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# PAST AND PRESENTLY KNOWN SPAWNING GROUNDS OF FISH IN THE MICHIGAN COASTAL WATERS OF THE GREAT LAKES

October, 1979

Michigan Dept of Natural Resources

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Fisheries Division

Technical Report: No. 79-1

October, 1979

# PAST AND PRESENTLY KNOWN SPAWNING GROUNDS OF FISHES IN THE MICHIGAN COASTAL WATERS OF THE GREAT LAKES

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This document was prepared with financial assistance provided by the Coastal Zone Management Act of 1972 administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration and by the Michigan Coastal Management Program, Division of Land Resource Programs, Department of Natural Resources.

## DEDICATION

Dedicated to the active and retired commercial fishermen of the Great Lakes, without whose help this study could not have been completed.

ACKNOWLEDGEMENTS

The field data for this report was collected largely by graduate and undergraduate students from Michigan Technological University, Central Michigan University, and Michigan State University. We thank all persons and organizations listed on page *x* and in Appendix 1 for their contributions to this report. We also thank Asa Wright and Ned Fogle of the Michigan Department of Natural Resources, Fisheries Division, for their advice and direction in the acquisition of necessary data. We also greatly appreciate the assistance of Carol Goodyear (United States Fish and Wildlife Service) for supplying reference material.

This study was sponsored and funded by the Michigan Department of Natural Resources and the Office of Costal Zone Management, National Oceanic and Atmospheric Administration.

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ABSTRACT

In an attempt to summarize past and present knowledge relating specifically to the spawning grounds of fishes in the Michigan coastal waters of the Great Lakes, two primary sources of material were used. Personal interviews were conducted with commercial fishermen, researchers, Michigan Department of Natural Resources personnel, United States Fish and Wildlife Service personnel; and additional information was obtained from published and unpublished literature. Designated graphically, according to substrate composition, are approximately 900 spawning grounds that have been or are being used in the Michigan coastal waters of the Great Lakes. This report includes information on 55 species of fishes and spawning ground utilization from the 1890's through 1978.

# INTRODUCTION

Michigan's coastal waters have in recent years undergone rapid changes brought about by a rapidly moving society. Dredging and filling projects have changed the face of much of the coastline. Agricultural modifications of the Great Lakes drainage and influences of urbanization and industrialization have caused major changes in the Great Lakes which have affected fish populations (Trautman, 1957). Knowledge concerning the locations of fish spawning areas may help in their preservation and thus the perpetuation of species which might otherwise fall pray to human cultural expansion.

Relatively little information is available, in the literature, relating directly to fish spawning ground locations in Michigan's coastal waters of the Great Lakes and their physical characteristics. Some literature of this type is available for individual species or families (Peck, 1978; Koelz, 1929; Commercial Fisheries Material, 1927-28). Although many recent studies concerning ichthyoplankton have appeared in the literature, this information was generally concerned with the impingement and entrainment of the egg, fry and larval stages of fishes in the water cooling systems of large electrical generating power plants. These reports indicated locations of fish nursery grounds but rarely mentioned spawning ground locations or characteristics.

It appears that fish spawning locations in Michigan's coastal waters and their characteristics; such as bottom types, depths, and other pertinent spawning data, have been rather neglected.

> "...The whole secret of fishing this lake (Lake Superior) is all based around the fish egg; the fish egg has been terribly neglected over the years...Fish life is a very uncertain thing. It doesn't follow an exact pattern; it changes from day to day..."
>
> Tom Brown
> A commercial fisherman
> for over 65 years

The locations of many traditional spawning grounds have been known for well over 100 years by commercial fishermen and these locations have been passed on from generation to generation by word of mouth. Very few of these spawning locations have been documented, however; and the knowledge, gained by the hard work of commercial fishermen in the past, is being lost as the number of commercial fishermen diminishes.

Many areas of Michigan's coastal waters were not identified as exhibiting any known fish spawning grounds during the course of this study. These areas should not be considered as non-fish spawning areas, but only as regions where there is no information available at the present time.

In this report, an attempt was made to collect as much of this information yet available and couple it with the literature to map the past and presently known fish spawning grounds in Michigan's coastal waters of the Great Lakes.

# MATERIALS AND METHODS

Data on fish spawning grounds were collected from two primary sources. Personal communication was used to collect data from people who had knowledge of past or present spawning areas, and an extensive literature search was also utilized.

## Literature Search

The literature search for data relating to fish spawning grounds included an extensive computer search, a search of the Michigan State Archives, and a search of various university libraries. Bibliographical sources that were searched by computer included; BIOSIS, DATRIX II, National Technical Information Service (NTIS), Aquatic Science Abstracts, Denver Public Library Fish and Wildlife Reference Service, Smithsonian Science Information Exchange, Smithsonian Science Information Exchange-Current Exchange, and the Michigan Technological University Lake Superior Basin Bibliography.

## Personal Communication

Personal interviews were used to collect unpublished information from active and retired commercial fishermen, Michigan Department of Natural Resources personnel, and other professional fisheries biologists (Appendix 1). Before any interviews were conducted, the staff members of Aquatic Systems, Inc., were instructed by a professional oral historian as to the techniques of collecting information via interviews. Staff members were then assigned to the thirteen Michigan Department of Natural Resources' fisheries districts. A list of those fishermen who purchased 1978 Michigan Commercial Fishing Licences was used as an appropriate list from which to start the search, as was a suggested list of professionals obtained through the Michigan Department of Natural Resources. Retired commercial fishermen and retired professional biologists were also contacted.

During each interview a list of prepared questions was used and the responses recorded. These questions concerned fish species, bottom characteristics of spawning grounds, depth of spawning, duration of spawning, and other related information. Unless otherwise requested by the interviewee, the conversation was also recorded using a cassette tape recorder.

United States Department of Commerce, National Oceanic and Atmospheric Adminstration Great Lakes navigational charts were used in each interview as a map upon which to reference spawning areas. A sheet of 30 mil (.030 inch) clear acetate was used to cover the charts, and permanent marking pens were used to outline spawning locations on the acetate. Before any locations were drawn, however, three referencing points, usually compass rose centers, were marked on the overlying acetate to assure that the acetate could be removed from the chart and repositioned later with no loss of accuracy. The interviewee was encouraged to draw the locations of spawning grounds to further increase accuracy.

At the completion of each interview, the acetate sheet(s) was indexed as to the name and address of the interviewee and was given an interview number. The tape recording was referenced in a similar manner. Later, with interview notes, acetates, a typed transcription of the interview, information from other interviews and the literature, spawning areas were located on photocopied sections of NOAA Great Lakes charts (Appendix 3). Other data from which the text could be written were also recorded.

## Mapping of Fish Spawning Grounds

In an effort to best represent and map fish spawning areas, sections of NOAA Great Lake Charts (13th edition) were photocopied as closely to a one to one magnification as possible. This allows each figure (Appendix 3) to be extracted from the report and overlaid onto the corresponding lake chart for an accurate perspective view of spawning ground locations. Several maps are included which have no spawning grounds referenced as "grounds not defined", however, the authors included these figures to complete the mapping of the entire Michigan coastline. Some large, offshore, open water spawning areas were not entirely mapped, but their locations were discussed in the text. For ease of location identification, the general area covered by each figure has been further referenced as to the areas of Michigan and Michigan's coastal waters that it covers (Appendix 2). As an added reference, the latitude and longitude of the approximate center of each lake chart sectional map have been included on each figure (Appendix 3). Spawning grounds in certain areas were too congested to include all spawning areas on a single map; therefore, two or more maps of the same area were used, identically numbered, and referenced alphabetically (A, B, C, etc.).

Every spawning area referenced, either by personal interview or from the literature, was done so with symbols representing the bottom characteristics (Table 2) as indicated by the source of the information. Spawning grounds referenced by a mixture of symbols indicate a mixture of various bottom types. When described locations of spawning areas were rather vague, dashed lines were drawn around the area indicating that only an approximate location was referenced.

Spawning grounds were then coded for fish species with a one or two letter code (Table 3). In some cases, when sources were not specific as to the individual species or subspecies within a group or family of fishes, a one or two letter code was used referencing the group or family. This situation arose several times with lake trout, for which there exists two subspecies and several races. When a source referred to a lake trout spawning ground with no reference as to a particular race or subspecies, an "L" was used (Table 3), however, when a source specified a particular race or subspecies, a two letter code representing that particular group was used.

The cumulative number of fishermen and other sources that referenced a particular species as spawning on each spawning ground was also reported (Figure 1).

Finally, the time span that each species was known to have utilized each area for spawning was indicated (Figure 1). If one source referred to a species as spawning on a particular reef in the 1920's and his knowledge of the area ended in 1956, but another source referred to spawning on the same reef by the same species from 1940 until 1978, the code would then include years of spawning for the species in question from the 1920's through 1978. If more than one species were referenced on a spawning ground, and the years of spawning of each species were different, the spawning ground was labeled with more than one code. In all cases "00's" refers to the 1900's or that span of time between 1900 and 1910.

As an added reference, the locations of all near shore fish spawning grounds were recorded by county, township, range and section (Appendix 5).

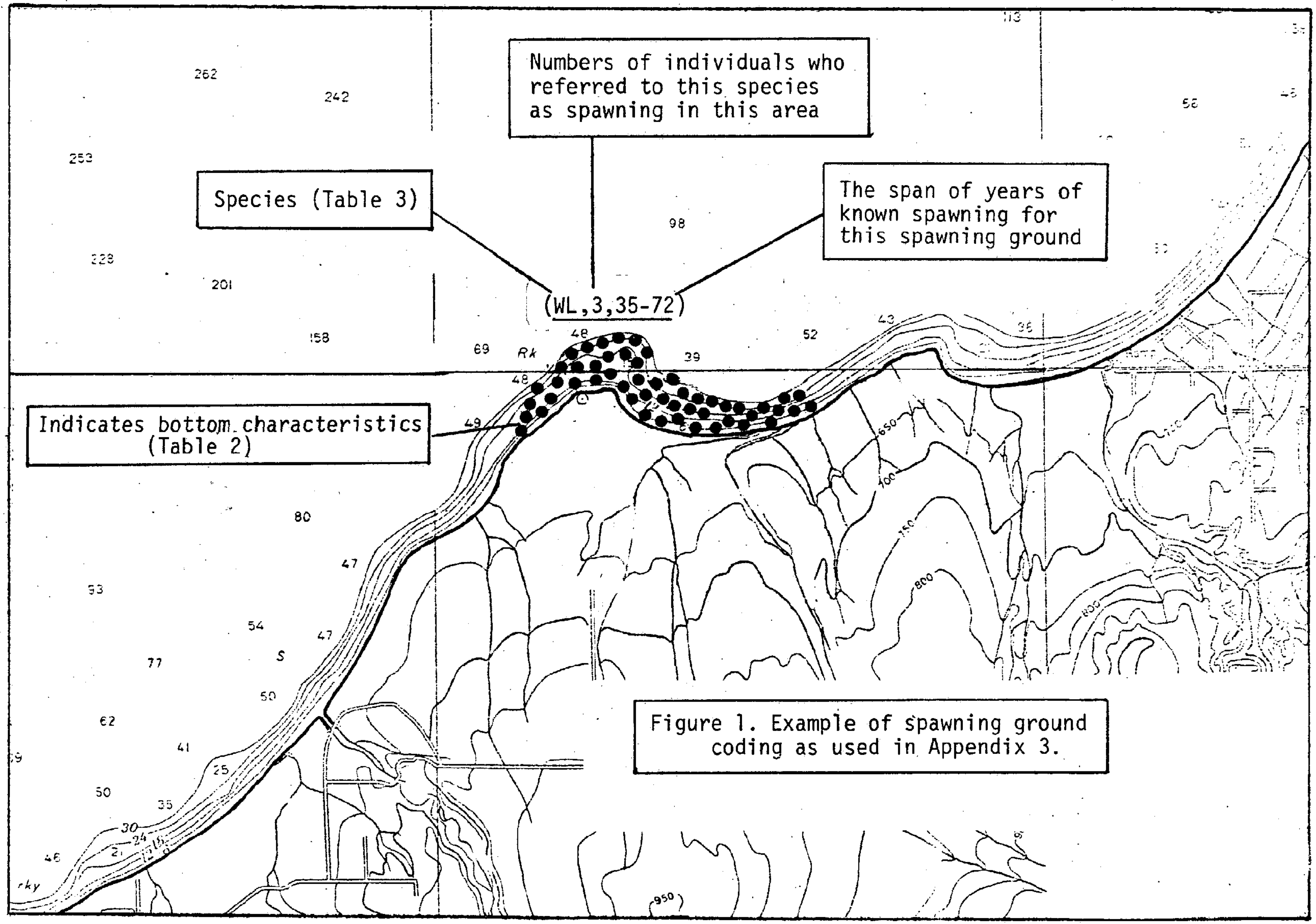


Figure 1. Example of spawning ground coding as used in Appendix 3.

TABLE 2 . Symbols representing spawning ground bottom characteristics.

| Bottom Characteristics | Symbol |
| --- | --- |
| ROCK | ● |
| GRAVEL | ⊕ |
| ROCK AND GRAVEL | ◒ |
| SAND | △ |
| SAND AND ROCK | ▲ |
| SAND AND GRAVEL | □ |
| CLAY | ○ |
| MUD | ■ |
| AQUATIC VEGETATION | \| |
| HONEYCOMB (Limestone) | ▩ |
| OTHER: Referenced for specific figure | ⊖ |

TABLE 3. Letter designations of fish species as shown on spawning ground maps

| FISH SPECIES | DESIGNATIONS |
|---|---|
| Alewife, *Alosa pseudoharengus* (Wilson) | A |
| Bowfin, *Amia calva* Linnaeus | AC |
| Lake Sturgeon, *Acipenser fulvescens* Rafinesque | AF |
| Black bass (unspecified) | B |
| Largemouth bass, *Micropterus salmoides* (Lacepede) | BL |
| Smallmouth bass, *Micropterus dolomieui* Lacepede | BS |
| White bass, *Morone chrysops* (Rafinesque) | BW |
| Chubs, *Coregonus spp* | C |
| a. Bloater, *C. hoyi* (Gill) | CB |
| b. Blackfin cisco, *C. nigripinnis* (Gill) | CC |
| c. Kiyi, *C. kiyi* (Koelz) | CK |
| Gizzard shad, *Dorosoma cepedianum* (Lesueur) | DC |
| Emerald Shiner, *Notropis atherinoides* (Rafinesque) | ES |
| Freshwater drum (Sheepshead), *Aplodinotus grunniens* (Rafinesque) | FD |
| Goldfish, *Crassius auratus* (Linnaeus) | G |
| Gar, *Lepisosteus spp.* | GP |
| Lake herring (Cisco), *Coregonus artedii* (Lesueur) | H |

TABLE 3. (Continued)

| FISH SPECIES | DESIGNATIONS |
|---|---|
| Bullhead, *Ictalurus spp.* | I |
| a. Brown, *I. nebulosus* (Lesueur) | IN |
| Channel catfish, *Ictalurus punctatus* (Rafinesque) | IP |
| Crappie, *Pomoxis spp.* | K |
| Lake trout (unspecified), *Salvelinus namaycush* (Walbaum) | L |
| a. Rock of Ages lake trout, *S. namaycush namaycush* (Walbaum) | LA |
| b. Channel salmon, *S. namaycush namaycush* (Walbaum) | LC |
| c. Humpers, paperbellies, humpies, bankers, *S. namaycush namaycush* (Walbaum) | LH |
| d. Lean, *S. namaycush namaycush* (Walbaum) | LL |
| e. Moss trout, *S. namaycush namaycush* (Walbaum) | LM |
| f. Native, Mackinaw, *S. namaycush namaycush* (Walbaum) | LN |
| g. Planted (fin-clipped), *S. namaycush namaycush* (Walbaum) | LP |
| h. Redfin, *S. namaycush namaycush* (Walbaum) | LR |
| i. Siscowet, fat, halfbreeds, *S. namaycush siscowet* (Agassiz) | LS |
| Splake, *Salvelinus namaycush* X *fontinalis* | LV |
| Smelt, *Osmerus mordax* (Mitchill) | OM |
| Blue Pike, *Stizostedion vitreum glaucum* (Hubbs) | PB |

TABLE 3. (Continued)

| FISH SPECIES | DESIGNATIONS |
|---|---|
| Muskie, *Esox masquinongy* Mitchill | PM |
| Northern Pike, *Esox lucius* Linnaeus | PN |
| Sauger, *Stizostedion canadense* (Smith) | PS |
| Walleye, *Stizostedion vitreum* (Mitchill) | PW |
| Rainbow trout (Steelhead) *Salmo gairdneri* Richardson | R |
| Suckers, *Moxostoma spp.; Catostomus spp.* | S |
| Salmon (unspecified) *Oncorhynchus spp* | SA |
| Brown Trout, *Salmo trutta* Linnaeus | ST |
| Burbot (Lawyer), *Lota lota* (Linnaeus) | T |
| Minnows (unspecified) | UM |
| Bigmouth Buffalo, *Ictiobus cyprinellus* (Valenciennes) | V |
| Whitefish (unspecified) | W |
| a. Lake whitefish, *Coregonus clupeaformis* (Mitchill) | WL |
| b. Round Whitefish(Menominee), *Prosopium cylindraceum* (Pallas) | WR |
| Carp, *Cyprinus carpio* Linnaeus | X |
| Quillback, *Carpiodes cyprinus* (Lesueur) | XQ |
| Yellow Perch, *Perca flavescens* (Mitchill) | Y |
| Sunfish (unspecified) | Z |

TABLE 3. (Continued)

| FISH SPECIES | DESIGNATIONS |
|---|---|
| a. Bluegill, *Lepomis macrochirus* Rafinesque | ZB |
| b. Pumpkinseed, *Lepomis gibbosus* (Linnaeus) | ZP |
| c. Rock bass, *Ambloplites rupestris* (Rafinesque) | ZR |

# RESULTS AND DISCUSSION

Relatively little information concerning locations of spawning grounds in Michigan's coastal waters was found in the literature. Some spawning locations and bottom characteristics have been documented for individual species, but on the whole very few spawning grounds of the Great Lake fishes have been charted in the past.

In all, 151 personal interviews were conducted with commercial fishermen and other people who had knowledge of fish spawning grounds from a total of 221 contacted individuals. Some interviews were conducted with Wisconsin fishermen who has purchased licenses to fish in Michigan waters; however, the vast majority of information was provided by Michigan residents.

The authors wish to note that some pertinent sources of information may have been overlooked in the preparation of this report. Any omission of material or information was unintentional as every attempt was made to assemble as much data as possible in the time allotted.

Each species for which pertinent spawning ground information could be obtained is dealt with separately in the following pages of this report. For each species, general information concerning spawning in Michigan's coastal waters of the Great Lakes is discussed in the following sequence: Lake Superior, Lake Michigan, Lake Huron, Lake St. Clair and Lake Erie. In turn, within each lake discussion, spawning grounds are discussed following the numerical order of the Michigan Department of Natural Resources statistical districts (Figure 2) (Smith et al., 1961).

