CHARTING A NEW COURSE FOR THE MONITOR

A Comprehensive, Long Range Preservation Plan
With Options for Management, Stabilization,
Preservation, Recovery, Conservation and
Exhibition of Materials and Artifacts
from the Monitor National Marine Sanctuary

April 1998

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
National Ocean Service
Office of Ocean and Coastal Resource Management
Sanctuaries and Reserves Division
Frontispiece: An isometric drawing identifying key features of the Monitor’s hull.
Management Summary

The National Oceanic and Atmospheric Administration (NOAA) is confronting a serious management situation at the Monitor National Marine Sanctuary: the collapse of the Monitor’s hull is imminent. To forestall the inevitable collapse and preserve the Monitor’s most significant components for future generations, this long-range, comprehensive preservation plan calls for the remains of the Monitor to be preserved through a combination of stabilization and selective recovery actions.

In March 1862, the Civil War ironclad USS Monitor survived a four-hour assault by the Confederate ironclad CSS Virginia at Hampton Roads, Virginia, before succumbing a few months later to a severe storm off Cape Hatteras, North Carolina. Now the Monitor is facing a new crisis. Photographic evidence clearly shows that there has been a marked increase in the rate of disintegration of the Monitor’s hull since 1990, the result of both natural and human causes. Current data suggest that collapse of the Monitor’s hull could occur at any time and that the result would be the loss of much of the ship’s structure and many of its historic contents. In 1993, after extensive archival and on-site research, NOAA initiated a revised planning effort designed to further define the extent of the problem and to identify viable options for preservation of the Monitor.

The Monitor was undeniably one of the most significant ships in U. S. history. The Monitor wreck site is listed on the National Register of Historic Places and is also a National Historic Landmark. In 1975, in recognition of the Monitor’s unique historical and archaeological significance, the Secretary of Commerce designated the remains of the Monitor as the first National Marine Sanctuary. The Sanctuary is administered by NOAA’s Office of Ocean and Coastal Resource Management, National Ocean Service.

In section 4 of Public Law 104-283 (The National Marine Sanctuaries Preservation Act) Congress responded to NOAA reports of the Monitor’s disintegration by mandating that the Secretary of Commerce produce “a long-range, comprehensive plan for the management, stabilization, preservation, and recovery of artifacts and materials of the U.S.S. MONITOR.” The Secretary of Commerce was also directed, “to the extent feasible utilize the resources of
other Federal and private entities with expertise and capabilities that are helpful” and to submit the plan within twelve months of the date of enactment of the Act (October 11, 1996). NOAA, on behalf of the Secretary, developed a draft preservation plan within the required one-year time frame and submitted the plan to Congress on November 6, 1997. NOAA’s rapid response was possible only because the planning process had already begun and because valuable assistance was rendered by several key organizations, as described herein. Because of the Monitor’s exceptional historical significance and the severity of the current threat to its hull and contents, NOAA elected to release the plan in draft form in order to permit a panel of experts and the public at large to review and comment on the plan. Those comments were taken into account during the revision of this plan.

The result is this final preservation plan which outlines a variety of possible options for the stabilization and preservation of the Monitor, provides supporting data, discusses the advantages and disadvantages of each option, presents preliminary cost estimates for evaluation purposes and describes the selected option. The goals of this plan are in keeping with the National Marine Sanctuary Program’s “Strategic Plan for the 21st Century.” The plan should not only prove to be effective at the Monitor Sanctuary, but may serve as a model for other cultural resource projects as well.

Preservation of the Monitor will involve considerations of technological feasibility, compliance with the National Historic Preservation Act and other applicable laws, consistency with the Division’s Strategic Plan, and availability of adequate funding. The technological requirements for implementation of the plan can be met by any major ocean engineering firm. Since the combined costs of stabilization, recovery and conservation are estimated to be in excess of $20 M, possibly the greatest challenge for NOAA will be to create a partnership of interested organizations that can generate the required funds. The next phase of planning will include detailed engineering and conservation plans and a “business” or funding plan. NOAA is confident that this preservation plan contains the necessary information for decisionmaking and for implementing the next phase of planning and preservation.
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CHARTING A NEW COURSE FOR THE *MONITOR*

April 1998

Nowhere else in our history has a ship with such a short career been so celebrated as the Monitor. ... There was only one original USS Monitor and there will never be another.

1.0 Introduction

1.1 Crisis: The Disintegration of the Monitor

NOAA has determined that the collapse of the Monitor's hull is imminent. Photographic evidence from the Monitor National Marine Sanctuary clearly shows that there has been a marked increase in the rate of disintegration of the Monitor's hull since 1990. The Monitor was first mapped in April, 1974, shortly after it was located off Cape Hatteras, North Carolina, the previous August. The mapping expedition produced a detailed photomosaic of the wreck that has served for more than two decades as the initial reference for assessing changes to the site. Since its discovery, the Monitor has suffered notable deterioration of almost every portion of its hull, with the most extensive damage occurring in the stern.

This accelerated deterioration since 1990 apparently results from several causes. The primary long-term factor contributing to hull deterioration is exposure to the high-current, high-temperature, saltwater environment. The Monitor's iron components are being reduced by oxidation and electrochemical corrosion while the wooden structures are suffering cellular deterioration and destruction by shipworms. There are also human causes. In 1991, a private fishing vessel was cited by the U.S. Coast Guard for illegally anchoring in the Sanctuary. Evidence documented by NOAA strongly suggests that stresses on the hull caused by that anchoring incident initiated a chain reaction of deterioration in the Monitor's stern. Over the years and as recently as 1997, commercial fishing gear has been found tangled in the wreck, signalling the potential for even more extensive damage.

There is a general consensus that the Monitor's hull has reached a critical state of decomposition beyond which catastrophic collapse could occur at any time. In 1990, even before the anchoring incident, a NOAA consultant reported that without corrective action the Monitor might be unrecognizable in ten years (Arnold, et al. 1991:85-86) and the archaeolo-
gist who was codiscoverer of the *Monitor* also predicted catastrophic deterioration (*Ibid.*:214-216). In summary, current evidence points to the unavoidable conclusion that the *Monitor*’s hull is collapsing and that a rapid response to the crisis is required.

1.2 NOAA’s Response to the Crisis

In 1992, responding to the alarming degradation of the *Monitor*’s hull, NOAA delayed issuance of a newly-revised management plan for the *Monitor* National Marine Sanctuary in order to conduct additional site assessments. NOAA’s Sanctuaries and Reserves Division (SRD) then commenced a broad range of initiatives including several expeditions to the Sanctuary, a cooperative effort with the U. S. Navy and other organizations to help stabilize the *Monitor*’s hull, and development of a comprehensive plan for management and preservation of the Sanctuary and possible recovery of portions of the *Monitor*. Because of the importance of these efforts and the limitations on funding, SRD developed partnerships with several organizations, including the U. S. Navy, the National Undersea Research Program, The Mariners’ Museum, Key West Diver, Inc., private research groups and others.

In 1993 and 1995, NOAA conducted major engineering and archaeological surveys at the Sanctuary in conjunction with further archival research and several small-scale site operations. Private research divers also assisted NOAA during this period in the recovery of additional data on the *Monitor*’s condition. The results of this research led to the conclusion that a concerted, well-planned effort would be required to preserve the remains of the *Monitor*. Planning was initiated for the conduct of additional archival, engineering and on-site research aimed at identifying viable options for the preservation of the *Monitor*. SRD also communicated the situation to NOAA administration, Congress and the public.

In 1996, Congress formally expressed its interest and concern. Section 4 of Public Law 104-283 (The National Marine Sanctuaries Preservation Act), contained a Congressional mandate for the Secretary of Commerce to produce “a long-range, comprehensive plan for the management, stabilization, preservation, and recovery of artifacts and materials of the U.S.S. MONITOR.” The Secretary was also directed, “to the extent feasible utilize the resources of other Federal and private entities with expertise and capabilities that are helpful” and to submit the plan within twelve months of the date of enactment of the Act (October 11, 1996). In response, NOAA produced this plan, “Charting a New Course for the *Monitor*.”

In this plan NOAA, on behalf of the Secretary of Commerce, presents a comprehensive management strategy that should ensure that, insofar as possible, the *Monitor* will be preserved and protected for future generations. The plan recommends the application of
state-of-the-art ocean technology in overcoming the crisis at the Sanctuary through the combined strategies of stabilization and selective recovery. Therefore, the plan is in keeping with the National Marine Sanctuaries Program’s "Strategic Plan for the 21st Century." The Program’s primary goal is to "protect sanctuary resources, making our sanctuaries world-class models for effective innovative management of protected areas" (NOAA 1997).

1.3 A Brief History and Significance of the Monitor

The *Monitor*, designed by Swedish-American engineer John Ericsson, was a radical departure from traditional warship design. The vessel was built almost entirely of iron; it was fully steam powered with no masts or sails; the engineering spaces, crew’s and officers’ quarters, and galley were all below the waterline; the hull was completely armored with a 5-foot-high, 32-inch-thick armor belt encircling the vessel for protection during battle. The most novel feature was the *Monitor’s* 22-foot-diameter, 9-foot-high iron turret. Positioned amidships, the armored turret could be rotated to train its two 11-inch Dahlgren smoothbore cannon in any direction.

The *Monitor* was launched at Greenpoint, New York, on January 30, 1862. In early March, the *Monitor* was ordered to Hampton Roads, Virginia where, on March 9, it engaged the CSS *Virginia*, a Confederate ironclad constructed over the modified hull of the scuttled USS *Merrimack*. In the ensuing four-hour battle, the two vessels frequently bombarded each other at point-blank range with no substantial damage to either vessel (Figure 1). Although the battle ended in a draw, the *Monitor’s* performance impressed the U.S. Navy and introduced features—including the combination of iron armor, low freeboard and revolving turret—that altered naval technology forever.

*Figure 1. The USS Monitor (right) battling the CSS Virginia at Hampton Roads, Virginia on March 9, 1862 (Monitor Collection, NOAA).*
produced by the Naval Intelligence Division. A wreck was made (Figure 3) from which an assessment of the vessel's condition was made. Research Vessel *Eastward*, utilizing a side-scanning sonar and multi-beam hydrophones, was able to locate the Monitor. A second expedition in May 1974, partly sponsored by the U.S. Navy and the National Geographic Society, provided additional photographic data.

The wreck was located by the Duke University survey vessel *Invictus* in August 1973. A search was conducted on the wreck site for additional materials. The area was surveyed by the National Geographic Society and the Duke University survey vessel *Invictus*. The survey vessel located the wreck site and confirmed the presence of the Monitor. The wreck was located in August 1973, after nearly a year of intensive research and discovery of the wreck.
The USS Monitor's career was brief. Of the Monitor's losses, one historian lamented, "This vessel, all of which incorporated the unique revolving turret (Figure 4), unfortunately, designed proved to be quite successful and spawned several generations of monitor-type construction between the Monitor and its sisters. While the battle was a virtual draw, the Monitor had a profound impact on naval technology and the way in which battles were fought. The Monitor was without question one of the most significant ships in American history. The Monitor was without question one of the most significant ships in American history. See frontispiece.

Significance of the Monitor

(See frontispiece)
American Icon, carrier strong for a concerted preservation effort.

The Monitor’s uniqueness and remarkable historical significance, along with its status as an

never before familiar with, there was only one original USS Monitor and there will

junction of our history will continue to inspire and inspire all who are

collected at the Monitor. The story behind Monitor, the story behind Monitor and the story of the Monitor, Monitor is a critical

in our history has a ship with such a short career been so

Millner (1987:109) captured the essence of the Monitor’s significance when he wrote:

Landmark in 1986 (Thiel:195). On the National Register of Historic Places in 1975 and designated a National Historic

criteria for National Register listing (Appendix E: December 1986:1), the Monitor was placed in the National Register of

History Places. The Monitor is one of relatively few cultural resources that meets all four

readily available and quantifiable utilizing criteria established for the National Register of

In management terms, however, the significance of the Monitor can be somewhat more

our naval heritage:"

believed in himself and for nation canapan by Civil War a story that is so much a part of

called ‘Monitor Boys’, became a triumph for a new technology, for a man who

Rebel guns, but a reminder of their black Sunday in 1862 when the resolve of a few who

this symbolic aspect, still feels the significance of the Monitor is... not as a deserted artifact

A U.S. Naval Academy study (U.S. Naval Academy, 1974:40) expressed a similar view of

the part of people associated with the Monitor, from John Ericsson’s Griffin to those

of the Monitor is based on legend, an incredible history, and very good public relations on

North Carolina State Preservation Office (1978:63), said that “much of the value

American people, their integrity, their capabilities, and most importantly, their recognition of those

important, not just as a ship that changed the course of naval warfare, but as a symbol of a

memorial, cultural resource manager Charles W. McKimmy (1978:99-101) viewed the ship as

was discussed in both military and twentieth century terms. U.S. Department of the

acknowledged, A conference held in Raleigh, North Carolina, in April 1978, the vessel

The significance of the USS Monitor in American and naval history has been widely

1978:40).

in which the heavy iron arrow of the Monitor was no defense” (U.S. Naval Academy

ability to fight another frontal. The battle was a personal one, man and ship against the sea.
Much of the deck plating is still intact, although several holes completely penetrate the deck space. Much of the deck plating on the lower hull has fallen away, exposing the interior of the machinery collapsed and the stern hull and armor belt at the propellers have disappeared. Most of the forward portion of the lower hull has completely sunk in the compartments below. The forward portion of the lower hull section directly over the engine room space, where it is partially supported by the boilers and machinery, has collapsed, holding the upper hull section up, which is then supported by the upper hull section directly over the engine room space, the only remaining intact portions of the deck.

The hull has developed a considerable deflection, with the only relatively intact portion of the hull near the bow.

The changes in weather conditions and visibility factors such as wind, surface sea conditions, current, water temperature and visibility are a result of environmental conditions, changing conditions and eddies. As illustrated in the horizontal and vertical cross section, the hull is near the bow with the bow at a compass head.

The Montrose's hull is upside down on a relatively flat, sandy bottom.

