PHOTOGRAMMETRY BRANCH
COASTAL MAPPING PROGRAM

PROJECT CM-8509
COMPLETION REPORT

MICHIGAN

Southeastern Shore of LAKE SUPERIOR

Au Sable Point to Crisp Point
TP-01411, TP-01412, TP-01413, TP-01414
TP-01415, TP-01416, TP-01417
Agency Vault - Original Report

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Year of Source - 1986

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
OFFICE OF CHARTING AND GEODETIC SERVICES
NAUTICAL CHARTING DIVISION

PHOTOGRAMMETRY BRANCH
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Au Sable Point to Crisp Point
TP-01411, TP-01412, TP-01413, TP-01414, TP-01415, TP-01416, TP-01417

Clearance and Approval

This report summarizes the photogrammetric operations related to project completion and is submitted for approval. The maps, associated project data, and this report meet the requirements and standards of the Photogrammetry Branch Coastal Mapping Program. Clearance for project registration is requested.

Submitted by,

Robert W. Rodkey, Jr.
Chief, Coastal Mapping Unit
Photogrammetry Branch, NCD

APPROVED:

Commander Lewis A. Lapine, NOAA — Date
Chief, Photogrammetry Branch
Nautical Charting Division, Office of Charting and Geodetic Services

COASTAL MAPPING PROGRAM PROJECT CM-8509
Michigan
Southeastern Shore of Lake Superior
Au Sable Point to Crisp Point

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COASTAL MAPPING PROGRAM PROJECT CM-8509

Introduction

Coastal Mapping Program Project CM-8509 was originally planned to provide seven coastal survey maps depicting the shoreline and other cartographic features of mapping interest in the coastal zone of the southeastern shore of Lake Superior between Au Sable Point and Crisp Point, Michigan. Refer to FIGURE 1 for a graphic reference of the project site location.

The maps were assigned map identifiers TP-01411 through TP-01417. Refer to FIGURE 2 for information on the general area of coverage for each map and geographic limit coordinates. Map TP-01412 was prepared at 1:10,000 scale, Map TP-01417 at 1:5,000 scale, while all other maps were prepared at 1:20,000 scale. All maps were prepared with the transverse Mercator projection based on the North American Datum of 1927. The Michigan State Plane Coordinate System (Central Zone) is depicted on the 1:20,000 scale graphics with grid ticks at a 10,000 foot interval, the 1:10,000 scale graphic at a 5,000 foot interval and the 1:5,000 scale graphic at a 2,000 foot interval.

The purpose of the project is consistent with the Photogrammetry Branch Coastal Mapping Program, which is to provide contemporary coastal zone survey data for the maintenance of the National Ocean Service Nautical Charting Program.

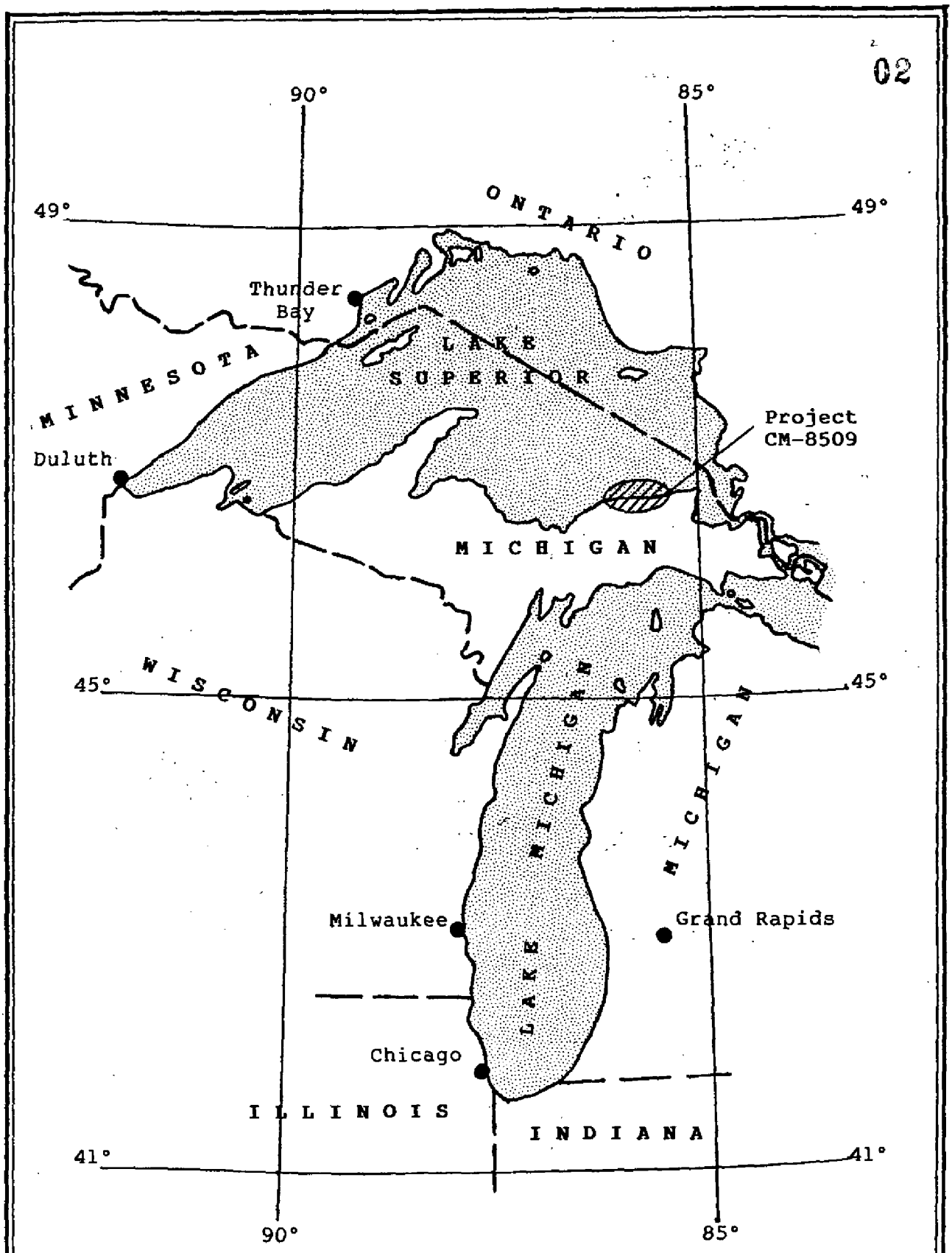
Planning

The planning phase for this project was initated in 1985. The Atlantic Photo Party was assigned all horizontal control activities. The Flight Operations Unit of the Headquarters Office was assigned the responsibility of providing the proper photographic platform for photography acquisition. A photographer from the Coastal Planning Unit photographed the project area, selecting equipment, materials, and procedures as required to meet specified quality and accuracy requirements. Field instructions were issued on February 11, 1986. The instructions are bound in Appendix A. They fully define requirements for the field operations phase of this project.

