



INDIANA UNIVERSITY CENTER FOR UNDERWATER SCIENCE

***J.D. Marshall (12PR723) 3D Photogrammetry
and Underwater Museum Interpretation***

2019 Lake Michigan Coastal Program Grant CZ844

Funding for this program was provided in part by the Indiana Department of Natural Resources Lake Michigan Coastal Program

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Executive Summary

Indiana University Center for Underwater Science conducted underwater archaeological investigations of the historic shipwreck *J.D. Marshall* during 2019, in order to produce highly accurate 3D models, which will aid researchers and site managers in tracking the state of biological and cultural resources on the *J.D. Marshall* Preserve. The results of these investigations can be used for baseline monitoring and management, as well as for increased interpretation for outreach and education purposes.

Built in 1891, *the J.D. Marshall* was a wooden lumber hooker that operated on Lake Michigan until it sank in 1911. Before sinking, the *Marshall* was semi-converted to a sand-barge by using parts salvaged from the burned *Muskegon*. This conversion ultimately led to the *Marshall's* demise, as the old wooden vessel was unfit to carry large loads of lumber, let alone large loads of wet sand. The *J.D. Marshall* represents important innovations in engineering, commerce, transportation, and industry. Since 2016, Indiana University has been conducting ongoing direct-diver and photogrammetric surveys in order to assist with management decisions and support public outreach efforts, with funding from the Indiana Department of Natural Resources Lake Michigan Coastal Program and the National Oceanic and Atmospheric Administration. This report presents the methodology and results of this ongoing assessment.



UNDERWATER SCIENCE

INDIANA UNIVERSITY
School of Public Health
Bloomington

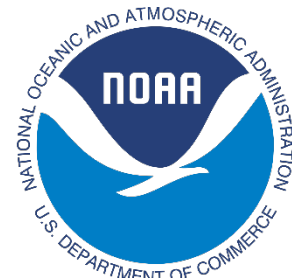


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Fully Signed Grant Agreement

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844



**Purchase Order
Grant
State of Indiana**

Approved by Encompass Leadership Team - 2011

Order # 0020006359 Date 04/29/2019 Required Date 05/29/2019 Page 1 of 3
 Requisition Number: 0000098408
 Vendor ID: 0000004796 REMIT001
 Agency: 00300 Natural Resources
 Pay Terms: 35 Days in Arrears
 Fund/Object/Center: 61610/ 571300/ 231000

Vendor 0000004796 REMIT001 77

Remit to INDIANA UNIV
 IU FINANCIAL MGMT SUPPORT
 DEPT 78867 PO BOX 78000
 DETROIT MI 48278

Ship To IDNR, Lake MI Coastal Program
 Indiana Dunes State Park
 1600 N 25 E
 CHESTERTON IN 46304

Vendor Name Address INDIANA UNIV
 IU FINANCIAL MGMT SUPPORT
 509 E 3RD ST
 BLOOMINGTON IN 47405

Bill To Natural Resources
 IDNR, Lake MI Coastal Program
 Indiana Dunes State Park
 1600 N 25 E
 CHESTERTON IN 46304

Vendor Contact Name:
 eMail:
 Phone:

Buyer Name: Griffin, Shelia-300
 eMail: SGriffin@dnr.IN.gov

Purchase Order Instructions & Comments

This purchase order is intended for use only as an instrument to encumber the funds necessary to satisfy the State's payment obligations and to order those items listed herein.

Purchase Order Line Details

| Item No | Description | (FOB Destination) | Qty Ordered | Qty Recd | UOM | Unit Price | Extended Amt |
|---------|-------------|-------------------|-------------|----------|-----|------------|--------------|
|---------|-------------|-------------------|-------------|----------|-----|------------|--------------|

| | | | | | | | |
|------|--|--|--------|--|-----|-------------|-----------|
| 1- 1 | Grant to conduct an underwater archaeological investigation of the JD Marshall historic shlpwerck. | | 1.0000 | | SVR | 15,568.0000 | 15,568.00 |
|------|--|--|--------|--|-----|-------------|-----------|

Contract ID: 0000000000000000000029081 Open Item Contract Release: 1
 Contract Dates: 4/25/2019-12/31/2019

Units of Measure, Handling, Totals, Signatures

The following UN/CEFACT Unit of Measure Common Codes are used in this document:
 SVR Service

This area left blank

Total PO Amt. \$ 15,568.00

| | | |
|---|---|-----------------------------|
| Indiana Department of Administration Authorized Approver Griffin, Shelia-300 | CONFIRMATION OF RECEIPT | |
| | I certify that the items listed above were received. All commodities appeared to conform to specifications and showed no patent defects, except as otherwise noted. | |
| 29-APR-2019 | Signature of State Employee Receiver | Date Signed(Month/Day/Year) |
| FUNDING ENCUMBERED BY THE AUDITOR OF STATE | | |
| I certify that there is sufficient unencumbered balance in the above account to cover the amount of this order, and that funds have been set aside for payment thereof. | | |



00300 0020006359

Grant Agreement

Lake Michigan Coastal Program

Contract #0000000000000000000029081

This Grant Agreement (this "Grant Agreement"), entered into by and between the Indiana Department of Natural Resources (the "State") and Trustees of Indiana University (the "Grantee"), is executed pursuant to the terms and conditions set forth herein. In consideration of those mutual undertakings and covenants, the parties agree as follows:

1. Purpose of this Grant Agreement; Grant Funds.

The purpose of this Grant Agreement is to enable the State to award a grant of \$15,568.00 to the Grantee for eligible costs of the services or project (the "Project") described in **Exhibits A and B** of this Grant Agreement, which are incorporated fully by reference. The funds shall be used exclusively in accordance with the provisions contained in this Grant Agreement and in conformance with Indiana Code § 14-11-1 establishing the authority to make this Grant, as well as any rules adopted thereunder. The funds received by the Grantee pursuant to this Grant Agreement shall be used only to implement the Project or provide the services in conformance with this Grant Agreement and for no other purpose.

2. Representations and Warranties of the Grantee.

A. The Grantee expressly represents and warrants to the State that it is statutorily eligible to receive these Grant funds and that the information set forth in its grant application is true, complete and accurate. The Grantee expressly agrees to promptly repay all funds paid to it under this Grant Agreement should it be determined either that it was ineligible to receive the funds, or it made any material misrepresentation on its grant application.

B. The Grantee certifies by entering into this Grant Agreement that neither it nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from entering into this Grant Agreement by any federal or state department or agency. The term "principal" for purposes of this Grant Agreement is defined as an officer, director, owner, partner, key employee or other person with primary management or supervisory responsibilities, or a person who has a critical influence on or substantive control over the operations of the Grantee.

C. The Grantee shall file the annual financial report required by IC 5-11-1-4 in accordance with the State Board of Accounts Uniform Compliance Guidelines for Examination of Entities Receiving Financial Assistance From Governmental Sources. The Grantee should use the information in **Exhibit E** as a guide to complete this annual financial report. Specifically the source of the funds; the formal federal grant program name and CFDA number if applicable; and classification of the funding as fee for service or not is documented here. All grant documentation should be retained and made available to the State Board of Accounts if and when requested. The State agrees to complete the information in **Exhibit E**.

This annual report is not to be confused with the periodic filing of the Indiana Secretary of State's Business Entity Report. Additional information concerning this annual financial report can be obtained using notforprofit@sboa.in.gov.

3. Implementation of and Reporting on the Project.

A. The Grantee shall implement and complete the Project in accordance with **Exhibit A** and with the plans and specifications contained in its Grant Application, which is on file with the State and

is incorporated by reference. Modification of the Project shall require prior written approval of the State.

B. The Grantee shall submit to the State written progress reports until the completion of the Project. These reports shall be submitted on a quarterly basis and shall contain such detail of progress or performance on the Project as is requested by the State.

C. The Grantee agrees to complete the Project in accordance with the Coastal Zone Management Act of 1972, as amended (16 U.S.C. §1451, *et seq.*), which is incorporated herein.

D. The Grantee shall cause to be erected at the site of any construction project, and maintained during the construction, signs satisfactory to the DNR, that identify the Project and indicate that the Project is being funded under the Coastal Zone Management Act by the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean and Coastal Resource Management (OCRM) and the Indiana Department of Natural Resources Lake Michigan Coastal Program. The Grantee also shall maintain a permanent plaque or sign at the Project site with the same information.

E. The Grantee must acknowledge the support of the National Oceanic and Atmospheric Administration and the Indiana Department of Natural Resources Lake Michigan Coastal Program on the title page of any publication written or published under this Grant Agreement. Correct examples of acknowledgement of support are: "This publication was made possible by a grant from the National Oceanic and Atmospheric Administration and the Indiana Department of Natural Resources, Lake Michigan Coastal Program." Or "Funding for this program was provided in part by the National Oceanic and Atmospheric Administration and the Indiana Department of Natural Resources, Lake Michigan Coastal Program."

4. Term. This Grant Agreement commences on the date of last required State signature, and shall remain in effect through December 31, 2019. Unless otherwise provided herein, it may be extended or renewed upon the written agreement of the parties and in conformance with IC §5-22-17-4, and as permitted by the state or federal law governing this Grant.

5. Grant Funding.

A. The State shall fund this grant in the amount of \$15,568.00. The approved Project Budget is set forth as **Exhibit B** of this Grant Agreement, attached hereto and incorporated herein. The Grantee shall not spend more than the amount for each line item in the Project Budget without the prior written consent of the State, nor shall the Project costs funded by this Grant Agreement and those funded by any local and/or private share be changed or modified without the prior written consent of the State.

B. The disbursement of grant funds to the Grantee shall not be made until all documentary materials required by this Grant Agreement have been received and approved by the State and this Grant Agreement has been fully approved by the State.

6. Payment of Claims.

A. Unless otherwise authorized by statute and agreed to in this Grant Agreement, all payments shall be made 35 days in arrears in conformance with State fiscal policies and procedures and, as required by IC §4-13-2-14.8, by the direct deposit by electronic funds transfer to the financial institution designated by the Grantee in writing. If advance payment of a portion of the grant funds is permitted by statute, and the State agrees to provide such advance payment, it shall be made only upon submission of a proper claim setting out the intended purposes of those funds. After such funds have been expended, Grantee shall provide State with a reconciliation of those expenditures.

Unless authorized by statute, all payments will be made in arrears only upon presentation of an approved and signed invoice from Grantee detailing disbursements of state, local and/or private funds by Project budget line items as set forth in **Exhibit B** using the format provided in the Lake Michigan Coastal Program (LMCP) Grants Manual, which is incorporated herein by reference.

B. Requests for payment will be processed only upon presentation of a Claim Voucher in the form designated by the State. Such Claim Vouchers must be submitted with the budget expenditure report detailing disbursements of state, local and/or private funds by project budget line items.

C. The State may require evidence furnished by the Grantee that substantial progress has been made toward completion of the Project prior to making the first payment under this Grant. All payments are subject to the State's determination that the Grantee's performance to date conforms with the Project as approved, notwithstanding any other provision of this Grant Agreement.

D. Claims shall be submitted to the State within 30 calendar days following the end of the quarter in which work on or for the Project was performed. The State has the discretion, and reserves the right, to NOT pay any claims submitted later than 45 calendar days following the end of the quarter in which the services were provided. All final claims and reports must be submitted to the State within 60 calendar days after the expiration or termination of this agreement. Payment for claims submitted after that time may, at the discretion of the State, be denied. Claims may be submitted on a quarterly basis only. If Grant funds have been advanced and are unexpended at the time that the final claim is submitted, all such unexpended grant funds must be returned to the State.

E. Claims must be submitted with accompanying supportive documentation as designated by the State. Claims submitted without supportive documentation will be returned to the Grantee and not processed for payment. Failure to comply with the provisions of this Grant Agreement may result in the denial of a claim for payment.

F. Matching funds in excess of the required 1:1 match requirement may not be applied as matching funds to other grant projects receiving funds from LMCP.

G. Grantee must observe the closeout procedures provided by the Lake Michigan Coastal Program within 30 days after the expiration or termination date of this Grant Agreement. The Grantee is responsible for submitting to DNR a Final Report using the format provided in the Lake Michigan Coastal Program (LMCP) Grants Manual, which is incorporated herein by reference, within 30 days after the expiration of this Grant Agreement. When the DNR determines that all required reports have been submitted, the DNR will send a letter advising the Grantee that closeout has been completed. The letter will also advise the recipient regarding records retention requirements. If closeout action results in a debt to the DNR, Grantee must pay the debt within a reasonable period, not to exceed thirty (30) days.

H. The Grantee is responsible for submitting to the DNR on a quarterly basis, both a Progress Report and a Financial Report until the completion of the Project. Quarters consist of a three (3) month period as follows: January through March; April through June; July through September; and October through December. DNR must receive reports no later than fourteen (14) days following the end of each quarter (i.e., April 14th, July 14th, October 14th, and January 14th) beginning on the date of the last required state signature. These reports should provide a detailed explanation of what was accomplished under each task during the quarter. The Progress Report should be organized in the same format as the Project description and timeline in the original grant application and include the following:

1. **Status of tasks within each Project phase, organized by task title (e.g. meetings held, work products completed, contracts completed, difficulties that may impede timely completion).**
2. Status of objectives due during the quarter.
3. Status of special grant conditions, if any, due during the quarter.
4. Financial reports should conform to the format provided by the Lake Michigan Coastal Program and detail progress made on each budget item in **Exhibit B**.
5. LMCP Performance Indicators Checklist is to be submitted every January and July.

I. If this Grant Agreement is terminated by either party prior to the Expiration Date of this Grant Agreement, the DNR may promptly conduct an on-site monitoring of the Project and complete a Project monitoring report.

J. Failure to complete the Project and expend state, local and/or private funds in accordance with this Grant Agreement may be considered a material breach of the agreement and may entitle the DNR to impose sanctions against the Grantee including, but not limited to, suspension of all grant payments, and/or suspension of the Grantee's participation in DNR grant programs until such time as all material breaches are cured to the DNR's satisfaction. Sanctions may also include repayment of all DNR funds expended for activities that are not in the scope of the Project as set forth in **Exhibits A and B**.

K. Grantee must comply with the federal policies and regulations in **Exhibit D**, attached hereto and incorporated herein.

L. The payment of this Grant by the DNR to the Grantee shall also be made in accordance with the following schedule and conditions: (i.) This Grant Agreement must be fully executed, (ii.) All of the evidentiary materials required by **Exhibit C**, attached hereto and incorporated herein, must be submitted to and approved by the DNR, and (iii.) Any other grant conditions must be met to the DNR's satisfaction.

7. Project Monitoring by the State.

The State may conduct on-site or off-site monitoring reviews of the Project during the term of this Grant Agreement and for up to twenty (20) years for 306A projects after it expires or is otherwise terminated. The Grantee shall extend its full cooperation and give full access to the Project site and to relevant documentation to the State or its authorized designees for the purpose of determining, among other things:

- A. whether Project activities are consistent with those set forth in **Exhibit A**, the grant application, and the terms and conditions of the Grant Agreement;
- B. the actual expenditure of state, local and/or private funds expended to date on the Project is in conformity with the amounts for each Budget line item as set forth in **Exhibit B** and that unpaid costs have been properly accrued;
- C. that Grantee is making timely progress with the Project, and that its project management, financial management and control systems, procurement systems and methods, and overall performance are in conformance with the requirements set forth in this Grant Agreement and are fully and accurately reflected in Project reports submitted to the State.

8. Audits and Maintenance of Records.

A. Grantee shall submit to an audit of funds paid through this Grant Agreement, and shall make all books, accounting records and other documents available at all reasonable times during the

term of this Grant Agreement and for a period of three (3) years after final payment for inspection by the State or its authorized designee. Copies shall be furnished to the State at no cost.

B. The Grantee is a "subrecipient" of federal grant funds under 2 C.F.R. 200.330. If required by applicable provisions of 2 C.F.R. 200 (Uniform Administrative Requirements, Cost Principles, and Audit Requirements), Grantee shall arrange for a financial and compliance audit that complies with 2 C.F.R. 200.500 *et seq.*

9. Compliance with Laws.

A. The Grantee shall comply with all applicable federal, state and local laws, rules, regulations and ordinances, and all provisions required thereby to be included herein are hereby incorporated by reference. The enactment or modification of any applicable state or federal statute or the promulgation of rules or regulations thereunder after execution of this Grant Agreement shall be reviewed by the State and the Grantee to determine whether the provisions of this Grant Agreement require formal modification.

B. The Grantee and its agents shall abide by all ethical requirements that apply to persons who have a business relationship with the State as set forth in IC §4-2-6, *et seq.*, IC §4-2-7, *et seq.*, and the regulations promulgated thereunder. **If the Grantee has knowledge, or would have acquired knowledge with reasonable inquiry, that a state officer, employee, or special state appointee, as those terms are defined in IC 4-2-6-1, has a financial interest in the Grant, the Grantee shall comply with the disclosure requirements in IC 4-2-6-10.5 prior to the execution of this grant.** If the Grantee is not familiar with these ethical requirements, the Grantee should refer any questions to the Indiana State Ethics Commission, or visit the Inspector General's website at <http://www.in.gov/ig/>. If the Grantee or its agents violate any applicable ethical standards, the State may, in its sole discretion, terminate this Grant immediately upon notice to the Grantee. In addition, the Grantee may be subject to penalties under IC §§ 4-2-6, 4-2-7, 35-44.1-1-4, and under other applicable laws.

C. The Grantee certifies by entering into this Grant Agreement that neither it nor its principal(s) is presently in arrears in payment of taxes, permit fees or other statutory, regulatory or judicially required payments to the State. The Grantee agrees that any payments currently due to the State may be withheld from payments due to the Grantee. Additionally, payments may be withheld, delayed, or denied and/or this Grant suspended until the Grantee is current in its payments and has submitted proof of such payment to the State.

D. The Grantee warrants that it has no current, pending or outstanding criminal, civil, or enforcement actions initiated by the State, and agrees that it will immediately notify the State of any such actions. During the term of such actions, the Grantee agrees that the State may suspend funding for the Project. If a valid dispute exists as to the Grantee's liability or guilt in any action initiated by the State or its agencies, and the State decides to suspend funding to the Grantee, the Grantee may submit, in writing, a request for review to the Indiana Department of Administration (IDOA). A determination by IDOA shall be binding on the parties. Any disbursements that the State may delay, withhold, deny, or apply under this section shall not be subject to penalty or interest.

E. The Grantee warrants that the Grantee and any contractors performing work in connection with the Project shall obtain and maintain all required permits, licenses, registrations, and approvals, and shall comply with all health, safety, and environmental statutes, rules, or regulations in the performance of work activities for the State. Failure to do so may be deemed a material breach of this Grant Agreement and grounds for immediate termination and denial of grant opportunities with the State.

F. The Grantee affirms that, if it is an entity described in IC Title 23, it is properly registered and owes no outstanding reports to the Indiana Secretary of State.

G. As required by IC §5-22-3-7:

(1) The Grantee and any principals of the Grantee certify that:

(A) the Grantee, except for de minimis and nonsystematic violations, has not violated the terms of:

(i) IC §24-4.7 [Telephone Solicitation Of Consumers];

(ii) IC §24-5-12 [Telephone Solicitations]; or

(iii) IC §24-5-14 [Regulation of Automatic Dialing Machines];

in the previous three hundred sixty-five (365) days, even if IC 24-4.7 is preempted by federal law; and

(B) the Grantee will not violate the terms of IC §24-4.7 for the duration of this Grant Agreement, even if IC §24-4.7 is preempted by federal law.

(2) The Grantee and any principals of the Grantee certify that an affiliate or principal of the Grantee and any agent acting on behalf of the Grantee or on behalf of an affiliate or principal of the Grantee, except for de minimis and nonsystematic violations,

(A) has not violated the terms of IC §24-4.7 in the previous three hundred sixty-five (365) days, even if IC §24-4.7 is preempted by federal law; and

(B) will not violate the terms of IC §24-4.7 for the duration of this Grant Agreement even if IC §24-4.7 is preempted by federal law.

10. Drug-Free Workplace Certification. This clause is required by Executive Order 90-5 and applies to all individuals and private legal entities who receive grants or contracts from State agencies. This clause was modified in 2005 to apply only to Grantee's employees within the State of Indiana and cannot be further modified, altered or changed. As required by Executive Order No. 90-5, April 12, 1990, issued by the Governor of Indiana, the Grantee hereby covenants and agrees to make a good faith effort to provide and maintain a drug-free workplace. Grantee will give written notice to the State within ten (10) days after receiving actual notice that the Grantee, or an employee of the Grantee in the State of Indiana, has been convicted of a criminal drug violation occurring in the workplace. False certification or violation of the certification may result in sanctions including, but not limited to, suspension of grant payments, termination of the Grant and/or debarment of grant opportunities with the State of Indiana for up to three (3) years.

In addition to the provisions of the above paragraphs, if the total amount set forth in this Grant Agreement is in excess of \$25,000.00, the Grantee certifies and agrees that it will provide a drug-free workplace by:

A. Publishing and providing to all of its employees a statement notifying them that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the Grantee's workplace and specifying the actions that will be taken against employees for violations of such prohibition; and

B. Establishing a drug-free awareness program to inform its employees of (1) the dangers of drug abuse in the workplace; (2) the Grantee's policy of maintaining a drug-free workplace; (3) any available drug counseling, rehabilitation, and employee assistance programs; and (4) the penalties that may be imposed upon an employee for drug abuse violations occurring in the workplace; and

C. Notifying all employees in the statement required by subparagraph (A) above that as a condition of continued employment the employee will (1) abide by the terms of the statement; and

(2) notify the Grantee of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction; and

D. Notifying in writing the State within ten (10) days after receiving notice from an employee under subdivision (C)(2) above, or otherwise receiving actual notice of such conviction; and

E. Within thirty (30) days after receiving notice under subdivision (C)(2) above of a conviction, imposing the following sanctions or remedial measures on any employee who is convicted of drug abuse violations occurring in the workplace: (1) take appropriate personnel action against the employee, up to and including termination; or (2) require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state or local health, law enforcement, or other appropriate agency; and

F. Making a good faith effort to maintain a drug-free workplace through the implementation of subparagraphs (A) through (E) above.

11. Employment Eligibility Verification.

As required by IC §22-5-1.7, the Grantee hereby swears or affirms under the penalties of perjury that:

A. The Grantee has enrolled and is participating in the E-Verify program;

B. The Grantee has provided documentation to the State that it has enrolled and is participating in the E-Verify program;

C. The Grantee does not knowingly employ an unauthorized alien.

D. The Grantee shall require its contractors who perform work under this Grant Agreement to certify to Grantee that the contractor does not knowingly employ or contract with an unauthorized alien and that the contractor has enrolled and is participating in the E-Verify program. The Grantee shall maintain this certification throughout the duration of the term of a contract with a contractor.

The State may terminate for default if the Grantee fails to cure a breach of this provision no later than thirty (30) days after being notified by the State.

12. Funding Cancellation. When the Director of the State Budget Agency makes a written determination that funds are not appropriated or otherwise available to support continuation of performance of this Grant Agreement, it shall be canceled. A determination by the Director of the State Budget Agency that funds are not appropriated or otherwise available to support continuation of performance shall be final and conclusive.

13. Governing Law. This Grant Agreement shall be governed, construed, and enforced in accordance with the laws of the State of Indiana, without regard to its conflict of laws rules. Suit, if any, must be brought in the State of Indiana.

14. Information Technology Accessibility Standards. Any information technology related products or services purchased, used or maintained through this Grant must be compatible with the principles and goals contained in the Electronic and Information Technology Accessibility Standards adopted by the Architectural and Transportation Barriers Compliance Board under Section 508 of the federal Rehabilitation Act of 1973 (29 U.S.C. §794d), as amended. The federal Electronic and Information Technology Accessibility Standards can be found at: <http://www.access-board.gov/508.htm>.

15. Nondiscrimination. Pursuant to the Indiana Civil Rights Law, specifically including IC §22-9-1-10, and in keeping with the purposes of the federal Civil Rights Act of 1964, the Age Discrimination in Employment Act, and the Americans with Disabilities Act, the Grantee covenants that it shall not discriminate against any employee or applicant for employment relating to this Grant with respect to the hire, tenure, terms, conditions or privileges of employment or any matter directly or indirectly related to employment, because of the employee or applicant's: race, color, national origin, religion, sex, age, disability, ancestry, status as a veteran, or any other characteristic protected by federal, state, or local law ("Protected Characteristics"). Furthermore, Grantee certifies compliance with applicable federal laws, regulations, and executive orders prohibiting discrimination based on the Protected Characteristics in the provision of services.

The Grantee understands that the State is a recipient of federal funds, and therefore, where applicable, Grantee and any subcontractors shall comply with requisite affirmative action requirements, including reporting, pursuant to 41 CFR Chapter 60, as amended, and Section 202 of Executive Order 11246 as amended by Executive Order 13672.

16. Notice to Parties. Whenever any notice, statement or other communication is required under this Grant, it shall be sent by first class mail or via an established courier / delivery service to the following addresses, unless otherwise specifically advised.