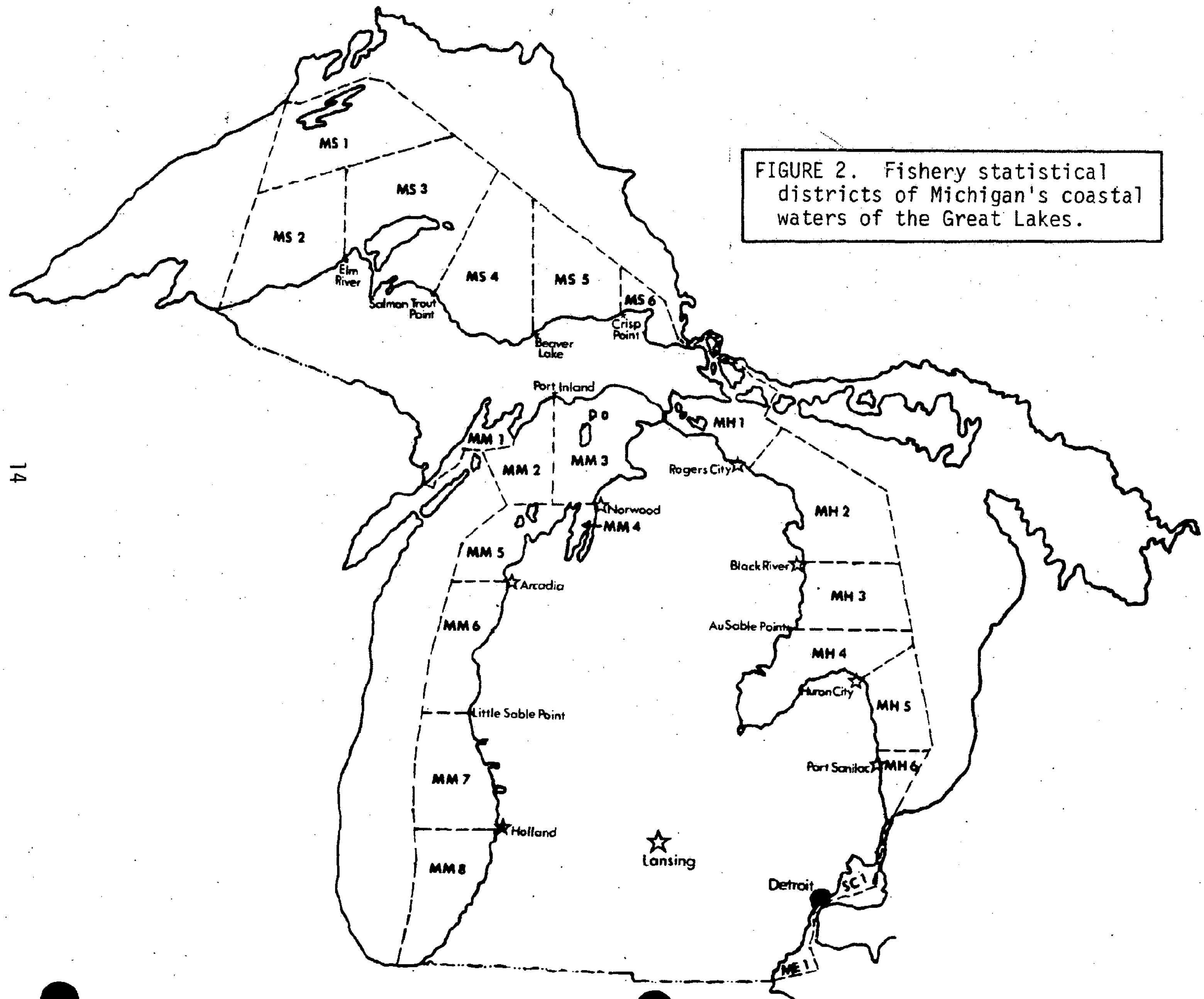


FIGURE 2. Fishery statistical districts of Michigan's coastal waters of the Great Lakes.

## LAKE TROUT

The lake trout is indigenous to the entire Great Lakes region and, in the past, has comprised an important part of the Great Lakes commercial fishing industry. The nomenclature currently in use by commercial fishermen for the lake trout is quite extensive. Pycha (1975) has indicated two forms with subspecific ranking, the lean or typical lake trout, *Salvelinus namaycush namaycush* (Walburn), and the siscowet or fat, *Salvelinus namaycush siscowet* (Agassiz), and has suggested that many races may exist withing these groups. Information obtained from commercial fishermen indicated that "distinguishable races" do indeed exist. For the purpose of this study, common names currently in use by commercial fishermen are used.

Spawning seasons for lake trout vary by specific location; however, the season may be considered to start generally in September and continue through early December in the Great Lakes' coastal waters of Michigan. Rahrer (1965) made reference to "humpers" near Isle Royale and Caribou Island that began their spawning run in mid-September. Michigan DNR spawn records for Lakes Superior, Michigan, and Huron indicate the majority of spawning occurred between 20 September and 15 November 1927, with the longest noted spawning period, 25 days, at Thunder Bay in Lake Huron (Van Oosten, 1927).

Spawning by lake trout throughout the Great Lakes is generally considered to take place over rocky shoals consisting of boulders, cracked rock, and gravel (Figure 3). Spawning depth may vary

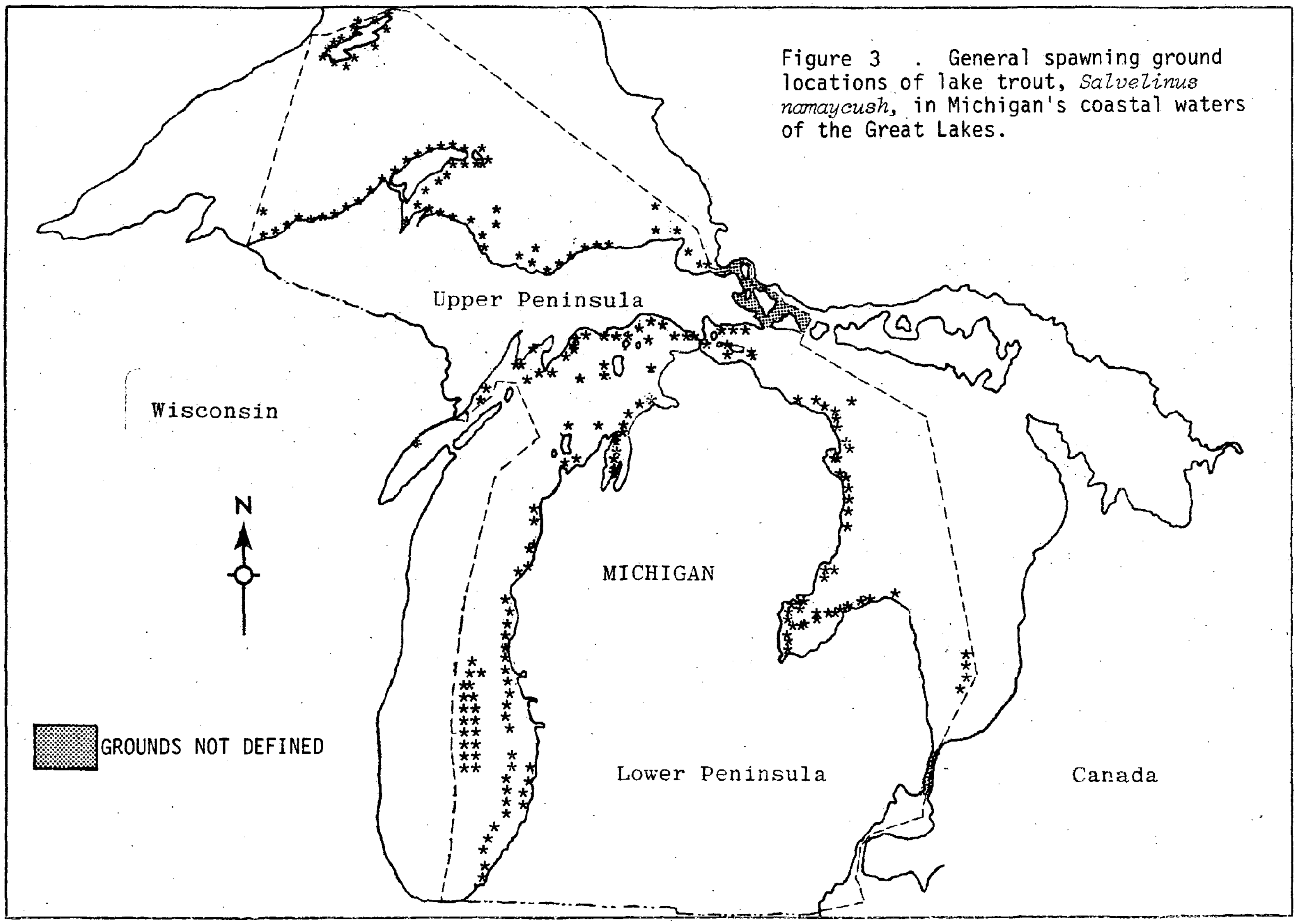


Figure 3 . General spawning ground locations of lake trout, *Salvelinus namaycush*, in Michigan's coastal waters of the Great Lakes.

from .15 meters to over 30 meters (1 to 100 feet) with various races seeming to prefer specific depth and reef type.

Lake Superior. Eschmeyer (1955) has reported the principal spawning grounds, for lake trout, in the United States waters of Lake Superior to be rocky shoals of less than 18 meters (60 feet). The Lake Superior spawning runs generally begin near the end of September at Isle Royale, followed by a run at the northern tip of Keweenaw County, followed by runs along the north shore of Michigan's upper peninsula (Cook, 1929).

"Humpers" congregate near reefs or "humps" on known spawning grounds southeast of Isle Royale and west of Caribou Island during late September (Eschmeyer, 1965). Rahrer (1965) has also indicated mid-September spawning for "humpers" living in the area of Isle Royale and Caribou Island.

In the vicinity of the Caribou Islands, near the Michigan-Ontario border, numerous lake trout spawning areas were reported (Wright, 1978). This area is composed of uplifted bedrock (banks) with "humpers" spawning on the ridges and siscowet spawning in the valleys or trenches. Spawning depth varies somewhat with the bottom configuration. Wright (1978) reported the spawning runs to begin generally in August and that "halfbreeds" also spawn in this area.

Two fishermen reported spawning grounds throughout the Caribou Islands area with spawning beginning in late August for "humpers" and "halfbreeds" and September for others (Appendix 3, Figures 36.1 and 36.2).

The following lake trout spawning areas were provided by

Michigan Department of Natural Resources Biologists R. Schorfhaar and J. Peck and were originally supplied, to the above, by commercial fishermen. The areas will not appear in Appendix 3 unless they were identified and geographically located during an interview. The material appears verbatim as it was received from the Michigan Department of Natural Resources, with the exception that the source of material has been deleted.

MS-1

Lake Trout Spawing Areas
1. McCormick Reef
2. Hay Bay Reef
3. McCormick Rocks
4. Brandsford Reef
5. Harlem Reef
6. Domen and Doden Reefs
7. Rock of Ages Reefs

Isle Royale fishermen have a number of different names for lake trout they feel are different strains. Some of these strains used certain reefs for spawning. A few of the names given the lake trout are: (1) Rock of Ages trout; (2) Redfin (also Redfin Mackinac); (3) Silver-Greys; (4) Channel salmon (believe they sapwn in Malone Bay area); (5) Salmon-Trout.

MS-3

Lake Trout Spawning Areas
1. Shore Bank - located west of North Portage Entry. Extends from 1 1/2 miles west of the "entry" for approximately 4-5 miles southwest toward Redridge. Depth of spawning area approximately 15-40'. According to lake chart the bottom type is rock.
2. Located one mile northeast of North Portage Entry. This reef extends lakeward in a NNE direction for slightly over one mile. Depth is 8-40' and bottom type assumed to be rocky.
3. Hutchinson Shoal - five miles southwest of Eagle River. Top of shoal is 14' deep and approximately .6 mile offshore with the reef paralleling shore for about .5 mile. North end of shoal is due east of a tower located on shore. Bottom type is rocky according to the lake chart.
4. Eagle River Shoals - west end of the shoals start approximately 1 1/2 miles SW of Eagle River .8 mile from shore and extends ENE for 5-5 1/2 miles across the mouth of Great Sand Bay to its east point. Bottom type is assumed to be rock.
5. Little Grand Marais Harbor Reef - located off the mouth of Little Grand Marais Harbor approximately two miles east of Eagle Harbor. These reefs extend eastward from the

mouth of the harbor for an unknown distance (believed to be 1-2 miles) toward Agage Harbor. Bottom type is rock.

6. Devil's Wash Bowl - located four miles west of the entrance to Copper Harbor. This is apparently a steep shore bank with rock bottom.
7. Copper Harbor Reef - forms the partial barrier to Copper Harbor. Bottom type is rock. Lake trout spawning occurred earlier than in most areas.
8. Keweenaw Point - located at the tip of the Keweenaw Peninsula. Extends lakeward in a southerly direction for approximately .4 mile. Bottom assumed to be rock.
9. Manitou Island Reefs - located all around Manitou Island off Keweenaw Point. Lake trout were known to spawn all around the island. Spawning occurred early on a reef on the south side of the island. This reef extends eastward from the southernmost extention of the island for about one mile. Redfins spawned late in the area north of the Gull Rock end of the island. This area encompasses about two square miles and was felt to be the best lake trout spawning ground in MS-3. Bottom type is rocky in the entire area.
10. Point Isabelle - located on south side of Bete Grise. Spawning occurred from approximately two miles northwest of the point to two miles southwest of the point. Bottom type is rocky.
11. Betsy Reefs - extend from about 3.8 miles northeast of the Betsy River to 1 1/2 miles southwest of the river. Bottom type is rock.
12. Buffalo Reef - Grand Traverse Bay - located 1.2 miles NNE of the mouth of Traverse River. This reef extends lakeward due east for 1.6 miles. Bottom type is rocky. This reef is known to have been used by lake trout as recently as 1969 when an estimated 3,000' of gill net took 370 lake trout.
13. Traverse Point - spawning area extends from the north tip to the south tip of the point. Bottom type is rock.
14. Red Rocks - off south point of Little Traverse.
15. Traverse Island - spawning area all around island but mostly off south side for 4 1/2 miles. Bottom type is rock. This reef was used by Redfin with the best area from 10-50'. A plant of 85,000 lake trout was made on this reef in 1973 with an adipose fin clip.
16. Point Abbaye Reef - extend northeastward from Point Abbaye for 1.7 miles and is .8-1 mile wide. This reef is marked by a Coast Guard bell buoy and by a red nun buoy. Bottom type is boulders and rock.
17. Huron River Point Reef - extend northeastward from Huron River Point for 1.6 miles. Bottom type is rock.

*Note: Reef Nos. 3, 4, 5, and 7 are formed by the upturned edges of the formations which form the Keweenaw Peninsula. The rock which forms these reefs was more resistant to erosion than the rock shoreward of them.

MS-4

Lake Trout Spawning Areas

1. Big Bay Point Reef - extend due north from Big Bay Point

for 1 1/2 miles with the outer end marked with a black can buoy. Bottom type is rock.

2. Unnamed Point on Lake Chart - located 2.8 miles SSE of Yellow Dog Point. Spawning area apparently located for about one mile north of point to one mile south of point. Bottom type assumed to be rock.
3. Garlic Island Reef
4. Thoney Point - spawning area extends from the point southward to about the mouth of the Little Garlic River (1.4 miles). Bottom type is rocky. This reef was felt to be the best in the Marquette-Big Bay area.
5. Partridge Island Reef - locate 1.3 miles north of Partridge Island, approximately one mile in diameter. Bottom type is rock. Netting in October, 1973, produced spawning lake trout.
6. Laughing Fish Point Reef - located from the point eastward for approximately two miles. Bottom type is rock. Netting in October, 1973, produced few spawners. Depth is 10-40'.
7. AuTrain Island Reef - extends northward from Autrain Island Reef for 1.3 miles. Bottom type is rocky, depth 10-40'.
8. AuTrain Point to Five Mile Point Reefs - much of the shoal area between these points and the shoal areas including Wood and William Islands was apparently good lake trout spawning area. Bottom type is mostly ledge rock with areas of rubble.
9. Grand Portal Shore Bank - most of area from Mosquito River to Chapel Creek reported to be good spawning area. Bottom type is ledge rock and rubble.
10. Beaver Hump - located due north of Beaver Lake, 2.6 miles from shore. Hump lies NE x SW and is about two miles long. Depth is 40-60'.
11. Others - There are a number of offshore reefs in the Munising area including Wood Island Reef, Trout Reef, East Bank, Grand Portal Reef and Big Reef.

<u>MS-6</u>

Lake Trout Spawning Areas

1. Offshore Reef - located 2-3 miles of Tahquamenon Island. Extend in a north-south direction for about ten miles. Depths range from 35-100'. Bottom type mostly unknown but partially clay.
2. Salt Point Reef - extends from Salt Point southward to about 1 1/2 mile west of Pendills Creek. Bottom type is mostly rocky.
3. Iroquois Island Shoals - extensive shoal area in approximately a two-mile radius of Iroquois Island. Bottom type is listed as rocky and boulders on the lake chart.
4. Canadian Lake Trout Spawning Areas - located in Whitefish Bay.
    a) Parisienne Shoal
    b) Maple Island
    c) Sandy Islands and Steamboat Island Shoals
    d) Pancake Shoals

In the vicinity of the North East end of Isle Royale native lake trout were reported to have spawned in near shore waters (Appendix 3, Figures 1 and 2). "Redfin" spawning took place in the vicinity of Passage Island and Gull Island over rock bottom (Appendix 3, Figure 1), and "Humpers" spawned over rock and clay near Middle Island Passage (Appendix 3, Figure 2).

"Native" lake trout spawn on the north shore of Isle Royale at four specific spawning locations ranging in depth from 2 to 9 meters (6 to 30 feet) of water (Appendix 3, Figure 4A). In the current study it was found that off the southwest end of Isle Royale numerous shoals in 9 to 15 meters (30 to 50 feet) of water have been used since the early 1900's by "native" and "redfin" trout as spawning grounds (Appendix 3, Figures 5A and B). Just west of Isle Royale is "Rock-of-Ages Reef", a known spawning ground of the "Rock-of-Ages" lake trout (Appendix 3, Figure 5A). The "Rock-of-Ages" lake trout began their spawning run near the end of September in this area.

In Washington Harbor on the southwest end of Isle Royale and just west of Beaver Island is a spawning ground utilized by the "channel salmon" lake trout (Appendix 3, Figure 5A). Other spawning areas used by the "channel salmon' are on either side of Malone Bay adjacent to Wright Island along the south shore of Isle Royale (Appendix 3, Figure 3). In these areas "channel salmon" begin their spawning run in mid-October. "Native" and "redfin" lake trout spawn in 9 to 15 meters (30 to 50 feet) of water from near Rainbow Point to Siskiwit Island along the south shore of Isle Royale (Appendix 3, Figures 4A and 5B). The spawning season for lake trout in the vicinity of Isle Royale, generally begins in mid-September for the "redfin" and mid-October for the "native" lake trout. Bottom composition in this area is generally rock, and spawning depths range from 9 to 25 meters (30 to 90 feet) of water.

In the vicinity of the Keweenaw Peninsula, extending from near Ontonagon on the west to near Grand Portal Point on the east, are numerous lake trout spawning areas (Appendix 3, Figures 6 through 29). Spawning reefs in this area are generally rocky in composition, and water depths over the reefs range from 1 to over 30 meters (2 to over 100 feet). Spawning times are generally from the first part of October through mid-November.

In one instance on the north side of the Keweenaw Peninsula "siscowet" were reported to begin a spawning run in early July (Appendix 3, Figure 13). The west end of Manitou Island and an area near the end of Keweenaw Point were inciated as "native" and "redfin" spawning grounds (Appendix 3, Figure 17A). Two commercial fishermen indicated three locations in the Keweenaw Bay area where "planted" lake trout were spawning over rock, and rock and gravel (Appendix 3, Figure 21A). One reference was made to an isolated reef with rock and gravel bottom in the Keweenaw Bay where the spawning run began in the first part of October (Appendix 3, Figure 22).

Spawning grounds in the vicinity of Point Abbaye, Huron Islands and Huron River Point ran generally from near shore to 27 meters (90 feet0 of water, and spawning was heaviest from mid-October to the end of November (Appendix 3, Figures 22 and 23).

The area from near Big Bay Point on the west to near Grand Marias on the east is covered in current spawning ground survey work by the Michigan DNR (Peck, 1975) (Appendix 3, Figures 25 through 30). Exchmeyer (1956 and 1965) has also provided evidence for spawning in this area.

The Stannard Rock area was reported as a spawning ground for both lean and native lake trout (Appendix 3, Figure 26.1). One fisherman reported native trout taken in 6 meters of water to be fatter and develop quicker than others. It was also reported that the lean trout feed extensively on fresh water shrimp in this area.