Field Operations

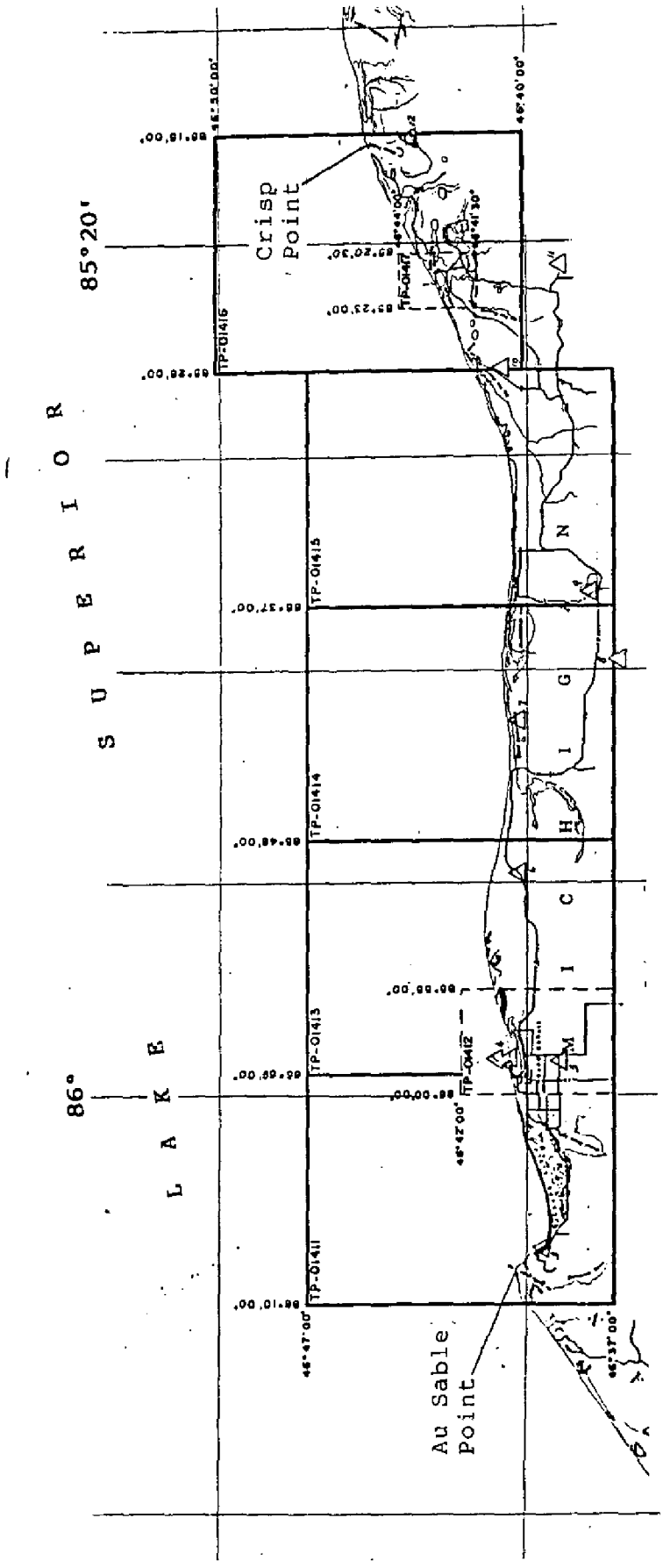
Field operations in support of this project were performed in May through June 1986 and consisted of aerial photography and the recovery, establishment and identification (premarking) of horizontal control necessary for aerotriangulation. Field surveying activities are summarized in a report bound in Appendix B.

Refer to LISTING 1 for information on the horizontal control related to this project.



PROJECT SITE LOCATION DIAGRAM FOR LAKE MICHIGAN AND LAKE SUPERIOR

FIGURE 1



COASTAL MAPPING PROGRAM
PROJECT CM-8509

MICHIGAN
Southeastern Shore of Lake Superior
Au Sable Point to Crisp Point

1:20,000 Scale Mapping
TP-01412 @ 1:10,000
TP-01417 @ 1:5,000

FIGURE 2. Project Diagram

A Turbo Commander aircraft piloted by Officers of the NOAA Corps was used for the photographic operation. The photography required for this project was executed in June 1986.

Natural color photographs were acquired for basic aerotriangulation and compilation at 1:15,000, 1:30,000 and 1:50,000 scales using a Wild RC-8 camera with "E" cone which has a calibrated focal length of 152.71 mm.

The aerial photographs of the project site were reviewed by the Coastal Planning Unit for proper endlap, horizontal control target visibility and adequate coverage of the project site. The photographs were also reviewed by the Quality Control Unit, for proper qualities required of mapping photographs under the quality assurance program. Both reviews took place in June 1986.

Aerotriangulation

Formal instructions for all office phases were issued on November 25, 1986 and are bound in Appendix C. The aerotriangulation phase was completed by the Aerotriangulation Unit of the Headquarters Office in October 1987. The Aerotriangulation Report is bound in Appendix D and contains information on placement of horizonatal control, photographs selected for data extraction, fit to control statistics and summary of the procedures employed in phase completion.

Compilation

The Compilation Instructions issued in November 1986 offer a limited summary of project operations and define standards and specifications for compilation. Basic procedures and requirements of the coastal mapping program were followed for completion of the project.

The compilation phase was initiated in November 1987 and completed in May 1988 by the Coastal Mapping Unit, Headquarters Office. Compilation was accomplished through application of standard analog compilation techniques.

For information on the photographs used in the compilation phase, refer to the control and photographs diagram of the Aerotriangulation Report. Map Compilation Sources (MCS) pages also provide information on the photographs used in the completion of each map and are bound in Appendix E. The actual limits of this photogrammetric survey may not coincide with the geographic limits of each map. The limits of a photogrammetric survey are determined by the extent and quality of photographic coverage, the density and placement of geodetic and aerotriangulated control and program requirements.

The final maps were smooth drafted except for the application of annotation which was accomplished using waxed back stripper film. Geographic names depicted on the maps were acquired from corresponding NOS nautical charts and USGS quadrangles and applied after approval by the Staff Geographer. The Final Geographic Names listings are bound in this report as Appendix F.

Office review of the project products was conducted by the Coastal Mapping Unit, Headquarters Office, in March and April 1988. The graphic products were judged as meeting the standards of the coastal mapping program.