A. Notices to the State shall be sent to: (Include contact name and/or title, name of agency & address)

Sarah Nimetz, Grant Specialist
Lake Michigan Coastal Program
Indiana Department of Natural Resources
Indiana Dunes State Park Annex Office
1600 North 25 East
Chesterton, Indiana 46304
snimetz@dnr.IN.gov
219-250-5401

B. Notices to the Grantee shall be sent to: (Include contact name and/or title, name of grantee & address)

Indiana University
Office of Research Administration
Attn: Associate Vice President, Office of Research Administration
509 E 3rd Street
Bloomington, IN 47401
Email: ruggs@indiana.edu

C. As required by IC §4-13-2-14.8, payments to the Grantee shall be made via electronic funds transfer in accordance with instructions filed by the Grantee with the Indiana Auditor of State.

17. Order of Precedence. Any inconsistency or ambiguity in this Grant Agreement shall be resolved by giving precedence in the following order: (1) requirements imposed by applicable federal law or other controlling document described in paragraph 20, below; (2) this Grant Agreement, (3) exhibits prepared by the State, (4) Invitation to Apply for Grant, (5) the Grant Application, and (6) exhibits prepared by Grantee.

18. Termination for Breach.

A. Failure to complete the Project and expend State, local and/or private funds in accordance with this Grant Agreement may be considered a material breach, and shall entitle the State to

suspend grant payments, and suspend the Grantee's participation in State grant programs until such time as all material breaches are cured to the State's satisfaction.

B. The expenditure of State or federal funds other than in conformance with the Project or the Budget may be deemed a breach. The Grantee explicitly covenants that it shall promptly repay to the State all funds not spent in conformance with this Grant Agreement.

19. Termination for Convenience. Unless prohibited by a statute or regulation relating to the award of the grant, this Grant Agreement may be terminated, in whole or in part, by the State whenever, for any reason, the State determines that such termination is in the best interest of the State. Termination shall be effected by delivery to the Grantee of a Termination Notice, specifying the extent to which such termination becomes effective. The Grantee shall be compensated for completion of the Project properly done prior to the effective date of termination. The State will not be liable for work on the Project performed after the effective date of termination. In no case shall total payment made to the Grantee exceed the original grant.

20. Federal and State Third-Party Contract Provisions. If part of this Grant involves the payment of federal funds, the Grantee and, if applicable, its contractors shall comply with the federal grant / contract provisions attached as **Exhibit(s) D** and incorporated fully herein.

21. State Boilerplate Affirmation Clause. I swear or affirm under the penalties of perjury that I have not altered, modified or changed the State's Boilerplate clauses (as defined in the 2016 OAG/IDOA *Professional Services Contract Manual*) in any way except for the following clauses: #3 Implementation of and Reporting on the Project (modified); #4 Term (modified); #6 Payment of Claims (modified); #7 Project Monitoring by the State (modified); #10 Drug-Free Workplace Certification (modified); and #22 Public Record (added).

22. Public Record. Unless an Access to Public Record Act exception applies, this Grant agreement will not be treated as confidential and will be posted on the State's website as required by Executive Order 05-07. Use by the public of information contained in this Grant shall not be considered an act of the State.

23. Provision Applicable to Grants with tax-funded State Educational Institutions:
"Separateness" The State acknowledges and agrees that because of the unique nature of State Educational Institutions, the duties and responsibilities of the State Educational Institution in these Standard Conditions for Grants are specific to the department or unit of the State Educational Institution. The existence or status of any one contract or grant between the State and the State Educational Institution shall have no impact on the execution or performance of any other contract or grant and shall not form the basis for termination of any other contract or grant by either party.

THE REMAINDER OF THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Non-Collusion and Acceptance

The undersigned attests, subject to the penalties for perjury, that the undersigned is the Grantee, or that the undersigned is the properly authorized representative, agent, member or officer of the Grantee. Further, to the undersigned's knowledge, neither the undersigned nor any other member, employee, representative, agent or officer of the Grantee, directly or indirectly, has entered into or been offered any sum of money or other consideration for the execution of this Agreement other than that which appears upon the face hereof. **Furthermore, if the undersigned has knowledge that a state officer, employee, or special state appointee, as those terms are defined in IC 4-2-6-1, has a financial interest in the Contract, the Contractor attests to compliance with the disclosure requirements in IC 4-2-6-10.5.**

Agreement to Use Electronic Signatures

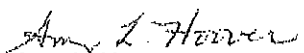
I agree, and it is my intent, to sign this Contract by accessing State of Indiana Supplier Portal using the secure password assigned to me and by electronically submitting this Contract to the State of Indiana. I understand that my signing and submitting this Contract in this fashion is the legal equivalent of having placed my handwritten signature on the submitted Contract and this affirmation. I understand and agree that by electronically signing and submitting this Contract in this fashion I am affirming to the truth of the information contained therein. I understand that this Contract will not become binding on the State until it has been approved by the Department of Administration, the State Budget Agency, and the Office of the Attorney General, which approvals will be posted on the Active Contracts Database:

https://hr85.gmis.in.gov/psp/pa91prd/EMPLOYEE/EMPL/h/?tab=PAPP_GUEST

In Witness Whereof, Grantee and the State have, through their duly authorized representatives, entered into this Grant Agreement. The parties, having read and understood the foregoing terms of this Grant Agreement do, by their respective signatures dated below, hereby agree to the terms hereof.

Trustees of Indiana University

Department of Natural Resources

By: 
Amy L. Hoover
Title: Contract Officer

By: 
Title: Deputy Director / CFO

Date: April 8, 2019

Date: 4-9-19

| | |
|---|---|
| <p>Approved by: Indiana Office of Technology -- N/A</p> <p>By: N/A (for) Deward Neely, Chief Information Officer <i>Refer to Electronic Approval History found after the final page of the Executed Contract for details.</i></p> | <p>Electronically Approved by: Department of Administration</p> <p>By: (for) Lesley A. Crane, Commissioner <i>Refer to Electronic Approval History found after the final page of the Executed Contract for details.</i></p> |
| <p>Electronically Approved by: State Budget Agency</p> <p>By: (for) Jason D. Dudlich, Director <i>Refer to Electronic Approval History found after the final page of the Executed Contract for details.</i></p> | <p>Approved as to Form and Legality: Office of the Attorney General</p> <p><i>Form approval has been granted by the Office of the Attorney General pursuant to IC 4-13-2-14.3(e) on July 27, 2018 FA 18-14</i></p> |

Exhibit A - Timeline
Indiana Lake Michigan Coastal Grants Program
Project Number: CZ844

Applicant: Trustees of Indiana University

Project Title: J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation

Project Timeline: March,2019-December,2019

Summary: Indiana University Center for Underwater Science will conduct underwater archaeological investigation of the J.D. Marshall historic shipwreck to produce an accurate 3D photogrammetric model, which will identify significant remaining features and their respective sensitivity. The results of this investigation and computer vision photogrammetry will be utilized for baseline monitoring and management, as well as an interpretive model for outreach and education.

TASK ONE: Project Planning

March,2019-June,2019

1. Apply for necessary permits and permission for archaeological investigation
2. Organize and secure equipment for field work
3. Coordinate travel and diving logistics (boats, hotels, etc.)
4. Coordinate photogrammetric data collection strategy

TASK TWO: Project Implementation

July 2019

1. Conduct photogrammetric survey of J.D. Marshall
2. Collect supplementary data using traditional methods
3. Identify key artifacts and features for interpretation and/or conservation
4. Create database for the storage of data collected for this project

July, 2019-September, 2019

1. Produce 3D model of J.D. Marshall using Agisoft Photoscan
2. Draft final report of photogrammetric survey with recommendations for future development as an underwater park
3. Submit models, photos, data, and metadata for this project to the state for inclusion in the Heritage Database

TASK THREE: Public Outreach and Education

September,2019-December,2019

1. Work with partners to make public aware of the project through outlets they use to communicate with the public
2. Post photogrammetric model and distribute this through outlets of project partners

TASK FOUR: Administration

March,2019-December,2019

1. Track and record the hours of volunteers and professionals whose work will be counted as match
2. Track and record the hours of staff whose work will be charged to the grant
3. Submit quarterly financial and progress reports, due to the LMCP Grants Specialist 14 days after end of each quarter, beginning on project start date

4. Submit semi-annual NOAA Performance Measures reports, in January and July, due to LMCP Grants Specialist at the same time as financial and progress reports
5. Submit Final Project Report at the conclusion of the project.

Work Products:

1. A report detailing the methodology used and the recommendations for protecting the site
2. 3D model of the site as a baseline monitoring tool for future research and management of the J.D. Marshall as a cultural resource
3. All photos, processing data, and metadata collected during the project

Exhibit B - Budget
Indiana Lake Michigan Coastal Grants Program
Project Number: CZ844

Applicant: Trustees of Indiana University

Project Title: J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation

| Category | LMCP Request | Match: Cash | Match: In-Kind | Total |
|-------------------------|---------------------|--------------------|-----------------------|------------------|
| Personnel | 6,635.00 | | 10,408.00 | 17,043.00 |
| Fringe | 1,008.85 | | 2,804.96 | 3,813.81 |
| Travel | 3,000.00 | | | 3,000.00 |
| Supplies | 1150.65 | | 2,355.54 | 3,506.19 |
| Contractual | | | | |
| Overhead / indirect 32% | 3,774.00 | | | 3,774.00 |
| Totals | 15,568.50 | | 15,568.50 | 31,137.00 |
| | | | | |

Exhibit C

Grantee agrees to the following special conditions:

- A. The DNR Lake Michigan Coastal Program will fund up to 50% of the project cost using the Department of Commerce, National Oceanic and Atmospheric Administration funds, not to exceed the total grant amount. The grantee will be responsible for providing cash and/or donated goods and services sufficient to complete the project. The matching share will not consist of funds from the federal government. Costs paid for with locally provided matching funds, or in-kind services, must be accounted for in the same manner as costs to be reimbursed with grant funds.
- B. The project must be conducted in accordance with: *Coastal Zone Management Act Section 306A Guidance* and the *Lake Michigan Coastal Program Grants Manual*.
- C. Grantee will not cut or remove any trees equal to or greater than three (3) inches in diameter at breast height (dbh) between April 1 and September 30 and all mechanical cutting activity must be restricted to times when the ground is frozen.
- D. Grantee will submit to the DNR, Lake Michigan Coastal Program for review a list of all plant species to be planted as part of this grant project.
- E. Grantee will comply with the requirements of the Indiana State Historic Preservation Office (Indiana SHPO).
- F. The grantee must submit plans, specifications, or other predevelopment information, to the DNR, Lake Michigan Coastal Program for review. No construction work can begin on the project until written approval is received from the DNR, Lake Michigan Coastal Program.
- G. The grantee may not enter into any contracts for any aspects of the project work without the prior written approval of the DNR, Lake Michigan Coastal Program. Federal regulations require a competitive procurement process in the selection of all professional services that are connected with a federally funded project. See the *Lake Michigan Coastal Program Grants Manual* for more information on procurement.
- H. Grantee agrees to obtain all necessary local, state, and federal permits for any work conducted under this grant agreement. Grantee will submit a copy of all permits to the DNR, Lake Michigan Coastal Program.
- I. The grantee will submit to the DNR, Lake Michigan Coastal Program a draft project report a minimum of 30 days prior to the expiration of this grant agreement. Before closeout of this grant agreement, the grantee shall submit to the DNR, Lake Michigan Coastal Program one hard copy, and one electronic copy of the final project report with, as applicable, photo documentation of the completed work.
- J. The DNR will retain 15% of the total grant amount until the DNR Lake Michigan Coastal Program, has reviewed the final products and has found them to be in compliance with applicable requirements in this grant agreement. When all work has been completed and accepted, and all required financial documentation has been submitted to the DNR Lake Michigan Coastal Program, the 15% retention, or the balance of approved grant expenditures will be released for payment.
- K. In the event there are title discrepancies or encumbrances that the DNR deems interfere with the purpose for which grant funds were granted, or if DNR determines that the project or property is no longer used for its original purpose, the grantee shall reimburse

the DNR for the federal funds received for the project. The grantee will maintain the project in perpetuity, or at a minimum, twenty (20) years.

- L. Grantee is required to retain all financial records, supporting documents, and other records and papers related to this grant for a period of three years after the expiration date of this grant agreement. Subgrantees must likewise retain such records for a three-year period.
- M. The State Board of Accounts, or its designee, will have the right to conduct financial audits of the grantee in accordance with established guidelines. Grantee agrees to comply with all reporting requirements prescribed by the State Board of Accounts. When a grantee is audited for the period of time that grant funds were being expended, a copy of the audit report must be provided to the DNR Lake Michigan Coastal Program. If the term of the grant covers more than one audit period, all applicable audit reports must be provided to the DNR Lake Michigan Coastal Program. All local government units must ensure that the federal funds in this grant are included in the Single Audit conducted on their governmental agency by the State Board of Accounts.
- N. Requests for time extensions must be submitted to the DNR Lake Michigan Coastal Program in writing and be fully justified. Requests for extensions must be received by the DNR Lake Michigan Coastal Program 60 days before the expiration of the grant agreement. The DNR reserves the right to deny any request for extension.

Exhibit D

Grantee agrees to the following federal terms and conditions set forth herein:

- A. Grantee must comply, as applicable, with the following: (1) 2 CFR Part 200: Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments; (2) Financial management standards as prescribed in 2 CFR Part 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements as Adopted Pursuant to 2 CFR § 1327.101; (3) Cost Principles in 2 CFR Part 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements as Adopted Pursuant to 2 CFR § 1327.101.
- B. For any projects involving the collection or production of geospatial data (i.e. GIS data), the Grantee will comply to the maximum extent practicable with Executive Order 12906 "Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure" Federal Register Vol. 59, Number 71, pp. 17671-17674, the Grantee shall document all new geospatial data it collects or produces using the standard developed by the Federal Geographic Data Committee (FGDC), and make that standardized documentation electronically accessible to the State. The standard can be found at <http://fgdc.gov/standards/standards.html>
- C. Grantee must comply with Part III of Executive Order 11246 (30 F.R. 12319, September 25, 1965) as amended by Executive Order 11375 (32 F.R. 14303, October 17, 1967) requiring federally assisted construction contracts to include the provisions of Section 203 of the Executive Order for Equal Employment Opportunity. Grantee must also comply with Department of Labor regulations implementing the Executive Order. These are found at 41 CFR 60-1.4 (b).
- D. Grantee is, for any construction activities funded through this grant, required to include, in contracts in excess of \$10,000, a provision requiring compliance with Executive Order 11246, concerning equal employment opportunity, as amended by Executive Order 11375 and supplemented in Department of Labor regulations (41 CFR Chapter 60). Grantee must observe all applicable requirements of the Orders and regulations and include in their nonexempt (see the supplementing regulation) construction contracts the specific clauses prescribed by 41 CFR 60-1.4 (b) and, if applicable, 41 CFR 60-4.3.
- E. The Grantee is prohibited from expending grant funds or in-kind goods or services for purposes of providing transportation, travel, and any other expenses for any Federal employee.
- F. The Grantee and any subrecipients or contractors shall not sub-grant or subcontract any part of the approved project to any federal agency.
- G. The Grantee shall include a statement in all lower tier covered transactions (Subgrants, contracts, and subcontracts), that the grant is subject to Executive Order 12549, "Debarment and Suspension" and Department of Commerce implementing regulations published at 15 CFR Part 26, Subparts A through E, "Governmentwide Debarment and Suspension (Nonprocurement).
- H. If appraisal of real property is required by an independent appraiser, Grantee must comply with the procedures for establishing the fair market value of land or a building or the fair rental rate of land or space in a building are governed by 2 CFR Part 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements as Adopted Pursuant to 2 CFR § 1327.101.

- I. Grantee shall be alert to organizational conflicts of interest as well as other practices among subrecipients that may restrict or eliminate competition. In order to ensure objective subrecipient performance and eliminate unfair competitive advantage, subrecipients that develop draft work requirements, statements of work, or requests for proposals shall be excluded from competing for such subgrants.
- J. The Grantee shall maintain written standards of conduct governing the performance of its employees engaged in the grant and administration of subgrants. No employee, officer, or agent shall participate in the selection, award, or administration of a subgrant under this grant agreement if a real or apparent conflict of interest would be involved. Such a conflict would arise when the employee, officer, or agent, any member of his or her immediate family, his or her partner, or an organization which employs or is about to employ any of the parties mentioned in this section, has a financial interest or other interest in the organization selected for a subgrant. The officers, employees, and agents of the Grantee shall neither solicit nor accept anything of monetary value from subrecipients. However, the Grantee may set standards for situations in which the financial interest is not substantial or the gift is an unsolicited item of nominal value. The standards of conduct shall provide for disciplinary actions to be applied for violations of such standards by officers, employees, or agents of the Grantee.
- K. The Grantee must retain and provide access to financial and programmatic records, statistical records, supporting document, and all other records associated with a grant project according to 2 CFR Part 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements as Adopted Pursuant to 2 CFR § 1327.101. Grantee must also require any sub-recipients to comply with this provision. In general, records must be retained for three (3) years from the date the Grantee submits its last expenditure report for the grant period. If any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the three-year period, the records must be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular three-year period, whichever is later.
- L. Grantee must comply with the requirements for retaining records of cost sharing or matching contributions as prescribed by 2 CFR Part 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements as Adopted Pursuant to 2 CFR § 1327.101. Complete records on matching costs should be kept and maintained by the Grantee. Records of cost-sharing or matching contributions are subject to audit in the same manner and to the same extent as records dealing with the use of federal grant funds.
- M. The Grantee is accountable to the State for any grant related income as prescribed in 2 CFR Part 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements as Adopted Pursuant to 2 CFR § 1327.101. Grant and sub-grant related income refers to: (1) interest and other investment income earned on advances of grant funds; and (2) program income.
- N. When applicable, Grantee must sign and comply with the assurances and certifications of Standard Forms 424D: "Assurances – Construction Programs", CD-511: "Certification Regarding Lobbying," and CD-512: "Certifications Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions and Lobbying."

Exhibit E

A.) Guidelines for filing the annual financial report:

- 1) Filing an annual financial report called an Entity Annual Report (E-1) is required by IC 5-11-1-4. This is done through Gateway which is an on-line electronic submission process.
 - a. There is no filing fee to do this.
 - b. This is in addition to any similarly titled report required by the Indiana Secretary of State.
 - c. The State Board of Accounts may request documentation to support the information presented on the E-1.
 - d. The Gateway User Guide is found at www.gateway.ifonline.org/userguides/E1guide.
- 2) Based on the level of government financial assistance received, an audit may be required by IC 5-11-1-9.
- 3) Additional information can be obtained using the nonforprofit@sboa.in.gov email address.

B.) As provided by the State:

Funding Source:

If funding source is passed-through federal funds:

Program Name per Catalog of Federal Domestic Assistance (CFDA):

Coastal Zone Management Administration Awards

CFDA #11.419

If funding source is state funds:

Program Title _____

Type of funding (State funding, federal grant passed through, fee for service) Federal Grant
Passed Through

Pre-Proposal

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

2018 FUNDING CYCLE PRE-PROPOSAL (continued)

State Form 54757 (R6 / 7-17)

10. Describe the activities your organization will accomplish with both the requested LMCP grant funds and the matching funds. Please list the proposed work products.

Indiana University Center for Underwater Science will conduct underwater archaeological investigation of the JD Marshall historic shipwreck to produce an accurate 3D photogrammetric model to be used for baseline monitoring and site management. The photogrammetric 3D model will be used to create an interpretive tour of the shipwreck for public outreach and education, demonstrating the importance of protecting Indiana's maritime heritage to both the diving and non-diving public.

The central data collection technique for this project is structure-from-motion photogrammetric imagery acquisition, which will be accomplished by IU scientific divers using SCUBA and cameras to collect thousands of images and/or video while swimming transects of delineated site sections. The ultimate objective of image acquisition is to collect sufficient overlapping imagery to align images and generate a 3D model and orthomosaic using computer vision photogrammetry.

11. Identify at least two (2) Plan documents that best support the high priority needs to be addressed by your proposed project. This should be a Plan document that was created through local governments, regional organizations, or other public processes. Be sure to provide a website location for the Plan, as well as page number where the needs being addressed may be found within the Plan. For your benefit, a collection of regional plans can be found in the Technical Assistance Planning Program (TAPP) Toolkit: <http://www.in.gov/dnr/lakemich/9396.htm>.

2000 Beeker et al. Assessment and Management Recommendations for Historic Shipwrecks Located in Indiana Territorial Waters of Southern Lake Michigan. In Coastal Recreation Study of Lake Michigan-Page 11,19

2012 Porter County Parks & Recreation Comprehensive Master Plan-Page 42-47
<http://www.porterco.org/DocumentCenter/View/2433>

12. DESCRIBE how your proposed project addresses the high priority needs of the Plans you identified in question 11.

Comprehensive documentation of the shipwreck is a high priority for the successful management and public interpretation of the JD Marshall. The final 3D model and orthomosaic produced by this project will be highly detailed and accurate, and will serve as invaluable monitoring tools for ongoing management of the JD Marshall shipwreck. The need for a highly detailed and accurate textured model is apparent and the primary way to quantify future damage to the site is through the creation of a baseline monitoring tool to develop a protection strategy.

Additionally, this project and the creation of an online-accessible 3D model aims to increase resource stewardship through public education and outreach about the importance of Indiana's maritime heritage. This project will increase public awareness of cultural heritage eco-tourism and additional recreation opportunities in Porter County.

13. Identify the target population for the project you are proposing. Please be specific.

The target population for the project is both the diving and non-diving general public. With the creation of a 3D photogrammetric model, the site can be appreciated and accessed not only by the diving population, but through modern technology by the non-diving public.

Resource managers and park officials will also be able to utilize highly accurate site data from the model to better monitor and manage the JD Marshall and its associated cultural resources.

14. Identify the project partners who will be involved with this project you are proposing. Please describe each partners' roles in this project, in detail.

Indiana University Center for Underwater Science: QP archaeologist and scientific divers for field investigation and 3D modeling production with identified areas of sensitivity and interpretation

Indiana DNR Division of Historic Preservation: Permit for archaeological survey and investigation

Indiana DNR Fisheries: Site access and dive platform operation assistance

15. Describe the outreach actions you will use to inform the target population of your proposed project. Please keep in mind that you must acknowledge NOAA and the LMCP in all outreach efforts.

This project is intended to use 21st century technology (computer vision photogrammetry) to provide Indiana DNR baseline 3D monitoring and interpretive information for public outreach and education. The JD Marshall is an underwater preserve, accessible by the diving population, that with advances in 3D modeling technology can be appreciated by the wider public via websites such as sketchfab.com or the Indiana DNR website.

2018 FUNDING CYCLE PRE-PROPOSAL (continued)

State Form 54757 (R6 / 7-17)

16. If you checked the box for a funding priority in number 5, explain how your project fits the priority funding category.

17. Preliminary Project Budget

Provide an estimated breakdown of the proposed project budget using the following table.

| Category | LMCP Request | Match: Cash | Match: In-Kind | Total |
|----------------------|---------------|----------------|-------------------|---------------|
| Personnel | 6,204 | | 10,392 | |
| Fringe | 1,035 | | 2,723 | |
| Travel | 3,000 | | | |
| Supplies | 500 | | 4,750 | |
| Contractual | 0 | | | |
| Indirect rate = 32 % | 3,437 | | | |
| Totals | 13,676 | | 17,865 | 31,541 |

18. Budget Description

a. Describe project activities that will be funded with LMCP FEDERAL funds. Give a line-item by line-item description of the work that will be performed, and/or items which will be purchased for each budget line-item.

Summer salary and travel (mileage, lodging, per-diem) for IU scientific divers, salary fringe benefits, coded photogrammetric targets, additional GoPro Hero camera for 3D documentation of the entire shipwreck site, and federally negotiated indirect (32%)

b. Describe the source of NONFEDERAL matching funds. What project activities will be funded with matching funds? Give a line-item by line-item description of the work that will be performed, or items which will be purchased for each budget line-item.

Second summer salary (11% FTE) and fringe (26.2%) benefits for project director/Qualified Professional Archaeologist (\$10,392 salary, \$2,723 fringe)
 In lieu of purchasing new equipment, IU scuba diving and research equipment (use value: \$4,750) provided by the Kinesiology diving locker will be utilized to include portable breathing air compressor, individual diving equipment, underwater GoPro Hero 5 cameras and video use for photogrammetric documentation, diver specific first aid and safety equipment (with AED and Oxygen), underwater archaeological documentation equipment (measuring reels, compasses, writing slates, Canon G11 cameras with underwater housing, photobars, etc) and the use of Indiana University's computer with adequate processing power (32+ GB RAM) in order to process photogrammetric models.

19. Attachments: You may provide a MAXIMUM of three (3) single-page attachments. Each attachment may be a maximum of 8 ½ by 11 in size. These attachments may be photos, maps, letters of support, or other supporting documentation.