North of Crisp Point in 9 meters (30 feet) of water one isolated reef was indicated as an active spawning site from the early 1900's until 1930 for "native" lake trout (Appendix 3, Figure 33). The Whitefish Bay area was indicated to have "native" lake trout spawning grounds of rock and gravel with the spawning run beginning about the first of November (Appendix 3, Figures 35 and 36).

Lake Michigan. In Lake Michigan the number of races of lake trout recognized by commercial fishermen is reduced from those recognized by commercial fishermen in Lake Superior; however, reference was made more often to the "moss trout" in Lake Michigan waters than in Lake Superior waters. The primary distinction of this lake trout is that is spawns over rocks covered with "moss".

The "moss" reported by fishermen appears to be *Dichotomosiphion tuberosus* (Needham, et al, 1922). Needham reported that fishermen refer to this plant as "moss" in Lake George, New York. The depth at which this plant grows and descriptions of Great Lakes fishermen are similiar to other descriptions of *Dichotomosiphion tuberosus*.

Generally, spawning in Lake Michigan takes place over rock, and rock and gravel shoals with the spawning run beginning slightly earlier on the north shore of the lake than along the eastern shore. Commercial fishermen reported spawning dates of mid-October through the end of November in the waters of Northern Lake Michigan. Van Oosten (1935) reported the mean spawning time for lake trout in Lake Michigan to be 15 October to 15 November. Chiotti (1973) reported a peak spawning period near Ludington of 1 November to 15 November. In a 1927 condensed report on spawning seasons, the mean spawning season for Lake Michigan was from 15 October to 15 November (Van Oosten, 1935). Commercial fishermen reported spawning seasons in the lower peninsula to be from mid-November to mid-December. In the upper peninsula, spawning times were reported to be generally from the first of November to near the end of November.

Lake trout spawning grounds along the northwestern shore of Lake Michigan are somewhat restricted to specific spawning sites. Van Oosten (1927), in a condensed report of Great Lakes spawning seasons, indicated only one spawning ground on the western shoreline of the upper peninsula near the north end of Big Bay de Noc, with a spawning run from 1 November to 1 December. Areas indicated by Peck (1975 and 1976) as traditional spawning grounds for lake trout are included in Appendix 3, Figures 50 through 76.

Lake trout spawning areas in the vicinity of Deadman's Point, Arthur Bay, and Whaleback Shoal are over rock, and rock and gravel shoals, and spawning runs extend from mid-October to the end of November (Appendix 3, Figures 51A, 52, and 53). In the area of

Cedar River in .15 meters (6 inches) of water "planted" lake trout spawn at unspecified dates (Appendix 3, Figure 53).

Approximately 2.5 kilometers (1.5 miles) northeast of Point DeTour, in 3 to 9 meters (12 to 30 feet) of water, is a lake trout spawning ground with spawning activity from mid-October through the first week in November (Appendix 3, Figure 61). An area 6 kilometers (4miles) south of Portage Bay over rock and gravel shoals is used by lake trout for spawning, also from mid-October through the first week in November. Spawning grounds at "Rock Reef" southeast of Point Aux Barques, in Parent Bay, and Wiggins Point Shoal are all rock and gravel with a general spawning run beginning in mid-October and extending through mid-November (Appendix 3, Figures 66 and 67). Just south of Manistique, "planted" lake trout have been noted spawning during the month of November in .15 meters (6 inches) of water along the shoreline (Appendix 3, Figure 68). From Seul Choix Point on the west to Point La Barbe on the east, numerous spawning grounds were indicated (Appendix 3, Figures 69 throuth 76). Spawning runs begin in the above mentioned area near the end of October and run into November. Peck (1975) indicated traditional spawning grounds in this general area for the lake trout.

There are numerous specific reefs and shoals in the vicinity of Beaver Island that were indicated as spawning locations for lake trout (Appendix 3, Figures 79A, B; 81B, 82A, C; 84B, 85A, B; 86A, B; and 87A, B). Bottom type in this spawning ground area was generally reported as honeycomb, rock, and rock and gravel. On the east shoreline are also well defined spawning reefs. Lake trout spawn on or near Dahlia Shoal, the point just south of Big Rock Point, Northport Point, Bellow Island, north of New Mission Point, Sutton's Point, and in Bowers Harbor (Peck, 1978) (Appendix 3, Figures 79A, 90, 94A, B; 96A, 97B, and 99 respectively). "Native" lake trout were reported spawning near shore in the vicinity of Seven Mile Point (Appendix 3, Figure 88). Offshore, rocky shoals were indicated as spawning grounds with spawning runs beginning near the end of October (Appendix 3, Figures 91A, B; 92, and 98B). Two other rocky areas were indicated in near shore waters for lake trout spawning and one offshore honeycomb shoal near the mouth of Guyer Creek (Appendix 3, Figures 93 and 95 respectively). Three locations in Grand Traverse Bay for "moss trout" spawning grounds were indicated (Appendix 3, Figures 96A, 97A, and 99). Bottom type in these areas was said to be "moss" and rock and spawning depth was 9 to 18 meters (30 to 60 feet). In one case the "moss trout" no longer utilize this area for spawning, however, no specific dates were given (Appendix 3, Figure 96).

Material received from the Michigan Department of Natural Resources indicates these planted lake trout spawn along the shoreline from near the Penn-Dixie Cement Plant silos in Little Traverse Bay south to Norwood in outer Grand Traverse Bay (Keller 1979).

From North Fox Island south to Sleeping Bear Point, lake trout spawn over rock or rock and gravel shoals in water from 2 to 18 meters (6 to 60 feet) in depth (Appendix 3, Figures 101A, B; 103A, C; 104, 105, 106A, B, D; 108C, 109A, B; 110A, B; and 111). Reported spawning seasons for the above areas were mid-October to mid-November.

An isolated spawning shoal in Platte Bay over rock bottom was indicated to be utilized "years ago" by lake trout (Appendix 3, Figure 113). Three areas were indicated near Arcadia and south to just north of Manistee over a rock and honeycomb bottom (Appendix 3, Figures 114 and 115). "Burnham Reef" north of Arcadia was fished for lake trout in the 1800's, however no indication was given that the area was still in use for spawning (Appendix 3, Figure 114). Planted lake trout were reported spawning from near shore to 2 kilometers (1 mile) off shore in water 15 meters (50 feet) or less, from south of Manistee to Little Sable Point (Appendix 3, Figures 115, 116, 117, and 118B). Bottom types in the spawning areas were rock, and stone and gravel.

From Stony Lake south to the Indiana state line are numerous near shore spawning grounds (Appendix 3, Figures 119, 120, 121A, 126B, 131B, 132A, and 134B). These spawning grounds were said to be generally composed of rock, rock and gravel, and in some cases sand. Spawning dates were reported as mid-October to mid-November. Three commercial fishermen made reference to large open water areas with primarily mud bottoms where lake trout spawn during October and November (Appendix 3, Figures 122A, 123A, 123B, 125A, 127B, 129A, 130, 132A and 133A). In this one instance, some question arose as to lake trout spawning over mud in over 107 meters (350 feet) of water. One of the fishermen was re-contacted and confirmed the area as a spawning ground and not just an area fished.

The "Milwaukee Reef" in mid-Lake Michigan runs from Little Sable Point south to Port Sheldon (Appendix 3, Figures 135 and 136). "Lean" and "Siscowet" lake trout were reported to have spawned over clay, rock and clinkers (ie. burned coal from ships), from the early 1930's until the late 1940's. Spawning was indicated to begin in mid-October and continue until mid-November in this area.

Lake Huron. The following lake trout spawning reefs were provided by the Michigan Department of Natural Resources Biologist R. Eschenroder and were originally identified by commercial fishermen in August 1968. These reefs will not appear in Appendix 3 unless they were identified and geographically located during and interview.

St. Martin Reef; Pomeroy Reef; Goose Island Shoal; Channel between Round and Mackinac Islands; Majors Reef; North and South Graham Shoals

Poe Reef; Spectacle Reef; Zela Shoal; Lafayette Point; Lighthouse Point; Lime Kiln Point

Old Presque Isle Lighthouse; Shorebank between Stoneport and Rockport; Reef Southeast of Middle Island Lighthouse in 22' of water

Six Fathom Bank; Yankee Reef; North Point (Thunder Bay); Shorebank off of Black River

Sturgeon Point; Shorebank between Harrisville and Thunder Bay; Port Austin Reef; Harbor Beach

South Graham Shoal and Major's Shoal, both in the Straits of Mackinac, were reported as lake trout spawning areas (Appendix 3, Figure 77). Reported depths for these grounds were 2 to 4 meters (6 to 12 feet with rock bottom. Goose Island and Goose Island Shoal were also reported as lake trout spawning grounds over a rock bottom (Appendix 3, Figure 139C); no spawning dates were given for the above mentioned area, although it was indicated that Lake Huron lake trout spawn generally a week earlier than in Lake Michigan.

Native lake trout spawning sites were reported from the east end of Drummond Island. These areas were noted to contain a rock bottom and spawning occured in 1 to 5 meters (3 to 15 feet) of water beginning in September (Appendix 3, Figures 145.1 and 145.2).

From north of Round Island south to Hammond Bay are a number of "native" lake trout spawning grounds (Appendix 3, Figures 141, 146, 148B, 149 and 151A). Bottom type in this area is rock and honeycomb, with October spawning runs reported most frequently. Planted lake trout were reported to spawn over rock bottom in the near shore area around the Hammond Bay Biological Station (Appendix 3, Figure 151B).

From Adams Point south to Greenbush numerous lake trout spawning sites were reported, generally over rock, gravel and honeycomb bottoms (Appendix 3, Figures 152, 153, 155 through 158 and 159B). Spawning seasons were reported only in one instance; from late October through early November. "Siscowets" were reported spawning northeast of Presque Isle Harbor in deep water but no specific spawning times were indicated (Appendix 3, Figure 154).

Lake trout were reported spawning in the Saginaw Bay area over rock, gravel, and sand bottoms from mid-October through mid-November (Appendix 3, Figures 160B, 162A, 163B, 163C, 164D, 168A, 169, 170, and 171). "Planted" lake trout were reported spawning in the fall of 1978 in near shore water west of the mouth of the Rifle River (Appendix 3, Figure 165B).

A November spawning period was indicated for lake trout in mid-Lake Huron (Appendix 3, Figures 175 and 176). Spawning depth in this area was 40 meters (130 feet) and spawning reportedly occurred during

November.

No spawning activity was reported from the Lake St. Clair or the Lake Erie areas.

CHUBS

The term chubs, *Coregonus spp.*, as it is referred to in this report, represents a collection of seven different species that are distributed throughout the Great Lakes. This group includes the deepwater cisco, *Coregonus johanne*; the blackfin cisco, *Coregonus nigripinnis*; the shortjaw cisco, *Coregonus zenithicus*; the longjaw cisco, *Coregonus alpenae*; the shortnose cisco, *Coregonus reighardi*; the kiyi, *Coregonus kiyi*; and the bloater, *Coregonus hoyi*. The last five species mentioned are endemic to the Great Lakes (Scott and Crossman, 1973; Jobes, 1943); however, not all seven species have been found concurrently in all of the Great Lakes. All species of chubs have been reported from Lake Michigan, four species from Lake Huron, and two species from Lake Erie (Koelz, 1929; Scott and Crossman, (1973), with Lake Superior reported as being represented by six species, all except the longjaw (Scott and Crossman, 1975).

Binding the above chub species together into a single group is their common deep-water habitat which also aids in their separation from the lake herring, *Coregonus artedii*, and the lake whitefish, *Coregonus clupeaformis* (Koelz, 1929). Both the lake herring and the lake whitefish were considered in separate sections of this study.

All but a few of the Great Lakes fishermen interviewed during the course of this study made no distinction between the various species of chubs. Koelz (1929) reported that the commercial catch of deepwater coregonids containing more than one species was also grouped under the general category of "chubs".

Chub spawning in the Great Lakes has been documented as occurring over a wide time span, a wide variety of bottom types, and over a wide range of depths. In Lake Michigan, spawning has been documented in all months except June and July. The Lake Huron chub spawning duration has been reported to be somewhat shorter, occurring in the fall between the months of August and January; and in Lake Superior, spawning took place between the months of October and January (Koelz, 1929). Little is known about the Lake Erie chub populations since the collapse of the commercial fishery (exemplified by a catch of 32 million pounds in 1924 to a catch of 3.5 million pounds in 1925 [VanOosten, 1929]). Scott and Smith (1962) showed that the longjaw was present in Lake Erie sometime after 1947, and Scott and Crossman (1973) have reported the presence of the deepwater cisco. Scott and Crossman and Scott and Smith indicate that the spawning season for Lake Erie chubs takes place between mid-August and November. Generally, the bloater spawns from mid-winter to early spring, the shortnose from spring to mid-summer, the deepwater from late summer to early fall, the kiyi and longjaw ciscos in early fall, and the shortjaw and blackfin ciscos in late fall and early winter (Smith, 1969).

Depth preferences for each of the various species of chubs are fairly constant. The bloater prefers the shallower areas; the shortjaw, shortnose and longjaw have been found in intermediate depths; the deepwater and blackfin somewhat deeper; and the kiyi is considered to be the deepest dwelling chub (Smith, 1969).

Various bottom characteristics have been reported to be conducive to chub spawning (Koelz, 1929; Jobes, 1943).

Very little information is available as to the temperature preferences of spawning chubs. Scott and Crossman (1973) reported that spawning seems to take place during times of decreasing temperature. Jobes (1943) showed temperature for the spawning of the shortjaw in Lake Michigan to be from 3.8 to 4.7°C; however, reports that temperature seems to have little effect on chub spawning and distribution.

Because the spawning characteristics of chubs are so variable, specific information pertaining to each species was condensed for this report (Table 4 and Figure 4).

Lake Superior. Chub spawning has been reported to occur in Lake Superior from September to January between the depths of 27 and 180 meters (90 and 600 feet) (Table 4 ). Bottom characteristics for the chub spawning grounds of Lake Superior cited from the literature are clays (Koelz, 1929); however, rock and mud characteristics have been reported by various commercial fishermen. Again, little information concerning the chub spawning areas for the Michigan coastal waters of Lake Superior appears to be available in the literature. All presently known spawning grounds will be discussed in the following section.

From the information available at this time, there were no known chub spawning areas from the Isle Royale region of Lake Superior or the Saxon Harbor to Redridge area.

Between Redridge and Big Bay Point, the area of Michigan's Keweenaw Peninsula, there were a number of reported chub spawning grounds. Two known areas of spawning existed in Keweenaw Bay (Appendix 3, Figure 21B) in depths exceeding 30 meters (100 feet);

TABLE 4. Chubs, *Coregonus spp.*, Spawning Seasons, Depths, and Bottom Types Reported from the Literature (Modified from Scott & Crossman, 1975)

| SPECIES | LAKE | DEPTHS(ft) | BOTTOM | MONTHS | AUTHOR(S) |
|---|---|---|---|---|---|
| *C. alpenae* | Erie | 9-204 | --- | November | Scott & Crossman,1975 |
| Longjaw | Erie | --- | --- | November | Scott & Smith,1962 |
| | Huron | 84-480 | --- | November | Scott & Crossman,1975 |
| | Huron | 60-144 | Mud w/rock gravel | November | Koelz,1929 |
| | Michigan | 30-540 | --- | November | Scott & Crossman,1975 |
| | Michigan | 60-150 | --- | November | Koelz,1929 |
| | Michigan | 150-546 | --- | November | Jobes,1949a |
| *C. hoyi* | Huron | 180-300 | --- | February-March | Koelz,1929;Scott & Crossman,1975 |
| Bloater | Michigan | --- | --- | February-March | Jobes,1949 |
| | Michigan | 180-300 | --- | March | Scott & Crossman,1975 |
| | Michigan | --- | Sand | March | Koelz,1929 |
| | Michigan | --- | --- | January-March | Wells,1966 |
| | Superior | 90-540 | --- | After December | Scott & Crossman,1975 |
| *C. johannae* | Huron | 90-600+ | --- | Late August-September | Scott & Crossman,1975 |
| Deepwater | Michigan | 180-540 | --- | Mid-August to End Sept. | Scott & Crossman,1975 |
| *C. kiyi* | Huron | 360+ | --- | October-November | Scott & Crossman,1975 |
| Kiyi | Huron | --- | --- | October-November | Koelz,1929 |
| | Michigan | 345-558 | --- | End September-mid-Nov. | Hile & Deason,1947 |
| | Michigan | --- | --- | End October-November | Deason & Hile,1947 |
| | Michigan | 300-540 | --- | October | Scott & Crossman,1975 |
| | Michigan | --- | --- | October | Koelz,1929 |
| | Superior | 240+ | --- | Late November-Early Dec. | Scott & Crossman,1975 |
| | Superior | --- | Clay | Late November-Early Dec. | Koelz,1929 |

TABLE 4. (Continued)

| SPECIES | LAKE | DEPTHS(ft) | BOTTOM | MONTHS | AUTHOR(S) |
|---|---|---|---|---|---|
| *C. nigripinnis* Blackfin | Huron | 210-600+ | --- | Late November-Early Dec. | Scott & Crossman,1975 |
| | Michigan | 180+ | --- | Late December-Early Jan. | Scott & Crossman,1975 |
| | Michigan | 360-540 | Clay | October-March | Koelz,1929 |
| | Superior | 90-600+ | --- | September-Early October | Scott & Crossman,1975 |
| | Superior | 360-600 | Clay | September | Koelz,1929 |
| *C. reighardi* Shortnose | Michigan | 120-474 | Sand,Silt Clay | May-June | Jobes,1942 |
| | Michigan | 36-540 | --- | May-Early June | Scott & Crossman,1975 |
| | Michigan | 84-210 | Mud,sand | May-Early June | Koelz,1929 |
| | Superior | 60-180 | --- | November | Scott & Crossman,1975 |
| | Superior | --- | --- | November | Koelz,1929 |
| *C. zenithicus* Shortjaw | Huron | 82-600 | --- | Mid-September-October | Scott & Crossman,1975 |
| | Huron | 240-300 | Clay | Mid-September-October | Koelz,1929 |
| | Michigan | 72-540 | --- | October-November | Scott & Crossman,1975 |
| | Michigan | 60-360 | Sand,Clay | Mid-October-Movember | Koelz,1929 |
| | Michigan | --- | --- | November | Jobes,1943 |
| | Michigan | --- | --- | November | Jobes,1942 |
| | Superior | 120-240 | Clay | Late November-Early Dec. | Koelz,1929 |
| | Superior | 66-600 | --- | Late November-Early Dec. | Scott & Crossman,1975 |