The results of the comparison against the NOS nautical charts of the area were annotated on the Chart Maintenance Print for each map. Comparisons were made against the following NOS nautical charts:

14962, 17th Edition (Oct. 12, 1985), 1:120,000 scale and Insets
14963, 17th Edition (Feb. 1, 1986), 1:120,000 scale

Final Review

The final review phase was initiated in January 1989 by the Coastal Mapping Unit of the Headquarters Office. The coastal survey maps and associated discrete point data of this project were evaluated as meeting the horizontal requirements of the National Standards of Map Accuracy. Refer to Appendix G for the final listing of cartographic features of charting interest for application in the nautical charting program. The coastal survey maps and project data sets comply with the general requirements for a standard coastal mapping project. All photographic devices, surveying and photogrammetric mensuration instrumentation meet the standards of accuracy established for the disciplines of photography, field surveying, and photogrammetry.

During the final review phase, all necessary copies of project products and data were acquired. A Chart Maintenance Print was generated for each map within the project.

This Project Completion Report is the authorative summary and is in compliance with Section 14, of the Coastal Mapping Program Operations Manual dated Feburary 1989.

Dissemination of Project Data

Federal Records Center of the National Achives and Records Admin.
- Copy of this Project Completion Report
- Brown Jacket containing:
  - Field Data Binder titled "Project CM-8509" containing Control Station Identification forms, numerous computational forms and diagrams
  - One copy of Descriptive Report Control Record (2 pages)
  - One copy of Project Diagram (page size)
  - One copy of Aerotriangulation Report
  - One copy of Cartographic Features of Charting Interest listing
  - Two NOAA Form 76-52, Observations of Horizontal Directions
  - One copy of Chart 14962 with Horizontal Control Stations locations annotated

Agency Archives
- Registration Copy of Each Map
- Original Project Completion Report

Photogrammetric Electronic Data Library
There is no project digital data maintained in the library

Reproduction Branch, Aeronautical Charting Division
8X Reduction Negative of Each Map

Marine Chart Branch
Chart Maintenance Print of Each Map

All final project data and products were forwarded to the Production Control Unit, Headquarters Office for project registration and dissemination of products.

PROJECT GEODETIC CONTROL LISTING

COASTAL MAPPING PROJECT: CM-8509; Southeastern Shore of Lake Superior, Au Sable Point to Crisp Point, Michigan

GEODETIC DATUM: North American Datum of 1927

The following permanent geodetic control was recovered or established during project operations. Data pertaining to stations is resident in the National Geodetic Survey Division (NGSD) Horizontal Control Databank.

The Station Identifier **(STA ID)** consists of the NGS Quad Number (Q) and the assigned station number (S) within the Quad, e.g. QQQQQQSSSSSS.

Refer to Nautical Charting Division Standard Digital Data Exchange Format documentation for quality code **(QC)** criteria.

STATION NAME	STA ID	Geodetic Coordinates(°-'-") Latitude	Longitude	QC	Location Day/Year
AGATE	4608511013	46-40-49.129	085-25-51.242	3	001/1965
AGATE RM 2	4608511013	46-40-49.112	085-25-52.133	3	001/1965
BLIND	4608541005	46-40-17.554	085-42-22.314	3	001/1965
BLIND RM 1	4608541005	46-40-18.196	085-42-22.171	3	001/1965
HARBOR	4608541011	46-40-44.438	085-58-17.913	3	001/1965
HARBOR RM3	4608541011	46-40-44.281	085-58-16.758	3	001/1965
G MARAIS HBR OF REF IN LT	4608541013	46-40-35.980	085-58-16.042	3	001/1965
G MARAIS HBR OF REF OUT LT	4608541012	46-41-01.589	085-58-18.306	3	001/1965
LAKE (U.S.E.)	UNKNOWN	46-42-57.078	085-21-47.273	3	UNKNOWN
LITTLE LAKE HBR ENT LT RED	UNKNOWN	46-43-04.567	085-21-51.849	4	140/1986
LITTLE LAKE HBR ENT LT GRN	UNKNOWN	46-42-59.822	085-21-50.995	4	140/1986
VERMILLION	4608511005	46-45-10.281	085-08-18.142	2	001/1965

- end -

Remarks: The aforementioned stations were recovered or established in 1986 by the Atlantic Marine Center Photo Party or confirmed during the aerotriangulation and compilation phases.

Listing approved by: _____ 4/16/90
Final Reviewer — Date

APPENDIX A

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF CHARTING AND GEODETIC SERVICES
ROCKVILLE, MARYLAND 20852

February 11, 1986 N/CG2313:EP

Chief, Photogrammetry Branch
Atlantic Marine Center

PROJECT INSTRUCTIONS: FIELD - Job CM-8509, Lake Superior, Au Sable Point to Crisp Point, Michigan, Shoreline Mapping

1.0. PURPOSE

These instructions provide specifications and a schedule for placing targets on horizontal control stations required for aerotriangulation.

2.0. AREA

Shoreline mapping at 1:5,000, 1:10,000, and 1:20,000 scale will cover the shoreline and adjacent waterways from Au Sable Point to Crisp Point, Michigan.

3.0. PHOTOGRAPHY

3.1. Aerotriangulation photography, at 1:50,000 and 1:15,000 scale, and supplemental compilation photography, at 1:30,000 scale, will be obtained using color film.

3.2. Target identification photography will be obtained at 1:15,000 scale and may be obtained at less than optimum photographic conditions.

4.0. ASSIGNMENT

You are assigned all field operations required to place targets on horizontal control stations. The Chief, Air Photo Mission 2, will be responsible for scheduling photography at the required times.

5.0. HORIZONTAL CONTROL

5.1. Horizontal control requirements for aerotriangulation have been furnished as part of the field data.

5.2. Limit recovery of horizontal control stations to those needed to meet aerotriangulation requirements. Prepare and submit recovery notes for each station for which a search was made.

5.3. New control stations, where needed, shall be established by triangulation, trilateration, traverse, satellite positioning, or a combination of the four methods, in accordance with Third-Order, Class I specifications provided in Standards and Specifications for Geodetic Control Networks, dated September 1984.

5.4. Notify the Chief, Coastal Planning Unit (N/CG2313), if recovery of existing control does not meet aerotriangulation requirements. An alternative will be selected, if possible, to avoid establishing new control.

6.0. PREMARKING OF CONTROL

Note 1: As soon as possible after all control stations have been paneled, the field party will forward to the Rockville Office, Attention: N/CG2313, a chart section, quad, or any graphic depicting the station location, panel array used, and the panel number. This will assist in the film quality review and target identification and will help expedite the results to the field unit.

Note 2: Wing panels will be used with all targets in accordance with established specifications but may be modified to conform with local terrain conditions.

6.1. Panel each station selected to meet horizontal control requirements in accordance with specifications given on the attached sheet for the various scales of photography indicated on the control requirements diagram.