20. Has your organization received a LMCP grant in the past? **YES**

21. Acceptance of the terms of the Grant Guidance

"I have read and accept the terms of the Lake Michigan Coastal Grants Program 2018 Funding Cycle Pre-Proposal Guidance document." Type your name in the space below.

| | |
|----------------------------------|--|
| Name Charles D. Beeker | Date (month, day, year) September 12, 2017 |
|----------------------------------|--|

Full Proposal

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844



Indiana Lake Michigan Coastal Program Coastal Grants Program 2018 Funding Cycle Full Proposal

INSTRUCTIONS:

1. Read the 2018 Funding Cycle Application Guidance before completing this form.
2. **Deadline for Submission: 5:00 p.m. C.S.T Friday, December 15th, 2017**
Proposals MUST be RECEIVED by the above deadline, and may be submitted at ANY time before the deadline.
3. Required for Submission:
 - 1 complete electronic copy, submitted via e-mail, or mailed or hand-delivered on CD – Preferred in MS Word format, or pdf that can be copied (**no scanned copies, please**). The electronic copy may be e-mailed to mbyrne@dnr.in.gov if it is smaller than 24 MB. ****Do not submit a hard copy.**** *Office Hours are 9:00 am-5:00 pm*

Grant applications may be e-mailed, mailed, or hand delivered to:

Maggie Byrne, Grant Specialist
mbyrne@dnr.in.gov
 Lake Michigan Coastal Program
 Indiana Dunes State Park Annex
 1600 North 25 East
 Chesterton, IN 46304
 Ph: 219-983-9912

| | |
|---|--|
| 1. Project Title: J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation | |
| 2. Organization Applying: Indiana University Center for Underwater Science | |
| 3. Type of Organization: State college or university | |
| 4. County: <input type="checkbox"/> Lake <input checked="" type="checkbox"/> Porter <input type="checkbox"/> LaPorte | |
| 5. Project Manager | 6. Grant Administrator |
| Name: Charles D. Beeker | Name: Steven A. Martin |
| Title: Director, Center for Underwater Science | Title: Associate Vice President, Office of Research Administration |
| Address, City, State, Zip: 1025 E. 7 th St, Bloomington, IN 47405 | Address, City, State, Zip: 509 E. Third St, Bloomington, IN 47401 |
| Phone: 812-855-5748 | Phone: 812-855-0516 |
| Email: cbeeker@indiana.edu | Email: rugs@indiana.edu |

**Indiana Lake Michigan Coastal Program
Coastal Grants Program
2018 Funding Cycle Full Proposal**

| | |
|---|--------------|
| Name of individual authorized to sign Grant Agreement, and their e-mail address: Steven A. Martin | DUNS Number: |
|---|--------------|

| | |
|---|--|
| 7. CHOOSE ONE PROJECT TYPE FIRST choose ONE color-coded project CATEGORY SECOND choose priority or "Other" WITHIN that category ***check only ONE box*** | |
| (§306a) Low Cost Construction <input type="checkbox"/> Improving access to coastal resources for persons with disabilities using the Public Access Needs Assessment – Report. Public Access Needs Assessment - Report <input type="checkbox"/> Other | (§306) Education / Outreach <input type="checkbox"/> Green infrastructure maintenance education or training <input type="checkbox"/> Other |
| (§306a) Acquisition <input type="checkbox"/> Lands identified as natural areas of high conservation value <input type="checkbox"/> Other | (§306) Applied Research <input type="checkbox"/> Economic impact of projects funded by the Lake Michigan Coastal Program <input type="checkbox"/> Other |
| (§306) Planning / Coordination / Management <input type="checkbox"/> Development of long-term, natural resource management plans for existing protected areas using the DNR's Nature Preserve Management template https://secure.in.gov/dnr/lakemich/6036.htm <input checked="" type="checkbox"/> Other | (§306) Emerging Issues (check two boxes) <input type="checkbox"/> Response coordination for spills and releases of hazardous materials (check one box below) <input type="checkbox"/> Planning/Coordination/Management <input type="checkbox"/> Education/Outreach <input type="checkbox"/> Applied Research |
| 8. Project Cost | |
| LMCP Share: \$15,428.29 | |
| Applicant Share: \$15,865.00 | |
| TOTAL: \$31,293.29 | |
| 9. Watershed Location: Hydrologic Unit Code (HUC). To find your HUC code, paste this link into your browser: http://in.gov/idem/cleanwater/pages/huc/ | |
| 10-Digit HUC: 04060200010 | 12-Digit HUC: 04060200010010 |

10. BRIEF SUMMARY OF PROJECT
All project categories

Use this space to write a **SHORT, ONE- OR TWO- SENTENCE PARAGRAPH** that summarizes your project. See "Full Proposal Guidance and Instructions" document for instructions on how best to answer this question:

Indiana Lake Michigan Coastal Program Coastal Grants Program 2018 Funding Cycle Full Proposal

The J.D. Marshall is currently a protected, underwater nature preserve offshore from the Indiana Dunes State Park beach. Indiana University will conduct underwater archaeological investigation of the J.D. Marshall historic shipwreck to produce an accurate 3D photogrammetric model to be used for baseline monitoring and site management. The photogrammetric model will be used to create an interpretive tour of the shipwreck on the Indiana DNR website for public outreach and education, demonstrating the importance of protecting Indiana's maritime heritage to both the diving and non-diving public.

11. ADDRESSING THE PROBLEM AND MEASURES OF SUCCESS

All project categories

Briefly and concisely:

- State the problem or issue that this proposal addresses
Shipwrecks in the Great Lakes are often in danger of negative impacts due to invasive species, weather activity, and human activity. The primary way to prevent potential unwanted natural or anthropogenic impacts to the shipwreck is through the creation of baseline monitoring to develop an immediate protection strategy. There is also a distinct lack of awareness of the existence of this important, historic shipwreck itself. This modeling project will aim to increase resource stewardship through public education and outreach, which will ultimately lead to much-needed resource protection and management, while providing accurate, reproducible 3D visual documentation of the shipwreck.
- Explain how the public has been involved in either identifying the problem or developing the project.
The public is widely unaware that just off of the coast of the Indiana Dunes State Park and National Lakeshore, there lies another, underwater, nature preserve. This project seeks to not only provide a baseline for monitoring to prevent damage to this public space, but also to bring the existence of this park to the attention of the public. Recent calls for the National Lakeshore portion of the Dunes to become a National Park reflect increases in tourism and a public desire to protect the resources of Lake Michigan. However, most people are unaware of the intrinsic values that a significant historic shipwreck brings to a region, such as knowledge of the past, increases in tourism revenue, and increases in biological activity. This project hopes to bring more attention and publicity to the submerged resources of the area, specifically the JD Marshall Underwater Preserve.
- How will the project will address the problem?
Comprehensive documentation of the shipwreck is a high priority for the successful management and public interpretation of the JD Marshall. The 3D model and orthomosaic produced by this project will be highly detailed and accurate, and will serve as invaluable monitoring tools for ongoing management of the JD Marshall shipwreck. The need for a highly detailed and accurate textured model is apparent and the primary way to quantify potential changes to the site is through the creation of a baseline monitoring tool to develop a protection strategy.

Additionally, this project and the creation of a online-accessible 3D model aims to increase resource stewardship through public education and outreach about the importance of Indiana's maritime heritage. This project will increase public awareness of cultural heritage eco-tourism and additional recreation opportunities in Porter County.
- Include important background information.
The JD Marshall is a significant historic shipwreck built in 1891 that sank in June of 1911. The shipwreck was first surveyed in 1984 by State Archaeologist Gary Ellis. The ship is likely eligible for inclusion on the National Register of Historic Places, based on its potential to yield important

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information about late 19th and early 20th century Great Lakes maritime technology and architecture. In 2013, the J.D. Marshall became the state of Indiana's first underwater preserve and shipwreck park.

- Discuss the project goals and outcomes.

The ultimate objective of image acquisition is to collect sufficient overlapping imagery to align images and generate a 3D model and orthomosaic using computer vision photogrammetry. The photogrammetric 3D model will be used to create an interpretive tour of the shipwreck for public outreach and education, demonstrating the importance of protecting Indiana's maritime heritage to both the diving and non-diving public. This model will be created as a part of this project and will then be available to the public via the Indiana DNR website.

- How you will measure success?

The first and most obvious measure of success will be the accuracy of the 3D model produced as a result of this project. Following the creation of the model, success of the public outreach portion of this project will be measured by the number of people who view the model online or as part of a display in the Indiana Dunes State Park Nature Center. Measurement of the success of the model as a monitoring tool could be measured by documenting the shipwreck in a few years time and noting the changes from the model.

12. PROJECT DESCRIPTION

Address all of the issues listed below as they relate to your project. All project categories must answer questions a-f. The rest are color-coded according to category.

- a. Describe the project location. Include street address, and latitude and longitude coordinates, where applicable.
600 yards off-shore from the Indiana Dunes State Park, Porter County.
- b. Describe what natural or cultural resources will potentially be affected.
No natural or cultural resources will be affected by the archaeological investigation of the J.D. Marshall. The investigation and creation of the 3D photogrammetric model will be entirely non-invasive.
- c. Does the project require the use, lease, or purchase of land?
No
- d. List all contracts that will be charged to the grant. Describe the scope of services for each contract.
N/A
- e. List all of the partner organizations that will be involved in the project. Describe their roles in the project.
Please be sure to attach letters of support for this project from each of the major organizations partnering with you on this project.
Indiana University Center for Underwater Science: QP archaeologist and scientific divers for field investigation and 3D modeling production with identified areas of sensitivity and interpretation
Indiana DNR Division of Historic Preservation: Permit for archaeological survey and investigation
Indiana DNR Fisheries: Location and dive operation assistance
- f. All LMCP grant projects are required to do some form of education and/or outreach, so that the public will be made aware of the project. Please describe how the public will be informed about this project.
This project is intended to use 21st century technology (computer vision photogrammetry) to provide Indiana DNR baseline 3D monitoring and interpretive information for public outreach and education. The J.D. Marshall

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is an underwater museum, accessible by the diving population, that with advances in 3D modeling technology can be appreciated by the wider public via websites such as sketchfab.com or the Indiana DNR website.

g. **For Low Cost Construction and Land Acquisition category projects**, NOAA requires maintenance for a minimum of 20 years. Describe how the project will be monitored/maintained for 20 years, who will be responsible for monitoring/maintenance, and the expected life of the project.

h. **For Low Cost Construction and Land Acquisition category projects**, describe the project's plan for public outreach/public access, and how that will protect the resource from unauthorized use.

i. **For Low Cost Construction and Acquisition Projects ONLY**, identify the specific flood zone(s) designation (e.g., V1-30 zone, A1-30 zone) in which your project is located, using this website <https://msc.fema.gov/portal>. Everything is identified as having some flood zone classification, so you cannot answer this question by saying, "project site is not located in a flood zone."

j. **For Low Cost Construction and Acquisition Projects ONLY**, describe the broad and lasting public benefit that will result. Please explain how this project will benefit many different user groups of people, and how it will benefit those people for at least 20 years.

k. **For Low Cost Construction and Acquisition Projects ONLY**, describe how the project meets requirements of the Americans with Disabilities Act.

l. **For Low Cost Construction Projects ONLY**, list all permits that may be required to undertake the proposed project.

m. **For Low Cost Construction Projects ONLY**, describe the type of construction materials, and the type of construction methods to be used.

n. **For Low Cost Construction Projects ONLY**, describe the best management practices which will be used both during and after construction to avoid, minimize, or mitigate any significant impacts, such as erosion and storm

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water pollution.

o. **For Natural Area Restoration Projects ONLY**, identify the restoration goals for the project area, discuss past work completed in the project area, if applicable.

p. **For stormwater BMP projects:**

- Discuss the potential pollutants the BMP will address, and the sources of those pollutants
- Provide a map that shows the location and approximate dimensions of the BMPs
- Provide seeding/planting specifications
- Provide operation and maintenance guidelines for each BMP

q. **For Applied Research Projects ONLY**, describe the end use of the research data and how your project partner will utilize the data/information.

r. **For Education/Outreach Projects ONLY**, describe the target audience, and explain how the project meets State of Indiana Academic Standards.

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**13. IMPACT ON COASTAL RESOURCES – FOR LAND ACQUISITION AND
LOW COST CONSTRUCTION PROJECTS ONLY**

**How does the project address an Area of Particular Concern
for the Lake Michigan Coastal Program (check all that apply):**

- Areas of unique, scarce, fragile or vulnerable habitats**
 - Habitat of endangered or threatened plant or animal species
 - Natural areas that contain high quality natural communities, and usually contain species of plants or animals considered endangered, threatened or rare
 - Areas that contain assemblages of rare species including one or more species of plant or animal considered rare, special concern, or watch list
 - Areas that contain natural community types that are rare in the State of Indiana (see Table 8.1)
 - Dedicated state nature preserves
 - Streams classified as natural, scenic, or recreational rivers

- Areas of historical significance, cultural value, or substantial recreational value or opportunity**
 - Site, district, object, and building significant in the development of Indiana, local history, architecture, archaeology, and culture that possesses integrity of location, design, setting, materials, and workmanship
 - Properties rated as “Outstanding” or “Notable” in the Indiana Historic Sites and Structures Inventory
 - Property achieving historical significance within the past 50 years
 - Archaeological sites whose contextual integrity has not been significantly altered by natural sources or human activities
 - Existing public access sites to lakes, fishing along the shoreline and boat ramp facilities
 - Areas along the Lake Michigan shoreline and salmonid streams that are suitable to provide public fishing access, are not presently providing access, and would not interfere with other areas of concern
 - Areas which are conducive to the expansion of interpretive and educational facilities
 - Marshes, bogs, and swamps of significant recreational value for sport fishing, hunting, and or wildlife viewing
 - Areas suitable to trail opportunities for walking, hiking, bicycling, horseback riding, and cross country skiing
 - Public lands managed by the Division of State Parks or the Division of Fish and Wildlife
 - Offshore shipwrecks

- Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, endangered species, and the various trophic levels in the food web critical to their well-being**
 - Sites designated as Salmonid streams and tributaries required for spawning and release sites
 - Isolated marshes, bogs, and swamps including those not regulated by federal and state laws
 - Offshore waters used by migratory waterfowl
 - Stopover habitat used by migratory birds
 - Public lands managed by the Division of Fish and Wildlife: Fish and Wildlife Areas or Wetland Conservation Area

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- Shoreline waters required for the reproduction of fish species other than salmonids
- Riparian corridors and in-stream habitat
- Wetlands including marshes, bogs, fens, mesic and wet prairie, and swamps as identified by the U.S. Fish and Wildlife Service National Wetlands Inventory

Areas needed to protect, maintain, or replenish coastal lands or resources including coastal flood plains, aquifers and their recharge areas, sand dunes, and offshore sand deposits

- Areas eligible as filter strips under the Filter Strip Act
- Undeveloped flood plains
- Wetlands as identified by the U.S. Fish and Wildlife Service National Wetlands Inventory
- Recharge areas mapped in the Atlas of Hydrogeologic Terrains and Settings of Indiana
- Sand dunes
- Offshore sand deposits

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14. CONSISTENCY WITH, AND IMPLEMENTATION OF, AREA PLANNING EFFORTS

All project categories must answer these questions. Assume that the reviewers of your application have not seen your answer in the Pre-Proposal.

- a. Describe how this project addresses a high priority need as identified in state/regional recognized plans, **local planning efforts, or your organization/agency's strategic plan**. Please identify the Plan, where this project specifically appears in the Plan (page number), and provide the link to the web page where it may be found. If it is not online, then provide a photocopy of the pages of the plan to which you refer.

As identified in the 2016 Muskegon Intrusive Modern Pipe Assessment (pages 7-8 attached) submitted to the Indiana Department of Natural Resources' Lake Michigan Coastal Program, comprehensive documentation of Indiana shipwrecks is a high priority and is necessary for the successful management of the J.D. Marshall. As with surrounding states and coastal regions, historic shipwrecks are of increasing interest to the diving and non-diving public and the J.D. Marshall is Indiana's first underwater preserve. Indiana University recommend that creating a full photogrammetric model of the entire shipwreck could be used as a "detailed, accurate, and cost-effective monitoring baseline, and if made available online, as a tool for interactive public outreach by the INDNR" (Maus, Haskell, 2016, p. 7). Indiana University has successfully created photogrammetric models of the Muskegon, and the creation of similar models for the J.D. Marshall would be invaluable for preserving Indiana's maritime heritage. This project would encompass the entirety of the ship, creating a baseline for annual rapid assessment protocol conducted by divers under the direction of a qualified archaeologist (Maus, Haskell, 2016, p. 8).

- b. for Planning/Coordination/Management category projects ONLY, describe how this project fulfills a planning **need** identified by a community or organization

"An updated archaeological survey of the J.D. Marshall is recommended as it could provide adequate documentation for NRHP nomination, and minimally document the extent of settling of the bow section" (Beeker, Budziak 2009, p. 11). This project will accomplish comprehensive documentation of the entire shipwreck.

- c. Will this project result in an application to the Regional Development Authority (RDA) or is connected to an existing RDA application or project? YES NO

15. HAS YOUR ORGANIZATION RECEIVED A LMCP GRANT IN THE PAST?

All project categories

YES NO

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16. PROJECT BUDGET

Provide an estimated breakdown of the project budget using the table below. Please be certain to re-read the 2018 Full Proposal Guidance Document when completing this section.

All project categories

| Category | LMCP Request | Match: Cash | Match: In-Kind | Total |
|----------------------|--------------|-------------|----------------|-------------|
| Personnel | \$5,935.00 | | \$10,392.00 | |
| Fringe | \$903.10 | | \$2,723.00 | |
| Travel | \$3,950.00 | | | |
| Supplies | \$900.00 | | \$2,750.00 | |
| Contractual | | | | |
| Indirect rate = 32 % | \$3740.19 | | | |
| Totals | \$15,428.29 | | \$15,865.00 | \$31,293.29 |

a. Describe, in detail, project activities that will be funded with LMCP FEDERAL FUNDS. Please be specific.

1. Summer salary for IU 2 faculty and 2 research assistants-\$5,935.00
2. Summer salary fringe benefits for faculty and research assistants-\$903.10
3. Travel (Mileage, lodging, and per-diem) for faculty, staff, and research assistants-\$3,950.00
4. Coded photogrammetric targets for increased alignment accuracy-~\$150.00
5. Additional GoPro Hero 5 camera with memory and underwater housing for 3D documentation of the entire shipwreck site-\$600
6. Filters for portable breathing air compressor to fill scuba cylinders-\$150.00
6. Federally negotiated indirect of 32%-\$3,740.19

b. Describe, in detail, project activities that will be funded with NONFEDERAL matching funds.

1. Second summer salary (11% FTE) for project director/Qualified Professional Archaeologist from the Indiana University Department of Kinesiology (\$10,392.00)
2. Fringe (26.2%) benefits for project director/Qualified Professional Archaeologist from the Indiana University Department of Kinesiology (\$2,723.00)
3. IU scuba diving and research equipment (use value: \$2,750) provided by Department of Kinesiology diving locker will be utilized to include:

Portable breathing air compressor, individual diving equipment, underwater GoPro Hero 5 cameras and video use for photogrammetric documentation diver specific first aid and safety equipment (with AED and Oxygen), underwater archaeological documentation equipment (measuring reels, compasses, writing slates, Canon G11 cameras with underwater housing, photobars, etc) and the use of Indiana University's computer with adequate processing power (32+ GB RAM) in order to process photogrammetric models.

Total Non-Federal matching funds: \$17,865

c. Explain the source of these matching funds. Please be specific. Attach proof of match.

Indiana University Academic Diving Program, Department of Kinesiology, Center for Underwater Science

17. ACCEPTANCE OF THE TERMS OF THE GRANT GUIDANCE

All project categories

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"I have read and accept the terms of the Lake Michigan Coastal Grants Program 2018 Funding Cycle Application Guidance document."

Signature:

Date:

Exhibit A
Project Timeline
Indiana Lake Michigan Coastal Grants Program

Applicant: Indiana University

Project Title: **J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation**

Project Timeline: September 2018 – December 2019

Summary: Indiana University Center for Underwater Science will conduct underwater archaeological investigation of the *J.D. Marshall* historic shipwreck to produce an accurate 3D photogrammetric model which will identify significant remaining features and their respective sensitivity. The results of this investigation and computer vision photogrammetry will be utilized for baseline monitoring and management, as well as an interpretive model for outreach and education.

TASK ONE: Project Planning

September 2018- June 2019

1. Apply for necessary permits and permission for archaeological investigation
2. Organize and secure equipment for field work
3. Coordinate travel and diving logistics (boats, hotels, etc)
4. Coordinate photogrammetric data collection strategy

TASK TWO: Project Implementation

July 2019

1. Conduct photogrammetric survey of *J.D. Marshall*
2. Collect supplementary data using traditional methods
3. Identify key artifacts and features for interpretation and/or conservation
4. Create database for the storage of data collected for this project

July 2019 – September 2019

1. Produce 3D model of *J.D. Marshall* using Agisoft Photoscan
2. Draft final report of photogrammetric survey with recommendations for future development as an underwater park
3. Submit model, photos, data, and metadata for this project to the state for inclusion in the Heritage Database.

TASK THREE: Public Outreach and Education

September 2019 –December 2019

1. Work with partners to make public aware of the project through outlets they use to communicate with the public
2. Post photogrammetric model and distribute this through outlets of project partners

TASK FOUR: Administration

September 2018 – December 2019

1. Track and record the hours of volunteers and professionals whose work will be counted as match
2. Track and record the hours of staff whose work will be charged to the grant
3. Submit quarterly financial and progress reports, due to LMCP Grant Specialist 14 days after each quarter; beginning with your project start date.
4. Submit semi-annual NOAA Performance Measures reports, due to LMCP Grant Specialist at the same time as financial and progress reports.

Work Products:

1. A report detailing the methodology used and the recommendations for protecting the site.
2. 3D model of the site as a baseline monitoring tool for future research and management of the *J.D. Marshall* as a cultural resource
3. All photos, processing data, and metadata collected during the project

Muskegon (aka Peerless) Shipwreck (12LE0381)

Intrusive Modern Pipe Assessment



Authors:

Matthew Maus, MA, RPA, Research Coordinator, IU Center for Underwater Science

Samuel Haskell, Research Associate, IU Center for Underwater Science

Submitted by: Charles Beeker, PhD, RPA, QP, Director, IU Center for Underwater Science
(Principle Investigator)

Submitted to:

Lake Michigan Coastal Program, Indiana Department of Natural Resources

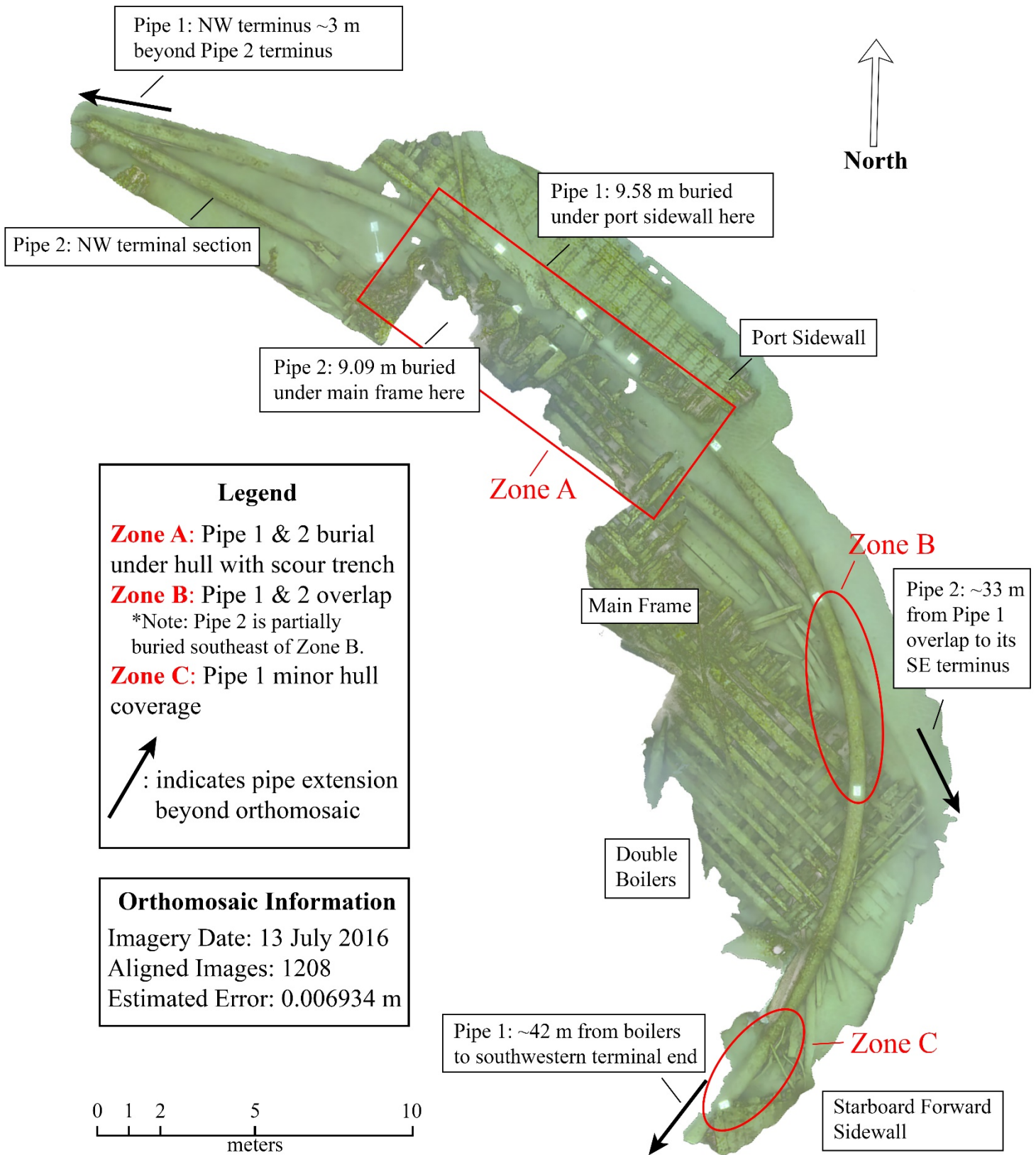
Division of Historic Preservation and Archaeology, Indiana Department of Natural Resources

Project Dates: 12 – 13 July 2016

Report Date: 15 August 2016

This report and the work detailed herein were made possible with financial and logistical assistance from the Lake Michigan Coastal Program, Indiana Department of Natural Resources.