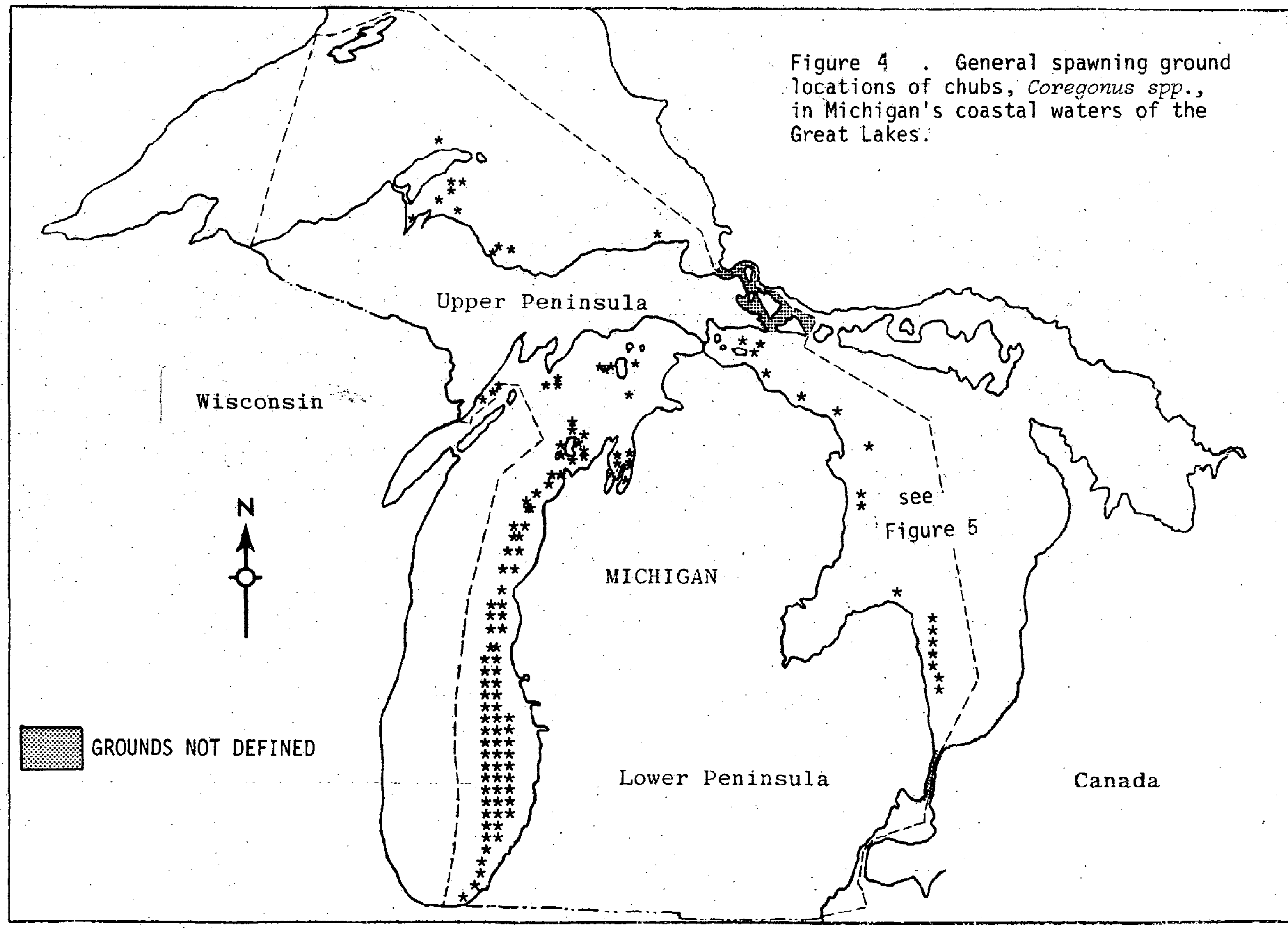


Figure 4 . General spawning ground locations of chubs, *Coregonus spp.*, in Michigan's coastal waters of the Great Lakes.

activity occurred in November over a mud bottom. Another area was reported off the Keweenaw Peninsula from Grand Traverse Bay (Appendix 3, Figure 19) to Point Isabelle (Appendix 3, Figure 18), extending southward to Big Bay (Appendix 3, Figure 24), in all depths exceeding 30 meters (~90 feet). Here the bottom was hard (probably hard clay or rock) and activity occurred during the months of October and November. Reported but undefined chub spawning occurred along the north shore of the Keweenaw Peninsula in depths of 150 to 180 meters (500 to 600 feet) again, on a mud bottom during October and November. Females seem to dominate the early spawning runs at this area, with the males moving in somewhat later. Koelz (1929) also states that the females tend to dominate the early spawning runs, as well as the general chub populations of Lake Superior.

Koelz (1929) reported a spawning ground for the bloater in the Marquette area off Granite Island in 126 meters (420 feet) of water over a clay bottom; however, there is no information from the commercial fishermen of Michigan concerning this location, so it is not known whether or not it is still an active chub spawning area (Appendix 3, Figure 25). The 126 meter depth off Granite Island is not shown; however, this area can be located directly northeast of the island. Another area 16 kilometers (10 miles) N by W 1/4 W of Marquette has been reported by Koelz (1929) to contain a spawning ground for the shortjaw cisco within the dpeths of 54 to 108 meters (180 to 360 feet) on a clay bottom (Appendix 3, Figure 26, unmapped).

According to one fisherman, who stated that there are seven species of chubs involved, spawning occurs year round outside of Marquette Harbor in 70 to 80 meters of water (210 to 240 feet).

Extensive chub spawning has also been reported off Grand Marais, Michigan, over a rocky bottom in depths from 108 to 195.8 meters (300 to 656 feet) (Appendix 3, Figures 30 and 31). This area was described by Koelz (1929) as a spawning ground for the blackfin cisco in 1917, but at that time the bottom structure was noted to be clay.

At this time, there is no information available concerning chub spawning activity for the St. Mary's River system.

Lake Michigan. As with Lake Superior, Lake Michigan chubs do not appear to have any specific spawning requirements. Chubs have been known to spawn over a wide range of depths and variety of bottom types (Jobes, 1943). In general, depending on the particular species, spawning has been reported to occur from mid-August to early June (Table 4).

There are many general chub spawning locations that are discussed later in this report, but have not been mapped becuase of the extent of information available. Many fishermen, for example, have described large areas of the lake as being conducive to chub spawning. These areas cover not only a large surface area but also a wide range of depths, usually from 30 to 180 meters (180 to 600 feet). Those chub areas that have been mapped should not be taken as well-defined locations due to the general nature of chub spawning behavior.

There was one report of chub spawning from the Michigan waters of Upper Green Bay by the commercial fishemen contacted during this study. This area is just northeast of Ingallston and spawning occurred during late November, in 20 to 32 meters

(60 to 100 feet) of water, over mud. Jobes (1949a), reported November spawning of the longjaw cisco in Green Bay, and has reported the occurrence of minimal numbers of the shortnose cisco in this general area, but did not indicate any spawning locations (Jobes, 1943).

In the region of Big and Little Bay de Noc of northern Lake Michigan, there were again no specific locations determined for chub spawning. One general area (unmapped) noted for chubs (the bloater) is located from 22 to 24 kilometers (14 to 15 miles) SSE of Point Aux Barques in all waters 90 to 98 meters (300 to 360 feet) deep. The bottom at this location was reported to be mud, and spawning occurred in the spring. Following this general format, one other source noted that chubs spawn wherever the waters are deep enough [54 to 90 meters (180 to 300 feet)], over pea sized gravel from mid-November to early December. This source did note that there seemed to be a greater predominance of females during the 1940's, which corroborates Jobes (1943) who noted a larger percentage of female chubs during the early 1930's in Lake Michigan. The Fox Island region, in waters of 108 meters (360 feet) has also been reported for chub spawning but no dates or bottom types were given.

Between Seul Choix Point and Waugoshance Point, which includes the Beaver Island group, there are two general chub spawning locations. Just south of Simmons Reef (Appendix 3, Figure 74B) has been reported for chub spawning and probably extends further south than is shown. Located between Gull and High Islands, in waters of 36 to 72 meters (120 to 240 feet), is another chub spawning area. Again, this area probably extends further south than is shown (Appendix 3, Figures 85 and 86). Spawning reportedly took place here in November and December.

From reports by the commercial fishermen, there do not appear to be any chub spawning locations in the Lake Michigan waters for the region of Waugoshance Point to Detour Passage until the Lake Huron waters commence, which will be discussed later.

Lake Michigan's Grand Traverse Bay region has been reported to contain chub spawning grounds in nearly all of its waters. Most spawning in this area took place in 72 to 180 meters (240 to 600 feet) of water, over a mud bottom during November and December. Three general areas have been noted by the commercial fishermen: off of Grand Traverse Light (Appendix 3, Figure 92); in the West arm of Grand Traverse Bay (Appendix 3, Figures 96B, 97A, and 99); and in the East arm (Appendix 3, Figures 95, 98, 100). Koelz (1929) has also reported chub (longjaw cisco) spawning in this general area over mud and stone in 18 to 45 meters (60 to 150 feet) of water, but it is not known if this species of chub is still present in Grand Traverse Bay.

Chub spawning has been reported from many areas for the region of Leland to Platte Bay. The majority of spawning is known to occur in this area from November to February over substrates consisting of sand, mud, rock, or other various combinations. Various depths for spawning have also been reported ranging from 37 to 157 meters (124 to 523 feet), depending on the area. Many of the chub spawning areas in this region are located around the Manitou Islands. South of-and between North and South Manitou Islands have been reported as chub spawning areas (Appendix 3, Figures

108A, 108C, 109A and 109B), as well as the area north of North Manitou (Appendix 3, Figure 104); some of which is not entirely mapped, but spawning occurs from 63 to 108 meters (210 to 360 feet) over sand. Unmapped chub spawning also occurs due east of North Manitou, again in 63 to 108 meters over sand. Further chub spawning areas have been reported west of North Manitou Island (Appendix 3, Figure 106C). Chub spawning was also reported from the area northwest of Leland (Appendix 3, Figures 102 through 105) and north of Pyramid Point (Appendix 3, Figure 110). The Fox Island Shoal area is also reported to show chub spawning activity along the East shoal area and to the south of the shoals, part of which is not mapped, but extends south to form a "V" shaped region (Appendix 3, Figure 103A). The last chub spawning areas from this region are located southwest of South Manitou Island (Appendix 3, Figure 111) and due west of South Manitou (Appendix 3, Figure 107).

The general chub populations in this area have been reported to have changed to a bloater dominated population. It is also interesting to note that chub reproduction has been reported by commercial fishermen to occur with better results when the ice is thickest on the lake.

The entire area from Point Betsie to Benona, in all waters greater than 57 meters (190 feet) deep over mud, has been reported to show active chub spawning during the period of January to mid-February (Appendix 3, Figures 113 through 118A). Much of this region has not been mapped due to the expanse of area involved, but one location directly west of Ludington, extending from Big Sable Point in the north to Silver Lake in the south has been specifically referenced (Appendix 3, Figures 117A and 118A). Koelz (1929) has also reported two chub spawning locations known in 1920: one for the blackfin cisco 8 to 13 kilometers (5 or 8 miles) west of Manistee in depths of 72 to 144 meters (240 to 480 feet) over clay during December and January; and one for the kiyi (1920) at the 126 meter (420 foot) end of the "Northwest shoal", 19 kilometers (12 miles) northwest of Frankfort, Michigan.

Unspecified chub spawning occurs along the entire coastline from Benona to South Haven in most waters greater than 54 meters (180 feet) deep over mud, silt, sand and clay, primarily during October and November (Appendix 3, Figures 119 through 130).

Spawning of bloaters, which are a deeper water chub and replaced the longjaw as the dominant species during 1950's has also been reported from this area during the period of late December to March at depths from 36 to 108 meters (120 to 360 feet) with mud, sand, and clay reported as the normal bottom characteristics. The general bloater spawning area runs from 6 kilometers (3.5 miles) west of Mona Lake south to 6 kilometers (3.5 miles) west of South Haven and is approximately 20 kilometers (12.5 miles) at its widest point and 80 kilometers (50 miles) long (Appendix 3, Figures 120 through 130). The commercial fishermen from this region have also reported that during the early 1970's, female bloaters dominated the population at a ratio of approximately 97:3, with a shift back to a more balanced population occurring around 1973-74.

The same unspecified chub spawning situation appears to exist in the Lake Michigan waters from South Haven to the Michigan-Indiana border. Chubs were again reported to spawn throughout the middle of

Lake Michigan approximately 16 kilometers (10 miles) from shore in waters greater than 54 meters (180 feet) deep over mud, silt, and clay, during October and November. One general area exists about 16 kilometers (10 miles) southwest of St. Joseph Harbor and extends about 32 kilometers (20 miles) southwest, 14 kilometers (9 miles) further west than shown on the mapping (Appendix 3, Figures 132A, 132B, 133A and 133B). Chub spawning can be assumed to occur to the west of all figures depicting this area (Appendix 3, Figures 131 through 134).

The Milwaukee Reef area of Lake Michigan also contains chub spawning grounds (Appendix 3, Figures 135B and 136). These areas are approximately 75 to 144 meters (252 to 480 feet) deep and the bottom consists of mud, clay, some rock, honeycomb, and "clinkers". Chub spawning reportedly ended in this area around 1958.

Lake Huron. Chub spawning in Lake Huron has been known to occur from late August to March in deeper waters generally over mud or clay (Table 4) (Koelz, 1929), and on the "steep banks" (Cross, 1978).

In the Lake Huron section of the Mackinac Straits, chub spawning has been reported to cocur at depths of 36 to 90 meters (120 to 300 feet) on deep banks of mud and clay (Appendix 3, Figures 141, 142, 148 through 151). Koelz (1929) also reported spawning for the shortjaw cisco two miles northeast of Rogers City in water 63 to 90 meters (210 to 300 feet) deep (unmapped), both over a clay bottom.

In the region of Oscoda to Forty Mile Point, light chub spawning was reported to occur northwest of Black Point (Appendix

3, Figure 153), off the north point of Six Fathom Bank (unmapped) and from the Black River to Sturgeon Point (Appendix 3, Figures 158A and 159A) during November in approximately 30 meters (100 feet) of water. "Shoal chubs" were also reported to spawn in this area in water as shallow as 18 meters (60 feet), but were supposedly fished out in the 1940's (Cross, 1978).

Only one chub spawning area that "used to be good" was reported for the Saginaw Bay region of Lake Huron. Spawning was said to have occurred during November and December on steep banks with a mud bottom, in 54 to 135 meters (180 to 450 feet) of water (Appendix 3, Figure 171).

November to December chub spawning over mud was reported to occur in the steamboat lines off Port Hope and south to Lexington (Appendix 3, Figures 172 through 174, 177, and 178). The "Yankee Reef" was also mentioned as apossible chub spawning area with a rock (honeycomb) bottom (Appendix 3, Figures 175 and 176).

Cross (1978, and Unpublished data) reported that chubs may spawn on the steep banks of the chub fishing areas of Lake Huron noting that spawning occurs in November and December over sand, clay, mud, and klinkers in water 27 to 54 meters (90 to 180 feet) deep (Appendix 4, Figures 2 through 6)(Figure 5).

There were no chub spawning grounds reported for the St. Clair River, Lake St. Clair, the Detroit River, or Lake Erie, though Scott and Smith (1962) indicated that spawning of the longjaw cisco occurred in Lake Erie during November.

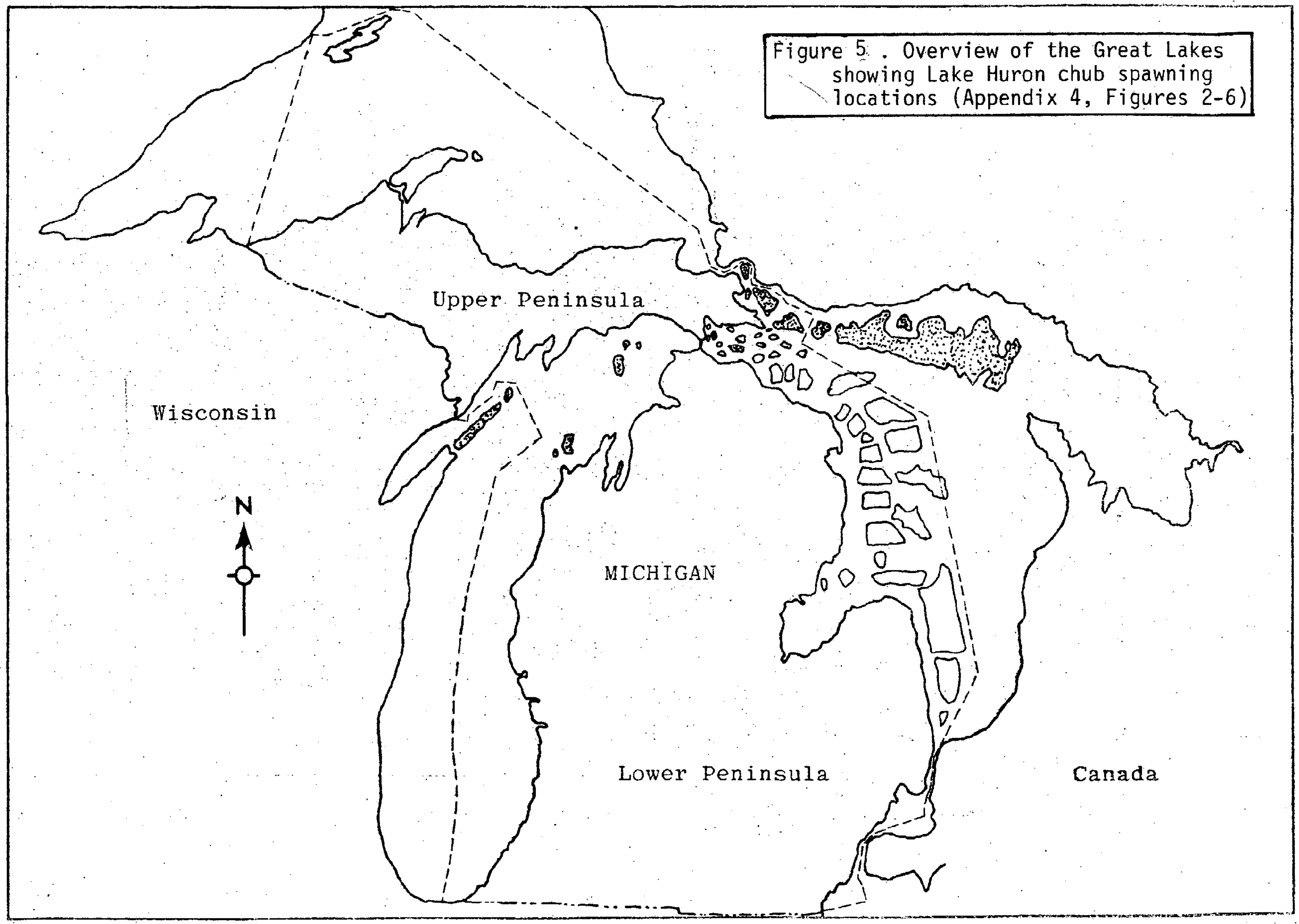


Figure 5 . Overview of the Great Lakes showing Lake Huron chub spawning locations (Appendix 4, Figures 2-6)

## LAKE HERRING

The lake herring, *Coregonus artedii*, is reported to be the most widely distributed member of its genus in the Great Lakes basin (Koelz, 1929) and the shallowest dwelling member of the corregonids, not being found generally deeper than 36 meters (120 feet) (Smith, 1969). The lake herring has been reported in all of the Great Lakes and probably has been one of the most important commercial species in past years (Koelz, 1929; Bails and Patriarche, 1974; Scott and Crossman, 1973) (Figure 6).

Despite the fact that many intraspecific variations of the lake herring have been reported from the various Great Lakes (Koelz, 1929), spawning time and duration seem to have remained fairly constant. The period from the end of November to mid-December has been reported to be the general range of greatest spawning activity for lake herring in the Michigan coastal waters of the Great Lakes (Koelz, 1929; Smith, 1956 and 1969; Dryer and Beil, 1964; Bails and Patriarche, 1974; Scott and Crossman, 1973). Spawning dates have been shown, however, to vary according to latitudes because of the specific temperature requirements necessary for the initiation of spawning behavior (Koelz, 1929; Smith, 1956). The lake herring has been reported to move into shallow waters during the fall, corresponding to periods of decreasing temperature, and to spawn when the water reaches a temperature of 3.9°C or lower (Smith, 1956; Dryer and Beil, 1964).