More information:

(Figure 3 also see Appendix D for more information.)
Evidence of Recent Deformation

Since 1991 significant changes have been noted at the Sanctuary by NOAA and NOAA...
revealed that the deck of the inverted liner now the upper end has disappeared and that the
structural components the apparent stability of the liner. A careful examination in 1993
collapsed in the vicinity of the liner could shift the angle of force on the upper deck and
the immense weight of a large portion of the hull and machinery. Any further structural
The upper heel appeared to remain a great deal of structural integrity. However, it appears
completed disappeared.

since the wreck was first documented in 1974, an examination of the back side of the stern
a six-foot section of the stern and of the port amon bell has disappeared
wood breaking material, dispersed hill plates can be seen in the sand near the section of
and the material to which they were attached has separated from the underwater structure and
the frame. Immediately aft of the upper on the port side a large section of deck including places
of plates are missing from the top and looking sides of this section, as many of the iron
plates appear to have settled sufficiently to be supported by the sand beneath the hull. A number
are the lower hull forward of the midships bulkhead has collapsed. The portion of lower hull
the shear, tunnel and after end of the engine room.

in 1991, the hull plate as the end of the lower hull separated with the shears, thus exposing
shear to the side, almost certainly a result of being sheared by a primary lifting wave another
the section below, now can be downwinded. The shears have separated from the lower hull and
shear, and produce assembly. Once in the same plane with the heel and parallel with
the majority of changes have occurred at the midships bulkhead. At the extreme
of disintegration of hull components those components reach stress limits.

of disintegration of hull components if components fail, rather, consists primarily of the periodic collapse
expected. The observed increase in the rate of deformation does not appear to be the result
deposition of the Monitors hull, the exterior of that deformation since 1991 was not
significant factor in recent degradation. Although NOVA is well aware of the continuing
renewal to endure and sustain the shock of impact water, the Monitors continue to sustain a
leather, cloth, press, bronze and other materials, all of which are degradation and different
deterioration and the action of shipwrecks. The Monitors continue include wood, hemp,
wooden components that make up since 1991, including the midships bulkhead frame, supports NOA's assumption that the
exhibit similar degradation. In fact, the observed collapse of many of the lower hull frames

Overview of the Comprehensive Preservation Plan

The increased rate of deterioration of the Monitor represents a management crisis for the NOAA National Ocean Service. The Monitor is one of the most significant shipwrecks in the nation's first maritime sanctuary. The location America, made more so by its designation as the nation's first maritime sanctuary. The location

Failure of structural integrity, resulting from long-term corrosion, strong currents and other forces, is the primary factor contributing to the Monitor's accelerating collapse rate. There is no other material failing through the deck from the weakenedspace above.

The weight of the hull resting on the keel has caused the deck to fracture and the keel to push through the deck. Lumps of coal on the keel under foot indicate this scenario. The hull is fluffed with steel. The weight of the hull resting on the keel has caused the deck to fracture.

This plan develops a framework for research and presentation, identifying all viable options for stabilization and presentation of the Monitor and comprehensive evaluations of other shipwrecks in other active and proposed sanctuaries. From a broader perspective, the plan should also be of potential to inform and influence management decisions throughout the world. The plan's management strategy and content may be particularly relevant to other deepwater shipwrecks in other sanctuaries. The resulting plan is critical to NOAA's mission statement, the mission statement's role in the comprehensive preservation plan, effective and efficient methods for continued preservation of this unique historical, archaeological, and educational resource has been emphasized. Through NOAAs efforts, public understanding of and interest in the Monitor have been enhanced and the need for continued preservation of this unique historical, archaeological, and educational resource has been emphasized.
Introduction

2.1 Review of the Options for Preserving the Monitor

preliminary analysis of these options was developed for NOAA and the US Navy by
shortly discussing and comparing, and recommendations are presented. The
advantages and disadvantages address potential impacts on the Monitor and its ecosystem. The
pertinent information on advantages, disadvantages, required action and estimated costs:
The options discussed below were carefully reviewed; they are presented alone with
a detailed implementation plan.

This report presents all options for stabilizing and preserving the Monitor that were
possible in this plan. Many of the components were helpful and have been incorporated in the ocear
and conservation strategies. Ocean education, marine archeology, physical preservation and
addition. NOAA also received 33 comments, mostly from specialists in such fields as ocean
in order to identify new technologies that might be applicable for the Monitor situation. In
also held internal discussions with numerous engineers, archeologists, and other specialists
(NeA 1992), all of which addressed preliminary studies and recommendations. NOA
the Draft Revised Management Plan for the Monitor National Marine Sanctuary
preservation and conservation trends in 1978 (National Trust for Historic
include papers presented at a Monitor conference in 1978 (National Trust for Historic
include these options, NOAA received all previous reports and proposals for on-site activities.
This section selects and discusses a wide range of options for comprehensive
prevention
prevention options, discussions of each option, and recommendations for future planning.

2.0 Description of the Monitor and Recommendation for Future Planning

detailed description of the Monitor’s hull and recommendations for future planning.

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This option could reduce the rate of determination without removing the Monitor or its associated features. The costs to NOAA, for this option would be within current budgetary limits.

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In situ preservation by encapsulation

Estimated cost: None. This option requires no additional NOAA commitments or expenditures.

Action Required: None. NOAA would continue the current management program.

This option would result in the destruction of cultural material and ecological information.

The Monitor, and its associated features, would be destroyed.

The Monitor may also continue to be damaged by illegal human activities (e.g.,...)

Causes:

Disadvantages:

No supplementary funds would be required.

The Monitor would remain an accessible site to be visited by researchers and recreational divers, although the location limits access to only a few.

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This option requires no additional NOAA commitments.

Advantages:

This option could be selected if it is determined that on-site stabilization and/or recovery operations are beyond the technological and physical capabilities of NOAA. NOAA would continue to manage the Monitor National Marine Sanctuary.

2.2 Non-intervention

Identified:

Evaluations purposes only: no formal estimates are available and no funding sources have been summarized in Appendix A. Note: The cost estimates presented in this section are for Oceanographic Information. Inc. at no cost to the government. The Oceanographic report is...
be accomplished through the use of approved methods and materials, such as sand.

This option could stabilize the monitor’s hull in its present location. Showing would

be a necessity.

In situ Preservation by Shoring

Estimated cost: No accurate estimate available, but probably $4-5 million.

have to be established.

Planning and implementation phases, and a long-term monitoring program would

review process. If this would have to be planned for preservation of the necessary
developed by consultants. A review would have to be conducted under section 106

development of conservation activities. It would have to be conducted under current

Action Required: Detailed engineering and conservation plans would have to be

Detailed engineering and conservation plans would have to be

Deepest penetration would not eliminate the deterioration process. This option

represented due to erosion:

Erosion occurs:

hazards, especially if the selected material is clay or silt.

If exposed material in the sanctuary prove to be unsuitable for encapsulation,

weight of encapsulating sand.

Even with shoring, damage to interior components could result from the

of the sand and / or the hull collapse the hull.

Erosion by shoring would have to be preceded by shoring (sect. 2.4), since the weight

Future generations:

The responsibility for research and recovery of artifacts would be delegated to

in the site would likely where:

Disadvantages:

The method is relatively simple and could be accomplished with conventional

To a periodic site inspection:

Openings would be easily reduced, since on-site research would be limited.

The monitor’s exposure to oxygen-rich water would be reduced:

and adverse effects of commercial fishermen.

The monitor would no longer be visible or readily accessible, and public interest

Advantages:

to be considered for nearly and as the covering material.

adequately reduce the amount of oxygen reaching the hull. Clay or fine silica may have
advantages:

the marine environment (impressed current cathodic protection system) to reduce the corrosive action from this option would involve the installation of a passive (selective anode) or active

2.5 in situ preservation by cathodic protection

counting annual maintenance.

estimated cost: no accurate estimate available, but probably $3-4 million, not

have to be established planning and implementation phases, and a long-term maintenance program would

this option for stabilizing the hull could result in further deterioration or collapse:

because of the inaccessibility of the hull and the difficulties of installing showing gear:

the inevitable collapse of the hull and loss of much of the enclosed cultural

1. the raison d'etre of the wreck would be unrealized, degrading its scientific and

the appearance of the wreck would be unnatural, defeating its scenic and

since the monitor would still be exposed, it would continue to deteriorate due

disadvantages:

discussed below.

the cost for this option would be moderate, compared to the recovery options

the collapse of the upper hull could probably be delayed by at least 5-10 years:

the monitor would remain visible and accessible for future research:

advantages:

pilings, green bars of jacks to support portions of the hull that are suspended above the
Selecteve Recovery

- Shoring and cathodic protection, not counting annual maintenance.

Estimated Cost: No accurate estimate available, but probably > 4.5 million. For recovery to be economical.

This option for stabilizing the hull could actually result in further deterioration.

Because of the instability of the hull and the difficulties of insulating Steel, material and archaeological information would be delayed but not eliminated:

The inevitable collapse of the hull and loss of much of the enclosed cultural.

Effective if combined with mechanical shoring (sec. 2.4).}

Because of the deteriorated condition of the hull, cathodic protection would only be

A has been reported from past corrosion studies. The deteriorated condition of the

Diver's on a regularly-scheduled basis.

Maintenance and replacement of system components would require the use of

Since the Monitor would still be exposed, it would continue to deteriorate due

Advantages:

- No terrestrial objects, engine and small art.
- Covers the entire area of the wreck, including all significant historic value. Objects
- Appropriate to recovery and could be a selective recovery.

- The Monitor would remain visible.

Disadvantages:

- Research and visualization of the areas easily accessible for future.
Chaining a New Course for the Monitor

because of the depth and adverse environmental conditions, large-scale on-site

Disadvantages:

- It was determined by extensive offshore research and monitoring activities.
- NOA would no longer be required to expend funds on maintenance of the sanctuary.
- Personnel effects would be preserved and would be accessible for exhibition.
- If successful, the entire Monitor's all equipment and stores, and all military and

Advantages:

- As a single unit,Alternatively, recovery in a series of smaller recoveries.
- Concerns and, eventually, dispersed; this could propose recovery of the entire hull
- In this option, the entire hull's unique canons and all concerns would be recovered.

FULL RECOVERY

The estimate does not include costs for annual inspection and maintenance of the inner

estimated cost: Approximately $10 million for recovery, plus an additional $5 to

Program would have to be established.

Compensation, recovery, conservation and exhibition phases; and a long-term monitoring

Consistencies, to preserve; would have to be conducted under section 11 review process.

Action Required: Detailed engineering plans would have to be developed by

operations would be expensive, particularly for recovery of the Monitor's on-site recovery

because of the depth and adverse environmental conditions, large-scale on-site

- The invaluable collapse of the remaining hull, cultural material and archaeology.
- Exposed, they would continue to diminish due to natural and human causes.
- Since the remaining portion of the Monitor and its cannons would still be

Disadvantages:

- hill and its concerns.
- the hill and concerns, including the officers' quarters for recovery;
- the hill and concerns, including the officers' quarters for recovery;
- the hill and concerns, including the officers' quarters for recovery;
- the hill and concerns, including the officers' quarters for recovery;
- the hill and concerns, including the officers' quarters for recovery;

The cost for this option depend upon the number and types of officers

- In contrast, regardless of the size of the remaining hill and concerns.
- The recovered officers would be preserved and made available to the public

Significant officers would be recovered, conserved, and placed on exhibit where
2.8 Combined Options

Recovery

Has the advantage of permitting shareholders to take place before recovery, thus

Refer to sections 2.4 and 2.6.

Advantages and Disadvantages:

This option combines in situ preservation by shotcrete (sect. 2.4) with selective recovery

2.8.2 Shotcrete Combined with Selective Recovery

Conservation

Estimated Cost: No accurate estimate available, but at least $20-22 million, including

Action Required: As presented in the above sections.

Advantages and Disadvantages: As presented in the above sections.

Material

Although the site would be unsuitable for protection of the remaining cultural

elements (sect. 2.3), following recovery of all selected hull components and

reconstruction (sect. 2.4), the site would be suitable for preservation of the remaining cultural

2.8.1 Selective Recovery Followed by Encapsulation

Options

Expected to exceed $50 million.

For selective recovery (sect. 2.6), full recovery and conservation costs could be

Estimated: No accurate estimate available. Based on the preliminary estimate

The recovery, planning and implementation phases:

The owners either be a visual disappointment to viewers.

Because of the advanced state of destruction, the reconstructed hull remains of

and time-consuming.

Because of the advanced state of destruction, conservation would be expensive

the hull and components.

Because of the instability of the hull and the difficulties of conducting recovery

operations at the bottom, recovery attempts could result in severe damage to
maneuvered routine surveillance. The vessel would be for providing coverage further offshore than necessary for currently enforced activities. In the future, cost associated with expanded enforcement.

Estimated cost: Both the Coast Guard and Fisheries Service are already engaged in enforcing commercial and sport fishing of the Morro Bay Sea Rr National Marine Sanctuary (approximately 21 miles offshore from the nearest inlet). An additional effort at this time may be advisable. The distance of the Morro Bay Sea Rr National Marine Sanctuary from the nearest inlet.

Advantages: An expanded enforcement of the Morro Bay Sea Rr National Marine Sanctuary from the nearest inlet. (1997) NOAA.)

Figure 6. A sample of fishing gear recovered

Sanctuary Regulations

Expanded Enforcement of Sanctuary Regulations

Including consultation.

Estimated cost: No accurate estimate available, but at least $20-22 million.

Procedural recovery:

Action Required: As presented in the above sections, establishment of a prohibition would

Has the disadvantage of additional on-site cost.