Muskegon (aka Peerless) (12LE0381) Intrusive Pipe Impact Area Orthomosaic



Matthew Maus, Indiana University (2016)

INDNR Division of Historic Preservation and Archaeology Permit

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844



Division of Historic Preservation & Archaeology 402 W. Washington Street, W274 Indianapolis, IN 46204-2739
Phone 317-232-1646 Fax 317-232-0693 dhpa@dnr.IN.gov



June 10, 2019

Dr. Charles Beeker
Indiana University Center for Underwater Science
1025 E 7th Street
Bloomington, Indiana 47405

Re: Archaeological investigations at site 12Pr723 (J.D. Marshall) Porter County, Indiana

Dear Dr. Beeker:

The Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology (DHPA) has reviewed the plan you submitted regarding the proposed scientific archaeological investigations on state property pursuant to Indiana Code 14-21-1-16.

The archaeological plan is acceptable with the following conditions:

1. All archaeological investigations will be directly supervised in the field and laboratory by a qualified professional archaeologist who meets the qualification standards for a principal investigator or field or laboratory supervisor under 312 IAC 21.
2. Please also be aware of the rules regarding the property as a nature preserve.
3. Any proposed revisions to the archaeological plan must be submitted in writing to the Division of Historic Preservation and Archaeology prior to implementation in the field or laboratory.
4. Human remains and associated artifacts will be left in place and remain unexcavated. If any human remains dating on or before December 31, 1939 are encountered, the discovery must be reported to the Indiana Department of Natural Resources within two (2) business days. The discovery must be treated in accordance with IC 14-21-1 and 312 IAC 22. In that event, please call 317/232-1646. If human remains are accidentally discovered during the field investigations or related laboratory analyses, and would be subject to the Native American Graves Protection and Repatriation Act (NAGPRA), the investigating or curational facility shall be the entity responsible for NAGPRA reporting and compliance.
5. A complete report on the field investigations must be submitted to the DHPA for review and comment within one year of the completion of the fieldwork. The report must include the location of the curational facility. A site form will need to be filled out and submitted to SHAARD, as applicable.
6. This plan is not transferable.

With these conditions, the proposed plan is acceptable, and the scientific investigations may proceed (2019038). A copy of this letter, along with proper identification, should be carried by the archaeologist in the field. This will ensure minimal confusion should they be requested to produce proper identification in the field by law enforcement personnel. If you have any questions regarding this matter, please contact Cathy Draeger-Williams at (317) 234-3791 or cdraeger-williams@dnr.IN.gov.

Very truly yours,


Beth K. McCord

Deputy State Historic Preservation Officer

BKM:CDW:cdw

J.D. Marshall Preserve

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Indiana's Maritime Heritage

The state of Indiana has the smallest territorial waters of any Great Lakes state, spanning just 45 miles of Lake Michigan shoreline and containing approximately 225 square miles of bottomland (See Figure 1) (Becker et. al 2000, Haskell et al. 2018). Despite the state's small amount of coastline, the Indiana Department of Natural Resources (DNR) has identified the potential of fifty unique, historic vessels in Indiana territorial waters, with wrecking dates ranging from 1843-1936 (Ellis 1989). Of these fifty potential shipwrecks, only fourteen have been located and are included in the Indiana Marine Cultural Resource Inventory (Ellis 1989).

Historic shipwrecks in Indiana territorial waters are valuable examples of Indiana's diverse and unique maritime history. These vessels offer a cross section of Indiana and Great Lakes cultural heritage and commerce, giving historians and archaeologists an intimate look into the historic use of our state's coastal waters. Archaeological investigations of these shipwrecks can answer important questions concerning maritime technology and its influence on the historical landscape of the Great Lakes (Rogers 2016). Public awareness of submerged cultural resources creates a tie between local communities and a shared maritime heritage of the region, fostering a sense of stewardship for the protection of cultural heritage.

***J.D. Marshall* Service History**

The *J.D. Marshall* was built in South Haven, Michigan in 1891, by J.C. Perene at the Martel Boatyard, though the engines and boilers were likely built in Port Huron, Michigan (Ellis 1986). Launched on July 4, 1891, *J.D. Marshall* originally served as a medium-sized wooden lumber hooker (See Figure 2) (Ellis 1986). Like other vessels of the type, the *Marshall* was an open-hulled wooden steamer, built to ply Lake Michigan with cut cordwood. Of average size for its vessel type, the *J.D. Marshall* measured 154.5', with a beam of 33.5' and a draft of 12' (Ellis 1986). During her early career *J.D. Marshall* worked under the Williams Transport Company, before being sold to J.O. Nessen and Company of Manistee, Michigan. Between these two owners, *J.D. Marshall* spent nearly twenty years involved in the lumber industry of Lake Michigan, before ultimately being sold to the Independent Sand and Gravel Company (Ellis 1986).

In late 1910 or early 1911, the Independent Sand and Gravel Company purchased the *J.D. Marshall*, in part with the insurance settlement from the loss of their only sand-barge, the *Muskegon*. When the *Muskegon* burned in October 1910, the *J.D. Marshall* was sent to

Manitowoc Shipyards in Manitowoc, Wisconsin with parts from the *Muskegon*. The *Muskegon* was fitted with the same sand-sucking equipment at the Manitowoc Shipyards, only a few months earlier. Unlike the *Muskegon*, the *Marshall* was not reportedly fitted with Bishop Arches, which likely contributed to the *Marshall's* demise (Ellis 1986). Metal reinforcement was reportedly added during the refitting of the *J.D. Marshall*, but the stresses of wet sand proved to be too much for the worn-down, converted lumber hooker (Ellis 1986; Michigan City Evening Dispatch 1911). Shortly after this refitting, the *Marshall* travelled back to Michigan City, Indiana. On June 10, 1911, the *Muskegon* was scuttled. On June 11, 1911, the newly-refitted *Marshall* sprang a leak. While under repair, a squall struck, re-opening the leak and eventually capsizing the converted sand barge. Upon capsizing, four men died and remnants of the *J.D. Marshall* littered local beaches, making the sinking event a community affair (Ellis 1986; Michigan City Evening Dispatch 1911).

***J.D. Marshall* Salvage History**

Upon rediscovery in 1979, the *J.D. Marshall* experienced tremendous disruption, mostly caused by salvage attempts (Ellis 1986). A number of large ship features were salvaged by divers, including the deck winch, rudder assembly, and bell. The deck winch and rudder assembly were later donated to the Michigan City Lighthouse Museum, and the bell, which was broken and has now been reconstructed, was donated to the Indiana Dunes State Park Nature Center (See Figure 3 and 4). It is unclear when the bell was broken, but extant fragments have been conserved and partially reconstructed by IU research students (See Appendix A).

A large, illegal salvage attempt was made on the *J.D. Marshall* site in 1982 (Ellis 1986). A group of salvors from Michigan planned to lift the entire shipwreck, remove the propeller, and re-sink the wooden hull in shallow Michigan waters, where it would later be cut up and used to construct coffee tables and other souvenirs. Indiana DNR District 11 Conservation Officers halted salvage operations under state law, but the *J.D. Marshall* was already lifted off the bottom and its propeller had been removed. The salvors dropped the main hull back to the bottom, which resulted in significant damage and caused the hull to land upside down (Ellis 1986). The propeller was confiscated and is housed at Indiana Dunes State Park (See Figure 5).

Archaeological Investigations

In August 2019, a team of researchers and archaeologists from Indiana University Center for Underwater Science (IU) completed two visual surveys on the *J.D. Marshall*. During these surveys, IU researchers used SCUBA to collect photogrammetric data, which were then processed to make 3D models of important features and the main portion of the *J.D. Marshall* shipwreck site (See Appendix B; Figures 5, 6, and 7). Additionally, IU divers collected images of the mooring system and other management aspects of the *J.D. Marshall*, in order to provide useful recommendations regarding management and public outreach of the *J.D. Marshall* Preserve.

Based on 2019 survey, the *J.D. Marshall* appears to contain significant integrity, relative to its history. Invasive quagga mussel coverage is significant, but wooden portions of the ship are not yet covered completely (See Figure 8). Based on Gary Ellis's 1986 Survey of the *J.D. Marshall*, the site condition appears to be relatively stable over a significant time period, with most disturbances stemming from anthropogenic impact, invasive species, and weather-related events. While a significant portion of the hull is now covered with sand, the stern portion of the hull remains extant and relatively intact (See Figure 9). The hull, as reported by Gary Ellis in 1986, appears to be flattening slightly, due to the upside-down position of the shipwreck. Both the scotch boiler and upper engine assembly, noted in 1986, are present and in stable condition. The remaining scotch boiler is comprised of the condenser, firebox, and preheater (See Appendix D).

Following 2019 surveys on the *J.D. Marshall* site, IU researchers visited salvaged artifacts around Michigan City, Indiana. Researchers stopped at the Old Lighthouse Museum in order to understand more about *J.D. Marshall's* salvage history; in an effort to understand the context lost by salvage, researchers aimed to talk to locals about the *Marshall's* history. While there, IU was consulted about the condition of the rudder, to which IU provided recommendations (See Figure 3). IU researchers also went to Indiana Dunes State Park Beach and collected images of the *J.D. Marshall's* propeller (See Figure 5).

In addition to underwater and visual survey, IU transported the bell of the *J.D. Marshall* to laboratory facilities in Bloomington, IN, where research students spent the remainder of 2019 cleaning and reconstructing it. The bell, which arrived in ten pieces, is now partially reconstructed. One piece remains unattached, to be used for hands-on outreach events. For more information on the reconstruction and conservation of the *J.D. Marshall's* bell, see Appendix A.

The newly-reconstructed bell will be displayed at the Indiana Dunes State Park Nature Center. A new name plate, which reads, "*J.D. Marshall* Bell", was also made to promote increased interpretation. The name plate and bell were returned to the Indiana Dunes State Park Nature Center on January 25th, 2020 (See Figure 10).

Diving Operations

On August 13th and August 20th, 2019, Indiana University conducted diving operations on the *J.D. Marshall* shipwreck from an Indiana DNR vessel, provided by Michigan City's Fish and Wildlife Office. Four divers collected data for this report while on open-circuit SCUBA. The team conducted 8 total project dives, with a total of 5 hours and 35 minutes of bottom time. On both days, water conditions were calm, with a maximum visibility of 20 feet. Divers collected data by direct survey, using compasses, writing slates, cameras, photo bars, and coded targets. This project was non-invasive.

Photogrammetry

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Photogrammetry

In recent years, technological advances have made computer-vision photogrammetry (using structure-from-motion techniques) feasible for routine underwater archaeological recording and analysis (Van Damme 2015). Recent research has demonstrated that photogrammetry is feasible in low-visibility underwater environments, in which researchers may compensate for a restricted field of view by collecting more images in order to generate comprehensive, detailed, and accurate photogrammetric models. The photogrammetric methodology as employed in this study permits rapid-image acquisition in the field while also generating a high-quality three-dimensional model that allows detailed measurement and analysis after the conclusion of field work. Because of this, diver-based photogrammetry was selected as the primary recording tool for this project in order to efficiently and accurately document and analyze the site of the *J.D. Marshall*, in an effort to create a baseline for future site monitoring and maximize our data collection during the short time on-site (See Appendix B).

Data Collection Methodology

Prior to collecting images, divers deployed coded targets around the main portion of the shipwreck. Coded targets assist with image alignment and provide known distances, which allows researchers to establish scale and estimate total error in data collection. In order to align images and resolve three-dimensional objects, photogrammetry requires the camera position to change with every photograph, while acquiring a minimum of 60% side and 80% forward overlap for each image (Agisoft LLC 2016). To accomplish this, divers swam transects over the site while taking top-down photos, on two-second intervals, by using the interval time lapse function on two GoPro Hero 5 Black cameras. While swimming transects, divers maintained an average distance of 2-3m from the target area. Where divers encountered significant relief, on the Marshall's boiler, main hull, and engine pieces, oblique photographs were also collected in order to resolve vertical complexity. Using this methodology, two IU divers collected 2,360 images of the *J.D. Marshall* on a single dive on August 13th, 2019 (See Appendix C).

Post-Processing Workflow

After data were collected, images were batch-processed in Adobe Lightroom, in order to correct white balance and to improve clarity, sharpness, and feature definition. Pre-processing

images in this way improves image alignment, final model quality, and texture detail resulting from photogrammetric processing. Next, AgiSoft Metashape was used to align images, and generate a dense cloud, mesh, and texture. The *J.D. Marshall* model was then processed as an orthomosaic, in order to create a site plan that can be distributed and labelled (See Appendix B). See Appendices C-G for full Agisoft Metashape Processing Reports.

Products

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Products

IU will provide an external hard drive containing all products. Additionally, 3D models are available for online viewing through Sketchfab.com.

- LMCP Full Grant Report
- *J.D. Marshall* Preserve 3D model
 - <https://sketchfab.com/3d-models/jd-marshall-preserve-d4e25b0433864be28075fe69f474625e>
 - *J.D. Marshall* Preserve Poster
 - *J.D. Marshall* Preserve 3D model video tour
 - *J.D. Marshall* Preserve 3D model processing report
- Boiler 3D model
 - <https://sketchfab.com/3d-models/jd-marshall-boiler-57dcb14f3c3442879b94e610dcc6d5b7>
 - Boiler 3D model video tour
 - Boiler 3D model processing report
- Engine 3D model
 - <https://sketchfab.com/3d-models/jd-marshall-engine-49fe2b7b745c4d21acb5eb440f1a78f0>
 - Engine 3D model processing report
- Propeller 3D model
 - <https://sketchfab.com/3d-models/jd-marshall-propeller-5030368c49474e9c96fa1d69e218bff5>
 - Propeller 3D model processing report
- Bell reconstruction/conservation
 - Bell name plate
 - Bell conservation report
- Bell 3D model
 - <https://sketchfab.com/3d-models/jd-marshall-bell-2aede847f7984d3fa5bbb79df5e33062>
 - Bell 3D model video tour
 - Bell 3D model processing report
- Underwater images for updated website content

Post-Project Maintenance Plan

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Post-Project Maintenance

Recent archaeological investigations of the *J.D. Marshall* prove that the site still has integrity. While obvious human-influenced factors have created irreversible change to the site, overall the integrity of the *J.D. Marshall* is not of great concern. Though invasive mussel species take a detrimental toll on submerged cultural resources in the Great Lakes, some site managers are suggesting that the quagga mussels may be affecting metal features faster than wooden vessels like the *J.D. Marshall*, due to pH changes (See Figures 11 and 12) (Thunder Bay National Marine Sanctuary 2013). While this is good news for shipwrecks like the *Marshall*, quagga mussels will likely continue to accumulate and degrade the remaining features. Documentation and baseline monitoring will ensure that future degradation does not discount the significance of the *J.D. Marshall* Preserve. In addition to cultural resource management, preserve managers should use photogrammetric data created during 2019 surveys as a baseline to monitor quagga mussel coverage on the *J.D. Marshall*. While there is significant coverage on the wooden hull and metal features, there is significantly less coverage on the *J.D. Marshall* than on other shipwrecks in Lake Michigan.

In order for the *J.D. Marshall* to continue to receive attention, a valuable asset for underwater resources, IU recommends that divers install all three mooring buoys, at the beginning of each dive season (See Figure 13). Because IU promotes a common pool resource management theory, researchers believe that attracting attention and ties to local heritage create a shared interest in the resources of the *J.D. Marshall* Preserve, ultimately reinforcing legal protection. If locals are invested in the condition and well-being of the shipwreck and larger preserve, it is less likely that resources will be negatively affected. To create a shared interest, IU recommends that an historic marker buoy be installed to alert divers and boaters to the location of the *J.D. Marshall* (See Figure 14) and that mooring installations be assessed for wear periodically. IU also recommends that the plaque be re-placed underwater, where it should be mounted permanently. In an effort to maintain accessibility, Indiana DNR should rely upon institutional partners, like IU, to help carry out site maintenance and monitoring (See Figure 15).

Public Outreach Plan

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Public Outreach Plan

All 3D models produced as a result of 2019 surveys should also serve as a valuable tool for education and outreach, as they are highly accurate site maps that allow individuals of all abilities to experience Indiana Maritime Heritage through readily available platforms, such as Sketchfab.com. This shared heritage can be communicated through exciting modes of outreach, like Virtual Reality, in order to depict the history and information that can be understood through Indiana's Underwater Cultural Heritage. In order to create a shared interest, preserve managers should utilize outreach materials created from 2019 surveys, and should plan to consistently install mooring buoys in an effort to make the *J.D. Marshall* an accessible dive site. Additionally, underwater dive slates could prove useful for attracting divers to the *J.D. Marshall* Preserve (See Figure 16).

By displaying the partially reconstructed bell, Nature Center visitors are able to see and touch a piece of maritime heritage. IU also recommends that the wrench from the *J.D. Marshall* is put on display or used during outreach activities, with interpretation (See Figure 17). With increased interpretation, in the form of signage, posters, pamphlets, and dive slates, local communities can continue to become involved in Indiana's Maritime Heritage.

Data Sharing Plan

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Data Sharing Plan

Three-dimensional models of decimated quality, due to site upload constraints, have been posted online through Sketchfab.com for accessibility purposes. All models will also be stored in IU's database and dispersed to *J.D. Marshall* Preserve managers via an external hard drive. These models will be a baseline for future resource managers, allowing scientists and preserve managers to understand the state of biological and cultural resources on the *J.D. Marshall* Preserve from above water. These models also serve as a valuable tool for education and outreach, as they are highly accurate site maps that allow individuals of all abilities to experience Indiana Maritime Heritage through readily available platforms, such as Sketchfab. This shared heritage can be communicated through exciting modes of outreach, like Virtual Reality, in order to depict the history and information that can be understood through Indiana's Underwater Cultural Heritage.

Quarterly Progress Reports

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844



QUARTERLY PROGRESS REPORT
State Form 56525 (5-18)
DEPARTMENT OF NATURAL RESOURCES
INDIANA LAKE MICHIGAN COASTAL GRANT PROGRAM



Project Number: CZ 844

Project Title: J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation Project Timeline:

Date: 7/10/19

Report Period: Quarter 1 Quarter 2 Quarter 3 Quarter 4

Year: 2019

Grantee: Indiana University

Project Administrator: Amy Hoover

Status of Tasks

Refer to Exhibit A-Timeline in your Grant Agreement and provide status of each task outlined.

Task One: Project Implementation

1. Apply for necessary permits and permission COMPLETE
2. Organize and secure equipment for field work COMPLETE
3. Coordinate travel and diving logistics (boats, hotels, etc.) IN PROGRESS

Task Two: Public Outreach and Education

7. Work with partners to make public aware of the project through outlets they use to communicate with the public IN PROGRESS
8. Post photogrammetric model and distribute this through outlets of project partners IN PROGRESS

Task Three: Administration

1. Track and record the hours of volunteers and professionals whose work will be counted as match
2. Track and record the hours of staff whose work will be charged to the grant
3. Submit quarterly financial and progress reports, due to LMCP Grant Specialist 14 days after end of each quarter, beginning on project start date.

Status of Work Products

Refer to Exhibit A-Timeline in your Grant Agreement and provide status of each work product.

Work Products:

- 1.A report detailing the methodology used and the recommendations for protecting the site - IN PROGRESS
- 2.3D model of the site as a baseline monitoring tool for future research and management of the J.D. Marshall as a cultural resource IN PROGRESS
- 3.All photos, processing data, and metadata collected during the project - IN PROGRESS

Additional Information

Please include any details about project work for this quarter. Include any meetings held, upcoming meetings, any favorable developments, actions taken, assistance needed, any milestones met, and explanation for any unmet objectives.

Additional Information:

TASK ONE CONTINUED: Project Implementation

July 2019

1. Conduct photogrammetric survey of J.D. Marshall
2. Collect supplementary data using traditional methods
3. Identify key artifacts and features for interpretation and/or conservation
4. Create database for the storage of data collected for this project

July 2019 – September 2019

1. Produce 3D model of J.D. Marshall using Agisoft Photoscan
2. Draft final report of photogrammetric survey with recommendations for future development as an underwater park
3. Submit model, photos, data, and metadata for this project to the state for inclusion in the Heritage Database.

TASK THREE CONTINUED: Administration

4. Submit semi-annual NOAA Performance Measures reports, in January and July, due to LMCP Grant Specialist at the same time as financial and progress reports. IN PROGRESS
5. Submit Final Project Report at the conclusion of the project. IN PROGRESS



QUARTERLY PROGRESS REPORT
State Form 56525 (5-18)
DEPARTMENT OF NATURAL RESOURCES
INDIANA LAKE MICHIGAN COASTAL GRANT PROGRAM



Project Number: CZ 844

Project Title: J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation Project Timeline:

Date: 10/7/19

Report Period: Quarter 1 Quarter 2 Quarter 3 Quarter 4

Year: 2019

Grantee: Indiana University Center for Underwater Science

Project Administrator: Amy Hoover

Status of Tasks

Refer to Exhibit A-Timeline in your Grant Agreement and provide status of each task outlined.

Task One: Project Implementation

1. Apply for necessary permits and permission (COMPLETE)
2. Organize and secure equipment for field work (COMPLETE)
3. Coordinate travel and diving logistics (boats, hotels, etc.) (COMPLETE)

Task Two: Public Outreach and Education

7. Work with partners to make public aware of the project through outlets they use to communicate with the public (IN PROGRESS)
8. Post photogrammetric model and distribute this through outlets of project partners (IN PROGRESS)

Task Three: Administration

1. Track and record the hours of volunteers and professionals whose work will be counted as match (IN PROGRESS)
2. Track and record the hours of staff whose work will be charged to the grant (IN PROGRESS)
3. Submit quarterly financial and progress reports, due to LMCP Grant Specialist 14 days after end of each quarter, beginning on project start date (IN PROGRESS)

Status of Work Products

Refer to Exhibit A-Timeline in your Grant Agreement and provide status of each work product.

Work Products:

1. A report detailing the methodology used and the recommendations for protecting the site (IN PROGRESS)
2. 3D model of the site as a baseline monitoring tool for future research and management of the J.D. Marshall as a cultural resource (COMPLETE)
3. All photos, processing data, and metadata collected during the project - (IN PROGRESS)

Additional Information

Please include any details about project work for this quarter. Include any meetings held, upcoming meetings, any favorable developments, actions taken, assistance needed, any milestones met, and explanation for any unmet objectives.

Additional Information:

TASK ONE: Project Implementation

July 2019 (COMPLETE)

1. Conduct photogrammetric survey of J.D. Marshall
2. Collect supplementary data using traditional methods
3. Identify key artifacts and features for interpretation and/or conservation
4. Create database for the storage of data collected for this project

July 2019 – September 2019 (IN PROGRESS)

1. Produce 3D model of J.D. Marshall using Agisoft Photoscan (COMPLETE).
2. Draft final report of photogrammetric survey with recommendations for future development as an underwater park (COMPLETE).
3. Submit model, photos, data, and metadata for this project to the state for inclusion in the Heritage Database (IN PROGRESS).

TASK THREE CONTINUED: Administration

4. Submit semi-annual NOAA Performance Measures reports, in January and July, due to LMCP Grant Specialist at the same time as financial and progress reports (IN PROGRESS).
5. Submit Final Project Report at the conclusion of the project (IN PROGRESS).



QUARTERLY PROGRESS REPORT
State Form 56525 (5-18)
DEPARTMENT OF NATURAL RESOURCES
INDIANA LAKE MICHIGAN COASTAL GRANT PROGRAM



Project Number: CZ 844

Project Title: J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation Project Timeline:

Date: 1/14/20

Report Period: Quarter 1 Quarter 2 Quarter 3 Quarter 4

Year: 2020

Grantee: Indiana University Center for Underwater Science

Project Administrator: Amy Hoover

Status of Tasks

Refer to Exhibit A-Timeline in your Grant Agreement and provide status of each task outlined.

Task One: Project Implementation

1. Apply for necessary permits and permission (COMPLETE)
2. Organize and secure equipment for field work (COMPLETE)
3. Coordinate travel and diving logistics (boats, hotels, etc.) (COMPLETE)

Task Two: Public Outreach and Education

7. Work with partners to make public aware of the project through outlets they use to communicate with the public (IN PROGRESS)
8. Post photogrammetric model and distribute this through outlets of project partners (IN PROGRESS)

Task Three: Administration

1. Track and record the hours of volunteers and professionals whose work will be counted as match (IN PROGRESS)
2. Track and record the hours of staff whose work will be charged to the grant (IN PROGRESS)
3. Submit quarterly financial and progress reports, due to LMCP Grant Specialist 14 days after end of each quarter, beginning on project start date (IN PROGRESS)

Status of Work Products

Refer to Exhibit A-Timeline in your Grant Agreement and provide status of each work product.