6.2. Use panel array No. 1 for targets with a normal background; it may be modified, as necessary, to conform with local terrain conditions. Any deviation from given panel and spacing dimensions should be indicated on the large-scale sketch on NOAA Form 76-53, Control Station Identification Card.

6.3. Panel array No. 3 shall be used in areas where the background offers poor contrast to the center panel, such as on sandy terrain.

6.4. The distance given for dimension "C" may be increased, but not decreased.

6.5. Panel substitute stations wherever shadows or relief displacement will obscure the home stations.

6.6. In cases where the target might be subject to vandalism, select two photoidentifiable objects. Observe directions and distances to them from the home station and record with sketch and description on separate NOAA form 76-53.

7.0. CONTROL STATION IDENTIFICATION CARD

Prepare and submit a NOAA form 76-53 for each paneled station. Observe Photogrammetric Instruction No. 22, Revised September 30, 1965, except as follows:

a. Record distances and directions in the usual manner to the center of the station panel of all targets used as substitutes for horizontal control stations.

b. In the space provided for the sketch of Substitute Station A, make a large-scale sketch of the immediate vicinity showing the array used.

8.0. SCHEDULE

All stations shall be premarked and ready for photography by June 1, 1986. If premarking is not completed by this date, inform the Chief, Coastal Planning Unit (N/CG2313), so that this information can be relayed to the air photo mission.

9.0. REPORT

A field operations report covering all pertinent information as to field work performed is required promptly upon completion of the field phase of the project.

10.0. RECORDS

All field records will be sent through N/MOA2222 for review prior to being forwarded to the Rockville Office, Attention: N/CG2313.

11.0. MODIFICATIONS OF INSTRUCTIONS

If changes in procedures and methods seem advisable, please make appropriate recommendations to this office.

12.0. COSTS

All costs incurred on this assignment shall be charged to Task 8K6C01.

13.0. RECEIPT

Receipt of these instructions shall be acknowledged.

J. Austin Yeager

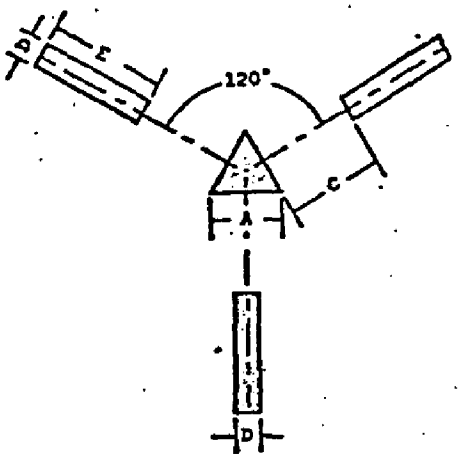
Wesley V. Hull
Director
Atlantic Marine Center
Marine Operations

J. Austin Yeager
Chief, Nautical Charting Division
Charting and Geodetic Services

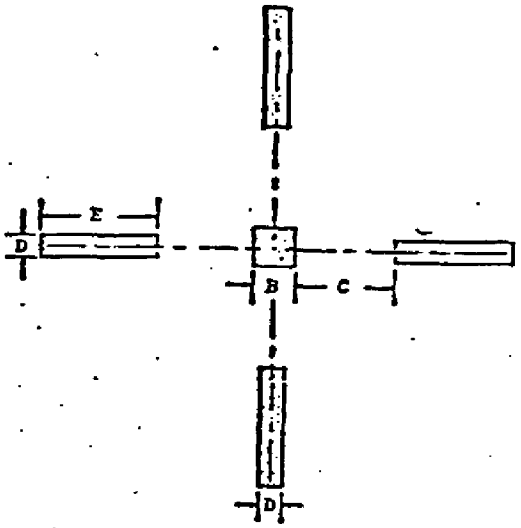
SPECIFICATIONS FOR PREMARKING CONTROL STATIONS

Revised November 23, 1976

ARRAY NO. 1



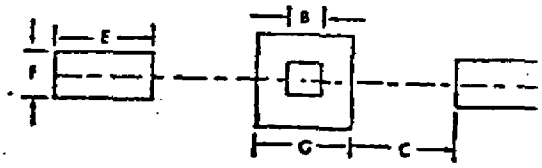
ARRAY NO. 2



NOTE:

1. The dimensions and centering of center panel over station or substitute station are critical.
2. Panel array No. 1 is preferred but No. 2 is acceptable.
3. Array No. 3 - for contrast in very light colored areas. The border surrounding center panel and the recognition panels shall be black.
4. Chief of party will select array that makes best application of field conditions and is authorized to adjust or omit one of the recognition panels if terrain is not suitable for placement of entire array.

ARRAY NO. 3



Photography Scale	PANEL AND SPACING DIMENSIONS (IN METERS) A	B	C	D	E	F	G
1:10:000	0.5	0.3	1.3	0.2	0.9	0.9	1.5
1:20,000	1.1	0.7	2.6	0.4	1.8	0.9	1.9
1:30,000	1.6	1.0	3.9	0.5	2.7	0.9	2.2
1:40,000	2.2	1.3	5.2	0.7	3.6	0.9	2.5
1:50,000	3.2	2.0	7.8	1.1	5.4	1.8	3.8
1:60,000	3.8	2.3	9.1	1.3	6.3	1.8	4.1
1:70,000	4.4	2.6	10.4	1.4	7.2	1.8	4.4
1:80,000	5.0	3.0	11.7	1.5	8.0	1.8	4.8
1:100,000	6.4	4.0	18.2	2.2	10.8	3.6	7.6

R E C E I P T

TO: N/CG2 - J. Austin Yeager
ATTN: N/CG23

THRU: N/MOA - Wesley V. Hull

Receipt of Project Instructions FIELD - Job CM-8509, Lake Superior, Au Sable Point to Crisp Point, Michigan, Shoreline Mapping, dated February 11, 1986, is acknowledged.

Chief, Photogrammetry Branch
Atlantic Marine Center

2/25/86
Date

FEB. 25 1986

APPENDIX B

PROJECT REPORT JOB CM-8509
LAKE SUPERIOR; AU SABLE POINT TO CRISP POINT, MICHIGAN

1.0 PURPOSE: This project was accomplished to provide pre-marked horizontal control stations required for 1:50,000 scale and 1:15,000 scale aerotriangulation in accordance with Project Instructions FIELD - JOB CM-8509 dated Feb. 11, 1986.

2.0 AREA: Shoreline mapping at 1:10,000 and 1:20,000 scales will cover the shoreline and adjacent waterway from Au Sable Point to Crisp Point, Michigan.

3.0 PARTICIPATION: The following personnel were involved with field operations on this project: J. Dunford, R. DeCroix, M. Johnson, P. Walbolt, J. Koster, T. Parker, and A. EbadiRad. J. Dunford was in charge of field operations.