Follow-up the procedural recovery phase:

Has the additional advantage of leaving the wreck in a stabilized condition
<table>
<thead>
<tr>
<th>Option</th>
<th>Disadvantages</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Intervention</td>
<td>Requires no additional commitments or funds; the remaining active</td>
<td>Monitors continuous, inaccessible, inaccessible collapse</td>
</tr>
<tr>
<td></td>
<td>Monitor no longer exposed to elements, minimal operating costs</td>
<td>Monitor accessible, collapse or half delayed, moderate cost</td>
</tr>
<tr>
<td></td>
<td>Method is extremely simple</td>
<td>Method is extremely simple</td>
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<tr>
<td></td>
<td>Expose to minimal elements</td>
<td>Expose to minimal elements</td>
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<tr>
<td></td>
<td>Monitor non-accessible, showing still required, destruction</td>
<td>Monitor continuous, inaccessible collapse</td>
</tr>
<tr>
<td></td>
<td>Cost: method is extremely simple</td>
<td>Cost: method is extremely simple</td>
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<tr>
<td></td>
<td>Shoring, encapsulation</td>
<td>Shoring, encapsulation</td>
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<td></td>
<td>Full Recovery Recovery</td>
<td>Selective Recovery Recovery</td>
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<td>Selective Recovery</td>
<td>Selective Recovery</td>
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<tr>
<td></td>
<td>Shoring &amp; Encapsulation</td>
<td>Shoring &amp; Encapsulation</td>
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<tr>
<td></td>
<td>$4.5 M</td>
<td>$3.4 M</td>
</tr>
<tr>
<td></td>
<td>More inspections required, irreversible collapse</td>
<td>More inspections required, irreversible collapse</td>
</tr>
<tr>
<td></td>
<td>Monitor continues to deteriorate, material appearance, no collapse</td>
<td>Monitor continues to deteriorate, material appearance, no collapse</td>
</tr>
<tr>
<td></td>
<td>$3.4 M</td>
<td>$4.5 M</td>
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</tbody>
</table>

**Table 1: Summary of All Options**
<table>
<thead>
<tr>
<th>Option</th>
<th>2.2 Non-Intervention</th>
<th>2.3 Encapsulation</th>
<th>2.4 Shoring</th>
<th>2.5 Cathodic Protection</th>
<th>2.6 Selective Recovery</th>
<th>2.7 Full Recovery</th>
<th>2.8 Combined Options</th>
<th>2.8.1 Selective Recovery &amp; Encapsulation</th>
<th>2.8.2 Shoring &amp; Selective Recovery</th>
</tr>
</thead>
</table>

**TABLE I: SUMMARY OF ALL OPTIONS**
In reviewing all intervention options, one major decision point is clear: all options involve either preservation by stabilization in situ of preservation by recovery and conservation. Stabilization options can be achieved with less technological difficulty and lower cost than can recovery options, however, stabilization will at best, only delay the inevitable collapse of the Monitor’s hull. Equivalently, NOAA will still have to decide if major hull repair can be attempted. Nonetheless, stabilization will, at its best, only delay the inevitable conformation of the Monitor’s hull, thus placing the Monitor’s hull and conservators in a situation of having to decide on-site which strategies are necessary if numerous significant artifacts are to be preserved.

The issue of stabilization vs. full recovery is severe, particularly in light of the Monitor’s former existence as a commercial vessel and salvage activity. The Monitor’s hull is under extraordinary stress, subjected to the ravages of currents, storms, corrosion, and even illegal decades with little degradation. The Center, on the other hand, is an almost complete puzzle, built in the coastal Broward County of the St. Johns River. Whether have survived many years, the Center’s recovery is a very impressive display of the Monitor’s hull and conservators. The Center’s story begins with a bold recovery project that began in 1980, the National Park Service (Bennetts 1980) has since recovered and interpreted the surviving artifacts and culminates in the visual rejuvenation of the recovered remains. (Bennetts, 1980) The Center’s story begins with a bold recovery project that began in 1980, the National Park Service (Bennetts 1980) has since recovered and interpreted the surviving artifacts and culminates in the visual rejuvenation of the recovered remains. (Bennetts, 1980)
The appearance of the wreck would be altered, and its scenic and aesthetic value expressed. They would continue to disfigure the site of natural and human causes.

Since the remaining portions of the monitor and its conning tower would still be

Disadvantages:

While damage to the hull and conning tower is minimal, if any, and the remaining portions of the monitor and its conning tower could be recovered, conserved, and displayed on exhibit when possible by 25 years or more:

The collection of portions of the hull left at the site would probably be delayed,

The stabilized portions of the monitor would remain visible and accessible for

Advantages:

This combined option offers a number of advantages while, at the same time,

The initial cost of installation but long-term maintenance and periodic replacement of the

reduction in material and personnel cost of a viable option. In fact, one researcher estimates that approximately 91% of

Stabilization by cathodic protection alone is not recommended because of the disadvantage

Second phase will be the recovery of all selected major components, as discussed below.

3.2 Conclusions

The selected option is: Stabilizing Combined with Selective Recovery (2.8.2).
recovery phase. At least two project diving organizations have also expressed interest in
goals and thus reduce the amount of on-site line required during the final stabilization and
continuation of the effort during FY99. The Navy expedition will accomplish several major
mapping and recovery activities will integrate be completed during FY98, with a possible
order to assist NOAA with implementation of the preservation plan. Some of the initial
Alaska has scheduled a three-week mapping operation at the Monitor Sanctuary in 1998.
Alaska’s efforts will lead to the recovery of the initial stabilization and
and involve the stabilization process. The US Navy has recovered the initial stabilization
properties that might be damaged by the major stabilization and recovery operations.
On-site research involves the long-term process of monitoring and mapping the site, recovery.
Concurrent with the above planning activities, on-site research activities will continue.
Schedule and fund each phase of activity and track overall funding efforts
a framework for project managers to develop the necessary partnerships and alliances,
mean will also have to be submitted for review. The funding of on-site research is vital
archaeology, conservation, exhibition, and finding. An environmental assessment and
FY98, it would be the development of detailed plans for stabilization and recovery,
recuperate operations could be completed. The first steps, which could take place during FY98
activities to take place over a period of at least three years before on-site stabilization and
As shown in Table II, implementation of this option will require a number of related
interpretive exhibits on the Monitor. More information is included in Appendix E and F.
object would be damaged or destroyed if left on the site. The significant aspect of the
logical significance. Ability to answer research questions about the site, the previously
The criteria for selecting objects for eventual recovery included historical and archae-
Because of the depth and adverse environmental conditions, on-site stabilization
Because of the depth and adverse environmental conditions, on-site stabilization
•
•
•
because of the unique nature of the object.
The shoreline system(s) would result in the loss of
The invaluable collapse of the remaining hull, with the subsequent loss of
involving damage to the hull and concerns, including the objects selected for
recovery, there exists a possibility that stabilization and recovery efforts could result
operations, there is a possibility that stabilization and recovery efforts could result
involving damage to the hull and concerns, including the objects selected for
because of the instability of the hull and the difficulties of conducting on-site
because of the instability of the hull and the difficulties of conducting on-site
Phase IV: Post-Roofed Survey and Stabilization
Following completion of all recovery activities, a support cirlcle will be worked beneath the interior and the interior will be supported on all sides before the interior now clear of overhead obstructions, it can be recovered.

Phase V: Removal of Turret: With the turret now clear of overhead obstructions, it can be recovered.

Phase VI: Removal of Armor Belt: With hull section above the turret. Whilie the hull section from near the keel:

- Be clean away and the debris removed. Lower hull plating and beams will be placed on the exposed or a combination of methods: the lower hull will also be removed by some method that will support the hull. (A type of common hearl will be placed after being pumped and dried), the mechanical jacks, "round back." (A type of common hearl will be placed after being pumped and dried), the mechanical jacks, "round back."

Phase VII: Shovel area: The hull will then be shaved at the pump area and all exposed areas beveled the hull form the shovel area:

Phase I: Pre-Shovel Archaeological Survey: Mapping and Recovery: A NOAA-approved

Operations take place. The six phases are as follows:

98 and P.Y.99. Identifying the number of leaks that must be completed when large-scale recovery will be conducted in six phases, as shown on these two pages.

Six Phases of the Shovel and Recovery Plan
Six Phases of the Shoring and Recovery Plan

Phase I: Pre-Shoring Archeology

Phase II: Shoring Beneath Hull

Phase III: Removal of Seep, Propeller, Lower Hull and Engine

Phase IV: Removal of Armor Belt and Hull Above Turret

Phase V: Removal of Turret

Phase VI: Post-Removal Survey and Stabilization

"Charting a New Course for the Monitor / 27"
TABLE II: PROPOSED IMPLEMENTATION

In making the final selection, because of the complex nature of the paper herein, the discussions below provide additional considerations that were taken into account in the implementation of each option of combination of options. Section 3 describes the selected option, along with advantages, disadvantages, action required, and estimated costs. Section 2 presents all major viable options that were identified for presentation of the

4.1 Introduction

Considerations for Selecting the Recommended Option

An ongoing basis, concern with planning activities and participating in the mapping and recovery of small articles, all of which can take place on
procedures to accomplish the desired results. However, a careful and thorough evaluation
for any given option is possible to propose several combinations of equipment and
higher probability of success.

Each option is tested-off annually, and makes recommendations to which options offer the
Oceanographic information, discusses various ichthyological options in more detail, subjects
probably not applicable to this project. Appendix F, the preliminary study prepared by
some conventional forms of salvage methodology, such as the use of explosives, will
ensure the maximum protection of the hull and its contents during all on-site operations.
While some conventional forms of salvage methodology, such as the use of explosives, will
human remains, as discussed in Appendix F. Therefore, special precautions must be taken
the Monitors’ offices and crew, earthing a plan for the proper handling and disposition of
resource, a National Historic Landmark. The hull may also contain the remains of some of
Planters must also take into account that the Monitors is a highly significant historical

Can change very rapidly, causing potential safety and operational problems.

Conducted in relatively heavy weather and strong currents, the conditions at the Shangri-La
and support, and skilled personnel, diving and recovery operations can be
require equipment and personnel to remain on site for weeks at a time. With proper
be considered when planning the local on-site schedule, especially since most options will
be 99% allocation of time to account for adverse weather. Also, the weather history must
in theory, the estimate includes expeditions staged from large research vessels and L.S.
Indications that the area is ripe, it was only possible to conduct diving operations on one day
and the window overlaps the historically June through September period. However, the window is
the site environment. As discussed in Appendix F, the most favorable weather window is
operations at the Monitor National Marine Sanctuary is the security and unpredictability of
One of the most important factors to be borne in mind when planning research or recovery

4.2 Techno-Cultural and Engineering Considerations

Review Committee, including on-site activities, conservation,
and funding. Final plans for the various aspects of the project, including on-site activities, conservation,
organizing experts were solicited and reviewed by the Committee to ensure a final decision was made and before the presentation plan was finalized.
recovery of information and documentation of the site, which will be continuous throughout the project, ensuring that the archaeological objects are protected and provide an approach that maximizes the
paramount importance in the development of a detailed stabilization/recovery plan. The plan

4.3 Archaeological and Historical Considerations

Portsmouth, England.

King Henry VIII's warship Mary Rose, raised in 1982, is a major tourist attraction in
10 was successfully raised in 1999 and is Sweden's most popular tourist attraction. Also,

The Swedish warship Vasa, which sank in 1628 (Figure 9), was discovered in 1956 and is

Chesapeake Bay, only to break apart immediately after it cleared the water's surface. Both

Kodak National Park, USS Maine, completely intact

concentrated on four cables or strips. The CIW warship USS Maine, completely intact

forces were raised from the water and, suddenly, all of their weight was

inches of recovery operations that successfully lifted and raised large objects from the

imposes of recovery operations on both dock and lifting gear motion. These are countless

Recovery operations will require even more precautions since the most dangerous phase

various options.

equipment and divers during installation, and the potential breaches to be gained from the

exposed on the hull during support/sandbagging installation, possible incidental damage from

was intended to prevent. The plan must take all factors into account, including pressures

installing stabilization materials may if not carried out properly, cause more damage than it

the Monitors' hull, pose additional threats to the hull and its components. The process of

Stabilization options, including cathodic protection, shown by mechanical supports and

and secure recovery options chosen by NOAA.

and other recovery options will be made as part of a detailed contingency plan, based on the

the Sanctuary. The final choice of methodology and equipment for any of the stabilization

of each proposed approach should yield a preferred methodology for the given conditions at

(continued)
Figure 10. The Swedish warship Vasa after her recovery in 1990. An underwater excavation was conducted from a depth of 100 feet, Vasa, which sank in 1628, floated and took part in few such large-scale excavations worldwide.

An archaeological plan for a more detailed preliminary investigation of Appendix E presents a plan that will allow teams to operate in water activities, taking part in the recovery of important materials. During 1999, two of the Monitor Sanctuary staff, both trained naval archaeologists, will take part in the field operation beyond acceptable limits, in preparation for the initial survey, which will take place by the end of the year.

Figure 9. Rotating a body-damaged hull section of the monitor. The assistance of the project archaeologist and the project director must be decisive in Appendix E, all possible consequences of the weather, ecological, and biological activities have been discussed in Appendix E, all the responsibilities of all phases of the project. The
The forward means of the ship shall contain the officers and crew's quarters and ship's

operations, to assist in this effort and to score an overall goal. A research model of the week is being conducted video and measurements from the site. A research model of the week is being conducted, photos, drawings, and documents are being housed and compared with photographs, paper plans, and drawings are being examined and compared with photographs, possible on the Monitor's construction, machinery and components, and are under consideration as

of historical data on the LSS Monitor is being conducted as a collection and interpretation of historical data and research, ongoing historical research and the

prepared and published to fill document all activities associated with the project.

Monitor Sanctuary office. Upon completion of all phases of the plan a final report will be

each calendar year of field operations. These reports will be prepared and published within the

archaeological survey must be conducted. If necessary, additional exposed artifacts will be

following the large-scale rehabilitation/recovery phase of on-site operations, another

encountered, will also make provisions for the proper recovery of human remains, should they be

recovered, the project is the right condition for initial investigations indicated. The plan

archaeological significance as well as the likelihood of their destruction if left on the bottom. The

Appendix E, the major components selected for recovery were chosen because of their

architectural integrity, documentation, recovery of cultural material. As described in

recovery phase will be outlined and incorporated into a detailed archaeological plan, which will be

Prior to the initiation of the recovery of large hull components, the major research

destroyed during rehabilitation/recovery operations.