Smith (1956) and Dryer and Beil (1964) have shown the lake herring to be a pelagic spawner, moving in schools over the spawning

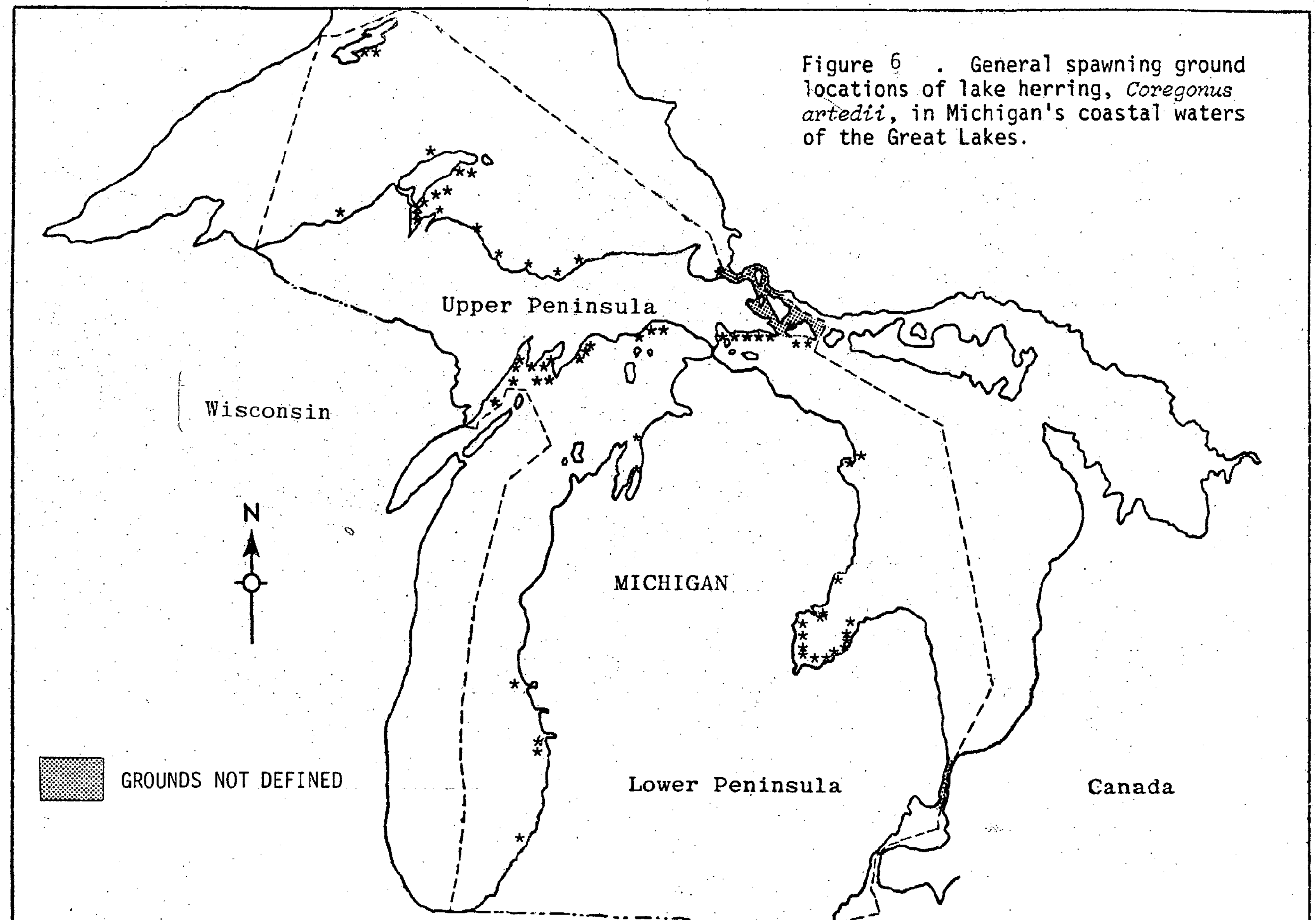


Figure 6 . General spawning ground locations of lake herring, *Coregonus artedii*, in Michigan's coastal waters of the Great Lakes.

grounds during the reproductive season, spawning in the mid-depth zone of waters up to 63 meters (210 feet) deep and migrating vertically to the bottom at night where spawning may continue. Smith (1965) does, however, report that shallower waters have been shown to be the preferred spawning areas.

Due to the pelagic nature of lake herring spawning activity, no distinct bottom type has been defined. Lake herring have been known to spawn over boulders, gravel, sand, mud, and aquatic vegetation, release their eggs at mid-water depths and allow them to settle to the bottom (Smith, 1956; Dryer and Beil, 1964).

Lake Superior. Lake Superior lake herring spawning habits are probably slightly different from those of the more southernly lakes. Lake Superior herring have been reported to spend more time in the surface waters, apparently due to the colder temperatures, than in the other Great Lakes (Koelz, 1929). Dryer and Beil (1964) have also reported the phenomenon that lake herring appeared to disappear in Lake Superior during the summer, possibly due to their pelagic nature; however, by mid-November (the beginning of the spawning season) turnover has occurred and temperature stratification has been eliminated (the water column, homothermous at approximately 6°C) supposedly causing the lake herring to move into shallower water to spawn (Dryer and Beil, 1964). The colder temperatures of Lake Superior were probably the cause of a few reports by the commercial fishermen of herring spawning in October, but Dryer and Beil (1964) have also reported the occurrence of a spent female as early as the 12th of November (1951) in Keweenaw Bay.

Depth requirements for lake herring spawning do not seem to be critical, having been reported by the commercial fishermen to occur from 1 to 64 meters (4 to 180 feet) and by Dryer and Beil to have occurred in depths of 5 meters early in the season and depths of 108 to 126 meters (360 to 420 feet) toward the end of the spawning season (mid-December).

In general, Lake Superior lake herring are reported to spawn in depths ranging from 1 to 126 meters (3 to 420 feet) from mid-November to mid-December over various bottom types and when the water reaches temperatures of 4.4°C or lower.

The following lake herring spanwing areas were provided by the Michigan Department of Natural Resources Biologists R. Schorfhaar and J. Peck and were originally supplied to the above, by commercial fishermen. The areas will not appear in Appendix 3 unless they were identified and geographically located during an interview. The material appears verbatum as it was received from the Michigan Department of Natural Resources with the exception that the source of the material has been deleted.

<u>MS-3</u>

Herring Spawning Areas

1. Eagle River Grounds - extends from Eagle River southwestward to about the Tamarack water intake (14 miles).

2. Manitou Island Grounds - herring reportedly spawned all around island.

3. Gay & Betsy Grounds - probably extended from Gay northeastward to about Point Isabelle. There was a very intense beach fishery in this area, but it is believed that the herring moved off the beach to 15-20 fathoms to spawn.

4. Buffalo Reef - Grand Traverse Bay. Reportedly a bluefin spawning area.

5. Traverse Island - expecially the south side was a bluefin herring spawning area.

Bait Herring Areas

1. Gay Area - extended from Gay to the middle of Hermit Bay.

MS-4

Herring Spawning Areas

1. Partridge Island Reef - located 1.3 miles north of Partridge Island approximately one mile in diameter. Bottom type is rock.

Bait Herring Areas

1. South Bay, Munising - located from east of VanLandschoot's dock northward for 1 1/2 miles.

MS-6

Herring Spawning Areas

1. Iroquois Island Shoals - extensive shoal area in approximately a two-mile radius of Iroquois Island. Bottom type is listed as rocky and boulders on the lake chart.

2. Point Iroquois Shoals Area - located along the Steamboat Channel.

3. Canadian Areas - Parisienne Shoals, Maple Island and Sandy Island area.

Bait Herring Areas

1. Big Two Hearted River Area - located from the mouth of the river to about two miles east. Bait herring were seined in this area.

2. Whitefish Point Area - located from about 1 1/2 miles west of the point to four miles west of the point. Fish were taken in 1-3/8 - 1/3/4 inch gill net.

3. Paradise to Tahquamenon Area - this area was fished with Pomeroy's pound nets in June after bait herring were not available in other areas.

4. Point Iroquois Shoals Area - bait herring were fished with gill net along the Steam boat Channel.

The only reported incidence of lake herring spawning from the

Isle Royale region of Lake Superior was reported to have occurred in all of Siskiwit Bay since the early 1900's. This activity took place in 13 to 24 meters (45 to 80 feet) of water over a sand bottom from mid-November to the end of December. Siskiwit Bay (Appendix 3, Figures 3 and 4) has not been specifically referenced for herring due to the general nature of the information. Bails and Parriarche (1974) have also reported the occurrence of herring in this general area but do not mention Siskiwit Bay or spawning activity; however, reports of the occurrence of herring have been assumed to contain spawning grounds since many of these locations could be correlated to information donated by the commercial fishermen.

Along the southern shore of Lake Superior, from Saxon Harbor to Redridge, there is again only one reported incidence of lake herring spawning (Appendix 3, Figure 10). This area is located from the Potato River to a point just west of Stoney Creek near Ontonagon. Spawning reportedly takes place in water 9 to 18 meters (30 to 60 feet) over rock gullies from mid-November until the end of December. Bails and Patriarche (1974) have reported this general location, as well as Keweenaw Bay and the northwest portion of the Keweenaw Peninsula, as areas of herring occurrence.

Located along the north shore of the Keweenaw Peninsula are three areas of rocky bottom where lake herring are reported to spawn in November. One area is located from Eagle Harbor to the east edge of Agate Harbor (Appendix 3, Figures 15 and 16A). The second location is from the Tamarack Waterworks along the shoreline to a point northwest of Calumet and Tamarack (Appendix 3, Figure 14) and the third area is just east of the North Portage Entry (Appendix 3, Figure 13).

Lake herring spawning activity seems to be very heavy in Keweenaw Bay. At many of these locations (Appendix 3, Figures 17A, 18A, 19,20A, B, C, 21A,and 22A, B, and 23B), spawning occurs from November to mid-December at depths ranging from 1 to 54 meters (4 to 180 feet) over sand, mud, and rock. One area, however, was reported to show spawning activity in mid-October (Appendix 3, Figure 20). Dryer and Beil (1964) have also reported this location as an area of herring occurrence.

One source of information for Keweenaw Bay made reference to a "deep-water" herring that spawned in a "deep trench" with a mud buttom (Appendix 3, Figure 20), but due to the dpeth of water at this location and the information available concerning chubs, it is very probable that this area is a spawning location for one of the smaller chub species (Author's note).

Commercial fishermen have reported lake herring spawning in the region of Big Bay Point to Grand Marias. Spawning occurs from early November to early December, with one fisherman stating that the heaviestspawning occurred around Thanksgiving. Spawning substrates were reported to be either rock or rock and gravel with water depths ranging from 4 to 20 meters (12 to 60 feet) (Appendix 3, Figures 25B, C; 26B, 27A, B; and 28B). Bails and Patriarche (1974) and Dryer and Beil (1964) have also reported the occurrence of lake herring from this area of Lake Superior.

The last herring location for Lake Superior known at this time is a well-defined area off Nodoway Point in the southwest corner of Whitefish Bay (Appendix 3, Figure 36). The herring were reported to have disappeared from this area in 1963, but when it was active, spawning occurred during October and November over rock and gravel.

Very little information is available concerning lake herring spawning sites in the St. Mary's River system. Eschenroder (1979) has reported the occurence of herring spawning activity for an area north of Grape Island in Potagannissing Bay (Appendix 3, Figure 49), where the bottom consists of marsh, mud, and rock. Gleason (1979) has also reported that potential herring spawning sites exist in the St. Mary's River between Lake Nicolet and Munuscong Lake which correspond to potential whitefish spawning sites. Westerman and Van Oosten (1937) reported the occurence of small numbers of herring in Potagannissing Bay, but did not report any spawning activity. It is possible, however, that the St. Mary's River system is an extremely important region for lake herring spawning (Eschenroder, 1979).

<u>Lake Michigan</u>. Lake Michigan lake herring seem to prefer long stretches of sandy shore for spawning. Although rock has been noted in a few instances, a majority of the data available referred primarily to sand as the preferred substrate (Koelz, 1929). Smith (1956), however, reports that lake herring, in general, show no preference for bottom types in Green Bay. Spawning activity has been reported to occur from late November in northern Lake Michigan to early December in southern Lake Michigan (Koelz, 1929). This is probably due to the fairly critical spawning temperature requirements (below 4°C) of lake herring (Smith, 1956).

Depth preferences for lake herring seem to be much shallower in Lake Michigan than in Lake Superior, and the fish do not appear to pelagic (Koelz, 1929). Spawning was reported to occur in depths between 1 and 9 meters (3 to 30 feet) (Koelz, 1929; Smith,1956).

It is interesting to note that a few of the commercial fishermen have reported the disappearance (or greatly reduced numbers) of the lake herring. This coincides with the onset of the smelt and alewife populations which reportedly (one source) caused the herring to resort to cannibalism because of the lack of prey organisms.

There are no present herring spawning grounds in the Michigan waters of Green Bay from Bailey's Harbor to Point Detour. Spawning reportedly ended in this area during the 1950's after having been quite pronounced along the entire Michigan shore of Green Bay for many years. Again this was reportedly due to the increased numbers of smelt and alewife. Smith (1956), however, noted lake herring spawning in Green Bay proper as late as 1952. When spawning did occur in this area, it was reported to be in depths of 3 to 18 meters (10 to 60 feet) during early November over sand (Appendix 3, Figure 51A).

The Big and Little Bay de Noc region of northern Lake Michigan seemed to have been an area fairly heavy with lake herring spawning activity during November and December over a sand and rock substrate (Appendix 3, Figures 55 and 59 through 61). The water depths in this region were reported as being 9 meters (30 feet) where herring spawning took place. As in the previous section, the herring were reported to have disappeared sometime during the 1940's and 1950's.

Herring were reported to spawn from the Seul Choix Point to

Waugoshance Point area near Mille Coquins Point, during late November as recently as 1972. Rock and gravel were reported to be the preferred substrates at these lcoations; and depths, to be 1 to 9 meters (5 to 30 feet) (Appendix 3, Figures 59, 68, 71A, 72A and B and 73B).

Remnant populations of lake herring are known to occur at the head of Little Traverse Bay and also at the head of the East Arm of Grand Traverse Bay where spawning is thought to still occur (Keller, 1979).

There are only a few instances of lake herring spawning along the eastern shoreline of Lake Michigan, and all of these are located within the area of Benona to South Haven, Michigan. Between Mona Lake and Muskegon (Appendix 3, Figure 121B) lake herring are reported to spawn from March to May, over sand, in 1 to 3 meters (1 to 10 feet) of water.

The last lake herring spawning areas reported for Lake Michigan concern what the fishermen call the "Greenback herring". (halfbreed chub or bay chub), and the information available is conflicting. One greenback herring spawning area is reported to run 8 or 9 kilometers (5 or 6 miles) along the shoreline from Muskegon (Appendix 3, Figure 120), where spawning reportedly occurred in 1 to 3 meters (1 to 10 feet) of water over sand from March to May. The other area, 5 kilometers (3 miles) offshore and south of Holland (Appendix 3, Figure 126B), however, was reported to show greenback herring spawning activity in 18 to 32 meters (90 to 108 feet) over mud from November to January.

There are no further lake herring spawning locations known for southern Lake Michigan at this time.

Lake Huron. The lake herring of Lake Huron has been reported to spawn during November, after an inshore migration (Koelz, 1929). Preferred substrates appear to be gravel or sand (Koelz, 1929). Koelz (1929) also reports that Saginaw Bay contained immense areas that were suitable for lake herring spawning, but the commercial fishermen interviewed during the course of this study did not report any recent lake herring spawning for the bay region.

An extensive area of lake herring spawning grounds showing activity from mid-November to December extends from St. Ignace to Brulee Point including Goose Island and the Goose Island Shoals (Appendix 3, Figures 137 through 139). All the waters in this area used by the herring for spawning were reported to be from 1 to 7 meters (5 to 25 feet) deep over a varied bottom consisting of sand, mud, and honeycomb rock. Also included in this general region and spawning conditions are Pomeroy Reef, Tobin Reef, the shoreline from Marquette Island to Surveyor's Reef along the Les Cheneaux Islands (Appendix 3, Figure 140), Marquette Bay, (Appendix 3, Figure 139C), Martin Reef and St. Vital Bay (Appendix 3, Figures 141 and 142).

Eschenroder (1979) has reported lake herring spawning activity over marsh and clay for the Government Bay area (Appendix 3, Figure 140B). Spawning reportedly occurred in Government Bay as late as 1972.

Herring spawning sites were also reported for the Scammon Point area where spawning occurred during November in approximately 3 to 8 meters (10 to 25 feet) of water. Herring in this area were noted to have spawned over a sandy substrate (Appendix 3, Figure 145B).

Middle Island and the shoreline opposite South Manitou Island (Appendix 3, Figure 155) as well as the south shore of North Point (Appendix 3, Figures 156 and 157) in waters approximately three meters (10 feet) deep have also been noted as areas showing herring spawning activity.

The lake herring has been reported by many commercial fishermen to have disappeared from Saginaw Bay in the late 1940's and early 1950's, but at one time all of Saginaw Bay contained actively utilized lake herring spawning grounds.

Eschenroder (1979) has however, reported herring spawning as late as 1973 at the tip of North Point (Appendix 3, Figure 157B), but also feels that this population might now be extinct. Other commercial fishermen reported that herring spawned all over Saginaw Bay from Pt. Au Gres South, where there was a sand bottom, these fishermen also reported that due to the deterioration of the bottom structure, the herring dissappeared from Saginaw Bay around 1958.

Lake herring spawning generally occurred in waters up to 7 meters (25 feet) deep from late October to December, depending on the temperature. Activity occurred primarily over a sand and gravel bottom, which, according to one commercial fisheman, has now changed to a "muck" bottom (Appendix 3, Figures 160 through 170).

Lake St. Clair. Lake herring have been reported as making substantial spawning runs into Lake St. Clair during the late 1800's to early 1900's (Haas, 1979). No further information concerning lake herring is available at this time.

Lake Erie. Koelz (1929) reports that herring used to spawn out of virtually every port on the lake. The only reported spawning requirements for lake herring in Western Lake Erie were depths of approximately 18 meters (60 feet) over clay, and in those cases, activity occurred during November and December (Koelz, 1929). No data concerning lake herring spawning were gathered during this study for Lake Erie. Reports from the commercial fishermen, however, did show that lake herring were pelntiful in Lake Erie during the period of 1892 to 1905.

LAKE WHITEFISH

The lake whitefish, *Coregonus clupeaformis*, has long been an important commercial species. Koelz (1929) reported that this species was the largest and most valuable of the Coregonids and that it was distributed generally throughout the Great Lakes.

Over the past century, references have been made to several different strains or forms of the lake whitefish. Although their forms may differ only slightly morphometrically, significant differences do exist between growth rates and size at maturity (Scott and Crossman, 1973; Koelz, 1929). River spawning populations were reported to have been eliminated over 100 years ago when wastes from sawmills covered the bottom of rivers where whitefish spawned (Smith, 1969). River spawning runs were greatly reduced near the turn of the century in the Detroit and Maumee Rivers and were later totally eliminated by enrichment from domestic, industrial and agricultural water (Smith, 1969). During the current study no references were made to river spawning whitefish.

In Michigan's coastal waters (Figure 7), it has been found that lake whitefish spawn in the fall, usually in November and December. The exact date of spawning has varied from year to year even in the same lake (Scott and Crossman, 1973), and there was some evidence that water temperature may be the factor which has triggered spawning activity.