4.0 HORIZONTAL CONTROL: The horizontal control requirements diagram required 8 areas to be targeted.

New control stations were established with the Magnavox MX 1502 Geoceivers using the translocation method. All panels that were offset were positioned in accordance with Photo Instructions No. 22. Recovery notes were submitted for horizontal control stations used on this project.

All positions were determined on North American Datum of 1927.

Panels were located using the following methods:

#1 Satellite station established and paneled direct
This is also Panel 13 for Job CM-8501.
#2 Traverse from NGS Control
#3 Traverse from NGS control
#4 Traverse from NGS control
#5 Traverse from satellite station established on this job
#6 Traverse from satellite station established on this job
#6A Traverse from satellite station established on this job
#6B Traverse from satellite station established on this job
#7 Satellite station established and paneled direct
#8 NGS control paneled direct, and is also Panel 2 for Job CM-8511.

It should be noted that Panels 1 and 3 for CM-8511 will also appear on the photos for this job.

5.0 SCHEDULE: Work on this project was performed in conjunction with 2 adjoining projects, CM-8501 and CM-8511. Field work was performed on these projects during the period May 12 to July 1, 1986. All panels in this job were ready for photography by 30 May.

6.0 CONTROL STATION IDENTIFICATION: A NOAA form 76-53 (CSI Card) was submitted for each panel. Panel Array No. 1 was used when possible, any change to the standard array is noted on the CSI card.

7.0 RECORDS: All field records were submitted to N/CG2314 on Aug. 1, 1986.

Submitted by

James E. Dunford

James E. Dunford

APPENDIX C

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF CHARTING AND GEODETIC SERVICES
ROCKVILLE, MARYLAND 20852

16

November 25, 1986 N/CG2321:GF

TO: N/CG2323 - Robert W. Rodkey

FROM: N/CG232 - John A. Mooney JAM

SUBJECT: Instructions - OFFICE - Job CM-8509, Au Sable Point to Crisp Point, Lake Superior, Michigan, Shoreline Mapping

1.0. PURPOSE

1.1. These instructions provide basic specifications for the compilation of data to be used in the nautical charting program. Compilation shall be based on aerotriangulation that has met the requirements of National Standards of Map Accuracy and on an office interpretation of aerial photographs.

1.2. Unless otherwise specified in these instructions, compilation, processing, and dissemination of all data shall be in accordance with the C&GS Topographic Manual, Part II, and applicable amending NOS Photogrammetric Instructions.

2.0. GENERAL

2.1. Scope. This project is planned to provide seven manuscripts (TP-01411 through TP01417) depicting the shoreline area of Lake Superior from Au Sable Point to Crisp Point. Map TP-01417 will be prepared at 1:5,000 scale, map TP-01412 at 1:10,000 scale, and the remaining maps at 1:20,000 scale.

2.2. Field Operations. Field work accomplished consisted of aerial photography and the recovery, establishment, and identification of horizontal control necessary for aerotriangulation There was no field inspection of the shoreline performed.

2.3. Photography. General information relating to project photography is indicated below.

TYPE	SCALE	CAMERA	DATE
Color	1:15,000	Wild RC-8(E)	6/6/86
Color	1:30,000	Wild RC-8(E)	6/6/86

17

Color	1:50,000	Wild RC-8(E)	6/6/86
Color	1:30,000	Wild RC-8(E)	6/8/86

The 1:50,000-scale photography was performed for basic aerotriangulation and 1:20,000 mapping; the 1:30,000-scale for 1:10,000 mapping, and the 1:15,000-scale for 1:5,000 mapping.

2.5. Charts Affected. Chart 14962 and 14963 will be affected by this survey.

3.0. ASSIGNMENT

You are assigned all office operations to effect shoreline mapping and to provide the data sets required in support of charting and hydrographic activities. This includes the aerotriangulation process.

4.0. DATA FURNISHED

a. Nautical charts and USGS quadrangles
b. Control and project diagrams
c. Color photographs (film positives and contact prints)
d. Geodetic control data
e. Lake level data
f. Field records

5.0. PRODUCTION REQUIREMENTS

5.1. Limits. Standard shoreline manuscripts are required. The offshore limit of compilation will be directly related to the extension, density, and placement of the aerotriangulated control determined. Use the chart insets as a guide for the selection and limit of interior detail to be shown on maps TP-01412 and TP-01417.

5.2. Aerotriangulation

5.2.1. Analytical aerotriangulation is required for the 1:50,000-scale color photographs. Geodetic control is premarked (paneled). Use elevation from U.S. Geological Survey quadrangles as vertical control.

5.2.2. Establish sufficient common image points between the 1:50,000-scale and other larger-scale photographs that cover the areas of TP-01412 and TP-01417, the 1:30,000-scale and 1:15,000-scale photographs respectively. This will provide the aerotriangulated control necessary for model orientation and instrument compilation of these two large-scale maps.

5.2.3. Locate all charted visible landmarks and fixed aids to navigation during bridging.

5.3.4. Establish shoreline points common to all color photographs that will used in map production; determine ratio values necessary to prepare enlargement prints of these photographs at map scale. Include values as part of the Aerotriangulation Report.

5.3.5. Adjust aerotriangulated control points to ground based on North American Datum (NAD) 1927.

5.3. Delineation

5.3.1. Prepare the manuscripts, based on NAD 1927, depicting the Lambert Conformal Conic Projection (full line) and grid ticks based on the Michigan State Plane Coordinate System (Central Zone). Manuscript coordinates are identifed of the project diagram.

5.3.2. Delineation will be accomplished using instrument methods. Where selectivity is required because of density of detail, features that have landmark significance or of interest to a mariner are always retained. When features are too small or too numerous to show to scale, no attempt should be made to show all. Instead, a representative pattern of the symbol or area outline is to be shown, augmented by an explanatory note. Small features, especially when dangerous to navigation, may be slightly exaggerated in size, closely resembling their true shape; e.g., bare rock, islet.

5.4. Cartographic Comparison. A comparison with the most recently published chart(s) shall be made during all compilation phases. This effort (1) is particularly important to ensure charted alongshore and offshore features shown as bare or uncovering are investigated, and (2) will complement the interpretation of detail and/or identification of conflicts. Questionable differences between map detail and the chart(s) shall be noted and reported on map copies prepared in support of charting and hydrography; e.g. Chart Maintenance Print and Notes to Hydrographer Print.

5.5. Shoreline. Compile the visible line of contact between land features and the water surface as the shoreline.

5.6. Alongshore and Offshore Detail. Refer to "Vertical Datum References for Map Features, Photogrammetric Surveys, Great Lakes," dated July 13, 1976, for related symbolization and labeling.