References will be designed to map and recover artifacts that are likely to be damaged or

the following of qualified archaeologists, at least

|
of the objects that will be removed from the Monitor may be less than desirable for exhibition is to recover objects that may be adversely impacted by shoreline activities. Although some

The criteria for removal of cultural material during the stabilization phase of the project

4.5 Exhibition/Conservation Considerations

Laboratory conservation will be a major effort and will require a sizable facility and staff. As at least one qualified conservator supervises the operation, as described in Appendix B, the conservation activities can easily be carried out by relatively unskilled personnel. As long as the brokers from damage until they can be transferred to a laboratory for treatment, those on-ship

The conservation will consist primarily of ensuring that recovered objects are stabilized and displayed so that each type of material can be treated separately. Initially, however, when objects are disassembled, some with the Monitor will result in the recovery of cultural material consisting of a wide variety of materials, including iron, brass, copper, wood, customary objects, and artifacts.

Conservation must always be a major consideration when planning archaeological

4.4 Conservation Considerations

Monitor and its components have received considerable attention between areas of the ship. The large volume of plans of the vessel has been one of the major considerations is a revised version of the invaluable book, "Monitors," by James D. Morris which appeared in 1987. This book underlines the significance of the USS Monitor and the importance of current and historical research. The book is a result of Monitor-related efforts, including museum displays, manuscripts, and articles.

Chessbro's "The Sanitary Aid to Civilian Health," which is published twice a year and includes up-to-date information on current on-site and historical research, is included in the Library's collection of materials. Other research projects currently underway include a comprehensive "Monitor Bibliography" which is the subject of publication date for this study is the summer of 2001.
4.6 Funding Considerations

In consideration for extended periods of time, windows and archways over large atriums, areas will allow viewing of large artifacts that will be seriously affected by weather elements in the laboratory, such as viewing into unprotected public access areas. The need to exhibit large artifacts will also include the consideration of the security of the building. Access to artifact and exhibits will allow for the recovery of artifacts from the Monarch. A new comprehensive plan will be developed specifically to address those artifacts to be recovered. Also, exhibit design will include the consideration of how to address those artifacts to be recovered. A new, comprehensive plan will include the consideration of how to address those artifacts to be recovered. A new, comprehensive plan will include the consideration of how to address those artifacts to be recovered.

The preliminary exhibiton/consideration considerations included in Appendix F provide a more detailed study for further inspection. These considerations are discussed in more detail in the consideration, where they can be maintained in a stable condition and where they can be recovered. In cases that are not feasible for exhibition will be placed into secure storage following the recommendation of the Monarch, are too fragile to fail.

Because of poor condition, unwieldy size or other factors, all materials will be made available for exhibition purposes. Along with special handling and exhibiton guidelines, exceptions will be sold to those items that are in the opinion of conservators, are too fragile to fail.
Summary and Final Conclusions

5.0

Chalking a New Course for the Monitor

It is expected that this plan will develop numerous details of this option have not been fully developed, and an outside consultant will be consulted. But it also addresses diminishing the risk of damage during the recovery process. In addition, showing the Monitor before recovery, you only reduce the chances of collapse, but it also addresses diminishing the risk of damage during component recovery. Especially when the Monitor was recognized that recovered portions of the Monitor will be preserved in the risk of collateral damage during retrieval and recovery operations is somewhat mitigated, and concerns. If no action is taken, however, the Monitor will inevitably collapse. Therefore, the recommended option calls for actions that will substantially alter the Monitor's hull.

In establishing a realistic archaeological plan, suitable for NHPA review, consideration of preservation processes will facilitate such efforts. The Section 168 maritime organizations and expert individuals concerned with the activities. The Section 106 process will be coordinated with other preservation and heritage laws. Also, NOAA will need to consult closely with other preservation and heritage laws with the National Historic Preservation Act. Section 106 criteria and other activities that will disturb the site in any way must be reviewed by state and federal officials, the Register, and in addition, is a National Historic Landmark. Any plan proposing on-site measures to prevent or mitigate effects to the resource. Since the Monitor is listed on the National Register of Historic Places, Federal law provides that sites listed on the National Register of Historic Places are subject to protection, and criteria have been developed for the review of proposed actions.
opportunity to preserve the Monitor for future educational.

This plan provides an unprecedented federal guidelines and National Register criteria. The hull, discovered in 1973, suggests that the site has significance to the American public on a county and the sustained high level of public interest and excitement over the wreck since National Marine Sanctuary Program. The publicity received by the USS Monitor over more than 20 years has heightened our awareness of the Monitor's historic significance. The value to the public, and the long-range goals of the National Marine Sanctuary should be in proportion to both the documented and perceived potential of the Monitor.

The option assigned to large-scale stabilization and/or recovery operations at the Monitor of property assessed to $20-22 million, including construction, Commissions on the daily plan for presentation of the Monitor. However, this option is expensive, with costs estimated to $20 million. The option for stabilization combined with selective recovery appears to offer results that resources permit. In the forward areas of the hull where lining and seating areas are located.

Although showing limited and selected component recovery will improve the project, care must be taken to ensure that there is adequate professional input to the project. This proposal is advanced by a number of archaeologists, NNFA is planning to create an advisory group to be used as an advisory group to be used as a system used widely by the offshelf of industries because of the extensive work they afford the clients.

The proposal includes a re-construction system’s St. John’s strategic objectives and issues that could best be achieved by the Monitor’s remains, it would contribute to the national monument of the hull, and the character of the Monitor’s remains, it would contribute to the national monument of the hull.

Equipment will probably be similar to the equipment used by the preliminary post-recovery inspection and additional salvage work (if necessary).
References Cited

Naval Academy. 1974. Research manuscript prepared by the Midshipmen, Class of 1974, United States Naval Academy, Project Cleopatra: A Journey into History (3 volumes).


25 April 1997

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Submitted by:

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Naval Sea Systems Command, SEA OOC
Supervisor of Salvage and Salvage
Officer of the Director of Ocean Engineering

Submitted to:

Stabilization and Preservation of the Monitor

Preliminary Proposal for the Emergency Recovery

Note: In order to provide details on the engineering aspects of the stabilization and recovery options proposed in this plan, the Ocean Engineering Preliminary proposal is summar.

Summary of the Stabilization and Recovery Plan

Appendix A
5.0 RECOMMENDATIONS

4.8 Post Operation Report & Recommendation
4.7 Demobilization & Conservation
4.6 Post Operation Assessment
4.5 Mobilization and Initial Recovery
4.4 Limited Recovery
4.3 Site Assessment
4.2 Equipment Mobilization & Transist
4.1 Pre-Job Planning & Project Management

4.0 COST ESTIMATE

3.8 Post Operation Report & Recommendation
3.7 Demobilization & Conservation
3.6 Mobilization and Initial Recovery
3.5 Limited Recovery
3.4 Site Assessment
3.3 Equipment Mobilization & Transist
3.2 Pre-Job Planning & Project Management
3.1 OFFICE OF OPERATIONS

2.0 TRADE STUDIES SUMMARY

1.0 EXECUTIVE SUMMARY
Most cost-effective underwater intervention work system

Minimization of deterioration during recovery operations

Maintenance of the aesthetic and integrity of the site

The optimal offshore work platform

The best recovery methods

Evaluation and selection of the top level management options for preservation

Executive Summary

2.4. Consisted of:

Appends

Recommendations

Cost Estimate

Concept of Operation

Trade Studies Summary

The sections of the Preliminary Proposal are divided into:

Exhibition to the General Public. The sections of the Preliminary Proposal are divided into:

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Exhibition to the General Public. The sections of the Preliminary Proposal are divided into:

Exhibition to the General Public. The sections of the Preliminary Proposal are divided into:
The success of the emergency recovery, stabilization, and preservation of the Monitor and preparation of the detailed Recovery Operations Plan

underwater cutting of high bake points, determining the position of the Daedalus Guns, and positioning the ship

would aid in the advance planning and on-site operations. These include the generation of descriptions, and assumptions.

Appendix B with individual Basis of Estimates (BOE) sheets which contain the task

Appendices are presented in Section 4.0. The phase costs are broken down to a WBS level 2 in

summarized at a top level by segment of operation (WBS) level 3. The cost of Phase II is

based on the concept of operation described in Section 3.0. The cost of Phase II and is

The preliminary cost estimate is a rough order of magnitude (ROM) for Phase II and is


![Diagram](image)

Figure 1.1: Monitors Recovery Operations Plan: Seven Segments of Operation

II island into 7 distinctive segments of operations as shown in following Table 1.1. Phase

conducted over a 14 day period which includes a weather containment of 26 days. Phase

for Phase II, the Recovery and Stabilization Phase. The operations are estimated to be

outlined a preliminary concept of operation and resources required which is the foundation

emergency recovery, stabilization, and preservation of the Monitor. In Section 3.0, we have

Key to a successful operation is a realistic and feasible concept of operation for
2.0 TRADE STUDIES SUMMARY

and historic project personal will have the expertise, knowledge and experience to succeed in this challenging

---

**Interrogation Methodology**
- *Preparation Selection*
- *Synchronization Methodology*
- *Recovery Methodology*
- *The Investigation*
- *Top Level Methodology*

Based on the available information the following six Trade Studies were conducted:

- *Oceaneering*: assembled a proposal team to research, select and propose the best preserved in Section 3.0.

Conjecture of these Trade Studies that ultimately lead to the proposed Concept of Operation (Coe)

In this section, this section will present an Operation that would lead to a successful mission. In short, this section will present a single approach of Concept of Operation that might solve the trade studies.

The objective of these Trade Studies was to select a single concept of Concept of Operation for providing the long-term preservation of the *Monitor* and associated historic volumes of information generated by these past efforts. It was decided to perform volumetric amounts of information generated by these past efforts. It was decided to perform exploratory studies for reducing its detection. Many of these studies were used to form the concept of Operation for recovery of preservation of the *Monitor*. Given the form an operational concept of Operation for recovery of preservation of the *Monitor*, this section will present seven segments of Operation.

Since the discovery in 1974 of the *Monitor*'s preserved location, several expeditions and
<table>
<thead>
<tr>
<th>ROV</th>
<th>System methodology for MONITOR</th>
<th>To determine best underwater work methodology</th>
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<tr>
<td></td>
<td>Recovery efforts:</td>
<td>Methodology selection</td>
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<td></td>
<td>Submerge the MONITOR during</td>
<td>Study the potential alternatives of the</td>
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<td>repair, etc. to help support and</td>
<td>MONITOR to to determine the best methodology</td>
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<td>the repair, etc.</td>
<td>for ROV to support the repair.</td>
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<td>SHP SH AvP's) for</td>
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<td>recovery operations.</td>
<td>alternatives of the MONITOR.</td>
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<td>During recovery operations.</td>
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**Table 2.1: Trade Study Summary Table**

For each Trade Study:
1. Begin less desirable and 10 being the most desirable, Table 2.1 lists the final outcome of the proposal team. Each methodology of a given study was scored from 1 to 10. A score of 10 indicates the proposal team was scored highest overall. The panel consisted of three individuals outside of the industry and the weighted selection criteria. Each trade study was conducted by the proposal team.

Finally, after the Trade Studies were conducted, the objectives defined methodologies.

Each methodology was scored based on the trade study criteria. The selection criteria was weighted on a 1 to 10 scale based on the criteria. Information of the selected methodology for each of the selected methodologies. The panel was then used to rank each methodology. The next step was to list the major advantages and disadvantages of each methodology. After the Trade Studies were conducted, the objectives defined methodologies.
The purpose of using a contractor barge for this portion of the operation is as follows:
Based on the trade studies a contractor barge was chosen as the most desirable work platform as it:

- Meets resource lead: work vessel
- Deploys real time mission monitoring devices and sensors
- Secures and moors contractor barge at site
- Handles equipment and personnel onto the contractor barge and transfers to the site

This phase of the operation involves bringing all different equipment and personnel together and mobilizing into the work vessel. The major activities to be performed in this phase of the operation involves bringing all different equipment and personnel together and mobilizing into the work vessel. The major activities to be performed in this phase of the operation.

3.2 Equipment Mobilization and Transfer

The mobilization and follow on logistical support of the operation is understood and well planned. The mobilization and follow on logistical support of the operation is understood and well planned.

The mobilization and follow on logistical support of the operation is understood and well planned. The mobilization and follow on logistical support of the operation is understood and well planned.

Overall project management will be under the supervision of US Navy and NOAA, and project planning will be performed by a joint team of diving, engineering, and technical personnel at the Upper Wharf Company.

3.3 Pre-Task Planning and Project Management

As depicted in Figure 3.3, recovery flow chart, the overall project management will be administered by a qualified person who can perform all phases of project planning in a logical and efficient manner and can be understood as a practical, well-understood and well-planned plan for the project. The primary goal is the recovery of significant artifacts and materials from the Monitor. The recovery of significant artifacts and materials from the Monitor has necessitated a comprehensive plan for the management, mobilization, and operation.

The Monitor lies in about 230 feet of water 16 miles off the coast of Cape Hatteras.
as follows:

The benefits of using SHIP SHAPE as the primary navigation and documentation tool are necessary to completely document the wreck site.

Video from the divers' helmet-mounted cameras can be combined to provide the information of the operation without unnecessarily delaying the recovery efforts. The divers' position and remain at the motion. This system will allow continuous documentation during all phases of the recovery. SHIP SHAPE has been identified as the best method for mapping and documenting the wreck site.

Major Resource Listed: SHIP SHAPE

SCUBA (Tech Diving)

- Twice the working time of surface-supplied and other times that of other divers
- Cost effective
- The safest method, based on amount of bottom time expected

The benefits of using SAHMATION diving as the primary recovery method are as follows:

Major Resource Listed: SAHMATION Diving System

will also be employed during this and the subsequent phases.

Deep Diver by Diving bell from the deck barge, Surface Reel divers and the ROV Deep Dive

The site assessment and preparation will be conducted primarily by SAHMATION divers

- Documentation and calibrating
- Lift-time frames and design
- The survey to further refine the recovery procedures and design of the system
- Deployment of the navigation system

The operation are as follows:

begin the site assessment. The major activities to be performed during this phase of the site assessment.