Spawning has usually occurred over rocky reefs or shoals, but sometimes over sand, gravel or honeycomb rock in 1 to 18 meters (4 to 60 feet) of water (Smith, 1969; Scott and Crossman, 1973; Van Oosten, 1939). The eggs were reportedly deposited more or less randomly

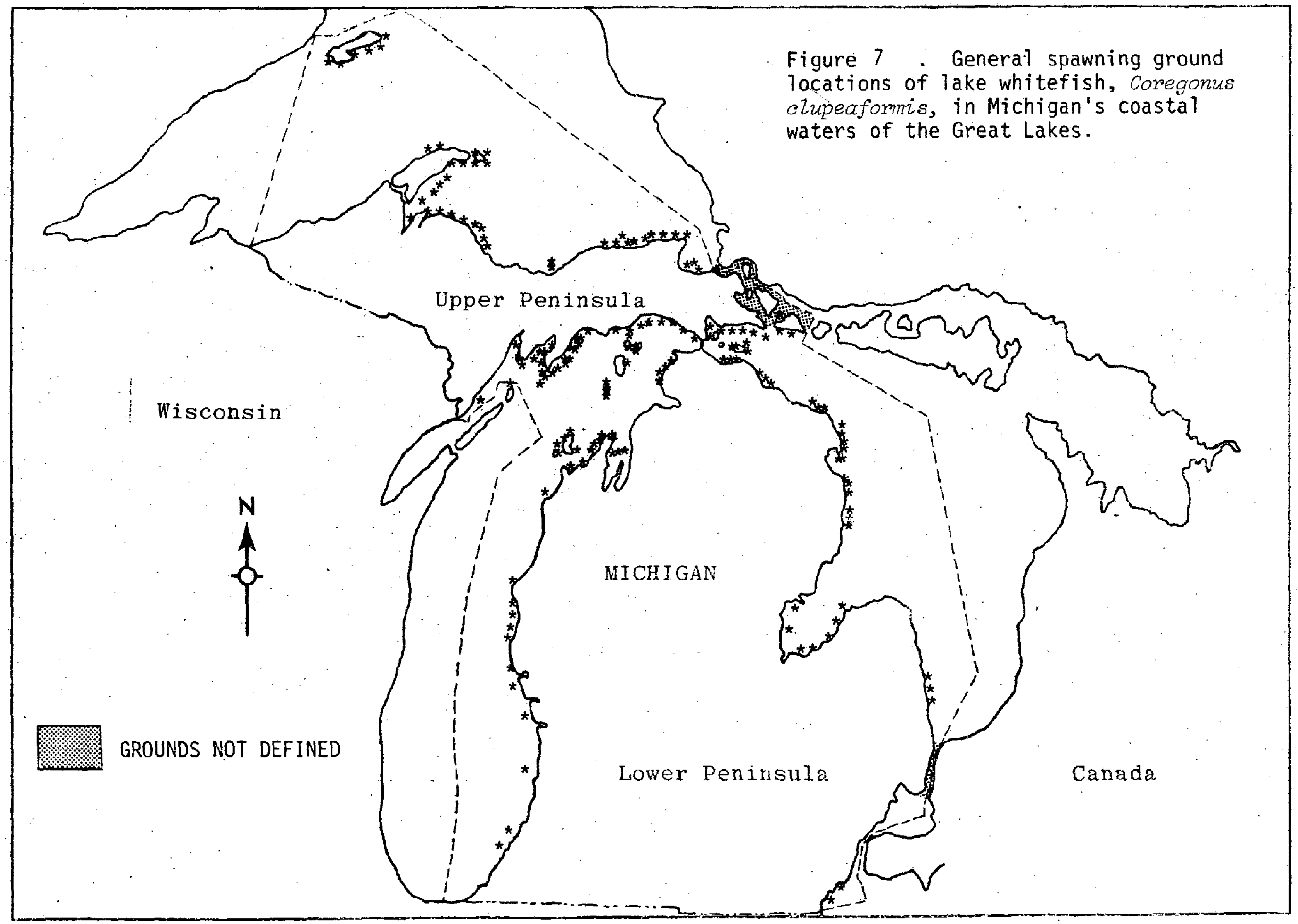


Figure 7 . General spawning ground locations of lake whitefish, *Coregonus clupeaformis*, in Michigan's coastal waters of the Great Lakes.

(Scott and Crossman, 1973) near the surface of the water, and the eggs settle slowly to the bottom (Smith, 1969).

When referring to whitefish spawning grounds on the lake charts (Appendix 3), a "W" was used whenever a fisherman or other source of information did not specify between lake whitefish and round whitefish or menonimee; however, it may be assumed that the vast majority, if not all, of the reefs designated with a "W" represent lake whitefish spawning areas. When specific reference was made to lake whitefish a "WL" was used to code spawning grounds, and when round whitefish were specified, their spawning grounds were designated with a "WR" (Table A).

<u>Lake Superior</u>. The average time of spawning for lake whitefish in Lake Superior was during the month of December; however, the spawning season was not uniform for every locality on the lake (Koelz, 1929). It appeared that whitefish along the north shore in Canadian waters spawned earlier than those along the southern shore of Lake Superior. Koelz (1929) suggested that lowered temperature may induce spawning and that this would follow as the bays which are more northerly and shallower probably cool more rapidly than the main lake.

The principal bottom types in Lake Superior which were used for spawning were sand, gravel, or small stones at depths 2 to 22 meters (6 to 72 feet) (Koelz, 1929).

In the current study it was found that spawning ground locations, depths, and bottom types of lake whitefish in Lake Superior coincided, to a great extent, with those of lake trout.

Along the shores of Isle Royale, references were made to this species as spawning in the last week of October until the middle of November. Spawning grounds were located off the southwestern end, along the eastern shore, and off the northeastern end of the island. Most spawning occurred over rock, and rock and gravel mixed in 2 meters (6 to 8 feet) of water (Appendix 3, Figures 2, 3, 4A, and 5B). There were also two small sandy areas referred to as whitefish spawning grounds (Appendix 3, Figure 3).

Sources of information concerning the time of lake whitefish spawning along the Keweenaw Peninsula seem to coincide somewhat with a phenomenon of earlier spawning in more northern waters. One fisherman referenced lake whitefish along the north side of Bete Grise Bay over rocky bottom (Appendix 3, Figure 18A) starting the first of November and running through December. Another source told of spawning on sand in Pequaming and Sand Bays during December (Appendix 3, Figure 21B). Yet another source expressed that whitefish spawned from Great Sand Bay on the northwest side of the Keweenaw Peninsula, east to Manitou Island and south to Big Bay Point over rock in the months of November and December (Appendix 3, Figures 15, 17A, 19, 20, 23, and 24). Spawning generally took place in 3 to 6 meters (10 to 20 feet) of water, but there were reports of spawning in waters up to 27 meters (90 feet) deep.

Very few whitefish spawning areas were reported for the Marquette area of the Upper Peninsula. Whitefish spawning reportedly occurred at Shot Point during November over gravel in 1 to 24 meters (2 to 72 feet) of water (Appendix 3, Figure 26B). It is also thought by commercial fishermen that whitefish spawning occurs around Partridge Island, but they have not fished this area during the spawning season due to weather conditions. Another whitefish spawning area occurs left of Shot Point, where spawning was reported to occur over gravel in 8 to 10 meters (24 to 30 feet) of water during December (Appendix 3, Figure 26B).

The following lake whitefish spawning areas were provided by Michigan Department of Natural Resources Biologists R. Schorfhaar and J. Peck and were originally supplied, to the above, by commercial fishermen. The areas will not appear in Appendix 3 unless they were identified and geographically located during an interview. The material appears verbatum as it was received from the Michigan Department of Natural Resources, with the exception that the source of the material has been deleted.

MS-3

Whitefish Spawning Areas

1. Shore Bank - located west of North Portage Entry. Extends from 1 1/2 miles west of the "entry" for approximately 4-5 miles southwest toward Redridge. According to lake chart the bottom type is rock.

2. Shore Bank - located off Gratiot River, extending NE for 2 1/2 miles and SW 4 1/2 miles.

3. Great Sand Bay - between Eagle River and Eagle Harbor. May be whitefish spawning area.

4. Buffalo Reef - 1.2 miles NNE of mouth of Traverse River. Reef extend lakeward due east for 1.6 miles. Bottom type is rocky.

MS-4

Whitefish Spawning Areas

1. Partridge Island Area - located on shoal area around Partridge, Larus and Middle Island with a rocky bottom type.

2. Presque Isle Harbor Area - much of the area from Marquette

Coast Guard Station to 1/2 mile north of the Presque Isle breakwall is reported to be spawning area. Depth is 10-50'.

3. Shot Point - shoal area in a 1/2-1 mile radius of Shot Point may be spawning area.

MS-6

Whitefish Spawning Areas

1. Tahquamenon Island Area - the area from about one mile north of the island, in approximately a two-mile wide band, to Naomikong and Menekaunee Points is reported to be the best whitefish spawning area in Whitefish Bay. Most of this area is listed as being rocky on the lake chart.

2. Salt Point Area - extends from Salt Point southward to about 1 1/2 miles west of Pendills Creek. Bottom type is mostly rocky.

3. Canadian Areas - Parisienne Shoals, Maple Island and Sandy Island Area.

A population of whitefish in Munising Bay, was shown to exhibit an extremely slow growth rate (Edsall, 1960). Although no reference was made directly to spawning in that study, the population was reported as rather nonmigrative, and depths were described which appear conducive to whitefish spawning. This population was later briefly referred to as a separate spawning population from other whitefish in Lake Superior (Roeloffs, 1978).

Lake whitefish have also been reported as spawning along the east shore of Grand Isle from 15 November through 30 November 1927 (Van Oosten, 1927).

Other spawning areas for lake whitefish in the Munising area are near Au Train Bay and the thumb region of Grand Island (Appendix 3, Figures 27B and 28B). Spawning occurs from mid-November to the first week of December in shallow water over rock. One fisherman indicated that the actual time of spawning is dependent on the water temperature and weather conditions.

In Southeastern Lake Superior lake whitefish were reported to use gravel in 1 to 6 meters (2 to 20 feet) of water along the shore from Au Sable Point east to Whitefish Point (Appendix 3, Figures 31 through 34). Spawning was said to occur along that shore from about 8 November to mid-December; however, another source reported that whitefish spawned in October and November in the same general area over sand, sand and rock mixed, and rock and gravel mixed. Several fishermen reported the locations of whitefish spawning grounds in Whitefish Bay near Taquamenon Island (Appendix 3, Figures 35A, 35B and 36). Bottom types were described generally as rocky from boulders to gravel. One source emphasized that whitefish spawned on smaller rocks than did lake trout. Most fishermen concurred that the duration of the spawning season was from late October through mid-December in that area. A more specific spawning season in Whitefish Bay was documented in 1927 as occurring from the first of November through November 20 (Van Oosten, 1927).

Little information is available concerning whitefish spawning sites in the St. Mary's River or Potagannissing Bay. One study in which extensive netting was conducted in these areas during the whitefish spawning season produced no spawning whitefish (Westerman and Van Oosten, 1937). The authors of that study indicated that whitefish must spawn in the more sheltered areas of the St. Mary's River and Potagannissing Bay.

Other research conducted on the St. Mary's River indicates the possible locations of nine potential whitefish spawning sites between Six-Mile Point of Lake Nicolet and Munuscong Lake

(Gleason, 1979). Spawning was reported by fishermen to occur in these areas from late October to early November (Gleason, 1979).

Only two whitefish spawning areas for the Potagannissing Bay region have been reported; Bacon Island Shoals and Harbor Island Reef. Spawning has been known to occur in this region during November in 2 to 5 meters (6 to 30 feet) of water over a rock bottom. (Appendix 3, Figure 48). One fisherman indicated, as did Van Oosten (1937), that whitefish should spawn at all shoals of this type in Potagannissing Bay. Eschenroder (1979) has also stressed the importance of the St. Mary's River system as a whitefish habitat, even though most of the spawning grounds are unknown.

Very little information is available concerning the Canadian waters of the St. Mary's River system. Possible whitefish spawning has been reported from Mark's and Leigh Bays, in the upper reaches of the river, where coarse sediments occur. (Dames and Moore, 1978).

Lake Michigan. In the upper Green Bay region of Northwestern Lake Michigan, lake whitefish were reported to spawn on sandy areas between Menominee and Escanaba in water depths from 5 to 9 meters (15 to 30 feet); however, only one specific location was indicated (Appendix 3, Figure 51A). One fisherman specualted that large new populations of smelt and alewives in the area during the late 1930's outcompeted the whitefish which reportedly disappeared during the 1940's

Other fishermen reported that whitefish spawn all along the pound net fishing area which extends from Menominee to Cedar River. Whitefish were reported to spawn in this area around mid-November over honeycomb rock shoals between 10 and 13 meters (40 to 45 feet) of water at night. (Unmapped)

The area from Escanaba to Manistique along the northern shores of Lake Michigan, inclusive of Big Bay de Noc, has been an important whitefish spawning area for many years. All referenced spawning grounds included rock as a bottom type, and combinations of rock and gravel, rock and sand, and rock, sand, and gravel were also reported (Appendix 3, Figures 58 through 68). The vast majority of sources referenced very shallow water, some as shallow as 1 meter (2 to 3 feet), as the depth in which spaawning occurred; however, the depths commonly mentioned were 2 to 3 meters (8 to 10 feet). Some spawning grounds referenced several times by dirrerent fishermen were Wiggins Point Shoal (Appendix 3, Figure 67), Big Bay de Noc Shoal (Appendix 3, Figure 63A), and Parent Bay (Appendix 3, Figure 66). Nearly all fishermen referring to these areas reported that whitefish spawned in mid-November; however, other reported spawning times in this area ranged from the end of October to the first of December. Van Oosten (1927) reported that spawning in the area of Northern Big Bay de Noc occurred from the first of November to the first of December in 1927; yet, that report also listed spawning on Boulders Reef in the first two weeks in December.

One fisherman from the Beaver Island area noted that whitefish spawning continues into the first two weeks of December at Boulders Reef (Appendix 3, Figure 87), and available fisheries data from 1927 and 1928 showed that spawning took place at Boulders Reef during December, while outside of the Boulder Reef area spawning had ended by late November (Commercial Fish Material, 1927-1928).

The region of Northern Lake Michigan from Seul Choix Point to Waugoshance Point, inclusive of the Beaver Island group, has also been extensively referenced as a whitefish spawning area. Most reports from this area indicated that whitefish spawning occurs during November; however, spawning may start as early as late October, and continue into mid-December. The most commonly reported bottom type was rock and gravel, but sand, sand and gravel, and honeycomb rock were also said to be suitable spawning substrates. Depths for whitefish spawning most often reported were from 2 to 6 meters (7 to 20 feet), but depths of 9 to 12 meters (30 to 40 feet) were not uncommon. The areas referenced most often by the commercial fishermen in this region were the shoals around Hog and Garden Islands (Appendix 3, Figures 81A, B, C and D and 82A and B) and Sandy Bay of Beaver Island (Appendix 3, Figures 83A and 84). It appears that most shallow areas, with a rocky to sandy bottom are suitable whitefish spawning locations (Appendix 3, Figures 70, 71 through 76, 78 through 84, and 87).

Whitefish spawning in the Grand Traverse Bay region of Lake Michigan has been reported to occur primarily during November and appeared to continue slightly longer than other regions of Northern Lake Michigan, ending in mid-December. Rock and sand were again the most commonly reported bottom types, along with occasional references to rock, mud, clay, moss, and gravel. Spawning depths were reported to range from 3 to 9 meters (10 to 30 feet) but depths up to 60 meters (200 feet) were also noted in certain areas.

Many fishermen interviewed from the Grand Traverse Bay region indicated Bellow Island (Appendix 3, Figures 96A and B) as well as the Old Mission Point-Sutton's Point Area (Appendix 3, Figures 97A, 97B, and 98) to be excellent whitefish spawning grounds. A few other areas in the Grand Traverse Bay region were also mentioned as being utilized by whitefish for spawning (Appendix 3, Figures 93 through 95, 99 and 100). Keller (1979) has also reported whitefish spawning in the area of South Point during late November to early December in waters of less than 9 meters (30 feet) (Appendix 3, Figure 90).

Most whitefish spawning activity in the Leland to Platte Bay region was reported around the South Fox Island and Shoal area (Appendix 3, Figures 101A, B, and 103A). Spawning was stated to occur during November, at depths ranging from 1 to 7 meters (3 to 25 feet) and over a bottom primarily composed of rock. Van Oosten (1937c) has also reported that a late spawning race of whitefish existed on the Fox Island Shoals, but the information obtained during this study did not indicate any discrepencies in spawning dates for this area.

Lake whitefish also spawn along the western shore of North Fox Island during late November to early December. Spawning occurs in less than 9 meters (30 feet) of water over rock (Keller, 1979) (Appendix 3, Figure 101B).

Around North and South Manitou Islands, whitefish spawning has been reported to occur in slightly deeper water, from 3 to 18 meters (10 to 60 feet), primarily over rock (Appendix 3, Figures 106D, E and 108A and B). Pyramid Point was also specifically referenced as a whitefish spawning area (Appendix 3, Figures 109A and B and 110).

A few areas in the region of Point Betsie to Benona, inclusive of Big and Little Sable Points, have been noted for whitefish spawning. Spawning was said to occur during November over rock or sand and gravel, and at depths from 4 to 21 meters (18 to 70 feet) (Appendix 3, Figures 113 through 118).

Whitefish spawning in the region of South-Central Lake Michigan from Benona to South Haven has been reported to occur from mid-October to late November. Rock, sand and occasionally clay were referenced as bottom substrates over which spawning generally occurred. Depths from 3 to 18 meters (10 to 60 feet), extending along the shoreline, were reported by commercial fishermen as being typical for whitefish spawning in this region (Appendix 3, Figures 119 through 121, 124A, 124B, 126A, 126C, and 129B).

Only two areas in Southern Lake Michigan were identified as whitefish spawning grounds (Appendix 3, Figures 133A and 134A). In both instances, spawning was reported to occur over sand, gravel and clay in water 12 to 23 meters (40 to 72 feet) deep.

Lake Huron. Van Oosten (1939) has reported that lake whitefish spawn in Lake Huron during November and part of December over sand, gravel, stone or honeycomb rock, usually at depths of 2 to 18 meters (6 to 60 feet). Most of the reports for whitefish spawning in Northern Lake Huron, however, have shown spawning to occur most often in waters less than 8 meters (less than 25 feet). The most heavily utilized whitefish spawning zone appears to be the area from St. Ignace to Detour Passage where spawning has been reported to occur over sand and honey comb rock (Appendix 3, Figures 137 through 142). Hammond Bay was often referenced for whitefish spawning (Appendix 3, Figures 150 and 151A, B). Spawning has been reported to occur at this area from late October to mid-November over sand, gravel and rock at depths of 2 to 9 meters (6 to 30 feet). Bois Blanc Island has also been shown to contain suitable whitefish spawning grounds (Appendix 3, Figures 146, 148A, and 148B). Various other whitefish spawning grounds were also referenced by the commercial fishermen (Appendix 3, Figures 96A, 96B, 143 through 145 and 147 through 149).

R. Eschenroder of the Michigan Department of Natural Resources has also noted whitefish spawning between Cheboygan Point and Cordwood Point over clay and rock (Appendix 3, Figure 148C).

Sand and gravel have been reported as the general bottom characteristics for whitefish spawning from the area of Oscoda, Michigan, to Forty Mile Point Light. The majority of whitefish spawning in this area has been noted from Middle Island Reef to Sturgeon Point, which includes North Point and Thunder Bay (Appendix 3, Figures 155 through 159). Depths for whitefish spawning for this region are reported to be less than 4 meters (12 feet), and that spawning occurs during November. Spawning also occurs in the North Bay of Presque Isle according to reports from the commercial fishermen (Appendix 3, Figure 153).

Whitefish spawning in the Saginaw Bay region of Lake Huron has been reported as beginning from early in November to as late as 20 November (Van Oosten, 1927). Information gathered during this study indicated that spawning may, however, begin as early as late October. Spawning was reported to occur over sand, rock, and gravel in less than 8 meters (26 feet) of water.

Many of the commercial fishermen have referenced the Charity Islands (Appendix 3, Figures 163B and C) as well as Sand Point (Appendix 3, Figure 169A and B) and the area from Tawas Bay to Point Lookout (Appendix 3, Figures 162A and B) as being the primary whitefish spawning grounds for Saginaw Bay. Other whitefish spawning locations were also reported which basically encompass the entire Saginaw Bay shoreline and island areas (Appendix 3, Figures 160A, 160B, 161A, 161B, 164 through 171).

There were no concise whitefish spawning locations reported for the Point Aux Barques to the Saint Clair River region of Southern Lake Huron. Whitefish were noted, however, to spawn along the shoreline near Port Huron at depths of 9 to 15 meters (30 to 50 feet), and along the shoreline in depths of up to 80 feet from Harbor Beach to Port Huron (Appendix 3, Figure 174C and 177B).

Lake St. Clair. No whitefish spawning areas were reported by sport fishing guides or professional fisheries biologists in Lake St. Clair. It was reported, however, by B. Haas of the Michigan Department of Natural Resources that lake whitefish made substantial spawning runs into lake St. Clair during the late 1800's and early 1900's.