5.7. Vertical Datum. A statement shall be added to the manuscript specifying the shoreline datum. The statement shall read: "The Shoreline Datum is the water level at the time of

photography and plane of reference for symbolization. Based on the International Great Lakes Datum (1955) the water level taken at Marquette, Michigan, gage was 601.7 feet. Low Water Datum for Lake Superior is 600.0 feet."

5.8. Geodetic Control. Refer to memorandum instructions "Listing and Plotting of Control Stations on Shoreline Manuscripts," dated July 23, 1968, and "Labeling Triangulation Stations Field Positions on NOS Maps and in NOS Descriptive Reports," dated November 3, 1978.

5.9. Navigational Aids

5.9.1. Locate or confirm geodetic positions of visible charted landmarks, fixed aids to navigation, and/or cartographic features that have possible landmark value using photogrammetric analytical and/or analog methods.

5.9.2. Refer to Photogrammetric Instruction No. 78 for symbolization and labeling. Map features of possible landmark value are to be symbolized the same as charted landmarks, however, label with upper and lower case letters; e.g., Tank (Possible Landmark).

5.9.3. Prepare a listing of the charted landmarks and/or fixed aids identified. The listing shall also contain features of possible landmark value. The listing shall outline:

a. Feature description
b. Carto code
c. Geographic position
d. Nautical Charting Division (NCD) quality code
e. Date of photogrammetric source
f. Horizontal datum

Refer to Nautical Charting Division Standard Digital Data Exchange Format (NCD SDDEF), Version 1 documentation dated April 1, 1985, for clarification of NCD quality and carto codes. The carto code "933" shall be assigned to cartographic features of possible landmark value. Positional data determined using approved photogrammetric methods as described in NCD SDDEF, Appendix D, Quality Code 3 and 4 shall be reported to three decimal places, and Quality Code 5 through 7 to two decimal places.

5.9.4. The medium for reporting information concerning charted navigational aids investigated and not compiled will be the Chart Maintenance Print.

5.10. Roads and Streets. Requirements for symbolization are outlined in Photogrammetric Instruction No. 56, Amendment 1.

5.11. Buildings. Buildings coinciding with the shoreline, marine service and port facilities, and buildings on coastal structures are to be shown. These conditions complement the general requirements for the selection of buildings outlined in Photogrammetric Instruction No. 54, Revision No. 2, Provisional.

5.12. Bridges and Cable Crossings. Procedures are outlined in Photogrammetric Instruction No. 27, Revision 1.

5.13. Drafting. The manuscript will be drafted in accordance with Photogrammetric Instruction No. 55, Revision 2. When drafting small features or related symbols, the minimum length/size shall be .7 mm.

5.14. Geographic and Object Names

5.14.1. Requirements for names, including their placement, are outlined in Photogrammetric Instruction No. 63.

5.14.2. Obtain final geographic names list using the procedures outlined in Photogrammetric Instruction No. 63, section 2.03.1, last paragraph.

5.15. Reports. Refer to sections 1.2, 5.2, and 7.2 of these instructions. Include a brief statement in paragraph 49 (Notes to Reviewer) of the Compilation Report when selectivity of detail is required.

5.16. Chart Maintenance Print. A stable base copy of each final reviewed map will be prepared and labeled Chart Maintenance Print. General requirements are specified in Photogrammetric Instruction No. 69 for completing this print. When completing this print, keep in mind the objective is to provide comprehensive information about the adequacy, reliability, and completeness of map detail, as well as differences noted between the map and chart(s). Examples are the inability to satisfactorily interpret photographic images and a difference between the chart(s) and map in the representation of a feature. This effort cannot be emphasized too strongly, because proper evaluation and usage of map detail will depend on this information.

5.17. Support Data. Prepare standard data sets in support of N/CG241 and N/CG22 activities.

5.18. Communication. Data processed or prepared in support of N/CG22 and N/CG24 functions shall be routed through N/CG2321.

6.0. SCHEDULE

Schedule map production and associated requirements to be completed by November 15, 1987. If the schedule cannot be met, please inform this office immediately.

7.0. MODIFICATIONS OF INSTRUCTIONS

7.1. If changes in procedures and/or methods seem advisable, please make appropriate recommendations to this office.

7.2. Departures from basic specifications, as necessitated by unique characteristics and special requirements for this mapping project, shall be contained in supplementary instructions or described in the text of the Job Completion Report and/or the each applicable Descriptive Report.

8.0. COSTS

All costs incurred on this assignment shall be charged to Task 8K6C01.

APPENDIX D

AEROTRIANGULATION REPORT
CM-8509
AU SABLE POINT TO CRISP POINT
LAKE SUPERIOR, MICHIGAN

OCTOBER 1987

21. AREA COVERED

This report covers the shoreline and adjacent waterway from Au Sable Point to Crisp Point, Michigan. The project consists of five, 1:20,000-scale sheets; TP-01411, TP-01413, TP-01414, TP-01415, and TP-01416; one, 1:10,000-scale sheet, TP-01412; and one, 1:5,000-scale sheet, TP-01417.

22. METHOD

One strip of 1:50,000-scale color photographs and one strip each at 1:30,000-scale, and 1:15,000-scale color photographs were bridged by analytical aerotriangulation methods using the STK comparator.

These strips were adjusted to ground with the analytic program strip adjustment.

Ratio values were determined for the bridging compilation photographs. A copy of these values and a sketch of the photocoverage are attached to this report.

The base manuscripts were plotted on the Kongsberg plotter using the Michigan State Plane Coordinate System, Central Zone. This system is a traverse Mercator projection. All positions are on NAD 1927.

23. ADEQUACY OF CONTROL

The control was adequate and meets the National Ocean Service requirements. The horizontal control consisted of premarked, photoidentified, and office identified stations. Tie points were also used to supplement the control.

24. SUPPLEMENTAL DATA

USGS quadrangles were used to obtain the vertical control for bridging. NOS nautical charts were used to locate aids.

25. PHOTOGRAPHY

The coverage and quality of the photographs proved adequate for the project.