The first task is to ensure the deck barge has been anchored over the wreck site, will be to

3.3 Site Assessment

- Barge system
- Economical alternative to an engender a-point vessel and material
- The barge included for propelling barge and setting mooring anchors
- Helicopter landing pad
- Tow-point mooring

- Station keeping capability during operations and rough weather by
- Accommodations for 10 persons
- Support diving equipment and additional recovery equipment
- Deck space for all systems and auxiliary mission equipment, ROV system
- Crane for heavy and light lifts
During this phase of the operation, lifting and rigging equipment from recovered artifacts is necessary prior to the start of the recovery operation. Identifying and assigning priorities to artifacts is necessary prior to the start of the recovery operation. In this phase of the operation, the most efficient manner as much work towards assessment phase and the appropriate methods of recovery will have been determined. For assessment phase and the appropriate methods of recovery, have been determined the site recovery of selected artifacts. These artifacts will have been identified and located at the site. Following the site assessment and preparation phase of the operation the next step in the following could be: U.S. Navy asset investigations of the site.

3.4 Limited Recovery

- Can provide support for archaeological documentation and scientific
- Can assist in lifting and recovering artifacts
- Provides constant in-water presence for divers support
- Proven reliability, during TMA Flight 800 recovery, system operated for 14 weeks with less than 30 hours downtime
- System has previously been deployed to survey Monoar site

The purpose of using the Deep Drone ROV includes:

- Be employed throughout the operation that will increase productivity. In addition to the survey performed by the saturation divers, the Deep Drone ROV will

- Reaching the detailed recovery plan
- Recording all observations and measurements which will assist in the
- Inspect the entire area for exposed artifacts that can be removed
- Inspect, measure, and map key features or obstructions
- Articulate, future conservation and documentation efforts
- Creation of a database incorporating video and text to be used for
- Ability to guide divers and the ROV to exact positions on the wreck site
- Precise location of artifacts in three dimensions
Chaining a new course for the monitor / App - 13

Equipment between the vessel and shore-side facilities.

Support necessary for this recovery effort is a crew pool will be used to transport personal and

Many of the items recovered will be transferred ashore for more extensive preservation

on site.

Equipment and working equipment will be on the barge in the spill to respond to the conditions

equipment necessary raw materials such as steel, wire, rope, etc. for recovery on site. The necessary raw materials such as steel, wire, rope, etc. for recovery

exposed prior to the operation will be necessary to modify and build high-capacity equipment

many of the larger artifacts. These will be disassembled and placed in sand or large bags to

to the recovery effort. Specialized lifting frames, spreader bars, and slings will be needed for

Determining the proper type of recovery method to be employed for each artifact in order

Guides

Into recovery baskets brought on deck and identified by archaeology.

Small artifacts indistinguishable as marine growth will be sucked up.

may be neglected for successful recovery.

Air and water lift systems will generally uncover larger artifacts so they

of these methods are as follows.

Both air and water lift will be used to recover and free artifacts for recovery. These

Major resources used: Air and water lift systems

and data base entry for each item.

Document each article by the use of still photos, high resolution video,

Based on input from the archaeologist.

These containers will be built prior to the operation and will be

Place each artifact in the proper preservation containers above the

and stored inside the dryer’s unfiltered air conditioning box.

Small significant artifacts and materials are to be placed in plastic bags

Possibility damage to the artifact or the protective marine covering

Select the appropriate storage and transportation for each item to minimize

Excessive to free artifacts

The major activities to be performed during this phase of the operation are as follows:

Fabricate the necessary custom recovery and preservation equipment

Oceaneering has the engineering and maintenance resources to

Over 33 years, Oceaneering has extensive experience and equipment applicable

Oceaneering also provides surge隔离和 recovery services for

Of these resources are as follows:
The steps necessary to recover the turret are listed below:

- Transfers hull with weight from keels to 3:1 mixsand base support base
- Installs additional 3:1 mixsand bags
- Jack-up to support hull to remove weight from turret
- Installs jack-up support frame between 3:1 mixsand bags and hull
- Bell form and all of the turret to support the suspended areas
- Installs hull stabilization 3:1 mixsand bags under the hull and armor

Follows:

For the long term preservation of the Monitor, the steps necessary to accomplish this are as follows:

- Lift to surface
- Install supportive filling frame and filling
- Lift
- Before removing to lift
- Lift above the surface
- When necessary
- Determine location of armament
- Archeological excavation
- Hull above interior
- Remove stern position of interior
- Support
- Sand bags for hull stabilization
- Install 3:1 concrete mix and

Operation includes:

- Performed during this phase of the operation
- The major activity to be performed
- Cannons in the surface for the operation is to recover the turret and
- The objective of this phase of the operation

3.5 Stern Stabilization and Turret Recovery
3.6 Post Operation Assessment

Jot out area around the unit where lifting will come to facilitate removal
Secure crane to lifting shims and take strain
Install nylofon single lifting bridge around unit

Before the inside of the unit to handle the loads expected during the lifting process, ensure the inside of the unit is free from any obstructions that may affect the lifting. This would include the removal of any obstructions, such as shelves or other objects, that may interfere with the lifting process. Make sure the lifting equipment is secure and capable of handling the weight of the unit.

Note: This method requires that the unit's armor have sufficient side wall strength to support the lifting of the unit.

Option 2: Right shield exists
Store unit in specialized preservation container
Jot out area around the unit where lifting will come to facilitate removal
Secure crane to lifting shims and take strain

Option 1: No right shield
Remove and remove from the outside perimeter of the unit
Exeave sand and artifacts from inside unit

Clear the area above the unit to gain access to the unit and the surrounding area

Remove and remove from the outside perimeter and interior
Exeave sand and artifacts from the interior collection the artifacts

This information will present two options or not. It is provided as assistance to the recovery. By following outside the perimeter of the unit, it will be determined if the right shield is present or not.
RECOVERY OPERATIONS TOTALS 18 weeks (sea time) $9,800,000

is the day rate of NAVY, NOAA, Governmental and Archaeological personnel, other consumables, and required diving personnel (32), which is not included in this estimate. The daily cost of $9,800,000 is comprised of all diving equipment, deck crew, preservation equipment, diving operations. The daily cost of the recovery operation is roughly $570,000. This includes the work of the ARCHAEOLOGICAL and preservation only.

The SAVER 5 will make available their ROV Deep Diver, which would enable funding for the entire project. The assumption is that is an additional $2.8 million will result. A second assumption with significant impact to the operation is adverse weather. A 20% margin for weather downtime in Section 3.1. If the US NAVY can provide access to the deck space of a work vessel, this proposal assumes a realistic daily rate of $5,758,160 for the vessel. For the vessel, the ROV cost estimate. The assumption with the greatest impact on total cost is the availability

Due to the nature of this operation, assumptions of recovery cost will be provided as

4.0 COST ESTIMATE

included. Final recommendations for the future of the Monitor will be provided in the final report. This report will document the actual operation cost and recovery process.

3.8 Post Operation Report and Recommendations

The conservation effort will have already begun, based on planning by the archaeological
depth of 40 feet. The conservation divers will need a little over 3 days to

document their work. The assumption is that the conservation divers will need a little over 3 days to

immediately upon completion of the operation, the work vessel will recover its mooring

3.7 Demobilization and Conservation

has been collected on until weather becomes the deciding factor in determining the operation. The portion of the operation should continue until all the archaeological information necessary
5.0 RECOMMENDATIONS

The success of the emergency recovery, stabilization, and preservation of the Monitor Project depends on the knowledge of the project team, a well-documented and detailed Recovery Operations Plan, the proper selection of equipment, and good weather off the coast of Cape Hatteras during the operations. To enhance the success and mitigate risk, the following recommendations are made:

- Generate a list of artifacts by priority to be recovered and preserved. This list should be developed by the National Oceanic and Atmospheric Administration's Monitor Sanctuary Manager with input from Section 106 members and be factored into the Recovery Operations Plan.
- Conduct industry search for optimum method for underwater cutting of highly-corroded wrought iron and rolled iron armor plate. Trade studies should be performed based on the information received to select the best method and actual underwater testing conducted to confirm capability on representative samples.
- Determine the location and position of the two 11-inch Dahlgren shell guns that were located in the turret. Then factor this information into the Recovery Operations Plan for recovery of the turret. These guns and carriages probably came off their tracks as the Monitor rolled and capsized. They may have exited the turret before the Monitor impacted into the seafloor, stern first, or are contained in or
These four preliminary recommendations are based on what is considered feasible with
and transfer of recovered artifacts and unit to the conservation facility.

- Prepare a detailed Recovery Operations Plan for the project. The plan develop-
- Limited bolting time or underwater vehicles of opportunity.
- Suggest continuing an industry search for ground penetrating
- acoustic source (i.e., sub-bolting profiler) that can be used by technical divers with
- under the limit.
Method #3 - Limited Recovery. This concept includes a selective approach to recovering relatively unimportant artifacts, those exposed to vandalism and theft.

Advantages: Cost remains visible and readily available for future archaeological work; remains as an archaeological real.

Method #2 - In-Situ Preservation by Shoring. Method of decreasing mechanisms.

Advantages: Deemed the physical real. The monitor would no longer be visible or readily re-approachable for preserving some form of capturing the monitor.

Advantages: Due to less exposure and obviousness, the risk of damage and marine environment or strong currents, the risk of damage would be greatly reduced.

Method #1 - In-Situ Preservation by Encapsulation. Method for decreasing deterioration without removing the monitor from its current position.

Advantages: To establish a single management option for preservation of the monitor.

OBJECTIVE: TO establish a single management option for preservation of the monitor.

A1. TRADE STUDY #1: TOP LEVEL METHODOLOGY
Method #1 - Jack-Up Rig. Three leg platform capable of reaching up out of the water and out of the effects of surface waves in 240 ft.

Method #2 - Direct Lift. This method includes the use of traditional heavy lift.

**Methodology:**

- **Objective:** Select optimum work platform that will accommodate a direct lift
- **Method Selection:** Water intervention

<table>
<thead>
<tr>
<th>Platform Selection</th>
<th>3</th>
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<tr>
<td>DIRECT LIFT</td>
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<table>
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<th>DIRECT LIFT</th>
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<tr>
<td>Internal Buoyancy</td>
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<td>TECHNICAL RISK</td>
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<td>COST</td>
<td>6</td>
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Table A.2: Recovery Methodology Trade Study
Advantages: Availability, cost, self-propelled.

Method #4: Four Point Mooring Vessel. A vessel capable of maintaining a sustained mooring at anchor positions.

Disadvantages: Long-term lease, less availability, cost.

Advantages: The ability to work in deep water or near shores that are sensitive to mooring activities, self-propelled, helicopter pad.

Method #3: Dynamic Positioning Vessel. A vessel capable of keeping station without mooring by use of GPS controlled thrusters.

Disadvantages: Availability, cost.

Advantages: The US; mobilization expense that includes laying vessel, short bottom contact; helicopter pad.

Advantages: Large stable platform to stage operations from, no large submerged hull.

Method #2: Semi-Submersible Drill platform that maintains stability by using positioning of legs around monitor site; short term lease available.

Disadvantages: Limited number of legs capable of 230 ft, none on the East Coast; mobilization expense that includes laying vessel.
Disadvantages: No archaeological information of historic value is recorded.

Advantages: Recovery activities are not hampered by the document.

Method #1 - No Site Investigation. Full attention placed on recovery activities without consideration for documenting the location from which artifacts are recovered.

**Methodologies:**
- Gel Integrity during recovery efforts involving the Monitor.
- Objective: To select the best method of maintaining appropriate archaeological significance.

### A.4 Site Investigation

**Trade Study #4**

- The East Coast of the U.S. requires towing and anchoring capabilities.
- Disadvantages: Poor port access; limited space on platforms.
- Advantages: Large crane capable of making heavy lifts.
- Method #5 - Derrick Barge. A barge equipped with a permanently mounted crane.

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<thead>
<tr>
<th>Derrick Barge</th>
<th>Total Score</th>
<th>Accommodation</th>
<th>Capability</th>
<th>Preservation</th>
<th>Work/Storage Space</th>
<th>Station Keeping</th>
<th>Availability</th>
<th>Technical Risk</th>
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Divers' minimal impact on recovery activities.

Advantages: Provides for automated positioning of ROV and/or ROV.

Method 5 - **Trackpoint**

An acoustic system used for underwater positioning and navigation.

Disadvantages: Requires additional cost, associated with maintaining requirements.

Navy

minimal impact on recovery activities, system is owned by the US

relative to making an ideal environment for SHIP SHAPE.

The task of achieving can also be achieved in the database if position is

seized, data collected can be retrieved and later played back for view.

Advantages: One integrated system that collects and stores a variety of information, including tracks and documents points of interest on.

Method 4 - SHIP SHAPE

An integrated data management and positioning system for collection, sharing, and presenting data that includes underwater.

Disadvantages: Data collection activities may slow recovery activity.

Generated from the information gathered.

Advantages: A photographic record is captured for historic purposes.

Method 3 - Controlled Photo Survey.

This method would include using a photographic record.

Disadvantages: No records of precise location where artifacts are recovered.

Advantages: Recovery activities not hampered; a photographic record is captured for historic purposes.

Method 2 - **Uncontrolled Photo Survey**.

This method would include using a photographic record of precise location.

Disadvantages: No records of precise location where artifacts are recovered.

Advantages: Recovery activities not hampered; a photographic record is captured for historic purposes.
Method #2 - **Surface Gas Divene**

**Advantages:** Reduced surface pollution, lower decompression times.

**Disadvantages:** Limited working depth, no reliable computer assistance needed.

Method #1 - **Technical Diving**

**Objective:** To determine the best W/T work system methodology for monitoring

**Methodology:**

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<tr>
<th>Intervenion Methodology</th>
<th>A6 Trade Study #6:</th>
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<tr>
<th>Cost</th>
<th>1 2 3 4 5 6 7 8 9 10 11</th>
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**Table A5: Stabilization Methodology Trade Study**

Methods: Methodology: Eovan: Cost

**Advantages:** Reduced surface pollution, lower decompression times.

**Disadvantages:** Limited working depth, no reliable computer assistance needed.
Advantages: Flexibility to handle most configurations, multiple diving and ROV.