Lake Erie. Lake whitefish in Lake Erie have been reported to spawn from mid-November to early December, and it appears that males are more abundant and remain on the spanwing grounds longer during the spawning season than the females (Van Oosten and Hile, 1947). Very few whitefish spawning locations have been reported, and most of these were located in the Point Aux Peaux region (Appendix 3, Figures 201A and B). Most of the whitefish spawning was noted to occur in water less than 6 meters deep (20 feet) over a hard clay bottom (Appendix 3, Figures 202C and 203C).

ROUND WHITEFISH

The round whitefish or menominee, *Prosopium cylindraceum* (Pallas), has been found in all the Great Lakes but Lake Erie (Bailey, 1963). This whitefish has had some commercial importance; however, it is rarely found in abundance and seems to be one of the least studied of the coregonids (Bailey, 1963; Marz, 1964). Males have been reported to arrive on spawning grounds before the females of the species; and, as with other whitefish, no parental care is given to the eggs or young.

In the Great Lakes region, spawning has been reported to take place in the fall of the year, usually November, over the gravelly shallows of lakes, at river mouths or, on occasion, in rivers (Scott and Crossman, 1973). Sources which referred to spawning in this study seemed to concur, to a large extent, with these earlier reports (Figure 8).

Lake Superior. Experimental fishing in Lake Superior in 1960 indicated that round whitefish spawned in late November and early December over a gravel and rock bottom at a depth of 6 meters (21 feet) and at a temperature of 4.5°C (Scott and Crossman, 1973). In the present study, spawning in Lake Superior was reported to have occurred over rock, sand, and gravel. Times of spawning ranged from October through December and spawning ground depths were said to be from 3 to over 54 meters (10 to over 180 feet).

Only one round whitefish spawning ground was referenced on the northern shore of the Keweenaw Peninsula (Appendix 3, Figures 16B, 17 and

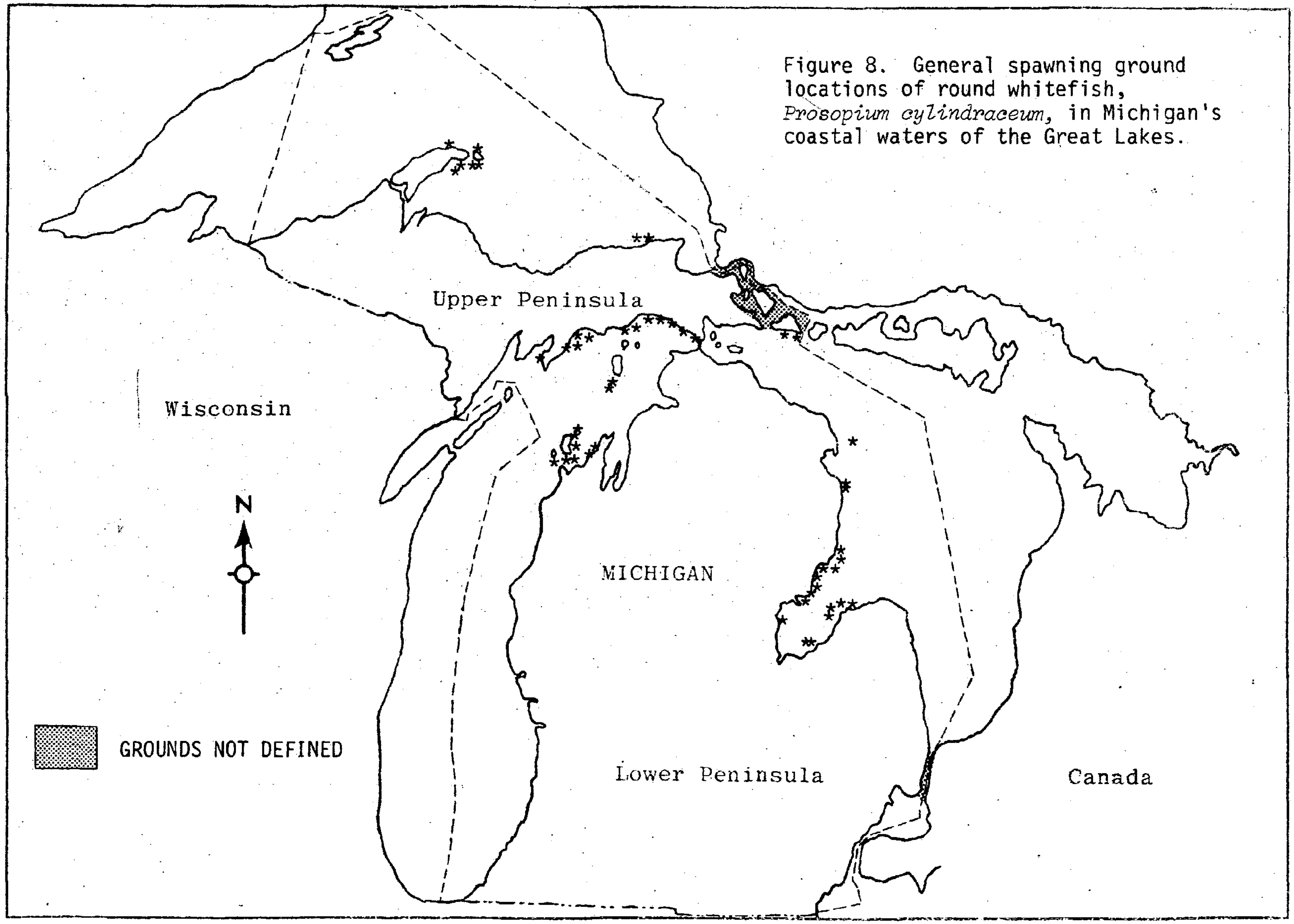


Figure 8. General spawning ground locations of round whitefish, *Prosopium cylindraceum*, in Michigan's coastal waters of the Great Lakes.

18). The bottom compositions of these spawning areas were referenced as rock. One fisherman reported spawning in water as shallow as 3 meters (10 feet) deep and that menominee followed spawning lake trout and ate the trout spawn. Spawning times of menominee were, for the most part, referenced as being from mid-November to mid-December.

Some spawning was also reported in Southern Keweenaw Bay over sand, but more references referred to rock, with depths ranging from 18 to over 54 meters (60 to over 180 feet). One fisherman reported that there had been a gradual decline of the species in this area in recent years (Appendix 3, Figures 19, 21A and B).

Only two other areas in Lake Superior were referenced as spawning sites during the course of this study (Appendix 3, Figure 32). Menominee were reported to spawn during the months of October and November over sand near the Two Hearted Rivers.

Lake Michigan. Koelz (1929) reported that, according to fishermen, menominees spawned in Lake Michigan on gravel and honeycomb rock in 4 to 11 meters (12 to 36 feet) of water. Fish movements in that study indicated that spawning times were in November. Although age and growth studies of this species do exist in the literature (Armstrong et al., 1977; Marz, 1964), no references have been made to spawning grounds.

In the present study nearly all spawning ground compositions referred to in Northwestern Lake Michigan included rock or combinations of rock and gravel and sand (Appendix 3, Figures 67 and 68). Spawning depths ranged from 3 to 9 meters (10 to 30 feet) and spawning seasons, from November through December. One fisherman reported that "heavy" spawning occurred along the shore from Manistique south to Wiggin's Point in 1975. Another source reported that the round whitefish population seemed to be increasing in recent years near Wiggin's Point Shoal (Appendix 3, Figure 67).

In Northern Lake Michigan, spawning grounds referenced were from 1.5 to 9 meters (5 to 30 feet) deep but averaged about 3 meters (10 feet). An exception to these depths occurred at St. Helena Shoal and along the south side of St. Helena Island where spawning was reported at 12 to 15 meters (40 to 50 feet) (Appendix 3, Figures 76A and 77). The spawning season was reported by most fishermen to be November; however, some sources were quite specific, referring to 25 November until 10 December and 11 November until the end of November (Appendix 3, Figures 71 through 75).

Along the Northeastern shore of Lake Michigan, menominee were referenced as spawning in Bowers Harbor, Grand Traverse Bay, over rock and gravel (Appendix 3, Figure 99) and along the shoreline west of Northport (Appendix 3, Figure 96C).

The shores of both North and South Manitou Islands were referred to as spawning grounds by many sources along with other areas near the northwestern shores of Michigan's lower peninsula (Appendix 3, Figures 101B, 103B, 105, 106B, 106C, 106D, 108A, 108C, 109A and 110). Although data on bottom types were not given in most cases, depth where spawning occurred was approximately 3 to 6 meters (10 to 20 feet). Spawning times reported were the third week of November through the first week of December. Menominee are also known to spawn along the north and south side of South Fox Island (Keller, 1979).

Liston (1978) reported that menominee spawn in late November and early December on the rock jetties of the Ludington Pumped Storage Reservoir (Appendix 3, Figures 117B and C). Depths given were to 9 meters (30 feet) of water. Tack (1978) reported menominee spawning grounds located from near Big Sable Point south to Ludington. Spawning in that area was reported over gravel in a depth of approximately 5 meters (15 to 18 feet) (Appendix 3, Figure 116B).

Lake Huron. Fishermen reported to Koelz (1929) that round whitefish in Lake Huron spawn at depths of 7 to 15 meters (24 to 48 feet) on honeycomb, rock, and gravel. Koelz (1929) indicated that spawning probably occurred in November.

Few references to spawning menominee in Lake Huron occurred during the course of the present study. Round whitefish were reported to spawn in the Big Shoal Cove area of the southern Drummond Island shoreline and in two areas of the southeastern shoreline (Appendix 3, Figures 145B, 145.1, and 145.2), where spawning occurred during November over sand and gravel. Menominee spawning has also been reported for the North Point region (Appendix 3, Figure 157B) (Eschenroder, 1979). One area was referenced northeast of Gull Island (Appendix 3, Figure 156); however, no other data were given on that spawning area. Another area, between Black River and Sturgeon Point, was reported as a menominee spawning ground (Appendix 3, Figures 158A and 159A). Spawning was said to occur in 3 meters (10 feet) of water over gravel in late October and early November.

Saginaw Bay Area. Menominee reportedly have spawned over rock, gravel, and rock and gravel mixtures in many areas of Saginaw Bay

(Appendix 3, Figures 160 through 170). Physical description of bottom types suggested that much mud and silt has recently covered some of the previously used spawning areas. Spawning was said to occur in from 2 to 9 meters (5 to 30 feet) of water, but averaged approximately 4 meters (12 feet) of water. One fisherman reported that the round whitefish populations have been increasing in recent years, again spawning generally occurred during November, but one fisherman reported that eggs begin to develop around the end of August.

## PYGMY WHITEFISH

Little is known of the spawning habits or locations of the pygmy whitefish, *Prosopium coulteri*. In the Great Lakes this species resides only in Lake Superior, with highest population concentrations in semiprotected bays such as Keweenaw Bay (Eschmeyer and Bailey, 1954). Available evidence suggests that spawning takes place in November or December and that the eggs of this species are probably scattered over coarse gravel (Scott and Crossman, 1973).

The spawning grounds of the pygmy whitefish are not known; however, the capture of young fish in relatively shallow water, 23 to 32 meters (78 to 108 feet) deep, at Keweenaw Bay, Point Abbaye, and Siskiwit Bay, as well as the tendency of yearling fish to inhabit shallow water, indicates that spawning occurs in shallow water (Eschmeyer and Bailey, 1954).

No references to this species were made by any of those interviewed during the course of this study, however, pygmy whitefish have been reported from Munising Bay (Keller, 1979).

## BURBOT

The burbot, *Lota lota*, has been a very important member of the deepwater fish community of the Great Lakes, being basically equal in rank to the lake trout as a predator species until the onset of the sea lamprey population (Moffett, 1957; Wells, 1972). Very little information is available in the literature, however, concerning the spawning habits of the Great Lakes' burbot (Cahn, 1936), and the reports that are available do not seem to reach any definite conclusions (Clemens, 1951).

The burbot supposedly spawned in deep and shallow water during March and early April in Lake Erie (Clemens, 1951), and during mid-February in Lake Superior (Bailey, 1972). Unpublished data suggests the occurrence of two distinct spawning populations for burbot in Michigan's Keweenaw Peninsula region; one which spawns in the open waters of Lake Superior, and one which migrates up the Sturgeon River to spawn under the ice, both cases of activity occurring in early January (Klos, 1978).

Dates for burbot spawning for waters outside of the Great Lakes have been reported to be from mid-January to late February (Hewson, 1955; McCrimmon, 1959; Lawler, 1963).

Depths of spawning for the burbot are generally agreed to be shallow, from 1 to 3 meters (1 to 10 feet) (Scott and Crossman, 1973); but deepwater spawning activity has also been reported (Cahn, 1936).

The burbot is reported to require sand or gravel bottoms with conditions of high oxygen saturation for successful spawning (Scott and Crossman, 1973; Volodin, 1968).

Burbot were referenced by the Great Lakes commercial fishermen to have spawned in Lake Superior, Lake Michigan, and Lake Huron (Figure 9).

Lake Superior. Very little is known of the Lake Superior burbot spawning habits. Generally, spawning occurs from November to early January, either in rivers (under the ice), or in the shallower waters of the lake (Bailey, 1972).

There were no burbot spawning areas reported from the Isle Royale region or the southern Lake Superior coastline from Saxon Harbor to Redridge. Burbot have been reported in the Apostle Islands region of the Wisconsin waters, but no spawning behavior was noted (Dryer, 1966).

Burbot spawning activity has been noted for three areas of the Keweenaw Peninsula. Burbot spawning has been reported from the Sturgeon River, which empties into Chassell Bay on Portage Lake (of the Portage Lake Canal connecting waters) in November (unmapped). The bottom at this location was reported to be mud, sand, and gravel. Klos (1978) has also reported this area for burbot spawning, but noted that the peak spawning run is in late December and early January under the ice.

Burbot spawning has also been reported off the South Portage Entry in November (Appendix 3, Figure 21B), from the middle of Keweenaw Bay in 108 to 144 meters (360 to 480 feet) of water and the deep water areas from Traverse Point to Big Bay during April or May (unmapped).

No burbot spawning areas were reported for the area from Big Bay Point to the St. Mary's River, where burbot spawning may

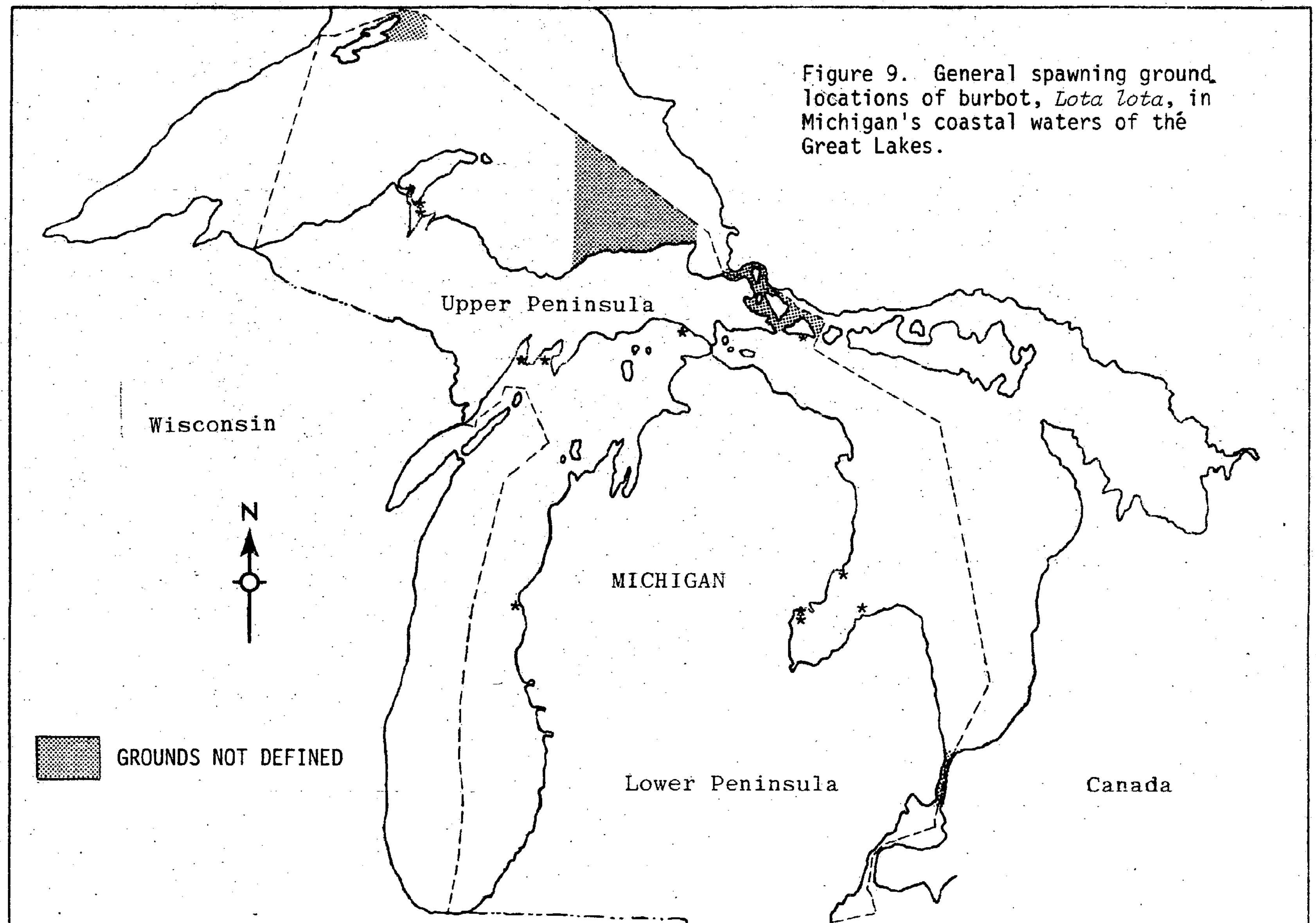


Figure 9. General spawning ground locations of burbot, *Lota lota*, in Michigan's coastal waters of the Great Lakes.

occur in the rapids area.

Lake Michigan. Burbot spawning in Lake Michigan is not well understood, but has been reported to occur in shallow waters during February and March over a rock bottom.

Burbot spawning has not been specifically noted for the region of Point Detour to Bailey's Harbor (Northern Bay de Noc areas); however, burbot have been reported to spawn wherever lake trout and whitefish spawn, but no specific spawning requirements for the burbot were noted by this source.

The Manitou Paymen Shoal (Appendix 3, Figure 75B) and Simmon's Reef (Appendix 3, Figure 74A) are reported to show burbot spawning activity during February and March in 1 to 10 meters (6 to 36 feet) of water over rock.

No locations have been reported for burbot spawning from the Mackinac Straits section of Lake Michigan.

The last reported burbot spawning location for Lake Michigan was in the Ludington area, off the Consumers Power Pumped Storage Project, during winter, under the ice (Liston, 1978).

Lake Huron. Burbot spawning does not appear to be very prevalent in Lake Huron according to reports from the commercial fishermen. Spawning generally occurred during February in shallow waters. Data concerning bottom characteristics were not available. One burbot spawning area was reported from Scammon Cove near Johnswood on Drummond Island. Spawning reportedly occurs in this area during March (Appendix 3, Figure 145.1).

All reported Lake Huron burbot spawning activity is included within the boundries of Saginaw Bay, and has not occurred with any great significance since the 1940's. Burbot are still reported to spawn occasionally in the area from Point Au Gres to Saganing Bar (Appendix 3, Figures 164A and 165C), from Tawas Bay south to Point Lookout (Appendix 3, Figures 162A and 163C), and along the shoreline from Sand Point to Flat Rock Point (Appendix 3, Figure 169A and 170).

St. Clair River. One larval fish study conducted in the St. Clair River shows the presence of burbot larva in the river which indicates that spawning might occur (Wapora, 1978), but no burbot spawning sites were defined during this study for the St. Clair River.

Lake Erie. Burbot in Lake Erie are reported to spawn during the last week of March and the first week of April in either shallow or deep water (Clemens, 1951). No data is available concerning any recent burbot spawning in Lake Erie.