Work Products:

1. A report detailing the methodology used and the recommendations for protecting the site (IN PROGRESS)
2. 3D model of the site as a baseline monitoring tool for future research and management of the J.D. Marshall as a cultural resource (COMPLETE)
3. All photos, processing data, and metadata collected during the project - (IN PROGRESS)

Additional Information

Please include any details about project work for this quarter. Include any meetings held, upcoming meetings, any favorable developments, actions taken, assistance needed, any milestones met, and explanation for any unmet objectives.

Additional Information:

TASK ONE: Project Implementation

July 2019 (COMPLETE)

1. Conduct photogrammetric survey of J.D. Marshall
2. Collect supplementary data using traditional methods
3. Identify key artifacts and features for interpretation and/or conservation
4. Create database for the storage of data collected for this project

July 2019 – September 2019 (IN PROGRESS)

1. Produce 3D model of J.D. Marshall using Agisoft Photoscan (COMPLETE).
2. Draft final report of photogrammetric survey with recommendations for future development as an underwater park (COMPLETE).
3. Submit model, photos, data, and metadata for this project to the state for inclusion in the Heritage Database (IN PROGRESS).

TASK THREE CONTINUED: Administration

4. Submit semi-annual NOAA Performance Measures reports, in January and July, due to LMCP Grant Specialist at the same time as financial and progress reports (IN PROGRESS).
5. Submit Final Project Report at the conclusion of the project (IN PROGRESS).

Quarterly Financial Reports

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844



INDIANA LAKE MICHIGAN COASTAL GRANT PROGRAM
QUARTERLY FINANCIAL REPORT
 State Form 55105 (R2 / 12-15)

| | | | |
|-----------------|-------------------------|----------------------------------|---------|
| Project Number: | CZ844 | Report Date (month, day, year) : | 7/12/19 |
| Report Period: | 04/09/2019 - 06/30/2019 | | |

| | | | |
|------------------------|--|-------------------------|---------------------|
| Project Sponsor: | Indiana Lake Michigan Coastal Grants Program | | |
| Project Title: | J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation | Telephone Number: | 812-855-5748 |
| Project Administrator: | Charles Beeker | Contact E-mail Address: | cbeeker@indiana.edu |

| Category | Authorized Budget | | Current Invoice | | Previously Invoiced | | Invoiced to Date | | Balance | |
|--------------|--------------------|--------------------|-------------------|---------------|---------------------|---------------|-------------------|---------------|--------------------|--------------------|
| | LMCP | Match | LMCP | Match | LMCP | Match | LMCP | Match | LMCP | Match |
| Personnel | \$6,635.00 | \$10,408.00 | \$977.19 | \$0.00 | | | \$977.19 | \$0.00 | \$5,657.81 | \$10,408.00 |
| Fringe | \$1,008.85 | \$2,804.96 | \$253.29 | \$0.00 | | | \$253.29 | \$0.00 | \$755.56 | \$2,804.96 |
| Travel | \$3,000.00 | \$0.00 | \$0.00 | \$0.00 | | | \$0.00 | \$0.00 | \$3,000.00 | \$0.00 |
| Supplies | \$1,150.65 | \$2,355.54 | \$0.00 | \$0.00 | | | \$0.00 | \$0.00 | \$1,150.65 | \$2,355.54 |
| Contractual | \$0.00 | \$0.00 | \$0.00 | \$0.00 | | | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Indirect | \$ 3,774.00 | \$0.00 | \$ 393.75 | \$0.00 | | | \$393.75 | \$0.00 | \$3,380.25 | \$0.00 |
| Total | \$15,568.50 | \$15,568.50 | \$1,624.23 | \$0.00 | \$0.00 | \$0.00 | \$1,624.23 | \$0.00 | \$13,944.27 | \$15,568.50 |

| | |
|-----------------------|--|
| Other Cost Explained: | |
|-----------------------|--|

| | |
|------------------------|--|
| Other Match Explained: | |
|------------------------|--|

| | | |
|-------------------------------------|----------------------------------|--|
| Signature of Project Administrator: | Date Signed (month, day, year) : | |
|-------------------------------------|----------------------------------|--|



INDIANA LAKE MICHIGAN COASTAL GRANT PROGRAM
QUARTERLY FINANCIAL REPORT
 State Form 55105 (R2 / 12-15)

| | | | |
|-----------------|-------------------------|----------------------------------|---------|
| Project Number: | CZ844 | Report Date (month, day, year) : | 11/5/19 |
| Report Period: | 07/01/2019 - 09/30/2019 | | |

Project Sponsor: Indiana Lake Michigan Coastal Grants Program

| | |
|---|--------------------------------|
| Project Title: J.D. Marshall 3D Photogrammetry and Underwater Museum Interpretation | Telephone Number: 812-855-5748 |
|---|--------------------------------|

| | |
|---------------------------------------|---|
| Project Administrator: Charles Beeker | Contact E-mail Address: cbeeker@indiana.edu |
|---------------------------------------|---|

| Category | Authorized Budget | | Current Invoice | | Previously Invoiced | | Invoiced to Date | | Balance | |
|--------------|--------------------|--------------------|-------------------|---------------|---------------------|---------------|-------------------|---------------|--------------------|--------------------|
| | LMCP | Match | LMCP | Match | LMCP | Match | LMCP | Match | LMCP | Match |
| Personnel | \$6,635.00 | \$10,408.00 | \$977.19 | \$0.00 | \$977.19 | \$0.00 | \$1,954.38 | \$0.00 | \$4,680.62 | \$10,408.00 |
| Fringe | \$1,008.85 | \$2,804.96 | \$272.25 | \$0.00 | \$253.29 | \$0.00 | \$525.54 | \$0.00 | \$483.31 | \$2,804.96 |
| Travel | \$3,000.00 | \$0.00 | \$1,508.73 | \$0.00 | \$0.00 | \$0.00 | \$1,508.73 | \$0.00 | \$1,491.27 | \$0.00 |
| Supplies | \$1,150.65 | \$2,355.54 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$1,150.65 | \$2,355.54 |
| Contractual | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Indirect | \$ 3,774.00 | \$0.00 | \$ 882.61 | \$0.00 | \$ 393.75 | \$0.00 | \$1,276.36 | \$0.00 | \$2,497.64 | \$0.00 |
| Total | \$15,568.50 | \$15,568.50 | \$3,640.78 | \$0.00 | \$1,624.23 | \$0.00 | \$5,265.01 | \$0.00 | \$10,303.49 | \$15,568.50 |

Other Cost Explained:

Other Match Explained:

| | |
|-------------------------------------|----------------------------------|
| Signature of Project Administrator: | Date Signed (month, day, year) : |
|-------------------------------------|----------------------------------|

COLLEGES AND UNIVERSITIES RATE AGREEMENT

EIN: 1356001673A1

DATE:06/15/2015

ORGANIZATION:

FILING REF.: The preceding agreement was dated 06/20/2011

Indiana University

Bryan Hall 212

Bloomington, IN 47405-1201

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section III.

SECTION I: Facilities And Administrative Cost Rates

| RATE TYPES: | | FIXED | FINAL | PROV. (PROVISIONAL) | PRED. (PREDETERMINED) |
|-------------------------|-------------|------------|----------------|---------------------|----------------------------|
| <u>EFFECTIVE PERIOD</u> | | | | | |
| <u>TYPE</u> | <u>FROM</u> | <u>TO</u> | <u>RATE(%)</u> | <u>LOCATION</u> | <u>APPLICABLE TO</u> |
| PRED. | 07/01/2011 | 06/30/2012 | 55.00 | On Campus | Organized Research |
| PRED. | 07/01/2012 | 06/30/2015 | 56.00 | On Campus | Organized Research |
| PRED. | 07/01/2011 | 06/30/2015 | 47.50 | On Campus | Instruction |
| PRED. | 07/01/2011 | 06/30/2015 | 32.00 | On Campus | Other Sponsored Activities |
| PRED. | 07/01/2011 | 06/30/2015 | 26.00 | Off Campus | All Programs |
| PRED. | 07/01/2015 | 06/30/2017 | 56.00 | On Campus | Organized Research |
| PRED. | 07/01/2017 | 06/30/2019 | 57.50 | On Campus | Organized Research |
| PRED. | 07/01/2015 | 06/30/2019 | 47.50 | On Campus | Instruction |
| PRED. | 07/01/2015 | 06/30/2019 | 32.00 | On Campus | Other Sponsored Activities |
| PRED. | 07/01/2015 | 06/30/2019 | 26.00 | Off Campus | All Programs |

ORGANIZATION: Indiana University

AGREEMENT DATE: 6/15/2015

| <u>TYPE</u> | <u>FROM</u> | <u>TO</u> | <u>RATE(%)</u> | <u>LOCATION</u> | <u>APPLICABLE TO</u> |
|-------------|-------------|------------|----------------|-----------------|--|
| PROV. | 07/01/2019 | 06/30/2021 | | | Use same rates and conditions as those cited for fiscal year ending June 30, 2019. |

*BASE

Modified total direct costs, consisting of all direct salaries and wages, applicable fringe benefits, materials and supplies, services, travel and up to the first \$25,000 of each subaward (regardless of the period of performance of the subawards under the award). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, rental costs, tuition remission, scholarships and fellowships, participant support costs and the portion of each subaward in excess of \$25,000. Other items may only be excluded when necessary to avoid a serious inequity in the distribution of indirect costs, and with the approval of the cognizant agency for indirect costs.

ORGANIZATION: Indiana University

AGREEMENT DATE: 6/15/2015

SECTION II: SPECIAL REMARKS

TREATMENT OF FRINGE BENEFITS:

The fringe benefits are specifically identified to each employee and are charged individually as direct costs. The directly claimed fringe benefits are listed below.

TREATMENT OF PAID ABSENCES

Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages and are claimed on grants, contracts and other agreements as part of the normal cost for salaries and wages. Separate claims are not made for the cost of these paid absences.

OFF-CAMPUS DEFINITION: For all activities performed in facilities not owned by the institution and to which rent is directly allocated to the project(s), the off-campus rate will apply. Actual costs will be apportioned between on-campus and off-campus components. Each portion will bear the appropriate rate.

Equipment Definition: Equipment means an article of nonexpendable, tangible personal property having a useful life of more than one year and an acquisition cost of \$5,000 or more per unit.

FRINGE BENEFITS:

| | |
|---|-------------------------------|
| FICA | Retirement |
| Life Insurance | Tuition Remission |
| TIAA/CREF | Worker's Compensation |
| Health Insurance | Unemployment Insurance |
| Long Term Disability | Fringe Benefit Administration |
| Employee Fee Courtesy (Faculty & Staff Fee Discount) | |

The next proposal based on actual costs for the fiscal year ending 06/30/2018 is due in our office by 12/31/2018.

ORGANIZATION: Indiana University

AGREEMENT DATE: 6/15/2015

SECTION III: GENERAL

A. LIMITATIONS:

The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its facilities and administrative cost pools as finally accepted; such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as facilities and administrative costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. ACCOUNTING CHANGES:

This Agreement is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from facilities and administrative to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES:

If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES:

The rates in this Agreement were approved in accordance with the authority in Title 2 of the Code of Federal Regulations, Part 200 (2 CFR 200), and should be applied to grants, contracts and other agreements covered by 2 CFR 200, subject to any limitations in A above. The organization may provide copies of the Agreement to other Federal Agencies to give them early notification of the Agreement.

E. OTHER:

If any Federal contract, grant or other agreement is reimbursing facilities and administrative costs by a means other than the approved rate(s) in this Agreement, the organization should (1) credit such costs to the affected programs, and (2) apply the approved rate(s) to the appropriate base to identify the proper amount of facilities and administrative costs allocable to these programs.

BY THE INSTITUTION:

Indiana University

(INSTITUTION)

(SIGNATURE)

(NAME)

(TITLE)

(DATE)

ON BEHALF OF THE FEDERAL GOVERNMENT:

DEPARTMENT OF HEALTH AND HUMAN SERVICES

(AGENCY)

Arif M. Karim - S

(SIGNATURE)

Arif Karim

(NAME)

Director, Cost Allocation Services

(TITLE)

6/15/2015

(DATE) 5044

HHS REPRESENTATIVE:

Ernest Kinner

Telephone:

(214) 767-3261

Approved by Arif M. Karim - S
Dir. of Cost Allocation Services, OIG, HHS
Arif M. Karim - S 36212 193513 1001 1520021205
Doc. 20150615 10 11 41 4302

COMPONENTS OF PUBLISHED FACILITIES AND ADMINISTRATIVE RATES

INSTITUTION: **Indiana University - 5044**

PERIOD COVERED BY RATE **JULY 1, 2015 through JUNE 30, 2019**

APPLICABLE TO: **ORGANIZED RESEARCH**

| RATE COMPONENT: | <u>FY 16-17 ON CAMPUS</u> | <u>FY 18-19 ON CAMPUS</u> | <u>OFF CAMPUS</u> |
|-------------------------|-------------------------------|-------------------------------|-------------------|
| Building Depreciation | 5.1 | 5.4 | |
| Equipment Depreciation | 3.7 | 3.9 | |
| Interest | 2.0 | 2.1 | |
| Operation & Maintenance | 17.5 | 18.3 | |
| Library | 1.7 | 1.8 | |
| Administration | 26.0 | 26.0 | 26.0 |
| TOTAL | 56.0 | 57.5 | 26.0 |

* Reflects provisions of Appendix III to Part 200 of Uniform Guidance—Indirect (F&A) Costs Identification and Assignment, and Rate Determination for Institutions of Higher Education (IHEs), C.8. dated December 26, 2013.

CONCURRENCE:

Indiana University - 5044
(Institution)

Mary Frances McCart
(Signature)

Mary Frances McCart
(Name)

SVP, CFO & Treasurer
(Title)

6 23 15
(Date)

Figures

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

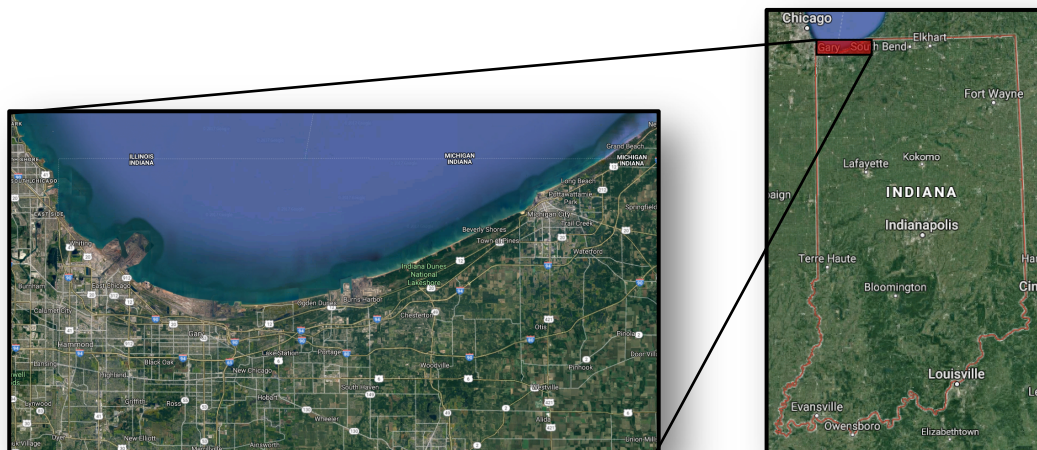


Figure 1. Indiana's Lake Michigan coastline has the potential for fifty unique, historic vessels.



Figure 2. An historic image of *J.D. Marshall*, as a lumber hooker (Alpena County George N. Fletcher Public Library).



Figure 3. The *J.D. Marshall's* rudder assembly and deck winch.



Figure 4. *J.D. Marshall* bell, pre- and post-reconstruction.



Figure 5. The *J.D. Marshall* propeller, on display at Indiana Dunes State Park beach.

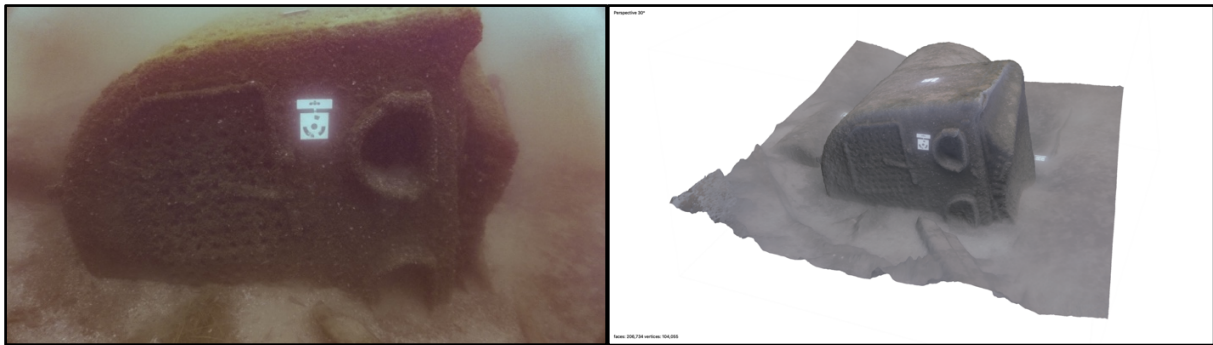


Figure 6. A two-dimensional image of the *J.D. Marshall* boiler, which was used to create a three-dimensional model.



Figure 7. 3D model of the *J.D. Marshall* engine.

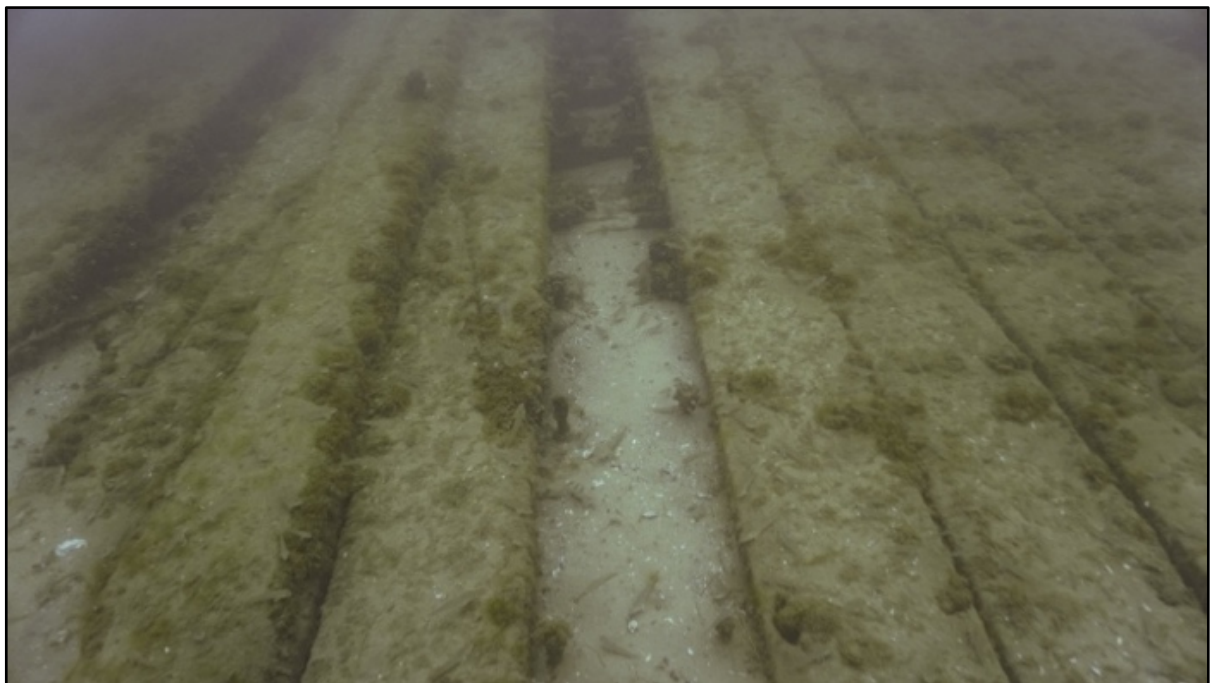


Figure 8. Quagga mussels partially cover the hull remains of the *J.D. Marshall*.



Figure 9. Exposed rudder post on the *J.D. Marshall's* stern.



Figure 10. The newly reconstructed *J.D. Marshall* bell and name plate at the Indiana Dunes State Park Nature Center.



Figure 11. Invasive mussel coverage on metal features.



Figure 12. Invasive mussel coverage on metal features.



Figure 13. Indiana DNR diver Shane Brown installs mooring buoy on August 13th, 2019.

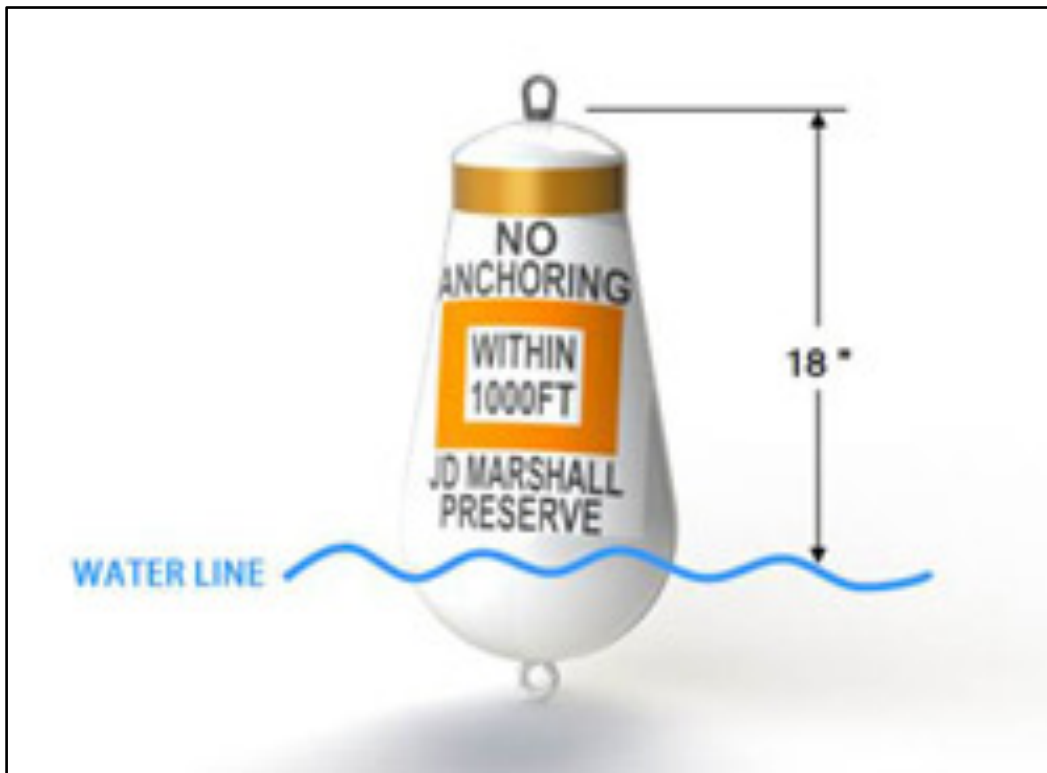


Figure 14. An example of an historic marker buoy, recommended for the *J.D. Marshall* Preserve.



Figure 15. An IU Diver assesses the condition of cultural resources of the *J.D. Marshall* Preserve.

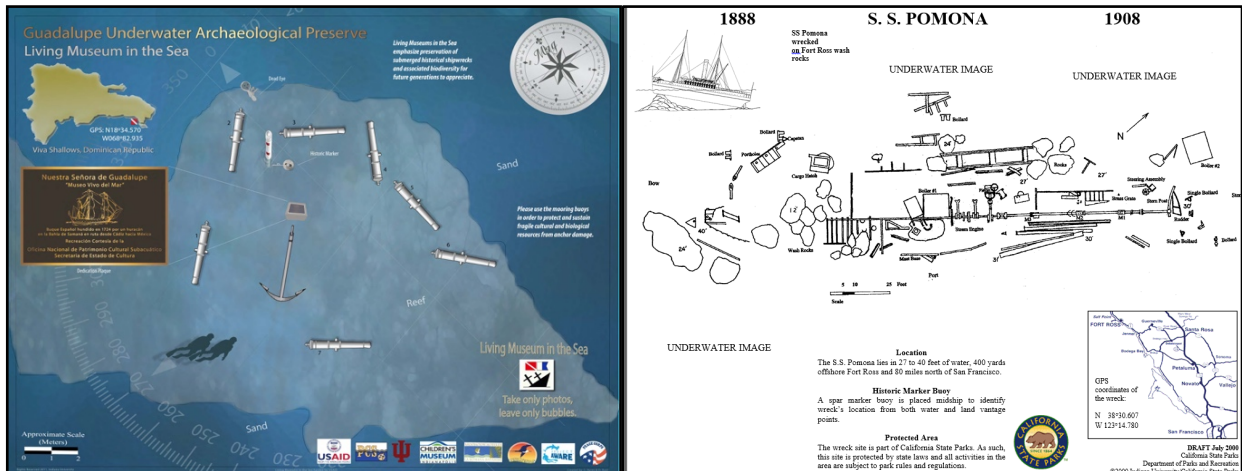


Figure 16. Example waterproof dive slates, recommended for public outreach.