Method #6 - Combination: A combination of surface support diving, saturation.

call operations, currents may inhibit work productivity.

Disadvantages: Limited dexterity for conducting detailed mechanical repairs.

Advantages: No limitations related to decompression required.

Time remaining in surface presssure environment, eliminating decompression needed, a trained operator to work in water depths to 2,500 ft with the ADS utilized in an atmospheric diving suit (ADS) to
gather mechanical failures possible.

Disadvantages: Support personnel and extensive equipment required.

Capacity unlimited, bottom time rapid surface to site delivery vehicle limited.

Disadvantages: No direct hazards to operating personnel, nearby construction tasks in the oil field sector.

Prevent many sub sea tasks, ROVs are extensively used for a variety of u/w with inspection, survey, construction and salvage tool packages to conduct.

Method #5 - ROV. This method utilizes remotely operated vehicles equipped.

Advantages: Exclusive, meaning requirements and support equipment required.

Disadvantages: Least risk of decompression sickness; greatest possible bottom time for the crew.

The work site for the divers.

The working depth, this method provides housing and transportation to the work site located on the work platform, which is pressurized to diving bell complex located on the work platform.

Method #3 - Saturation Diving. This method utilizes a living quarters and

in scope of project and amount of bottom time required.

Scope of project limited amount of bottom time, increased cost due to increased risk of decompression sickness due to

Advantages: Unlimited gas supply, direct audio/video link to
### Table A.6: Intervention Methodology Trade Study

<table>
<thead>
<tr>
<th>METHODOLOGY</th>
<th>Tech. Diving</th>
<th>Surface Gas Diving</th>
<th>Saturation Diving</th>
<th>ROV's</th>
<th>ADS</th>
<th>Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPORT VESSEL (TEN)</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>WEATHER/RECOVERY</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>TECHNICAL RISK</td>
<td>36</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>COST</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>TIME (TOT MIN)</td>
<td>5</td>
<td>7</td>
<td>6</td>
<td>45</td>
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</tr>
<tr>
<td>IMPACT</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>5</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>RESOURCES (PERSONNEL)</td>
<td>2</td>
<td>16</td>
<td>2</td>
<td>16</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>AVAILABILITY</td>
<td>2</td>
<td>16</td>
<td>2</td>
<td>16</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>TOTAL SCORE</td>
<td>213</td>
<td>315</td>
<td>349</td>
<td>40</td>
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<td>40</td>
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</table>

**EVALUATION:** Score is from 1 - 10 with 1 being least desirable and 10 being most desirable.
Cutting a New Course for the Monitor

For most metal artifacts, including wrought iron cast iron, copper, brass, bronze, tin, and pewter, or silver, the method of choice will probably be electrolysis. Molten, in sea water and

Electrolysis

Conservation Methods

Recovered from the Monitor Sanctuary

In conservation science, several conservation methods may be employed for artifacts in a number of years of exposure to chlorides and other aggressive ions (carbonates, sulfates, etc.). Conservation of oxides, chlorides, sulfides, and other materials when they are alive. The stabilization process sometimes requires a 2 inch thickness of sand to seal the artifacts from exposure to sea water. Some materials require a conservation slurry.

Artifacts recovered from the Monitor Sanctuary

Belle Chase, Louisiana
P.O. Box 9
International Maritime Conservation and Research Laboratory, Inc.
By: Robert D. Bump and David L. Johnson

From the Monitor National Marine Sanctuary

Summary of the Conservation Plan

Appendix B
after recovery from the sea, these chemicals will cause the artifact to corrode even if the exterior has been cleaned and freshly painted. On drying out, the corrosion products will expand, which in turn will lead to sections of the artifact falling away. Over time, the artifact may become unrecognizable. Electrolysis treatment is one of the most effective methods used to remove these chemicals and to stabilize metallic artifacts.

Electrolysis is a reaction requiring six components when treating artifacts: the artifact, a suitable tank to hold the electrolyte, an electrolyte solution, a power supply, a cathode, and an anode(s). When the system is set up correctly, the electrical current (as charged positive ions) travels from the positively charged anode through the electrolyte solution to the negatively charged cathode. The chloride ions migrate from the negatively charged anode toward the positively charged cathode. This causes the chloride molecule to break down into negative chloride ions. Since opposite charges attract, the chloride ions migrate out of the artifact, through the electrolyte toward the positively charged anode. Any iron ions (positively charged) remain behind with the negative charged cathode. This process removes the corrosive chloride ion within the artifact, where it would cause disintegration. Chloride concentration in the electrolyte solution can be monitored by measuring the increase in the chloride ion concentration.

Upon completion of the electrolysis treatment and after the electrolyte has been removed from the artifact, it is necessary to coat the artifact to protect it from atmospheric corrosion. A different coating system is required for an artifact retained in storage than for one that is placed in an out-of-doors exhibit, or put on display in a museum. The type of coating and the surface preparation for the coating must be determined by the conservator after the decision as to the disposition of the artifact is determined.

Consolidation

For waterlogged wood and other organic materials, a method known as consolidation, or chemical impregnation, will be used. This treatment is required to remove contaminants (salts) and prevent shrinkage of the artifact when the water is removed. The first phase
Hydrogen reduction furnaces used in marine runs conservation are electrical furnaces in which have provisions for heating objects in a hydrogen atmosphere. The size of the article in order to heat large objects, some shrinking may need to be controlled after documentation and then dried over extended periods of time in chambers. Larger wooden furnaces should be fully dried and other means of drying should be employed. A chamber large enough to heat the wooden check pieces of the London earthenware of the freeze dryer is placed in the chamber size of the freeze dryer.

The size of the article that can be heated is based on the chamber size of the freeze dryer.

**Freeze Drying**

The size of the article that can be heated by freeze drying is dependent on the chamber size of the freeze dryer. To remove water from most articles that have been heated with chamber condensation, freeze drying is the preferred method. Freeze drying is a vacuum process where the temperature of the condenser plate is maintained at a temperature lower than the water's freezing point. Water is removed from an article in a freeze dryer by sublimation. The condensate recovered.

Facility conservator will need to determine the proper type of conservation to use for each article recovered. Polyethylene glycol (PEG) is one of the water-soluble conservation materials that can be used. It is one that has been performed well in other skipper conservation projects. Polyethylene glycol provides dimensional stabilization and inhibits shrinking when the aquatic is dried. This phase of treatment is completed.

**Rinse:**

Once the soaking has removed the sea salts, the article can begin the second phase of the treatment. This phase of treatment is completed.
For a few weeks, it can be removed, washed, and all loose encrustation removed. If any
need for a few weeks, it can be removed, washed, and all loose encrustation removed. If any
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need for a few weeks, it can be removed, washed, and all loose encrustation removed. If any

For artifacts underfiring electrolytic treatment, only a carefully cleaned small area is

Garmented for each artifact:

Should be utilized to compile the records being generated and store the drawings and sketches
description as well as photographic and video documentation. Electrolytic records keeping
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description as well as photographic and video documentation. Electrolytic records keeping

All treatment steps should be fully documented by measurement, drawing, and treatment
All treatment steps should be fully documented by measurement, drawing, and treatment
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Organic artifacts will preferably go through a wash/sanitizing cycle. All other artifacts will
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Cleaning and Documentation Requirements
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Lickers, consolidation solutions used to heal wood can be corrosive to iron and steel
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Lickers, consolidation solutions used to heal wood can be corrosive to iron and steel
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Lickers, consolidation solutions used to heal wood can be corrosive to iron and steel

Some iron electrolytic treatment can be done after the electrolytic treatment has been completed.
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Unfortunately, there is presently no treatment procedure acceptable to most conservators
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Composite Articles
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Composite Articles

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Treatment tanks and the metallic to electrolysis treatment units
the organic compounds. The organic material can then be transferred to consolidation
held in wet storage until the leach can be cleaned and the metallic compounds removed from
Obstacles that are made up of metallic compounds fixed to organic compounds should be
material wet storage is estimated to be about 450 square feet.
should be utilized for wet storage until the antiques are prepared for treatment. Organic
The wet storage is estimated to require about 4,000 square feet. The electrolysis tanks
Wet Storage Requirements
exceeding 6 feet in height can be placed above the floor and moved as needed.
also utilized for equipment storage. The leechment tank and fabricated steel tanks not
the floor. The surface tanks can be covered over with flooring once treatment is complete and
number of them should be submerged into the floor of the building to reduce the height above
The leechment tanks should be designed to either be at the design of the building or as a
Building will be required.
artifacts above the facility. A minimum of a 10-foot overhead crane system interfaced with the
door should not interfere with the operation of the overhead crane needed to move heavy items
The facility should have a large doorway that can be opened to a minimum of 24 feet. The
The facility will require redundant lifting equipment in each facility.
becomes a large overhead crane system is needed to move the heavy
Multiple articulated lifts provide multiple smaller ones
area will be designed below a single large facility is provided multiple smaller ones
shall to required of each
reduction furnace and a dust-free control room plus a room to house a reportedly
High pressure reduction furnace and a dust-free control room and a control room with
such blast furnaces and wet blasting/cleaning tanks can be used. Close of areas that can be used
required to provide electrolysis treatment alone is 4,000 square feet. The additional area is
require to the consolidation requirements of many materials and the disassembly of
equipment for the consolidation requirements of many materials and the disassembly of
be disclosed. The findings should be documented by measurement.

Facility Requirements
been documented.
unattended until the antiques are stable and all information concerning the leechment process has
weeks and the same process repeated until all concentration is removed. This sequence is
should also be recorded. The antiques should then be returned to leechment for a few more
Data concerning the full leechment process to date
information disclosed at this time: the findings should be documented by measurement.
Conservation of the Monument Antiques under consideration will require a building of Group
The largest tank will be a 30-foot-diameter by 12-foot-deep round modular style tank.

The tank will be used to keep the items of the order intact. The tank will be filled with its contents.

The tank should be cleaned with a cleaning solution compatible with the equipment, and the internal surfaces should be cleaned with a cleaning solution. The tank should be emptied, and the internal surfaces should be cleaned again. The tank should be filled with the equipment, and the internal surfaces should be cleaned again. The tank should be emptied, and the internal surfaces should be cleaned again.

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The Turtled Comets (General Rise of multiplied comets)

The Sun's effect, due to a rise in the Sun's energy, may result in additional turbulence and proliferation. This increase may lead to increased pressure and explosivity, taking advantage of all phases of the Sun's cycle, including the solar wind, solar flares, and coronal mass ejections. Additional measures have been taken to keep the Sun's energy, which is necessary to protect the Earth from harmful solar radiation. To estimate the conservation difficulties that may be involved with this artificial

The 22' Diameter by 9' High Turret of the Monitor

Time Requirements for the Conservation of Water Items

The estimated area requirement for conservation and reclamation lakes is 40 square feet. The conservation area requirement for conservation of saline water is 40 square foot. The conservation area requirement for conservation of saline water is 40 square foot.

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The conservation area requirement for conservation of saline water is 40 square foot. The conservation area requirement for conservation of saline water is 40 square foot.

The conservation area requirement for conservation of saline water is 40 square foot. The conservation area requirement for conservation of saline water is 40 square foot.
The Engine and Associated Fittings, Valves, and Covers (not the motor).

The propeller and section of shaft

The propeller and section of shaft.

The personal items (disposable sea bags with clothing, etc.)

Organic compounds.

The wooden components are completed.

The metal-wood composite Catapults for Monitor Cannons.

Two 11-inch Dahlgren Smoothbore Cannons.

Two 12-inch Dahlgren Smoothbore Cannons.
part is still required for collection storage and a downsized treatment facility. At the end of the treatment phase, a part of the facility can be converted to exhibition space, while the remaining larger treatment plant that is available is still usable if possible. It would not be unreasonable to assume that the site is in a stable as possible. If the site has been gained, the structure is as stable as possible. Some of the larger structures may require additional treatment to ensure that chloride removal and appearance is maintained. If may take up to a year or two before some objects can be reassembled in the treatment process. From the above estimates, it can be seen that many of the parts may require at least 6 years of treatment.

The above estimates are also required to complete treatment of these objects.

The treatment time can be expected. If estimated, that about two years will be required to complete the treatment. As the condenser box is also above the condenser, be aware that any cleaning or maintenance would have the same requirement at the treatment.

The blower, blower, and blower would have the same requirement as the condenser box listed above.

The pumps would have the same requirement as the condenser box listed above.

The process-air blower, blower, and auxiliary steam engine would have the same requirement as the condenser box listed above.

The condenser box and valve mechanism would require the same requirement as the engine.

The auxiliary machinery and equipment.

The engine is therefore expected to require about six years of treatment. Disassembled in the ocean may need to be processed in order to join two existing pieces. Treatment and parts need to be processed in order to join two existing pieces. Additionally, parts that have fully treated parts need to be processed to support the engine may require 6 to 12 months to reassemble. In general, reassembly is complete. The assembly of the component parts will require less time. After all treatment is complete, the assembly of the component parts will require less time. Once the engine is reassembled, it can be reassembled in an additional three years of treatment. The other components of the engine will then need to be assembled for display. For an engine of this size, one to two years of treatment could be required to clean and loose parts so disassembly can take place. Once assembled, it may need to be processed in order to join two existing pieces.
additional funding requirements

- Annual estimated utilities cost
- Local estimated annual personnel cost, annual estimated consumable chemical costs, and the total estimated annual personnel cost is estimated to be between $450,000 to $500,000 per year. This cost is made up of the cost estimated to be between $450,000 to $500,000 per year. This cost includes the annual estimated utilities costs, the annual estimated local cost, and the annual estimated personnel cost.

- Annual Operating Cost

- Equipment and Supplies

- Facility Cost Estimate

The estimated cost for the minimum recommended facility of 12,000 square feet is approximately $2,000,000. This price is based on an average of $100 per square foot for construction cost. There are many factors that affect the cost of the building, including the size of the building, the location of the building, the materials used, and the labor costs. The estimated cost for the building includes all the necessary permits, engineering fees, and construction costs.