Submitted by:

Ed Allen
Cartographer

Approved and Forwarded:

Don O. Norman
Chief, Aerotriangulation Unit

FIT TO CONTROL

Strip #1

STATION NAME	POINT NO.	VALUE IN FEET X	Y
Panel No. 1	500100	.1	.6
Harbor RM #3 sub.pt.	775101	-1.7	-2.9
Blind, 1965 sub.pt.	509101	2.9	4.8
Agate, 1965 sub.pt.	513101	-1.0	-4.3
Vermillion, 1965 direct	518100	- .2	1.2

Strip #2

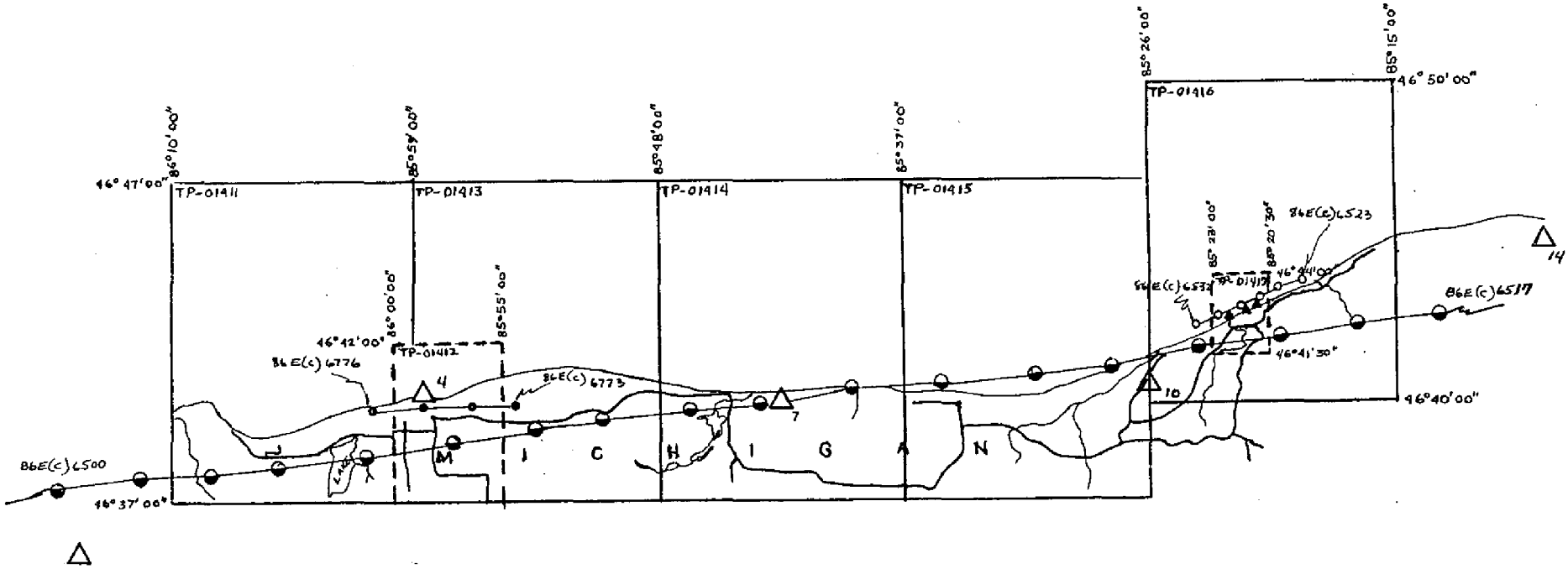
Tie from Strip #1	505801	.8	2.5
Tie from Strip #1	505803	-3.1	-3.2
Tie from Strip #1	506801	1.6	-2.5
Tie from Strip #1	506802	- .3	1.3
Tie from Strip #1	506803	1.4	.7
Harbor RM #3 sub.pt.	775101	.0	1.6
Tie from Strip #1	505804	.1	.6
Tie from Strip #1	505805	1.0	- .2

Strip #3

Panel No 7	530100	- .1	.4
Lake (USE) sub.pt. 5	530101	- .1	.5
Lake (USE) sub.pt. 6	531101	.1	- .8

JOB CM-8509
LAKE SUPERIOR
AU SABLE POINT TO CRISP POINT
MICHIGAN
SHORELINE MAPPING
SCALES = 1:20,000
1:10,000
1: 5,000

LEGEND:
- 1:50,000 Color (Bridging)
- 1:50,000 Color (Bridging)
- 1:30,000 Color (Supplemental)
- 1:5,000 Color (Bridging)



RATIO VALUES
CM-8509

1:50,000-Bridging Photographs

	Ratio Values
86-E(C) 6499-6521	2.54

1:30,000-Bridging Photographs

86-E(C) 6772-6776	2.97

1:5,000-Bridging Photographs

86-E(C) 6528-6531	2.96

APPENDIX E

MAP COMPILATION SOURCES for PROJECT CM-8509

MAP TP-01411 MAP SCALE = 1:20,000

PHOTOGRAPHY

YEAR/TYPE/NUMBERS	DATE	TIME	SCALE	LAKE LEVEL / GAGE
86E(C)6501 - 6505	06/06/86	1509-1511	1:50,000	+1.7 FT LWD/Marquette

Photography Type: (C) = Color, Multispectral (MS)
Standard Time is referenced to Eastern Time Zone (Meridian = 075°)

Office Reviewer - James W Massey for David P. Butler Feb 14, 90 Date

REMARKS: The Low Water Datum for Lake Superior is 600.0 FT.

****

MAP TP-01412 MAP SCALE = 1:10,000

PHOTOGRAPHY

YEAR/TYPE/NUMBERS	DATE	TIME	SCALE	LAKE LEVEL / GAGE
86E(C)6773 - 6776	06/08/86	1137-1139	1:30,000	+1.7 FT LWD/Marquette

Photography Type: (C) = Color, Multispectral (MS)
Standard Time is referenced to Eastern Time Zone (Meridian = 075°)

Office Reviewer - James W Massey for David P. Butler Feb 14, 90 Date

REMARKS: The Low Water Datum for Lake Superior is 600.0 FT.

****

MAP TP-01413 MAP SCALE = 1:20,000

PHOTOGRAPHY

YEAR/TYPE/NUMBERS	DATE	TIME	SCALE	LAKE LEVEL / GAGE
86E(C)6505 - 6508	06/06/86	1511-1513	1:50,000	+1.7 FT LWD/Marquette

Photography Type: (C) = Color, Multispectral (MS)
Standard Time is referenced to Eastern Time Zone (Meridian = 075°)

Office Reviewer - James W Massey for David P. Butler Feb 14, 90 Date

REMARKS: The Low Water Datum for Lake Superior is 600.0 FT.

MAP COMPILATION SOURCES for PROJECT CM-8509

MAP TP-01414 MAP SCALE = 1:20,000

PHOTOGRAPHY

YEAR/TYPE/NUMBERS	DATE	TIME	SCALE	LAKE LEVEL / GAGE
86E(C)6507 - 6511	06/06/86	1513-1515	1:50,000	+1.7 FT LWD/Marquette

Photography Type: (C) = Color, Multispectral (MS)
Standard Time is referenced to Eastern Time Zone (Meridian = 075°)

Office Reviewer - James W Massey for David P. Butler Feb 14, 90 Date

REMARKS: The Low Water Datum for Lake Superior is 600.0 FT.