Figure 17. The wrench from the *J.D. Marshall*, housed at the Indiana Dunes State Park Nature Center.

Appendix A: *J.D. Marshall* Bell Conservation Report

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

***J.D. Marshall* Bell Conservation Report**

Perspective 30°



faces: 359,335 vertices: 180,551



A brief report on the historical use of bells in maritime industry and the conservation of the bell recovered from the *J.D. Marshall*.

Indiana University Center for Underwater Science
Authored by: Jessica Jakubielski, Carley Divish, Sarah Muckerheide
Edited by: Tori Galloway
December 1, 2019

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Introduction

Bells have been, and continue to be, a very important part of a ship's routine and readiness. They have historically been used on ships for signaling, keeping time, and sounding alarms.

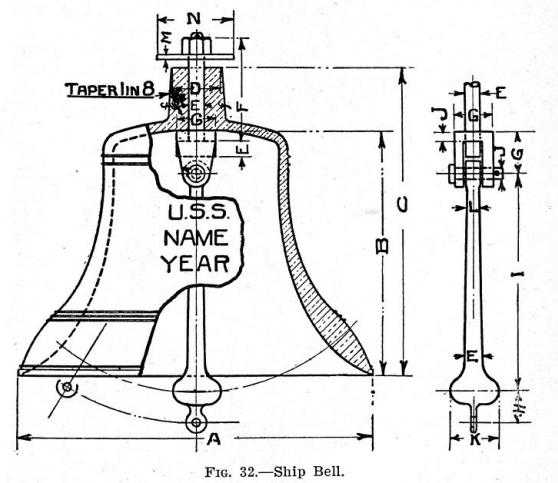
In June of 1911, the *J.D. Marshall* sprang a leak and sank, about 600 feet from shore, in Lake Michigan. Researchers, including those from Indiana University (IU), have performed archaeological surveys of the shipwreck site, which Indiana DNR has designated part of the "*J.D. Marshall* Nature Preserve." The *J.D. Marshall's* bell was salvaged and was later donated to the



Indiana DNR. Indiana University is currently working on conservation of the bell by reconstructing the pieces, using conservation-grade adhesive, and preparing the finished product for an educational exhibit. The IU Center for Underwater Science is working on the preservation of this bell for improved outreach at the Indiana DNR Nature Preserve.

History of Bells in Maritime Industry

Because of the ceremonial and functional uses of ship's bells, they remain relevant today. First mentioned aboard the *Grace Dieu* in 1485, bells have not lost their status as necessities aboard ships. Before the timekeeping technology that we see today, a crew member had the duty of watching an



hourglass that kept time on the half hour, where the crew member was responsible for ringing the bell when he had flipped the hourglass, in order to alert everyone aboard to the amount of time that had passed. Sounding the bell in specific patterns would relay signals to crew members of the ship or other ships, if the sea was foggy or if there was a risk of collision (Wede 1972). With the invention of steam whistles, many ships began to transition into signaling with whistles instead of bells. Some captains refused to switch at first, but eventually a letter to the Secretary of the Treasury noted that the transition had been received well and worked just as well as bells (Morrison 1903). Although steam whistles did gain popularity, today maritime law requires all ships to carry an “efficient bell” (Naval 2018).

Currently, when ships of the US Navy are decommissioned the bells are removed and remain permanent property of the US Government. Ship bells are intrinsically tied to their ship and the country they serve due to this property law (Naval 2018).

Recovery and Conservation

The *J.D. Marshall* was eventually fitted with used parts off of the *Muskegon*, a steam-powered passenger freighter formerly known as *Peerless*, which was renamed *Muskegon* after being converted into a sand barge (Keagle 2013). After being fitted with dredging equipment from *Muskegon*, the former lumber carrier sank on its very first voyage, as a result of heavy seas.

In 1982, unsuccessful salvage attempts were made. Salvors did keep an unknown number of artifacts, including pieces of the bell from the *J.D. Marshall* and a large wrench (Keagle 2013). The rudder, while in poor condition, has been placed on display at the Old Lighthouse Museum in Michigan City, Indiana. The ship's propeller, in better condition, can be found on the shore of the Nature Preserve, with a plaque for public interpretation.



Figure 1. IU Researchers' initial attempts to reconstruct the J.D. Marshall bell.

In order to effectively use these salvaged artifacts to engage the local community in Great Lakes Maritime Heritage, IU Researchers initially became interested in reconstructing the bell of the J.D. Marshall. To do this, conservation-grade techniques

and supplies were used to ensure that the job was museum-quality. For this project, researchers first needed to clean the bell with a material that would not harm the brass, but would be able to thoroughly clean the pieces. Each piece of the bell was labeled, using a system to easily identify which seams fit together. These coordinated cracks determined the order in which each piece was glued, one or two a week until the entire bell was complete.

As each piece was glued, all extra adhesive was cleaned off of the surface with acetone. After a short drying period, masking tape was placed on the bell, stretched across each seam to hold the pieces in place during the curing process. Once every piece was secure, the masking tape was removed, as was all remaining adhesive, with acetone and soft-bristled brushes. One piece was left as a tool for outreach events, as it did not fit with any remaining edges of the bell. Once conservation work and cleaning were complete, photogrammetry data was collected and processed.

Methodology

During this process, IU researchers used conservation-grade adhesive, ideal for large, heavy artifacts that require a durable adhesive, while retaining the ability to reverse the process, if necessary. After consulting with local conservators, IU researchers decided upon HYXTAL, a two-part adhesive made out of a resin and hardener.

After many trial processes, IU researchers decided that one method of curing seemed to work best, and from that point on, adhesive was heated to 140 degrees Fahrenheit; adhesive was kept at this temperature for approximately ten minutes. The

adhesive was allowed to cool until it reached a consistency ideal for applying to pieces of the bell without seeping from the cracks or becoming too hard to work with. Once this consistency was reached, 1-2 individuals applied the adhesive with small craft paintbrushes (see Figure 3). After setting the pieces into place, they were cleaned with acetone (see Figure 6), and masking tape was placed over the seams to ensure that the pieces would not slide or shift during the hardening process (see Figure 8).

This methodology was repeated for approximately six weeks, gluing 1-3 pieces per week, depending on the stability of the surrounding pieces. Each week, student-led conservation sessions were conducted until the entire bell was properly aligned and reconstructed. The conservation process took nine weeks of student-led efforts, with most of this time dedicated to the drying and curing process. See Figure 1-9 for conservation process.



Figure 2. Initial condition of bell pieces. Image taken 12 August 2019.



Figure 3. Placing the first large piece onto the main portion of the bell.



Figure 4. The bell, mid-conservation, with masking tape to ensure that pieces do not move during the curing process.



Figure 5. Internal view, mid-conservation.



Figure 6. IU Research Assistants, Carley and Sarah, work to clean the bell after another piece was successfully set.



Figure 7. Preparing to adhere final piece (top piece, seam E, F, G).



Figure 8. The final drying process.



Figure 9. IU Research Assistants (Left to Right: Carley, Sarah, Rachel, and Jessica) doing a final cleaning of the bell.

Photogrammetry

Photogrammetric data was collected by taking two-dimensional images from every external angle, with at least than 60% overlap of every image. This data, consisting of 229 images, was then entered into Agisoft Metashape, where it was processed using a standard workflow. This standard workflow consisted of aligning photos, generating a dense point cloud, generating a mesh layer, and creating the texture. Once these steps were complete, a processing report was generated (See Appendix 1). A promotional video was also created, using Metashape, in order to showcase the finished conservation work. Images were collected on November 19, 2019 by Rachel Wilson. Photogrammetric modeling completed on December 1, 2019 by Tori Galloway.

Appendix B: *J.D. Marshall* Preserve Orthomosaic

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844



J.D. Marshall Preserve
Porter County, Indiana



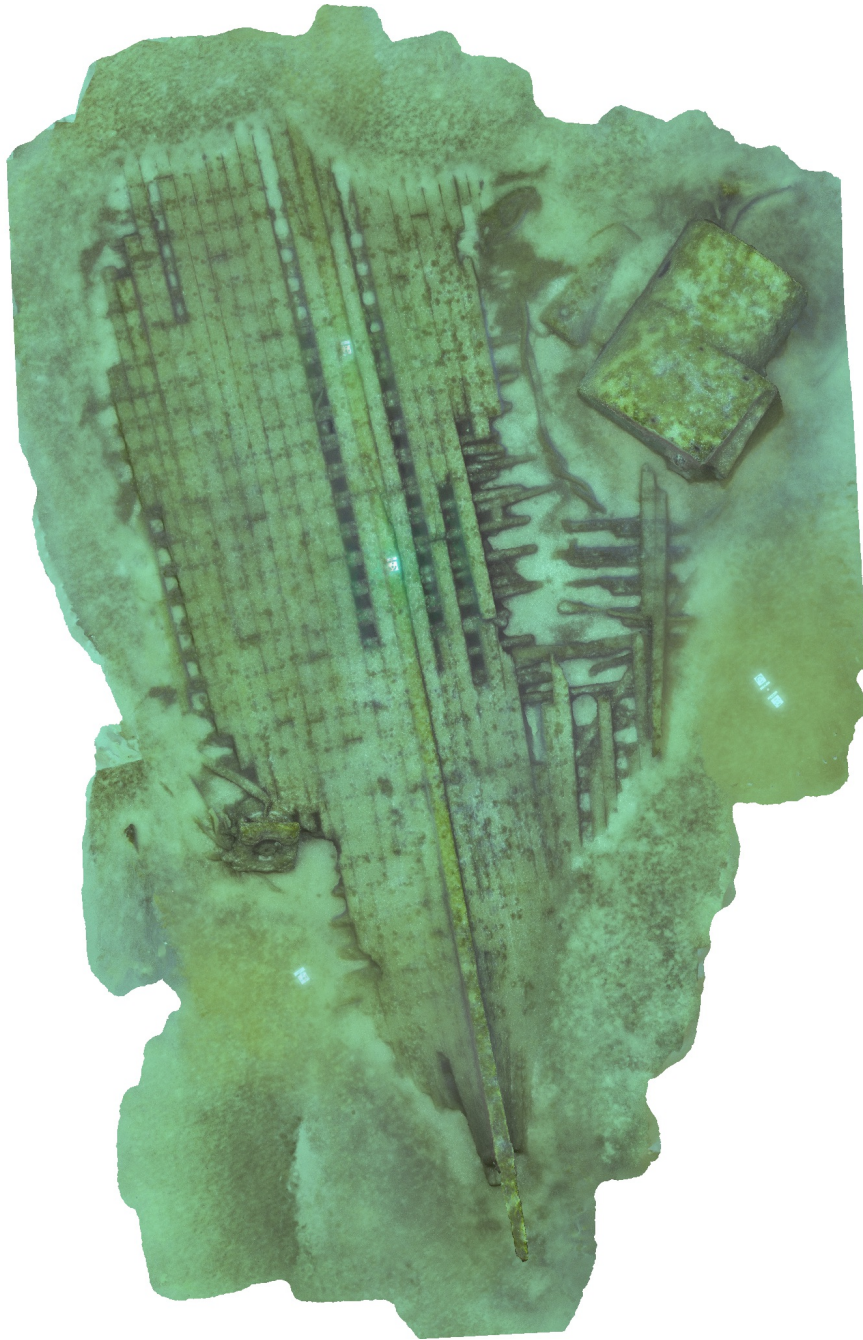
Appendix C: *J.D. Marshall* Preserve Processing Report

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Agisoft PhotoScan

Processing Report
29 August 2019



Survey Data

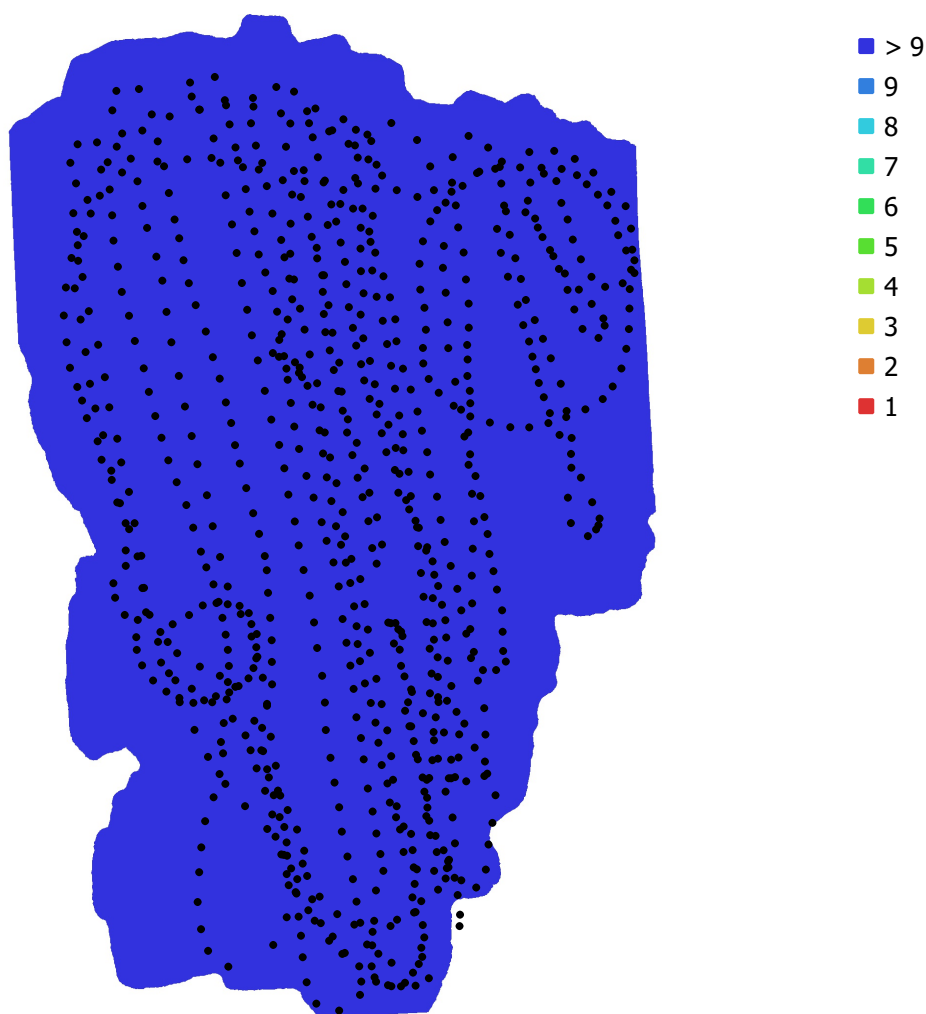


Fig. 1. Camera locations and image overlap.

Number of images: 834

Camera stations: 830

Tie points: 214,535

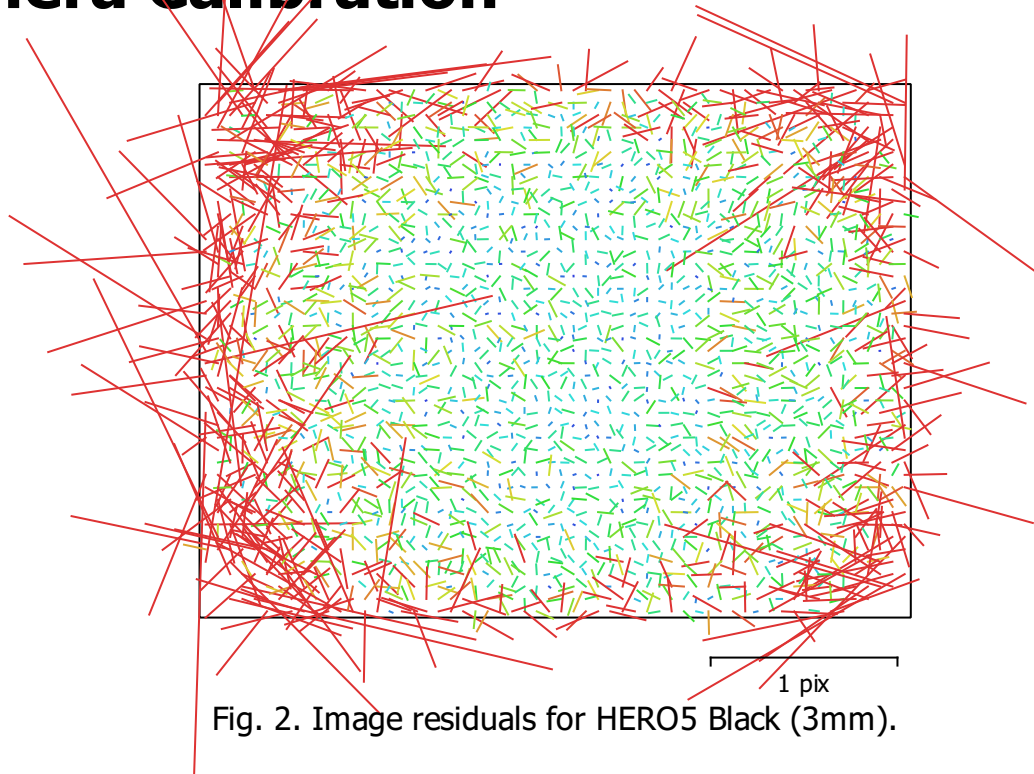
Projections: 572,180

Reprojection error: 1.68 pix

| Camera Model | Resolution | Focal Length | Pixel Size | Precalibrated |
|-------------------|-------------|--------------|---------------------|---------------|
| HERO5 Black (3mm) | 2048 x 1536 | 3 mm | 3.38 x 3.38 μ m | No |

Table 1. Cameras.

Camera Calibration



HERO5 Black (3mm)

834 images

| | | | |
|--------------|--------------------|--------------|---|
| Type | Resolution | Focal Length | Pixel Size |
| Frame | 2048 x 1536 | 3 mm | 3.38 x 3.38 μm |

| | Value | Error | F | Cx | Cy | K1 | K2 | K3 | P1 | P2 |
|-----------|---------------------|---------|------|-------|------|-------|-------|-------|-------|-------|
| F | 1201.87 | 0.16 | 1.00 | -0.36 | 0.08 | -0.14 | 0.23 | -0.12 | -0.17 | 0.08 |
| Cx | 7.21232 | 0.067 | | 1.00 | 0.01 | -0.04 | -0.03 | 0.00 | 0.66 | -0.01 |
| Cy | -5.1954 | 0.064 | | | 1.00 | 0.01 | 0.01 | -0.00 | 0.00 | 0.66 |
| K1 | -0.110063 | 0.00022 | | | | 1.00 | -0.94 | 0.89 | -0.08 | -0.00 |
| K2 | 0.112513 | 0.0006 | | | | | 1.00 | -0.97 | -0.01 | 0.02 |
| K3 | -0.00460829 | 0.00049 | | | | | | 1.00 | 0.00 | -0.00 |
| P1 | 0.00018429 | 1.5e-05 | | | | | | | 1.00 | -0.00 |
| P2 | -0.000102113 | 1.5e-05 | | | | | | | | 1.00 |

Table 2. Calibration coefficients and correlation matrix.

Digital Elevation Model

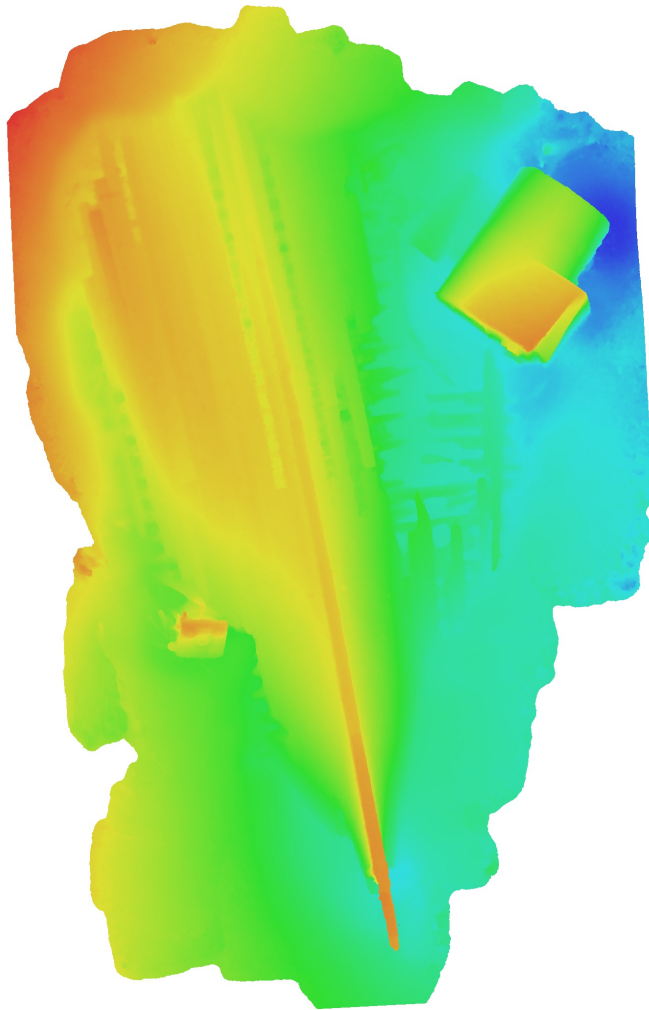


Fig. 3. Reconstructed digital elevation model.

Processing Parameters

General

| | |
|-------------------|-----------------------|
| Cameras | 834 |
| Aligned cameras | 830 |
| Coordinate system | Local Coordinates (m) |
| Rotation angles | Yaw, Pitch, Roll |

Point Cloud

| | |
|--------------------------------|------------------------|
| Points | 214,535 of 236,008 |
| RMS reprojection error | 0.21929 (1.6791 pix) |
| Max reprojection error | 0.662906 (36.6234 pix) |
| Mean key point size | 7.24644 pix |
| Point colors | 3 bands, uint8 |
| Key points | No |
| Average tie point multiplicity | 2.82776 |

Alignment parameters

| | |
|-------------------------------|----------------------|
| Accuracy | High |
| Generic preselection | Yes |
| Key point limit | 40,000 |
| Tie point limit | 4,000 |
| Adaptive camera model fitting | No |
| Matching time | 1 hours 37 minutes |
| Alignment time | 3 minutes 55 seconds |

Dense Point Cloud

| | |
|--------------|----------------|
| Points | 10,826,204 |
| Point colors | 3 bands, uint8 |

Reconstruction parameters

| | |
|-----------------------------|-----------------------|
| Quality | Medium |
| Depth filtering | Aggressive |
| Depth maps generation time | 23 minutes 22 seconds |
| Dense cloud generation time | 12 minutes 54 seconds |

Model

| | |
|---------------|-------------------------------|
| Faces | 721,745 |
| Vertices | 362,463 |
| Vertex colors | 3 bands, uint8 |
| Texture | 4,096 x 4,096, 4 bands, uint8 |

Reconstruction parameters

| | |
|-----------------|----------------------|
| Surface type | Arbitrary |
| Source data | Dense |
| Interpolation | Enabled |
| Quality | Medium |
| Depth filtering | Aggressive |
| Face count | 721,745 |
| Processing time | 5 minutes 37 seconds |

Texturing parameters

| | |
|------------------------|----------------------|
| Mapping mode | Generic |
| Blending mode | Mosaic |
| Texture size | 4,096 x 4,096 |
| Enable hole filling | Yes |
| Enable ghosting filter | Yes |
| UV mapping time | 33 seconds |
| Blending time | 7 minutes 39 seconds |

Orthomosaic

| | |
|-------------------|-----------------------|
| Size | 10,234 x 15,863 |
| Coordinate system | Local Coordinates (m) |
| Colors | 3 bands, uint8 |

Reconstruction parameters

Blending mode
Surface
Enable hole filling
Processing time

Mosaic
Mesh
Yes
2 minutes 58 seconds

Software

Version
Platform

1.4.4 build 6848
Windows 64

Appendix D: Boiler Processing Report

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Boiler

Processing Report
06 December 2019



Survey Data

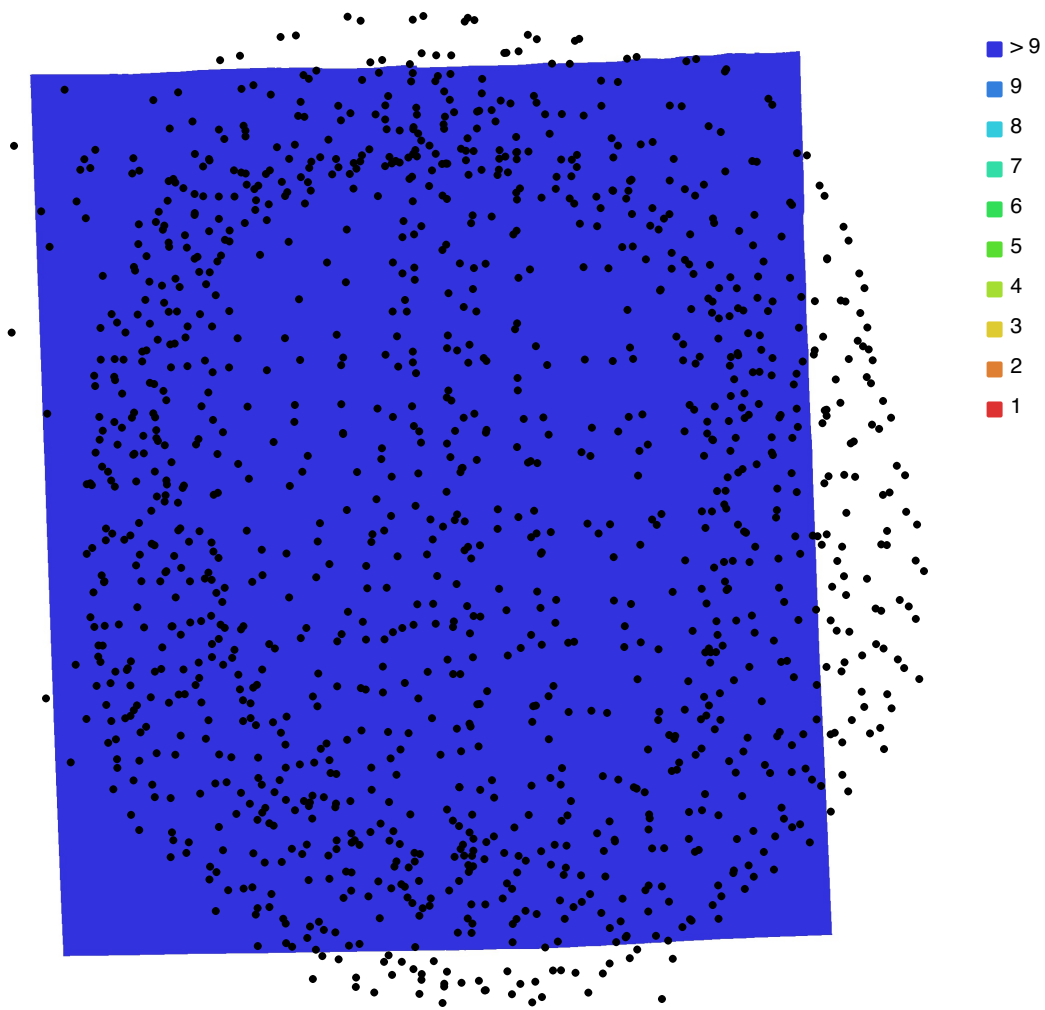


Fig. 1. Camera locations and image overlap.