The estimated cost for the additional equipment needed to be built into the building and any in estimated cost be between $3,500,000 to $4,500,000 with no allowance for land costs. The estimated cost for the equipment and supplies is estimated to be approximately $300,000 to $500,000 per year. The estimated cost for the equipment and supplies is estimated to be approximately $300,000 to $500,000 per year. The estimated cost for the equipment and supplies is estimated to be approximately $300,000 to $500,000 per year. The estimated cost for the equipment and supplies is estimated to be approximately $300,000 to $500,000 per year. The estimated cost for the equipment and supplies is estimated to be approximately $300,000 to $500,000 per year.
Temperature should be held at 70 degrees Fahrenheit, plus or minus 2 degrees.

Storm areas the relative humidity should be lowered to 45%, plus or minus 2%, and the
with a performance at about 70 degrees Fahrenheit and a relative humidity of about 50%.
In the exhibit and storage areas. Exhibited artifacts should be maintained in environmental
Atmospheric degradation is mitigated through the use of environmental controls in
be re-tested weekly or given additional measurement.

The facility conservator must then determine if the object or component part of the object must
If problems are detected, the object should be sent back to the treatment facility. The

Maintenance and Other Considerations

Infrareds for objects placed on display would not be deemed excessive.

Inspections should be made every six months if no major problems are found. After the first year, inspection at six month
the objects should be inspected at monthly intervals for the first six months and then every
developed. It is important for corrective action can be taken. For the first year after treatment
High, molds and fungus, and other degrading actions. Periodic examinations are necessary to
are newly installed objects. All materials are condensed in some fashion by the atmosphere.
periodic examinations is necessary to mitigate any damage that may occur on

Periodic Examinations

Chloride leaching is evident on any artifact, the artifact should be removed to the facility for
long-term treatment. Some residual chlorides may still be present in some artifacts. If
are needed. They must be readily visible in case re-treatment of the artifact is necessary. Even after
after treatment are used to inhibit atmospheric corrosion and should be inspected and replaced
visible at eye level and moisture can activate corrosion of the iron. Corrosion products from objects
Success is in stabilizing these artifacts. The conservation treatments described above have been
be removed from the ocean after years of exposure to sea water will

Physical and Environmental Concerns

$9.5 and $10.5 million.

Building, staffing, and operating cost for the 10 years is therefore estimated to be between
The total estimated cost for a project of this size will require 10 years to complete. The

An additional cost of $25,000 per year is recommended to meet these requirements.
The administration personnel that manage the Monmouth National Marine Sanctuary are located on the Mariner Museum property.

- The administration personnel that manage the Monmouth National Marine Sanctuary are located on the Mariner Museum property.
- The Mariner Museum has existing storage facilities to take any overflow produced by this project.
- The administration personnel that manage the Monmouth National Marine Sanctuary are located in the facility.
- The Mariner Museum has additional lighting equipment on site to augment the requirements of the facility.
- The Mariner Museum has some existing treatment tanks to augment the requirements of the facility.
- The Mariner Museum has security systems already in place. The cost estimate in this document placed at another location.

Facilities

- Yards, etc.
- Many acquisition contracts are located nearby to service facility needs (naval shipyards).
- The Mariner Museum is located close to docks to receive the Mariner artifacts after recovery.
- The document indicates no cost. No land cost has been calculated into the construction costs included in this document.
- The Mariner Museum is located on a 55-acre park that has ample room to house this facility.
- Where the USS Monitor fought the CSS Virginia (ex- Merrimack) on March 9, 1862.
- The Mariner Museum is within a few miles of Hampton Roads, the famous battle site.

Location

- Reason: The authors of this report recommend that the Mariner be considered for the following:
- 1997, the authors of this report recommend that the Mariner be considered for the following:
- Location of the Monitor that are used for possible recovery. Other facilities exist that could perform the research. Presently no facility exists in the United States with the capability to reach the artifacts
this bringing the vessel's deck down to 13 inches above the water line.

1383
ins. = 5 in.

At 10 ft draft of water, the vessel's deck would be 18 inches above water.

Surplus Weight

\[
\begin{array}{|l|l|}
\hline
\text{Displacement at 10 ft draft of water} & \text{Weight Total} \\
1038 \text{ Tons} & \\
1107 \text{ Tons} & \\
69 \text{ Tons} & \\
\hline
\end{array}
\]

" 70
Cooking appliances & utensils, etc.

" 50
Accommodations, furniture, &c.,

" 20
Masts, spars, rigging, boats, davits,

" 10
Interior fittings for cabins & crew

" 137
Provisions, water tanks with water,

" 125
Hawser, railings

" 15
Officers & crew, with their effects

" 40
Donkey engines

" 25
Windlass, capstans, anchors, cables,

" 335
Blowers & enginges with pipes, &c.

" 137 1/2
Eight days' coal (4 lbs. per hour per

" 142 1/2 tons
Engine complete (400 Horse

Stores

Ammunition

Two 1-inch guns & carriages

Total Weight Of Armor

Wood in d. of

Iron in construction of vessel

Contract

Weight as amended by sketch & letter of 21 Oct., 1861.

[National Archives, Record Group 45, Subject File AD]

J. Ericsson, Armbr Vessel
<table>
<thead>
<tr>
<th>Weight and Dimensions of Hull Components</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Propeller</strong></td>
</tr>
<tr>
<td>Diameter - 9.0 feet</td>
</tr>
<tr>
<td>Hub length - 2.0 feet</td>
</tr>
<tr>
<td>Weight (est.) - 401.5 pounds</td>
</tr>
<tr>
<td>Material - Iron</td>
</tr>
<tr>
<td><strong>Shaft</strong></td>
</tr>
<tr>
<td>Length - 17 feet from propeller to coupling</td>
</tr>
<tr>
<td>Diameter - 9 inches</td>
</tr>
<tr>
<td>Weight (est.) - 3740 pounds (~ 220 pounds/foot)</td>
</tr>
<tr>
<td>Material - Wrought iron</td>
</tr>
<tr>
<td>* Shaft length to coupling</td>
</tr>
<tr>
<td><strong>Skeg</strong></td>
</tr>
<tr>
<td>Length - 25.5 feet</td>
</tr>
<tr>
<td>Width - Approx. 6 inches</td>
</tr>
<tr>
<td>Weight - Approx. 5000 pounds</td>
</tr>
<tr>
<td>Material - Wrought iron</td>
</tr>
<tr>
<td><strong>Rudder</strong></td>
</tr>
<tr>
<td>Length - 6 feet</td>
</tr>
<tr>
<td>Width - 7 feet</td>
</tr>
<tr>
<td>Thickness - Approx. 6 inches</td>
</tr>
<tr>
<td>Stock size - 10 feet x 4.5 inches diameter</td>
</tr>
<tr>
<td>Weight - Estimated at under 4000 pounds</td>
</tr>
<tr>
<td>Material - Iron and wood</td>
</tr>
<tr>
<td><strong>Turret</strong></td>
</tr>
<tr>
<td>Height - 9 feet</td>
</tr>
<tr>
<td>Outside diameter - 21 feet 6 inches</td>
</tr>
<tr>
<td>Thickness - Approx. 8 inches</td>
</tr>
<tr>
<td>Weight (est.) - 126.3 tons</td>
</tr>
<tr>
<td>Material - Wrought iron</td>
</tr>
<tr>
<td>* Weight includes both guns and carriages</td>
</tr>
</tbody>
</table>

**NOTE:** The above weights include an extra 10% to account for the weight of corrosion products and marine fouling growth; however, corrosive deterioration of the iron has, in all cases, reduced metal weight. Therefore, the above weight estimates should be "worst-case" values.
Figure C.1. Profile and perspective drawings of shee, propeller, shaft and rudder.
Figure C.3. Monitor's Propeller

Figure C.2. Propeller, shaft, coupling and stuffing box
that support a variety of sea life. The Gulf Stream is the dominant current, creating a

environmental conditions:

4. The mandatory current meter on an anchored buoy; and four small concrete reference markers.

NOAA map

Location of Monitor National Marine Sanctuary

NOAA support facilities at the site

shallow-draft vessels,

Hatteras, NC, accessible via Hatteras

The nearest harbor facilities are at

Lighthouse, North Carolina.

NOAACSNH 11553; CHART 1961

16 1 nautical miles SSE of Hatteras

NOAACSNH (Sweatshirt) 3030.0, 227.0

Ocean located at coordinates:

from a center point in the Atlantic ocean located at coordinates:

face to seaward and extending horizon.

The sanctuary encompasses a

Detailed Description of the Monitor Site

Appendix D
Figure D.1. The Monitor wreck site, before displacement of the ships (NOAA illustration).

- Obelisks - The only objects protruding from the seabed within the Sanctuary.
- Bathymetry - The bottom slopes gently downward from northwestern to southeasterly.
- Curvatures are even more irregular and have been observed to occasionally exceed two
- Currents - Surface curvatures can range from zero to three knots or more; bottom curvatures within the water column.

Wreck depth - Between 65 and 70 meters (212 - 230 feet).

Water temperature - During July and August, water temperature on the wreck.

Lanier Current, creating unpredictable changes in current, water temperature, and visibility. Under certain environmental conditions such as weather, surface sea conditions, current, water temperature, and visibility, the Lanier Current can change rapidly and without warning.

Water temperature - Nominal ranges from approximately 20°C to 23°C (68°F to 74°F); surface temperature.

Precipitation - Some water may be present on the wreck.
We have not been using the previous and current conditions of the water to predict the best time to schedule our sailing activities. However, the season can disrupt the Hatteras environment, during the same season, favorable between June and September, with July and August being the best months. Surface and subsurface currents, and water clarity, on average, conditions are most suitable when the season is clear. The previous and current conditions at the sanctuary affect the research on the Research include wind, sea state, and wave height. The best times are in July and August.

Sea Conditions - Although the seawater is relatively clear and conditions are most likely to be tolerant, the surf, swells, and wind are significant. The subsurface buoys are positioned at a depth of approximately 15 meters (50 feet).
Displacement of the Skeg: The photographs on the next page illustrate the changes to the displacement of the stern. The photographs on the following two pages further illustrate the situation. It can be seen that the weight of the skeg and propeller bears down on the weakened bottom of the hull. The deck beams and planking, which are also deteriorating, further weaken the hull. The armament, which is losing structural integrity due to decontamination, exposure, and corrosion of the hull plate and the wooden support structure, must be removed. The lower hull, where almost all of the hull plate has fallen away, exposes the machinery space to increasing pressure from the atmosphere inside the hull plate and shielded to starboard.

Areas of deterioration of most concern are:

- Operations Manual and illustrations the Primary areas of rapid deterioration. The observed deterioration areas of key hull components and the Monitors' stern.

- Several deck armor plates, nearly all lower hull plating away from the lower hull, flipping away and shielded to this area.

- The skeg has collapsed, the segment of armor and bell has fallen off of the hull.
The skeg and propeller are heavily encrusted with oxidation products and marine growth, making their removal difficult. The encrustations will make removal of the propeller difficult.

Figure D.7. Plan of the Monitor, showing the skeg, propeller, shaft and rudder.

Figure D.6. The skeg, propeller and propeller shaft in 1990.
placing additional stress on the already-damaged stern. Support for the skeg, the skeg appears to remain unstable, shifting further to the side and now rests on hull debris on the seabed. Although this stern now seems to be providing some clockwise as they fall, the skeg support arm wrestles the camera. (Rear view of stern, figure C.2.) Support have slowly fallen toward the south (toward the camera), translating counter-clockwise into the hull in this area. Since 1990, when this photograph was taken, the skeg and stern is suspended above the bottom and illustrating the stern was taken from near the centerline at the very stern end of the}
against the inner has created a hole in the deck. The water is small and has the weight of the hull pressing against the bottom. The water is showing that the area of the Mer and the mer showed the danger of the water and the Mer.

Figure D.9. View of the lower hull and armor belt, looking forward.

Figure D.10. View of the interface between the upper and lower hulls. The show external of original hull structure showing damaged and missing supports and missing plating. dashed lines show the inner and outer hulls.

Figure D.10. View of the lower hull and armor belt, looking forward.
action in order to minimize the loss of irreplaceable cultural material and data. The USS Monitor was the first ship to be placed on the National Register of Historic Places in 1975, and the Monitor's position on the register reflects the importance of preserving its significance as a historical and cultural landmark.

The USS Monitor is significant because it is one of the most significant ships in American history. The Monitor played a critical role in the American Civil War, particularly in the Battle of Hampton Roads, where it engaged Confederate ironclads. Its design, which included a revolving turret, was revolutionary and helped to establish the ironclad as a significant naval weapon.

The Monitor's significance extends beyond its military history. It is considered a symbol of American ingenuity and innovation, and its design has had a lasting impact on naval architecture. The Monitor's preservation and study have contributed to our understanding of American history, particularly in the context of the Civil War and the role of technology in warfare.

The USS Monitor's placement on the National Register of Historic Places in 1976 was a significant milestone in its preservation and recognition. The Monitor's importance as a cultural and historical artifact is further highlighted by its designation as a National Historic Landmark in 1986, and its listing on the National Register of Historic Places in 1975. The Monitor's significance is not only in its military history but also in its role as a symbol of American ingenuity and innovation.

The Monitor's preservation and study have contributed to our understanding of American history, particularly in the context of the Civil War and the role of technology in warfare. Its significance extends beyond its military history, and it remains an important symbol of American ingenuity and innovation.
Phase VI: Post-Removal Survey and Subphase 1.

To assess the condition of the hull and conserve additional stabilization should be
conducted activities, an archaeo logical and ethnographic survey must be conducted
following completion of all recovery activities, an archaeo logical and ethnographic survey must be conducted.

Phase V: Removal of Hull: While the hull now clear of overhead obstructions, it
will be supported on all sides before being lifted to the surface.

Phase IV: Removal of Hull: While the hull now clear of overhead obstructions, it
will be supported on all sides before being lifted to the surface.

Phase III: Removal of Skeg, Propeller, Lower Hull and Engine: The skeg will be
removed and placed on the seabed to the south of the hull. The propeller and shaft
will be removed and placed on the seabed to the south of the hull. The propeller and shaft
will be removed and placed on the seabed to the south of the hull. The propeller and shaft
will be removed and placed on the seabed to the south of the hull.

