A one story brick kitchen, measuring eighteen square feet was added to the rear of the east facade in 1890. This addition blends with the older structure through the consistant use of cream-colored brick and boxed cornice. However, the windows on the kitchen are slightly arched and have wooden lintels. A final small addition was placed on the kitchen during the early part of this century, and some attempt was made to blend it in with the main structure.

SIGNIFICANCE

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW			
__PREHISTORIC	__ARCHEOLOGY-PREHISTORIC	__COMMUNITY PLANNING	__LANDSCAPE ARCHITECTURE	__RELIGION
__1400-1499	__ARCHEOLOGY-HISTORIC	__CONSERVATION	__LAW	__SCIENCE
__1500-1599	__AGRICULTURE	__ECONOMICS	__LITERATURE	__SCULPTURE
__1600-1699	__ARCHITECTURE	__EDUCATION	__MILITARY	__SOCIAL/HUMANITARIAN
__1700-1799	__ART	X ENGINEERING	__MUSIC	__THEATER
X 1800-1899	__COMMERCE	__EXPLORATION/SETTLEMENT	__PHILOSOPHY	X TRANSPORTATION
__1900-	__COMMUNICATIONS	__INDUSTRY	__POLITICS/GOVERNMENT	__OTHER (SPECIFY)
		__INVENTION		

SPECIFIC DATES 1852 built, 1866 rebuilt BUILDER/ARCHITECT W. F. Chittenden

STATEMENT OF SIGNIFICANCE

When the mineral and lumbering riches of the Upper Peninsula of Michigan were discovered, an efficient system of transportation was needed to exploit them in an economical manner. The Sault Ste. Marie locks and lighthouses had to be built. In 1847 the first lighthouse on the south shore of Lake Superior was erected, and property for a second obtained.

The Ontonagon River was an appropriate site for the second light, because of the natural harbor. The town's first sawmill opened in 1852, the same year the Department of Commerce's Lighthouse Service completed the Ontonagon Lighthouse. The original structure was built by W. F. Chittenden, a Detroit contractor. Samuel Peck was appointed the first keeper of the nine-room dwelling and brick tower.

By 1881 commerce in the Ontonagon Harbor had grown to the point where 121 steamers and 15 sailing vessels were counted in port that season. In 1882 the Ontonagon Lumber Company was formed and in 1890 the large Diamond Match Company opened two mills. Suddenly, in 1896, a huge fire causing a severe depression in the town.

Although the lumbering and eventually the mining industries declined along the lake, the lighthouse was kept in service until January 1, 1964. At that time, the building was leased as a private residence.

The light itself, removed by the Coast Guard after their station was demolished, was presented to the Ontonagon County Historical Society in 1965.

The lighthouse was recently threatened by a Corps of Engineers project, which would construct a dike around or through the building to contain silt dredged from the Ontonagon Harbor. However, the Ontonagon Coast Guard Flotilla 28-13 is seeking title to the lighthouse from the Corps of Engineers. The Flotilla and Ontonagon Historical Society hope to restore and maintain the structure.