Number of images: 1,335

Camera stations: 1,300

Tie points: 369,498

Projections: 1,167,374

Reprojection error: 3.4 pix

| Camera Model | Resolution | Focal Length | Pixel Size | Precalibrated |
|-------------------|-------------|--------------|---------------------------|---------------|
| HERO5 Black (3mm) | 4000 x 3000 | 3 mm | 1.73 x 1.73 μm | No |

Table 1. Cameras.

Camera Calibration

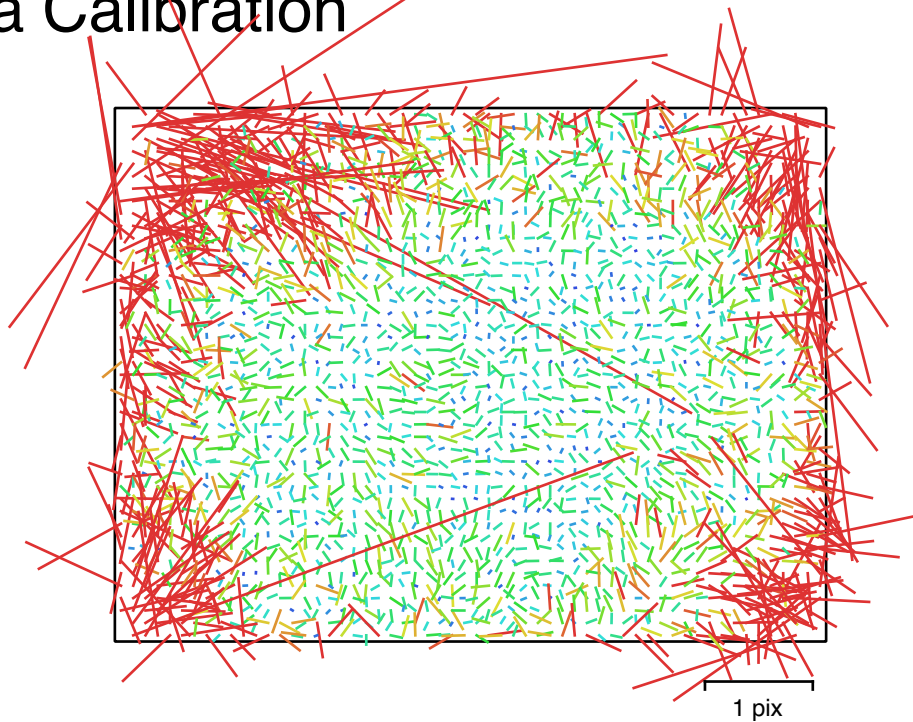


Fig. 2. Image residuals for HERO5 Black (3mm).

HERO5 Black (3mm)
1335 images

| | | | |
|-------|-------------|--------------|---------------------------|
| Type | Resolution | Focal Length | Pixel Size |
| Frame | 4000 x 3000 | 3 mm | 1.73 x 1.73 μm |

| | Value | Error | F | Cx | Cy | B1 | B2 | K1 | K2 | P1 | P2 |
|----|--------------|---------|------|------|-------|-------|-------|-------|-------|-------|-------|
| F | 2345.02 | 0.14 | 1.00 | 0.03 | -0.17 | -0.17 | -0.02 | -0.12 | 0.45 | 0.06 | -0.12 |
| Cx | 12.0674 | 0.078 | | 1.00 | 0.00 | -0.04 | -0.03 | -0.06 | 0.10 | 0.82 | -0.00 |
| Cy | -17.851 | 0.08 | | | 1.00 | 0.00 | 0.06 | -0.07 | -0.00 | -0.01 | 0.77 |
| B1 | -5.96801 | 0.026 | | | | 1.00 | -0.01 | -0.00 | -0.05 | -0.07 | 0.06 |
| B2 | -0.207907 | 0.025 | | | | | 1.00 | -0.00 | -0.01 | -0.07 | -0.02 |
| K1 | -0.107087 | 5.8e-05 | | | | | | 1.00 | -0.83 | -0.09 | -0.11 |
| K2 | 0.102654 | 7.2e-05 | | | | | | | 1.00 | 0.09 | 0.02 |
| P1 | -0.000460888 | 1.1e-05 | | | | | | | | 1.00 | -0.00 |
| P2 | -0.000820262 | 1e-05 | | | | | | | | | 1.00 |

Table 2. Calibration coefficients and correlation matrix.

Digital Elevation Model

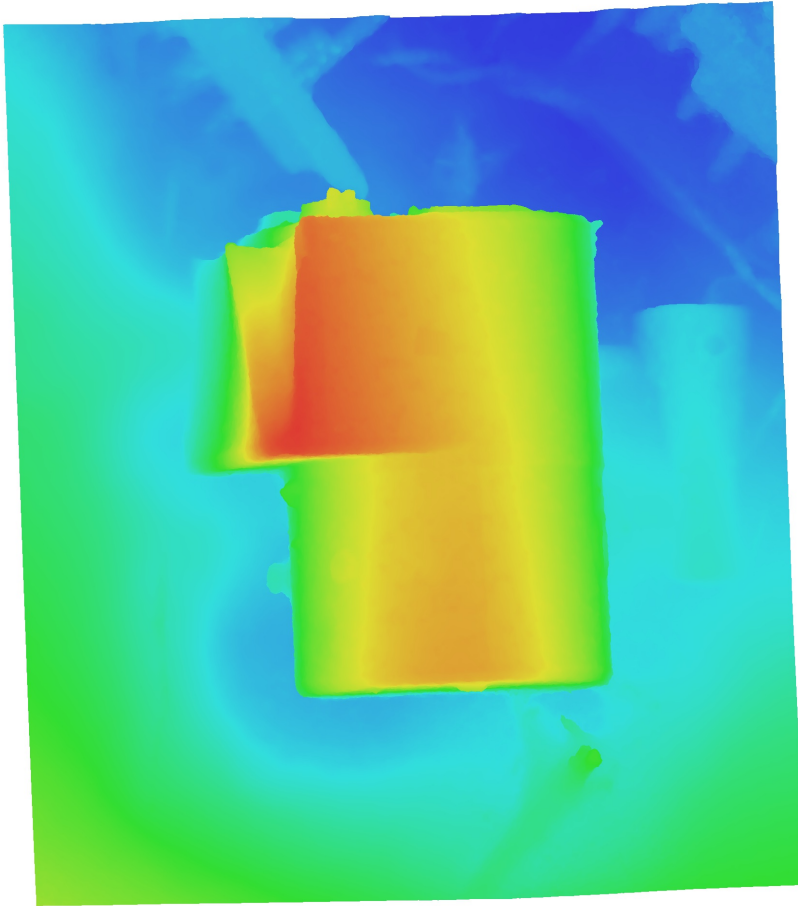


Fig. 3. Reconstructed digital elevation model.

Processing Parameters

General

| | |
|-------------------|-----------------------|
| Cameras | 1335 |
| Aligned cameras | 1300 |
| Coordinate system | Local Coordinates (m) |
| Rotation angles | Yaw, Pitch, Roll |

Point Cloud

| | |
|--------------------------------|------------------------|
| Points | 369,498 of 422,326 |
| RMS reprojection error | 0.294732 (3.40274 pix) |
| Max reprojection error | 0.893673 (91.9107 pix) |
| Mean key point size | 10.3736 pix |
| Point colors | 3 bands, uint8 |
| Key points | No |
| Average tie point multiplicity | 4.08499 |
| Alignment parameters | |
| Accuracy | Medium |
| Generic preselection | Yes |
| Key point limit | 40,000 |
| Tie point limit | 2,000 |
| Adaptive camera model fitting | Yes |
| Matching time | 4 hours 47 minutes |
| Alignment time | 19 minutes 2 seconds |

Dense Point Cloud

| | |
|-----------------------------------|--------------------|
| Points | 9,303,355 |
| Point colors | 3 bands, uint8 |
| Depth maps generation parameters | |
| Quality | Medium |
| Filtering mode | Aggressive |
| Processing time | 7 hours 38 minutes |
| Dense cloud generation parameters | |
| Processing time | 2 days 4 hours |

Model

| | |
|----------------------------------|-------------------------------|
| Faces | 206,734 |
| Vertices | 104,055 |
| Vertex colors | 3 bands, uint8 |
| Texture | 4,096 x 4,096, 4 bands, uint8 |
| Depth maps generation parameters | |
| Quality | Medium |
| Filtering mode | Aggressive |
| Reconstruction parameters | |
| Surface type | Arbitrary |
| Source data | Dense cloud |
| Interpolation | Enabled |
| Processing time | 6 minutes 53 seconds |
| Texturing parameters | |
| Mapping mode | Generic |
| Blending mode | Average |
| Texture size | 4,096 |
| Enable hole filling | Yes |
| Enable ghosting filter | Yes |
| UV mapping time | 20 seconds |
| Blending time | 3 minutes 12 seconds |

General
Software

Version
Platform

1.5.5 build 9097
Mac OS 64

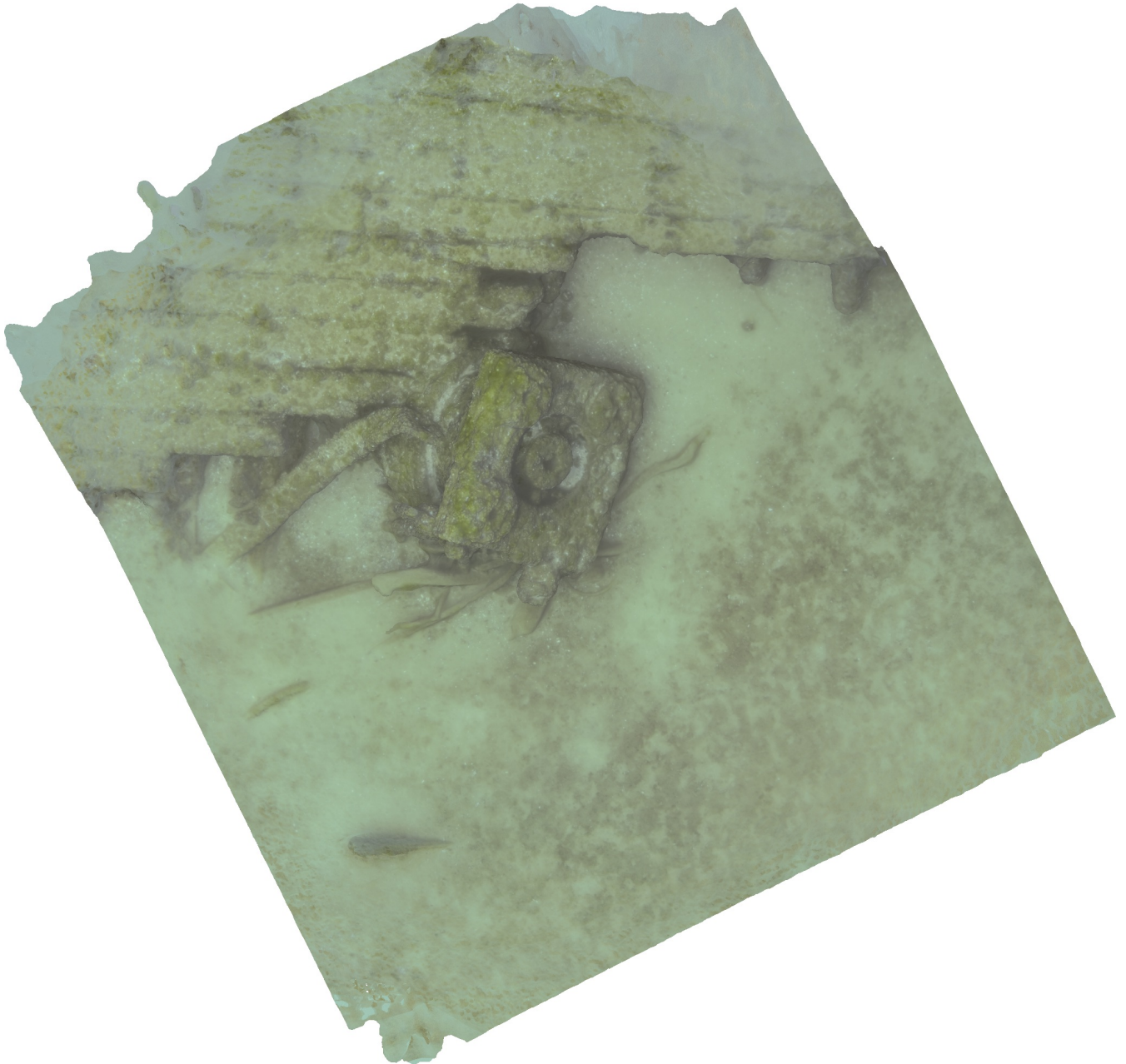
Appendix E: Engine Processing Report

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Engine

Processing Report
06 December 2019



Survey Data

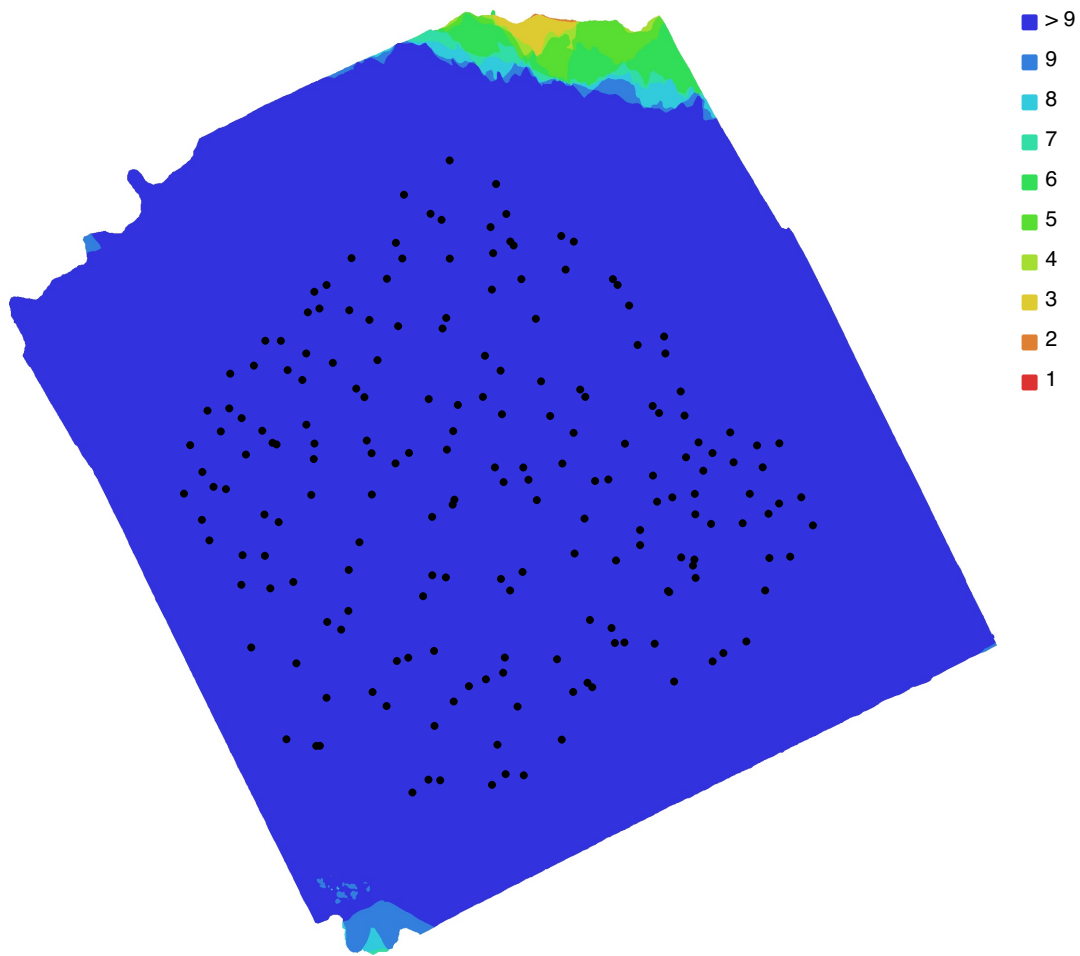


Fig. 1. Camera locations and image overlap.

Number of images: 192

Camera stations: 192

Tie points: 75,826

Projections: 256,535

Reprojection error: 3.85 pix

| Camera Model | Resolution | Focal Length | Pixel Size | Precalibrated |
|-------------------|-------------|--------------|---------------------------|---------------|
| HERO5 Black (3mm) | 4000 x 3000 | 3 mm | 1.73 x 1.73 μm | No |

Table 1. Cameras.

Camera Calibration

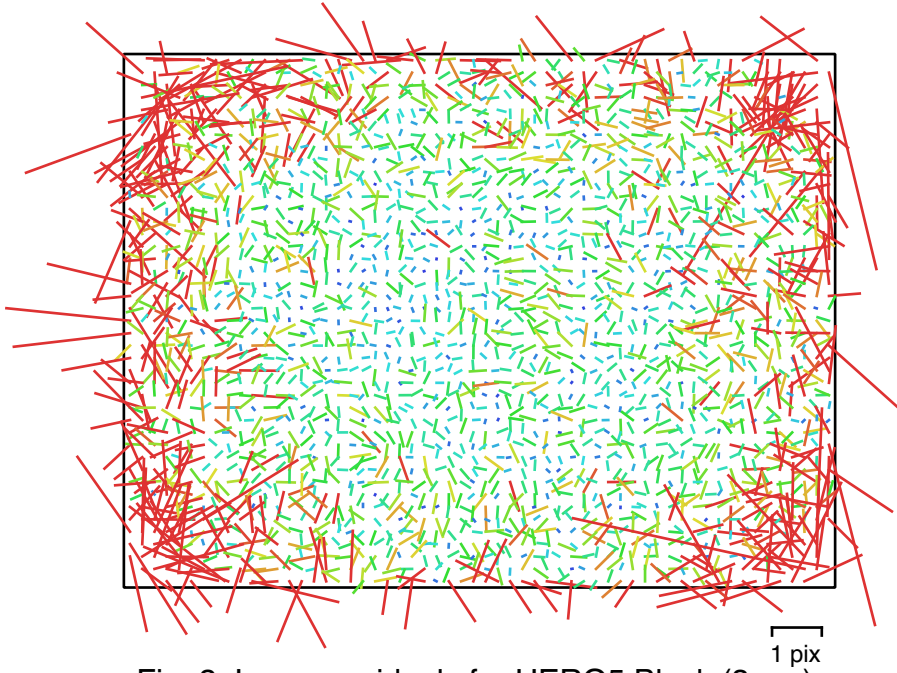


Fig. 2. Image residuals for HERO5 Black (3mm).

HERO5 Black (3mm)
192 images

| | | | |
|-------|-------------|--------------|---------------------------|
| Type | Resolution | Focal Length | Pixel Size |
| Frame | 4000 x 3000 | 3 mm | 1.73 x 1.73 μm |

| | Value | Error | F | Cx | Cy | B1 | B2 | K1 | K2 | P1 | P2 |
|----|--------------|---------|------|------|-------|-------|-------|-------|-------|-------|-------|
| F | 2344.53 | 0.28 | 1.00 | 0.09 | -0.14 | -0.15 | 0.05 | -0.09 | 0.50 | 0.01 | -0.07 |
| Cx | 15.123 | 0.16 | | 1.00 | -0.04 | -0.07 | -0.03 | 0.05 | -0.01 | 0.83 | -0.05 |
| Cy | -25.6976 | 0.14 | | | 1.00 | -0.01 | -0.04 | -0.03 | -0.05 | -0.05 | 0.75 |
| B1 | -4.28576 | 0.042 | | | | 1.00 | -0.03 | -0.02 | -0.06 | -0.02 | 0.04 |
| B2 | -0.18103 | 0.04 | | | | | 1.00 | 0.03 | 0.02 | -0.05 | 0.02 |
| K1 | -0.106561 | 0.00013 | | | | | | 1.00 | -0.80 | 0.06 | -0.06 |
| K2 | 0.105071 | 0.00016 | | | | | | | 1.00 | -0.00 | -0.00 |
| P1 | -0.000131235 | 2.3e-05 | | | | | | | | 1.00 | -0.06 |
| P2 | 8.78927e-05 | 1.9e-05 | | | | | | | | | 1.00 |

Table 2. Calibration coefficients and correlation matrix.

Digital Elevation Model

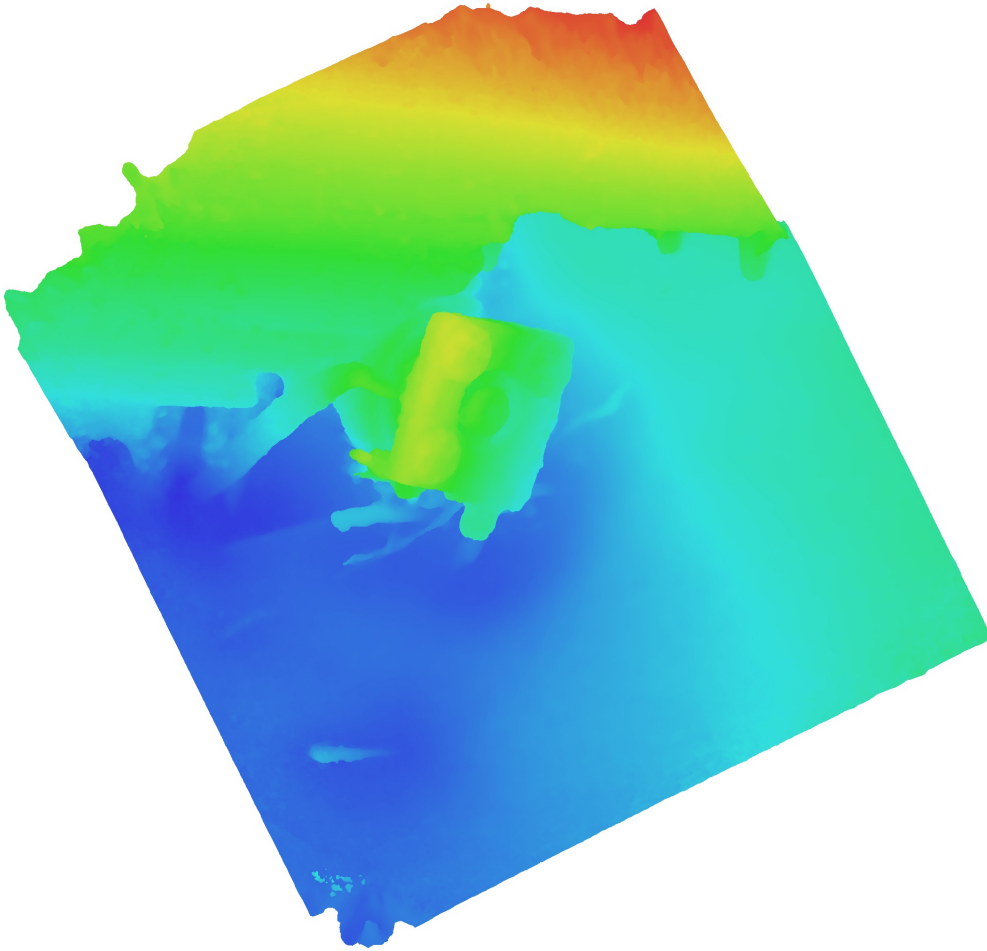


Fig. 3. Reconstructed digital elevation model.