Phase II: Shortening the Hull: The hull will be shorted using a pump.

Phase I: Pre-Shorining Archaeological Survey, Mapping and Recovery: A NOAA-
approved archaeological survey team will closely survey and map all exposed
archaeological features. Refer to instructions on facing page.

Six Phases of the Archaeology Plan.
Six Phases of the Archaeology Plan
peculiar to yield a wide variety
ghed excavations can be ex-
research expeditions, the re-
expedition and on subsequent
Material: Based on the 1979
Variety of Recovered

In the
presepting no overhead
completely collapsed, thus
area where the tower had
place in the port bow, in an
1979. The

an overhead enclosure. Figure E.2. Illustrates the excavation conducted within the hill in
the enclosure, and within the hill along the southeast. These areas will not receive work in
the enclosure, and within the hill along the southeast. Those areas will have to be conducted in
the hill in the southeast. Those areas will have to be conducted in

hydraulic dredge.

Recovery of Material: Beneath the Hill

Prevent their damage of destruction.

before believed activities are begin in order to
mining activities must be mapped and recovered.
submerged area by strong currents. Re-
fell to the southeast where are have become
decks, allowing artifacts from inside the hill to
scales. At least six holes have developed in the
is excavated as much as seven feet above the
Recovery: Archaeological surveys, mapping and

Figure E.1. Many artifacts will be found

Figure E.2. Excavation in the Monitor's port bow, 1979, using a

Pre-Showing Archaeological Mapping and

Archaeological Activities and Issues
Officers and Crew Listed as Missing after the Sinking of the USS Monitor

December 31, 1862

Figure F. Crew of Monitor, Crew Abandoning Ship

The crew of the Monitor were listed as missing after the sinking of the USS Monitor on December 31, 1862. The cause of the sinking was due to the U.S. Navy’s decision to abandon the Monitor, as evidenced by the crew abandoning the ship. The Monitor was the first attempt to create an ironclad warship, and the sinking was a significant event in naval history.

Discovery of Human Remains: Re-

Provisions will be made to transport recovered objects to a regional laboratory, and a preliminary survey of artifacts will be conducted. The recovered objects will consist primarily of metal, glass, and ceramic materials. The recovery will be conducted in a procedure that involves the use of metal detectors, and the results will be recorded. The recovered objects will be cataloged and analyzed for cultural context. As shown on the next page, there will be objects of metal, glass, and ceramic materials.
Figure E.4. Types of objects likely to be encountered on the Monitor (clockwise from upper left): the anchor, recovered in 1983; an iron centrifugal pump; a leather belt; a glass jar containing relics; and a signal lantern (NOAA).
Chaining a New Course for the Monitor / Apx - 65

...the activities, and will be carried out, under the guidance and approval of the Monitor, as described below.

As described below, the plan will be implemented, with support from the Monitor's vessel, the Monitor is an important component of the new approach. The Monitor is located in the immediate vicinity of the proposed archaeological site, and will be supervised and evaluated by the Monitor. The Monitor's role is to ensure that all activities are carried out in accordance with the Monitor's scheduling and coordination. The Monitor's scheduling and coordination will be reviewed and approved by the Monitor's vessel, the Monitor, as described below.

The Monitor is an American 'icon,' will be addressed as part of the planning process. In the strictest

...the Monitor's role must be met with a large-scale stabilization and recovery plan. The Monitor will be responsible for the coordination and implementation of the activities, and will be supervised and evaluated by the Monitor. The Monitor's role is to ensure that all activities are carried out in accordance with the Monitor's scheduling and coordination. The Monitor's scheduling and coordination will be reviewed and approved by the Monitor's vessel, the Monitor, as described below.

National Historic Preservation Act Review: As discussed in Section 4.7, a review must be completed prior to any large-scale stabilization or recovery operations at the Monitor.

Recovery of the remains:

...are located in the immediate vicinity of the proposed archaeological site, and will be supervised and evaluated by the Monitor. The Monitor's role is to ensure that all activities are carried out in accordance with the Monitor's scheduling and coordination. The Monitor's scheduling and coordination will be reviewed and approved by the Monitor's vessel, the Monitor, as described below.

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Chapter 4: New Course for the Monitor

Since the Monitor’s interest was his most unique and recognizable feature,
interest in two different canons and the other expected conserves are especially significant.
assumptions would certainly detract from the Monitor’s legacy and museum vision. The
dissertations, if not recovered, all have historical significance and, taken together, the
material and physical recovery activities. During all stabilization and recovery operations,
Archaeological Control: A NOVA-approved archaeologist will oversee all initial
and equipment used will be specified by the contractor.
the constraints will be responsible for all diving operations. The types of personnel
Once in-water operation commence (shoring and recovery activities), the prime
Examination procedures and equipment will be kept as simple as possible in order to
ascending this “down-line” for safety reasons.
including stabilization, reconnaissance, and recovery will probably be accomplished by free-
NOAA DIVE OFFICE, and the NOVA DIVE READY Program, the dive plan will be included as
The equipment selected will depend upon the part of the final operations plan for the project. The equipment selected will be in
Dive scenarios will be developed to correspond with the
Swimming in water, divers will not be required to wear dry suits. The
two different canons and the other expected conserves are especially significant. The
assumptions would certainly detract from the Monitor’s legacy and museum vision. The
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NOAA DIVE OFFICE, and the NOVA DIVE READY Program, the dive plan will be included as
The equipment selected will depend upon the part of the final operations plan for the project. The equipment selected will be in
Dive scenarios will be developed to correspond with the
Swimming in water, divers will not be required to wear dry suits. The
Any failures or weak spots will be noted on the site

Diving and Examination Equipment and Procedures: During pre-shipping on-site
Charting a New Course for the Monitor

and development facilities for the National Park Service, located in Harpers Ferry, West Virginia. The exhibit includes artifacts recovered from the Monitor, material from the Sanctuary. The exhibit also features a permanent display that tells the story of the Monitor, the Civil War, and the war in the Atlantic. The exhibit includes artifacts on loan from the Monitor, research material generated by investigations in the history of the Monitor, and material from the National Marine Sanctuary.

In March 1987, following an evaluation of the proposal by a committee of representatives...
The Monitors anchor on exhibish (NOAA)

**The Monitors anchor on exhibish (NOAA)**

Formalities for an interpretive presentation of the Monitors' role in the War of 1812.

Major portions of the week.

More subtle with the presence of the Monitors. Interpretation becomes far more subtle with the presence of the Monitors. Interpretation becomes far more subtle with the presence of the Monitors. Interpretation becomes far.

To utilize documentation in interpretive presentation of the Monitors. Interpretation becomes far more subtle with the presence of the Monitors.

Raising major portions of its.

Although an interpretive experience, the interpretive experience becomes a museum experience.

Another view in the interpretive category is "Archaeology in Need of Public Need for Relevance.

So why did the interpretive experience begin?

The interpretive experience began.

For the purpose of interpretive presentation of the Monitors' role in the War of 1812.

Raising major portions of its.

The Monitors anchor on exhibish (NOAA).
Maritime Museums

concerts, with all procedures and facilities meeting the standards of the Council of American
Museums. All exhibits recovered from the Monitor will receive long-term care by professional
Through an ongoing Cooperative Agreement between NOAA and The Mariners

Long-Term Conservation Plan

consideration.

comprehensive and smaller exhibits into an interpretive exhibit should be given sessions
sustaining the recovery. Integrating the conservation of at least some of the major
befits. As stated above, in order to maximize the amount of public involvement in the events
recovery of the Monitor will be recovered. Initial design of an interpretive exhibit should
Once the final recovery plan has been approved and agreement has been reached on which

Final Interpretive/Exhibition Plan

interpretive materials explaining the conservation process and why it is necessary.
The Monitor...s exhibit on the ship and on the wreck, and other

interpretive exhibit...a much-nan of those recovery efforts...larger role in the recovery of the Monitor.

interpretive exhibit into an interpretive exhibit. Since large iron objects

The recovery of major components of the Monitor would provide a unique opportunity

support interpretive exhibit of major component of the Monitor.

interpretive exhibit...the Monitor...a much-nan of those recovery efforts...larger role in the recovery of the Monitor.

interpretive exhibit into an interpretive exhibit. Since larger iron objects

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support interpretive exhibit of major component of the Monitor.

interpretive exhibit...the Monitor...a much-nan of those recovery efforts...larger role in the recovery of the Monitor.

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interpretive exhibit...the Monitor...a much-nan of those recovery efforts...larger role in the recovery of the Monitor.

interpretive exhibit into an interpretive exhibit. Since larger iron objects

The recovery of major components of the Monitor would provide a unique opportunity

support interpretive exhibit of major component of the Monitor.
OF CURRENT EXHIBITION PLANS
EARLY CONCEPT SKETCH—NOT PART

Harpers Ferry Center, National Park Service (NPS)
Monitor exhibition concept drawings prepared in 1986 by the
system-wide National Marine Sanctuary strategic goals and fundraising program.

The Monitor business plan should be implemented within the context of the existing private entities with resources, skills, and equipment that might be used in the preservation effort. The Monitor partnership could be sought with governmental agencies and preservation of the Monitor. Partnerships could be sought with governmental agencies and be to create an alliance of Federal, State, and private organizations with an interest in the

One possible approach to establishing the business of fundraising organization would be

predicts the net increase in funds, amounts, describes operations and administration, defines, and estimates all costs, and identifies sources of revenue (grants, donations, other fundraising, and fundraising revenue)

plan. In its simplest form, the business plan defines the structure of the organization.

The schematic diagram on the following page illustrates the flow in a typical annual business plan.

6. The Financial Plan
5. The Management Team
4. The Marketing/Marketing Strategy
3. The Project Needs
2. The Project Partners/Sponsors
1. The Project Mission and Goals

The Monitor Project should contain the following elements:

The conventional means of organizing these costs and income sources is through a project (NMFS) and other relevant laws.

Business Plan Concept and Plan Participants

Appendix G
Further Reading on Business and Strategic Planning

- "Business Plan (Draft)." Marine Learning Center.
Chapter a New Course for the Monitor / APX - 75

The Monitor

For the conservation, curation, exhibition, and interpretation of recovered material from the Monitor, the National Museum is cooperating with NOAA for the development of a comprehensive plan. The Small Craft Collection, William Francis Gibbs Naval Architecture Gallery, and others. The peaked Bay Gallery, the Chippe Collection of Maritime Ships, the Great Hall of Steam, and more. Interpretive galleries include the Age of Exploration Gallery, AnIQUE Boats Gallery, and more. Maritime artifacts include ship models, scrimshaw, marine paintings, decorative arts, and more. The influence of civilization. The Monitor's collection of more than 35,000 objects is dedicated to preserving the culture of the sea and its influence on the Monitor. One of the largest international maritime museums in the world, the Monitor.

The Monitor, Newport, Rhode Island, was designed by the Principal Monitor.

The Marine National Monument

With the development of a long-range preservation plan, the Monitor National Marine Sanctuary includes the Monitor’s anchor, and other artifacts recovered from the sanctuary. The Monitor is also responsible for preserving a permanent exhibit on the USS Monitor as well as relocating and restoring them. The Monitor has been designated a National Park. The Monitor National Marine Sanctuary in 1987. In 1997, the Monitor was declared the Principal Monitor, Newport, Rhode Island, was designated the Principal Monitor.

National Oceanic and Atmospheric Administration

This area comprises preservation plan was developed by NOAA, working with
Proposal was prepared at no cost to the government.

The proposal for the emergency recovery, stabilization and preservation of the Monitor, TWA Flight 800, for inclusion in this comprehensive plan. Oceanenumerate developed a preliminary survey and salvage application. Oceanenumerate and SUPSAV operate cooperatively on a complete project solutions. Oceanenumerate is the prime contractor to the U.S. Navy for ocean salvage and other harsh environments. The company's services and products are chosen and combined to offer complete customer solutions. Oceanenumerate, Inc., Upper Marlboro, Maryland, is a division of Oceanenumerate Technologies, Inc.

Island, New York.

Recuperation projects such as the Challenger disaster and the crash of TWA Flight 800 off Long Island. New York, SUPSAV has assisted with other salvage and ocean recovery involving dive systems, manned and unmanned. In support of the National Undersea Research Center (NAVSEC) and the National Oceanic and Atmospheric Administration (NOAA), the Office of the Director of Ocean Engineering, Supervisor of Salvage and Diving (SUPSAV), U.S. Navy, provided engineering assistance for this plan through the Office of the

U.S. NAVY
Bibliography

Appendix H
1978.


Navel Institute, 1994.


NOAA, 1977.


Proceedings of the Ninth Conference on Underwater Archaeology, 1, 2. Buenos Aires.


Ride, 1878.


X, October 1893.


In the "Monitor," Turner, Ballels and Leaders of the Civil War, Ned

Green, Samuel Dana. An Eyewitness Account. First Gun and This Commenced


Power, George L. "Eicsson's First Monitor and the Later Turret Ships." Engineering

the Confederate Ironclad Wards, C.S. Virginia. Published by the author, 1892.


Symposium of the U.S. Naval Academy. Whimtition. DE: Scholary Resources.

Could, Richard A. "The USS Monitor Project Research Design." Naval History, the Sevem

1890.


1876.


1899.


1975.


Eicsson, R. "Captains Eicsson's Narrative of the Battle of the Merrimack." Souvenir


DeLacido, James P., "A Symbol of America's Inenuity. Assessing the Significance of the

1875.
Changing a New Course for the Monitor / April - 81


“Systematic Planning and Sophisticated Technology: An Approach to Management of the Nation’s First Marine Sanctuary.” Underwater Archaeology.
June 1863.


author 1906.

Monitor, U.S.N. Hampton Roads, March 8 and 9, 1862. Previously printed by the
Green Naval Battle between the Merrimac-Virginia, C.S.N. and the Emsession
While, E. "The First Iron-Clad Naval Engagement in the World. History of Facts of the

Carolina Division of Archives and History, 1978.

Warren, Gooden P. and James A. Pleasants Jr., The Monitor: A Bibliographical, Raleigh:

The Proceedings of the Eleventh Conference on Underwater Archaeology, Calvin R.