****

MAP TP-01415 MAP SCALE = 1:20,000

PHOTOGRAPHY

YEAR/TYPE/NUMBERS	DATE	TIME	SCALE	LAKE LEVEL / GAGE
86E(C)6510 - 6514	06/06/86	1514-1516	1:50,000	+1.7 FT LWD/Marquette

Photography Type: (C) = Color, Multispectral (MS)
Standard Time is referenced to Eastern Time Zone (Meridian = 075°)

Office Reviewer - James W Massey for David P. Butler Feb 14, 90 Date

REMARKS: The Low Water Datum for Lake Superior is 600.0 FT.

****

MAP TP-01416 MAP SCALE = 1:20,000

PHOTOGRAPHY

YEAR/TYPE/NUMBERS	DATE	TIME	SCALE	LAKE LEVEL / GAGE
86E(C)6513 - 6517	06/06/86	1516-1518	1:50,000	+1.7 FT LWD/Marquette

Photography Type: (C) = Color, Multispectral (MS)
Standard Time is referenced to Eastern Time Zone (Meridian = 075°)

Office Reviewer - James W Massey for David P. Butler Feb 14, 90 Date

REMARKS: The Low Water Datum for Lake Superior is 600.0 FT.

MAP COMPILATION SOURCES for PROJECT CM-8509

MAP TP-01417 MAP SCALE = 1:5,000

PHOTOGRAPHY

YEAR/TYPE/NUMBERS	DATE	TIME	SCALE	LAKE LEVEL / GAGE
86E(C)6526 - 6531	06/06/86	1547-1548	1:15,000	+1.7 FT LWD/Marquette

Photography Type: (C) = Color, Multispectral (MS)
Standard Time is referenced to Eastern Time Zone (Meridian = 075°)

Office Reviewer - James W. Massey for David P. Butler Feb 14, 90 Date

REMARKS: The Low Water Datum for Lake Superior is 600.0 FT.

APPENDIX F

MAR 30 1988

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GEOGRAPHIC NAMES

FINAL NAME SHEET

CM-8509 (Au Sable Point to Crisp Point, Michigan)

TP-01411

Au Sable Point

Grand Sable Banks

Grand Sable Lake

Hurricane River

Sable Creek

Superior, Lake

Approved:

Charles E. Harrington

Charles E. Harrington
Chief Geographer
Nautical Charting Division

MAR 30 1988

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GEOGRAPHIC NAMES

FINAL NAME SHEET

CM-8509 (Au Sable Point to Crisp Point, Michigan)

TP-01412

East Bay

Grand Marais

Lonesome Point

Sucker River

Superior, Lake

West Bay

Approved:

Charles E. Harrington

Charles E. Harrington
Chief Geographer
Nautical Charting Division

MAR 30 1988

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GEOGRAPHIC NAMES

FINAL NAME SHEET

CM-8509 (Au Sable Point to Crisp Point, Michigan)

TP-01413

Blind Sucker River

Dead Sucker River

Grand Marais Creek

Props Lake

Randolph Lake

Sucker River

Superior, Lake

Approved:

Charles E. Harrington

Charles E. Harrington
Chief Geographer
Nautical Charting Division

MAR 30 1988

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GEOGRAPHIC NAMES

FINAL NAME SHEET

CM-8509 (Au Sable Point to Crisp Point, Michigan)

TP-01414

Blind Sucker Flooding
Blind Sucker River
Brucker Lake
Cranberry Lake
Dead Sucker River
Keopfgen Lake
Mud Lake
Muskallonge Lake
Rainy Lakes
Ready Lakes
Schaaf Lake
Snowplow Lake
Superior, Lake
Trout Creek
Trout Lake
Wheeler Lakes

Approved:

Charles E. Harrington

Charles E. Harrington
Chief Geographer
Nautical Charting Division

MAR 30 1988

3.

GEOGRAPHIC NAMES

FINAL NAME SHEET

CM-8509 (Au Sable Point to Crisp Point, Michigan)

TP-01415

Connor Lakes

Deer Park (locality)

East Branch

~~Little Perch Lake~~ not depicted ED

Muskallonge Lake

Superior, Lake

Two Hearted River

Approved:

Charles E. Harrington

Charles E. Harrington
Chief Geographer
Nautical Charting Division

GEOGRAPHIC NAMES

FINAL NAME SHEET

CM-8509 (Au Sable Point to Crisp Point, Michigan)

TP-01416

Bodi Lake

Crisp Point

~~Culhane Lake~~

~~Little Lake~~ Not depicted

Little Two Hearted River

Superior, Lake

Threemile Creek

Two Hearted River

Approved:

Charles E. Harrington

Charles E. Harrington
Chief Geographer
Nautical Charting Division

GEOGRAPHIC NAMES

FINAL NAME SHEET

CM-8509 (Au Sable Point to Crisp Point, Michigan)

TP-01417

Little Lake

Little Lake Harbor

Little Two Hearted River

Superior, Lake

Approved:

Charles E. Harrington

Charles E. Harrington
Chief Geographer
Nautical Charting Division

APPENDIX G

CARTOGRAPHIC FEATURES OF CHARTING INTEREST

COSATAL MAPPING PROJECT: CM-8509; Southeastern Shore of Lake Superior, Au Sable Point to Crisp Point, Michigan

NOS Nautical Charts Affected: 14962, 14963

Geodetic Datum: North American Datum of 1927

The following charted cartographic features and newly identified cartographic features of possible landmark value, if any, have been identified and measured during photogrammetric operations. Refer to Nautical Charting Division Standard Digital Data Exchange Format documentation for quality code (QC) criteria and clarification of cartographic codes (CC). Please note cartographic code 993 is a photogrammetric source code for cartographic features of possible landmark value. Descriptions in upper and lower case are for internal use.

FEATURE DESCRIPTION	NCD CC	GEOGRAPHIC POSITION(°-'-") LATITUDE	LONGITUDE	NCD QC	DATE OF LOCATION
TP-01411 (Charts 14962 and 14963):					
AU SABLE LIGHT	200	46-40-21.80	086-08-21.69	6	160/1986
TP-01412 (Chart 14962):					
G MARAIS HBR OF REF OUTER LT	200	46-41-01.589	085-58-18.306	3	001/1965
G MARAIS HBR OF REF INNER LT	200	46-40-35.980	085-58-16.042	3	001/1965
G MARAIS HBR OF REF LIGHT 1	200	46-40-50.62	085-58-09.93	6	160/1986
CHIMNEY (Grand Marais)	086	46-40-05.67	085-58-43.43	6	160/1986
TP-01417 (Chart 14962):					
L LAKE HBR OF REF W BKW LT	200	46-43-04.567	085-21-51.849	3	184/1986
L LAKE HBR OF REF E BKW LT	200	46-42-59.822	085-21-50.995	3	184/1986
TP-01416 (Chart 14962):					
CRISP POINT LIGHT	200	46-45-10.54	085-15-25.91	6	160/1986

- end -

Listing approved by: _____ 4/16/90
Final Reviewer Date