Processing Parameters

General

| | |
|-------------------|-----------------------|
| Cameras | 192 |
| Aligned cameras | 192 |
| Coordinate system | Local Coordinates (m) |
| Rotation angles | Yaw, Pitch, Roll |

Point Cloud

| | |
|--------------------------------|------------------------|
| Points | 75,826 of 84,780 |
| RMS reprojection error | 0.318023 (3.85276 pix) |
| Max reprojection error | 0.961859 (95.7178 pix) |
| Mean key point size | 12.1927 pix |
| Point colors | 3 bands, uint8 |
| Key points | No |
| Average tie point multiplicity | 3.92712 |
| Alignment parameters | |
| Accuracy | Medium |
| Generic preselection | Yes |
| Key point limit | 40,000 |
| Tie point limit | 2,000 |
| Adaptive camera model fitting | Yes |
| Matching time | 11 minutes 52 seconds |
| Alignment time | 1 minutes 34 seconds |

Dense Point Cloud

| | |
|-----------------------------------|--------------------|
| Points | 4,895,787 |
| Point colors | 3 bands, uint8 |
| Depth maps generation parameters | |
| Quality | Medium |
| Filtering mode | Aggressive |
| Processing time | 1 hours 31 minutes |
| Dense cloud generation parameters | |
| Processing time | 1 hours 19 minutes |

Model

| | |
|----------------------------------|-------------------------------|
| Faces | 326,374 |
| Vertices | 164,438 |
| Vertex colors | 3 bands, uint8 |
| Texture | 4,096 x 4,096, 4 bands, uint8 |
| Depth maps generation parameters | |
| Quality | Medium |
| Filtering mode | Aggressive |
| Reconstruction parameters | |
| Surface type | Arbitrary |
| Source data | Dense cloud |
| Interpolation | Enabled |
| Processing time | 2 minutes 27 seconds |
| Texturing parameters | |
| Mapping mode | Generic |
| Blending mode | Average |
| Texture size | 4,096 |
| Enable hole filling | Yes |
| Enable ghosting filter | Yes |
| UV mapping time | 28 seconds |
| Blending time | 38 seconds |

General
Software

Version
Platform

1.5.5 build 9097
Mac OS 64

Appendix F: Propeller Processing Report

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Propeller

Processing Report
09 December 2019



Survey Data

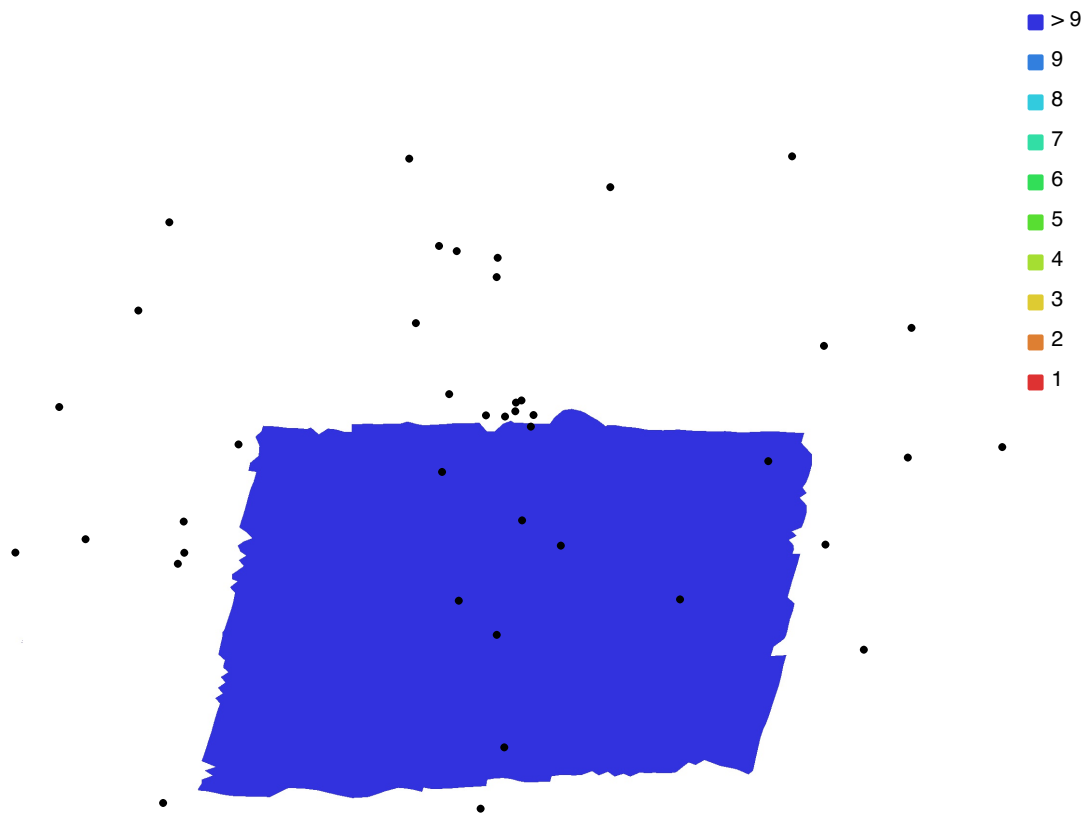


Fig. 1. Camera locations and image overlap.

Number of images: 43

Camera stations: 41

Tie points: 22,374

Projections: 64,766

Reprojection error: 0.883 pix

| Camera Model | Resolution | Focal Length | Pixel Size | Precalibrated |
|------------------|-------------|--------------|---------------------------|---------------|
| ILCE-6000 (16mm) | 6000 x 3376 | 16 mm | 4.19 x 4.19 μm | No |

Table 1. Cameras.

Camera Calibration

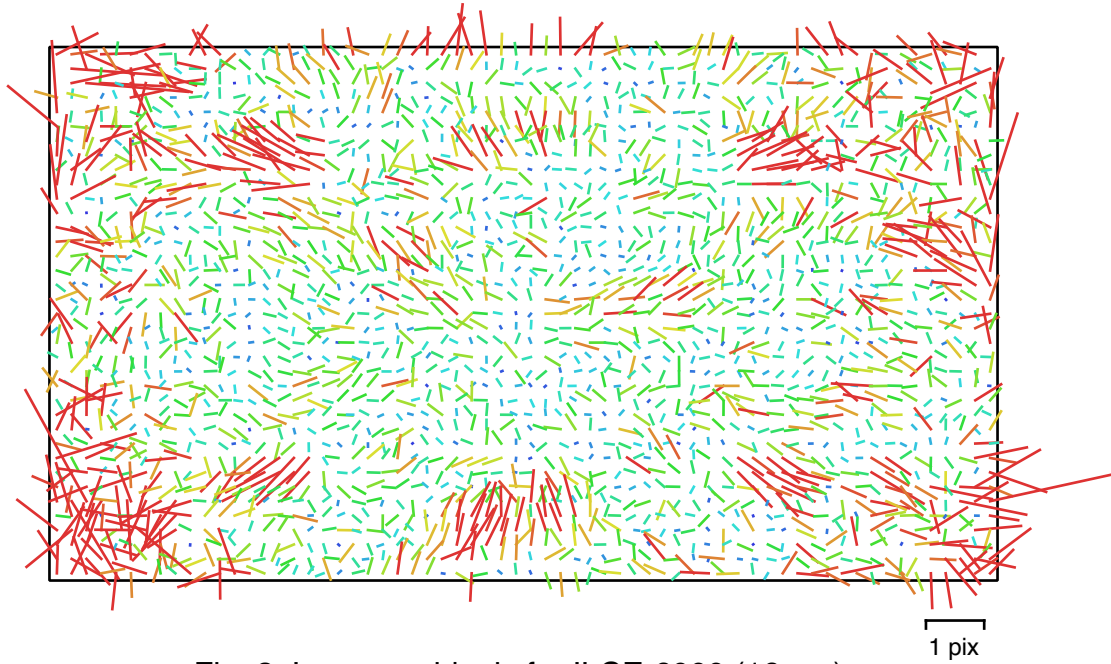


Fig. 2. Image residuals for ILCE-6000 (16mm).

ILCE-6000 (16mm)
43 images

| | | | |
|-------|-------------|--------------|---------------------------|
| Type | Resolution | Focal Length | Pixel Size |
| Frame | 6000 x 3376 | 16 mm | 4.19 x 4.19 μm |

| | Value | Error | F | Cx | Cy | B1 | B2 | K1 | K2 | P1 | P2 |
|----|-------------|---------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| F | 4030.17 | 0.2 | 1.00 | -0.01 | -0.17 | -0.29 | 0.08 | 0.06 | 0.20 | -0.04 | -0.23 |
| Cx | -58.1948 | 0.38 | | 1.00 | 0.05 | -0.01 | 0.10 | -0.10 | 0.05 | 0.94 | 0.10 |
| Cy | -95.478 | 0.32 | | | 1.00 | -0.06 | -0.05 | -0.06 | 0.01 | 0.01 | 0.88 |
| B1 | -1.53119 | 0.078 | | | | 1.00 | 0.04 | -0.09 | 0.05 | -0.05 | 0.07 |
| B2 | 1.73525 | 0.078 | | | | | 1.00 | -0.01 | 0.03 | -0.02 | -0.06 |
| K1 | -0.0500152 | 8.5e-05 | | | | | | 1.00 | -0.90 | -0.11 | -0.12 |
| K2 | 0.0376769 | 0.00012 | | | | | | | 1.00 | 0.04 | 0.02 |
| P1 | -0.00327069 | 2.5e-05 | | | | | | | | 1.00 | 0.07 |
| P2 | -0.00754806 | 1.9e-05 | | | | | | | | | 1.00 |

Table 2. Calibration coefficients and correlation matrix.

Digital Elevation Model

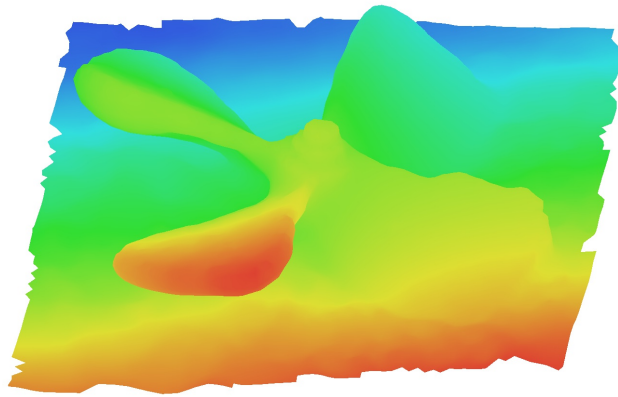


Fig. 3. Reconstructed digital elevation model.

Processing Parameters

General

| | |
|-------------------|-----------------------|
| Cameras | 43 |
| Aligned cameras | 41 |
| Coordinate system | Local Coordinates (m) |
| Rotation angles | Yaw, Pitch, Roll |

Point Cloud

| | |
|--------------------------------|-------------------------|
| Points | 22,374 of 24,333 |
| RMS reprojection error | 0.302381 (0.883156 pix) |
| Max reprojection error | 0.913207 (22.9816 pix) |
| Mean key point size | 3.08461 pix |
| Point colors | 3 bands, uint8 |
| Key points | No |
| Average tie point multiplicity | 2.9054 |
| Alignment parameters | |
| Accuracy | High |
| Generic preselection | Yes |
| Key point limit | 40,000 |
| Tie point limit | 2,000 |
| Adaptive camera model fitting | Yes |
| Matching time | 1 minutes 30 seconds |
| Alignment time | 5 seconds |

Dense Point Cloud

| | |
|-----------------------------------|-----------------------|
| Points | 28,397,369 |
| Point colors | 3 bands, uint8 |
| Depth maps generation parameters | |
| Quality | High |
| Filtering mode | Aggressive |
| Processing time | 33 minutes 41 seconds |
| Dense cloud generation parameters | |
| Processing time | 6 minutes 39 seconds |

Model

| | |
|---------------------------|-------------------------------|
| Faces | 25,259 |
| Vertices | 12,754 |
| Vertex colors | 3 bands, uint8 |
| Texture | 4,096 x 4,096, 4 bands, uint8 |
| Reconstruction parameters | |
| Surface type | Arbitrary |
| Source data | Sparse cloud |
| Interpolation | Enabled |
| Processing time | 1 seconds |
| Texturing parameters | |
| Mapping mode | Generic |
| Blending mode | Mosaic |
| Texture size | 4,096 |
| Enable hole filling | Yes |
| Enable ghosting filter | Yes |
| UV mapping time | 10 seconds |
| Blending time | 2 minutes 27 seconds |

Orthomosaic

| | |
|-------------------|-----------------------|
| Size | 7,287 x 6,525 |
| Coordinate system | Local Coordinates (m) |

General

Colors 3 bands, uint8

Reconstruction parameters

Blending mode Mosaic

Surface Mesh

Enable hole filling Yes

Processing time 44 seconds

Software

Version 1.5.5 build 9097

Platform Mac OS 64

Appendix G: Bell Processing Report

J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

Bell

Processing Report
06 December 2019



Survey Data

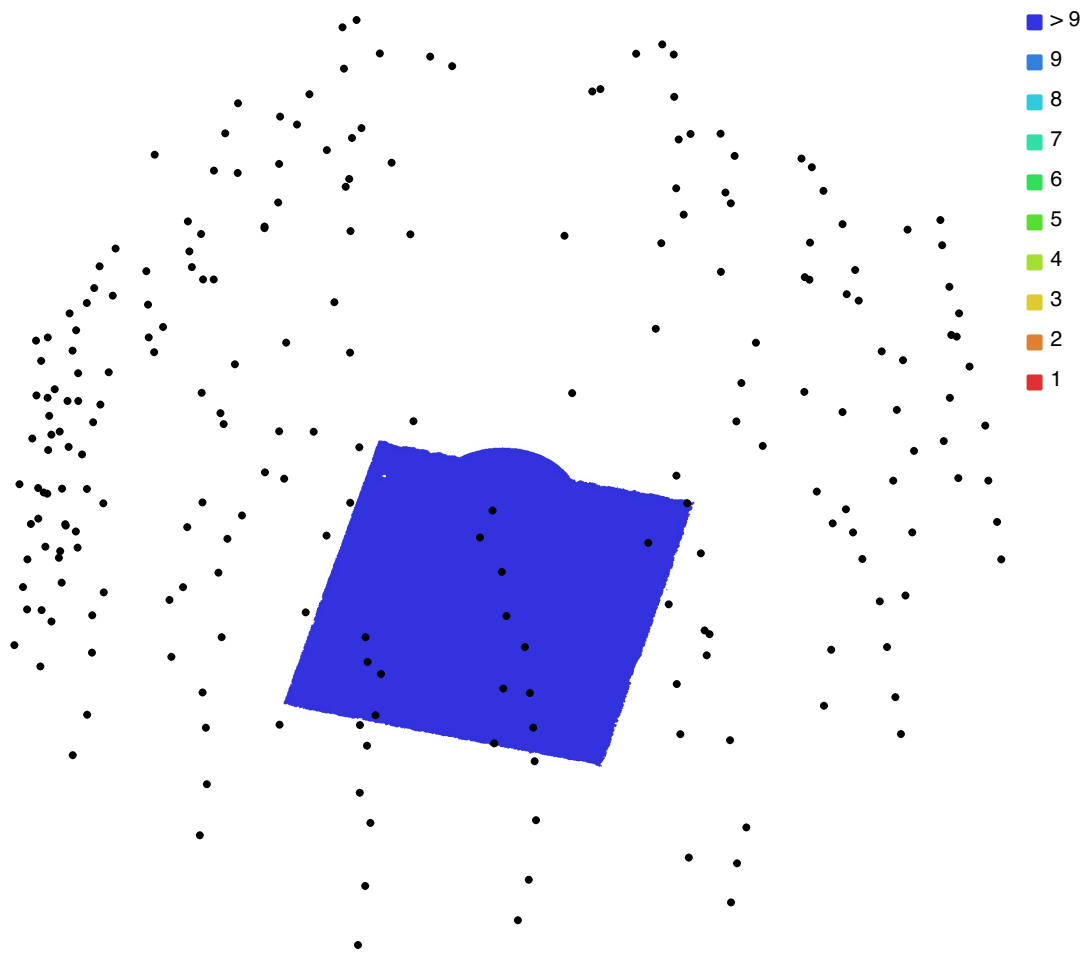


Fig. 1. Camera locations and image overlap.

Number of images: 237

Camera stations: 229

Tie points: 53,996

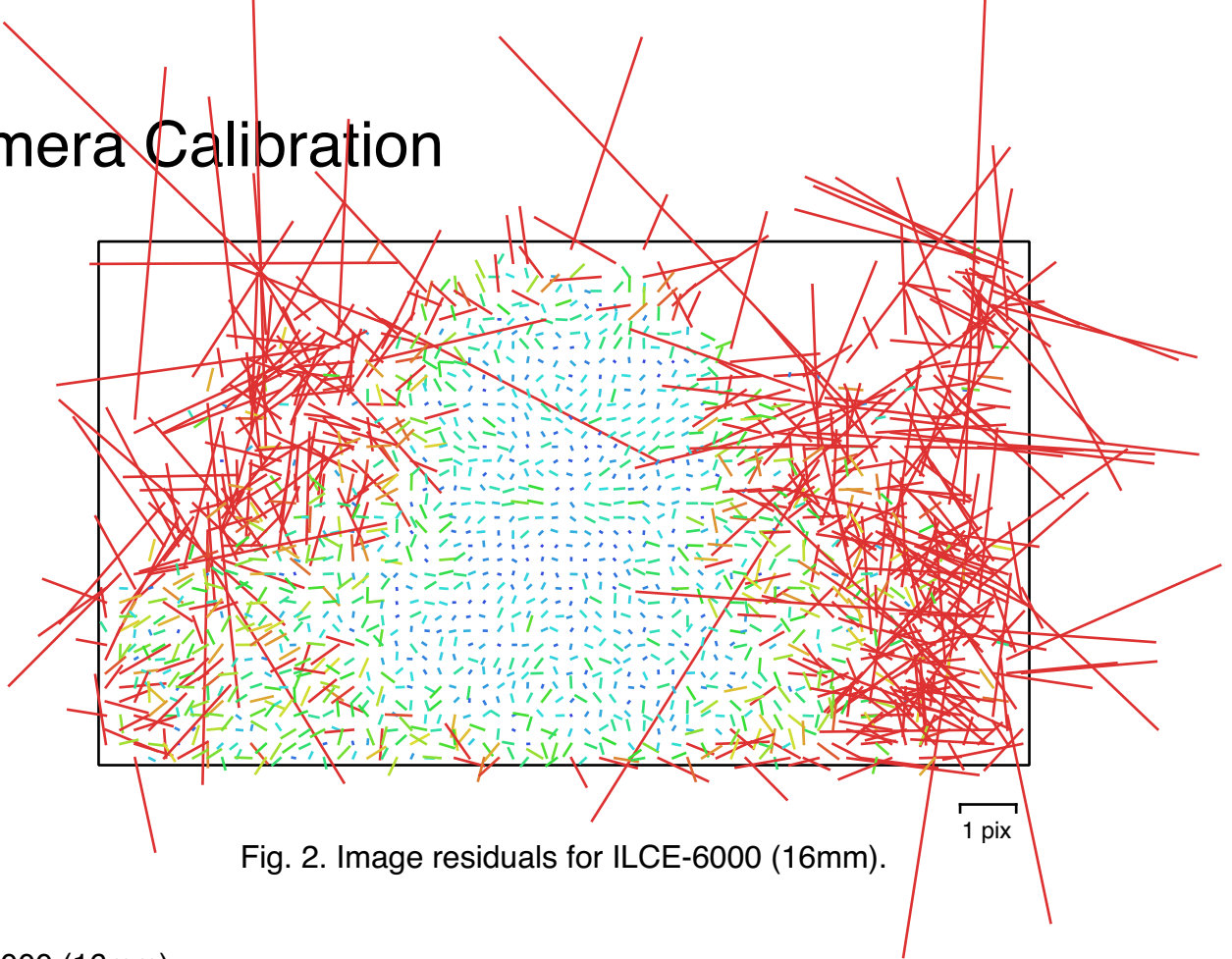
Projections: 143,670

Reprojection error: 2.18 pix

| Camera Model | Resolution | Focal Length | Pixel Size | Precalibrated |
|------------------|-------------|--------------|---------------------------|---------------|
| ILCE-6000 (16mm) | 6000 x 3376 | 16 mm | 4.19 x 4.19 μm | No |

Table 1. Cameras.

Camera Calibration



ILCE-6000 (16mm)
230 images

| | | | |
|-------|-------------|--------------|---------------------------|
| Type | Resolution | Focal Length | Pixel Size |
| Frame | 6000 x 3376 | 16 mm | 4.19 x 4.19 μm |

| | Value | Error | F | Cx | Cy | B1 | K1 | P1 | P2 |
|----|-------------|---------|------|-------|-------|-------|-------|-------|-------|
| F | 4045.65 | 0.67 | 1.00 | -0.17 | -0.04 | -0.31 | 0.27 | -0.11 | -0.16 |
| Cx | -46.7729 | 1.2 | | 1.00 | -0.00 | 0.09 | 0.02 | 0.86 | -0.03 |
| Cy | -125.902 | 0.73 | | | 1.00 | 0.05 | -0.05 | -0.02 | 0.75 |
| B1 | -0.22119 | 0.36 | | | | 1.00 | -0.13 | 0.08 | 0.28 |
| K1 | -0.0212514 | 0.00014 | | | | | 1.00 | 0.10 | -0.26 |
| P1 | -0.00232129 | 7.6e-05 | | | | | | 1.00 | -0.03 |
| P2 | -0.00908704 | 7e-05 | | | | | | | 1.00 |

Table 2. Calibration coefficients and correlation matrix.

Digital Elevation Model

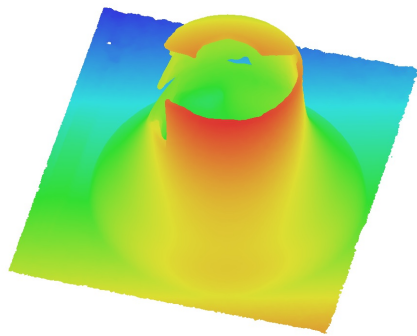


Fig. 3. Reconstructed digital elevation model.

Processing Parameters

General

| | |
|-------------------|-----------------------|
| Cameras | 230 |
| Aligned cameras | 229 |
| Coordinate system | Local Coordinates (m) |
| Rotation angles | Yaw, Pitch, Roll |

Point Cloud

| | |
|--------------------------------|------------------------|
| Points | 53,996 of 95,122 |
| RMS reprojection error | 0.218817 (2.17506 pix) |
| Max reprojection error | 0.686273 (68.7811 pix) |
| Mean key point size | 8.58082 pix |
| Point colors | 3 bands, uint8 |
| Key points | No |
| Average tie point multiplicity | 2.84965 |
| Alignment parameters | |
| Accuracy | High |
| Generic preselection | Yes |
| Key point limit | 40,000 |
| Tie point limit | 4,000 |
| Adaptive camera model fitting | Yes |
| Matching time | 16 minutes 26 seconds |
| Alignment time | 1 minutes 0 seconds |
| Software version | 1.5.5.9097 |

Depth Maps

| | |
|----------------------------------|--------------------|
| Count | 221 |
| Depth maps generation parameters | |
| Quality | High |
| Filtering mode | Mild |
| Processing time | 4 hours 17 minutes |

Dense Point Cloud

| | |
|-----------------------------------|---------------------|
| Points | 67,003,006 |
| Point colors | 3 bands, uint8 |
| Depth maps generation parameters | |
| Quality | High |
| Filtering mode | Mild |
| Processing time | 2 hours 25 minutes |
| Dense cloud generation parameters | |
| Processing time | 12 hours 22 minutes |
| Software version | 1.5.5.9097 |

Model

| | |
|----------------------------------|-------------------------------|
| Faces | 359,335 |
| Vertices | 180,551 |
| Vertex colors | 3 bands, uint8 |
| Texture | 4,096 x 4,096, 4 bands, uint8 |
| Depth maps generation parameters | |
| Quality | High |
| Filtering mode | Mild |
| Processing time | 4 hours 17 minutes |
| Reconstruction parameters | |
| Surface type | Arbitrary |
| Source data | Depth maps |
| Interpolation | Enabled |

General

Strict volumetric masks No
Processing time 1 days 11 hours

Texturing parameters

Mapping mode Generic
Blending mode Mosaic
Texture size 4,096
Enable hole filling Yes
Enable ghosting filter Yes
UV mapping time 2 minutes 0 seconds
Blending time 31 minutes 1 seconds
Software version 1.5.5.9097

Software

Version 1.5.5 build 9097
Platform Mac OS 64

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J.D. Marshall (12Pr723) 3D Photogrammetry and Underwater Museum Interpretation

Lake Michigan Coastal Program Grant CZ844

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