## YELLOW PERCH

The yellow perch, *Perca flavescens* (Mitchill), spawn in the spring, generally from mid-April to early May (Scott and Crossman, 1973). Smith (1969) reported that yellow perch spawn over sand bars or submerged vegetation in the spring when the water temperature ranges between 4 to 10°C. Brazo et al (1975) reported yellow perch spawning in the shallow littoral waters of Lake Michigan, near Ludington, to have taken place from mid-May through the end of June in 1972.

Spawning depths for the yellow perch range from near shore to over 15 meters (50 feet). The most commonly used spawning substrate in the Great Lakes water has been rock, sand, and sand and rock bottom. Available information indicates that the most concentrated perch spawning activities occurred in Saginaw Bay (Figure 10).

Lake Superior. Material relating to yellow perch spawning in Lake Superior is sparse, at best. Two areas in the Keweenaw Bay where yellow perch spawn in June are near Baraga in L'Anse Bay and in Pequaming Bay (Appendix 3, Figure 21B). In Whitefish Bay, yellow perch spawn over "grass" and rock areas in 3 to 4 meters (10 to 14 feet) of water during the spring and early summer (Appendix 3, Figure 35A).

St. Mary's River. Yellow perch were reported to spawn around the Ashman Island region of Potagannissing Bay. Spawning was noted to have taken place in approximately 1 meter (3 to 4 feet) of water during late April and early May (Appendix 3, Figure 49). This individual also noted that perch fishing is getting worse by the day and attributes this decline to an overabundance of suckers.

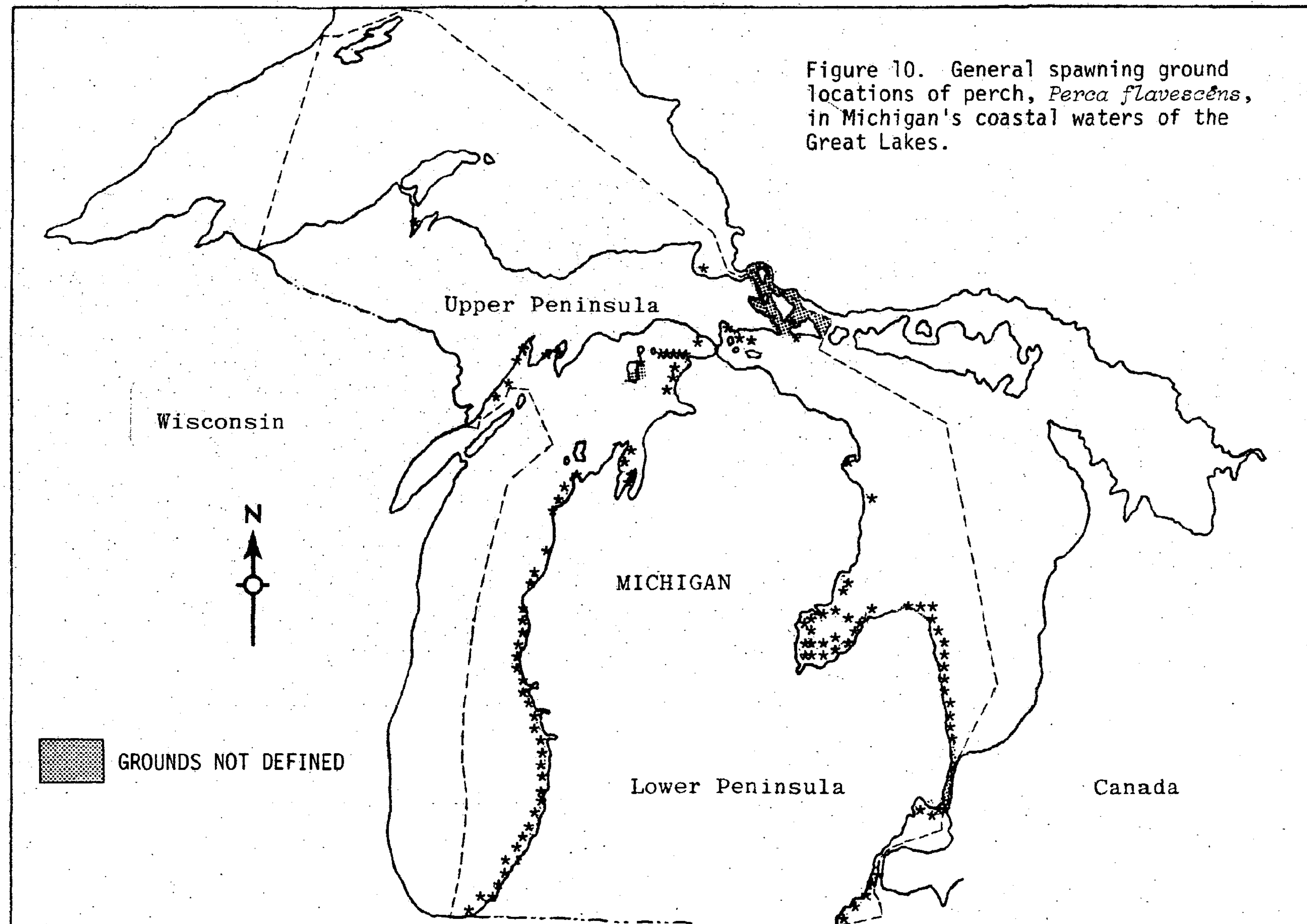


Figure 10. General spawning ground locations of perch, *Perca flavescens*, in Michigan's coastal waters of the Great Lakes.

Eschenroder (1979) has also reported that the lower St. Mary's River system, south of Munuscong Bay is an important yellow perch habitat. It has also been reported that yellow perch definately spawn in the near shore areas of Mark's and Leigh Bays of the Canadian St. Mary's River near Sault Ste. Marie (Dames and Moore, 1978).

Lake Michigan. Wells (1977) indicated that yellow perch had been an important commercial species since 1880 in Lake Michigan. Much of the past commercial output of yellow perch had come from Green Bay; however, the current study has turned up few spawning areas in Michigan waters of Green Bay. Spawning reportedly occurred in Green Bay over rock in approximately 1.5 meters (5 feet) of water during the period of mid-May to early June (Appendix 3, Figures 50, 51B, and 53). In a sand and rock area off Arthur Bay, yellow perch spawn during the month of May (Appendix 3, Figure 51B). Water depth on these spawning grounds average 2 meters (6 feet); the ratio of females to males was reported as 2:1 by one commercial fisherman.

On the east side of Little Bay de Noc, in about 4 meters (12 feet) of water, yellow perch begin a spawning run the first part of May (Appendix 3, Figures 57 and 58). This area extends into Big Bay de Noc along shoreline areas of sand, gravel and rock to near Valentine on the east shore of Big Bay de Noc (Appendix 3, Figures 57, 58, 63B, and 64A). On both sides of Point Epoufette yellow perch spawn in mid-May over mud and weed bottom. Further east in shallow water with sand and gravel bottom, yellow perch spawn in mid-May through June, this area extends from near Waugashance Point to Good Hart (Appendix 3, Figures 74B, 78B, and 79).

Gray's Reef east of Hog Island was reported as a yellow perch spawning ground. The reef is 19 kilometers long by 6 kilometers wide (12 by 4 miles); depths range from less than 2 meters to over 10 meters (6 to 33 feet), and bottom composition is generally rock (Appendix 3, Figures 80 and 81C). On Beaver Island in St. James Harbor yellow perch spawn over rock and gravel and were reported spawning in mid-June (Appendix 3, Figure 83A and 83C), and was reportedly an excellent area at one time (Keller, 1979). Keller also reported that the Garden Island shoreline used to be a good perch spawning area (Appendix 3, Figure 82C).

Four spawning areas for yellow perch were indicated in Grand Traverse Bay (Appendix 3, Figures 94, 96B, 97A and B, and 99). All of these areas were indicated to have rock and gravel bottom and spawning was reported to have taken place in the shallows. Keller (1979) has reported two perch spawning areas for the Grand Traverse Bay region. Spawning was noted to have occurred over rock in 2 to 5 meters (8 to 15 feet) of water (Appendix 3, Figures 89 and 93). Additional shallow, rock and gravel areas, were reported from the west shore of the Leelanau Peninsula south to near Empire (Appendix 3, Figures 105, 108A, 110, and 112). Spawning dates for the above mentioned areas were reported as mid-May to mid-June.

Near the mouth of the Platte River is a yellow perch spawning reef, over rock bottom, reported as "once a tremendous spawning ground" (Appendix 3, Figure 113). The Frankfort breakwater area was also reported as a yellow perch spawning area; however, no dates or depths were given for either of these areas (Appendix 3, Figure 113).

Spawning grounds over stone, gravel, and rock were reported from

Manistee to south of Ludington (Appendix 3, Figures 115 through 118). Spawning depths for these area were generally less than 15 meters (50 feet). Liston (1978) reported perch spawning from mid-May to the first week in June, near Ludington's pumped storage reservoir; the spawning areas were reported as rock bottom in 9 meters (30 feet) of water, although no specific sites were indicated (Appendix 3, Figure 117).

The shoreline area from Stony Lake south to South Haven was reported as a yellow perch spawning area (Appendix 3, Figures 119, 120, 121, 124, 126, and 129). The area is primarily sand with some isolated rock and gravel areas. General spawning dates were reported from mid-May through mid-June for this area. Wells (1967) reported spawning to take place over rocky bottom in less than 15 meters (50 feet) of water near Grand Haven, Michigan. Spawning depths were generally reported as less than 18 meters (60 feet) of water.

Possible extensive spawning grounds were reported south of Saugatuck for the yellow perch with variations in spawning times for 1972 and 1973 (G.L. Fish Lab Report). A triangular shaped area south of Saugatuck was indicated by a number of fishermen as a rock reef extending from shore to depths of 27 meters (90 feet) of water and utilized by the yellow perch for spawning (Appendix 3, Figure 126).

Shoreline areas from South Haven to the Indiana State border over sand and occasionally rock were indicated as yellow perch spawning grounds (Appendix 3, Figures 131, through 134A and C). Spawning times in this area were generally reported as early May and occasionally late April.

<u>Lake Huron</u>. O'Gorman (1975) reported that yellow perch do not spawn

before early summer in Northern Lake Huron. In the Hammond Bay area, yellow perch are reported to begin spawning in early June, although no specific locations are given (O'Gorman, 1978).

During this study, spawning locations along Michigan's Upper Peninsula-Lake Huron shoreline were reported generally as mud and weed (Appendix 3, Figures 138B, 139C, and 140). Other information indicated that yellow perch also spawn over rock in approximately 1 meter (3 to 4 feet) of water (Appendix 3, Figure 145.1). The Maxton Bay area of Drummond Island was reported by Carlson (1979) to be a spawning area for jumbo yellow perch. Spawning in this area occurred during the spring over sand and rock (unmapped). Spawning times for these areas were indicated as late April, depending on water temperature.

In Squaw Bay and on area off Harrisville State Park, yellow perch were reported spawning over sand bottom; water depth in the spawning area range from less than 1 meter to 6 meters (1 to 20 feet) of water and spawning occurs during April and early May (Appendix 3, Figures 157 and 159A). Other known yellow perch spawning areas in the vicinity of Alpena, Michigan, were reported by Eschenroder (1979) (Appendix 3, Figures 157B and 157C).

In the Saginaw Bay area numerous spawning areas were indicated (Appendix 3, Figures 164B through 170). Generally, spawning areas in Saginaw Bay were reported as shallow and over a sand bottom. Spawning times throughout Saginaw Bay were reported as April and May. Hile and Jobes (1941) reported yellow perch spawning grounds in Saginaw Bay as the most productive in the Michigan waters of the Great Lakes. Spawning season collection of yellow perch in Saginaw Bay is reported for the years 1943 through 1955 by El Zarka (1959).

Other fishermen indicated that perch spawn in the rivers of Saginaw Bay, including the Grey and Rifle Rivers, The Black River was reported to have been a good perch spawning area years ago. Tawas Bay was also indicated as a perch spawning area in 1970 where spawning occurred over clay and mud (Appendix 3, Figure 162B) (Eschenroder, 1979).

From near Huron City south to near Lakeport, perch were reported to spawn in near shore waters in the spring (Appendix 3, Figures 172 through 174A and 177 through 179). Two areas near Port Sanilac were reported to exhibit yellow perch spawning activity during late May to early June, where spawning occurred over sand and gravel from the shoreline out to a 6 meter depth (18 feet). (Appendix 3, Figure 177C).

Lake St. Clair. Yellow perch were reported spawning in two locations (Appendix 3, Figures 186A and 187). Spawning runs were reported to begin in April over sand, gravel, and marshy bottoms. In the Detroit River, yellow perch spawn over sand and gravel, and mud and gravel (Appendix 3, Figures 198B and 198C). Early to mid-April is reported as the spawning season; and, in one case, southeast of Celeron Island in 3 to 5 meters (10 to 15 feet) of water, yellow perch were reported to spawn during early fall (Appendix 3, Figure 199A).

Lake Erie. Spawning of yellow perch in Lake Erie was reported as generally occurring during the early part of May as the water temperature reaches 7 to 10°C (Van Meter, 1960). Fishermen in the Lake Erie area reported a number of yellow perch spawning locations, over a variety of bottom types (Appendix 3, Figures 201A, 202, 203A, and 203C). Spawning times were reported as being April to May with three exceptions: 6.5 kilometers (4 miles) south of La Plaisance

Creek, south to Turtle Island; near Muddy Creek; and southeast of Brest Bay, where spawning was reported to begin in mid-March (Appendix 3, Figure 202).

## SMELT

The smelt, *Osmerus mordax* (Mitchill), was introduced into Crystal Lake Michigan, on 6 April 1912, with a plant of 16,400,000 eggs (Van Oosten, 1937), and by 1918 the first specimen was taken in Lake Michigan near Frankfort, Michigan (Commercial Fish Material, 1929-1955). By 1936, the smelt had reached the Keweenaw Bay region of Lake Superior, presumably through the St. Mary's River system (Van Oosten, 1937b), and had become established in all of the Great Lakes (Commercial Fish Material, 1929 through 1955). Since smelt are widely distributed throughout the Great Lakes, it is interesting to note that very few precise spawning locations were reported (Figure 11).

The smelt is known to be an anandromous fish, entering small streams to spawn soon after the ice is out, generally in late March or early April (Scott and Crossman, 1973). The smelt spawning season may begin as early as 17 March, depending basically on the locality and the temperature, and continue until mid-May (Commercial Fish Material, 1929 through 1955). Spawning is reported to start when temperatures reach 8.9°C (Scott and Crossman, 1973). The smelt have also been reported to spawn first in the southern most areas and proceed, with the temperature, to the most northern areas (Commercial Fish Material, 1929 through 1955). Smelt have also been known to spawn over sand or gravel shoals in the major lakes, especially if there is a current or wave action (Commercial Fish Material, 1929 through 1955). Smelt have been shown to be extremely sensitive to light (Creaser, 1925) and have been reported to spawn at night in the

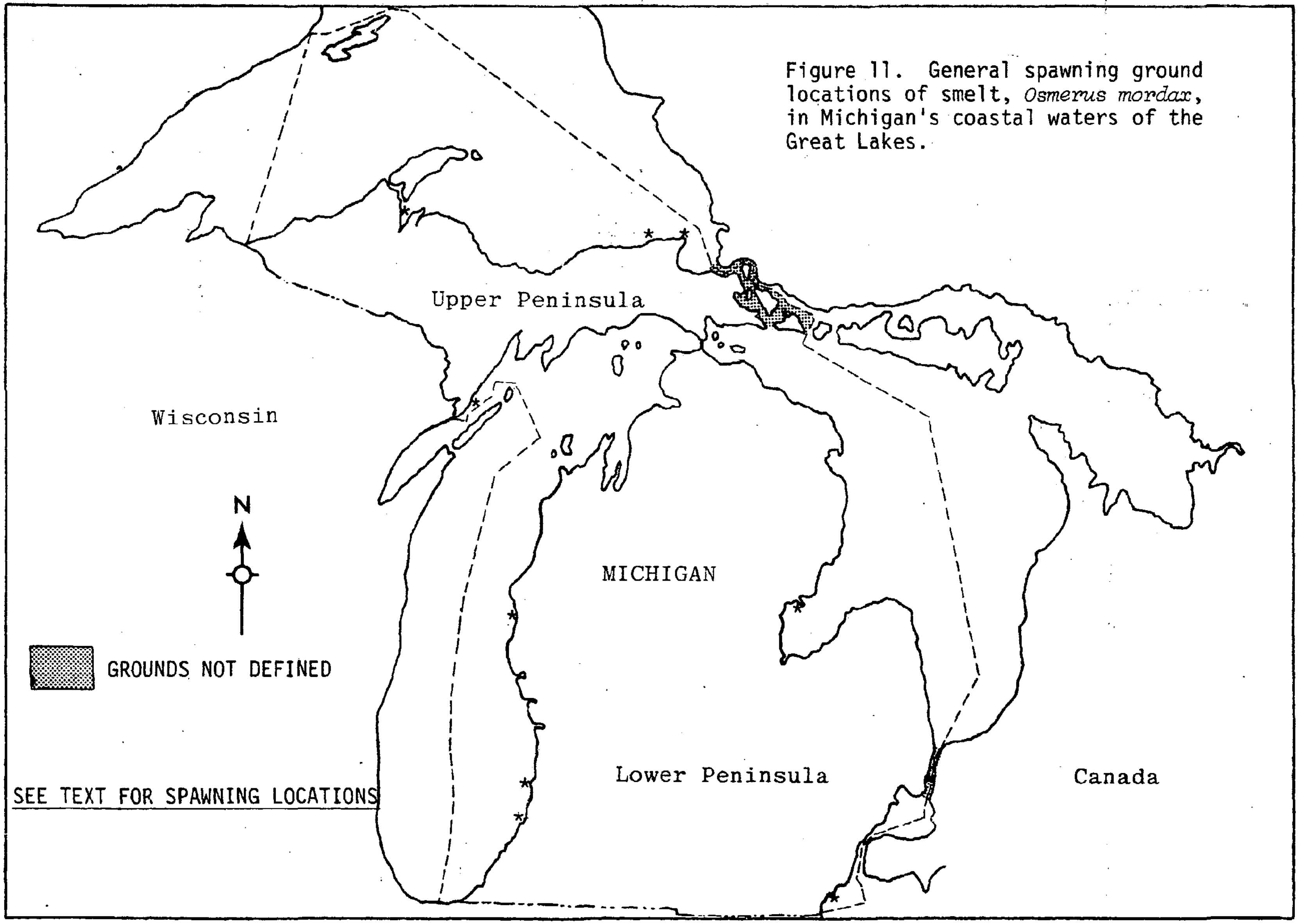


Figure 11. General spawning ground locations of smelt, *Osmerus mordax*, in Michigan's coastal waters of the Great Lakes.

streams and move (drift) back to the lake before day light (Commercial Fish Material, 1929 through 1955; Scott and Crossman, 1973).

Lake Superior. Smelt have been reported to spawn in the Apostle Island region of Lake Superior from mid-April to early May (Bailey, 1964) and in all of the small streams with a sand bottom in Keweenaw Bay where spawning occurs approximately 1 kilometer (less than 1 mile) inland from the bay. Smelt spawning has also been reported for many of the small rivers and streams for various counties in Michigan's Upper Peninsula, the runs beginning in late April and continuing into early May ("Smelt", 1951). The Carp River and Three Mile River along the south side of Lake Superior are also said to contain smelt spawning runs at their mouths over gravel (Appendix 3, Figure 33). The east side of Little Lake Harbor is reported as a site of spawning, where activity occurs over cobble, rock and gravel (Appendix 3, Figure 32). It is known that lake populations of smelt make spawning runs into the lower St. Mary's River system (Eschenroder, 1979); however, only one spawning location was identified for this region (Appendix 3, Figure 49).

Lake Michigan. An interesting smelt spawning area has been reported from the Michigan waters of Green Bay near Menominee, where smelt were reported to spawn in approximately 20 meters (60 to 65 feet) of water during the spring (Appendix 3, Figure 50). Smelt were also reported to spawn along the beaches and in many streams tributary to Green Bay. Available records concerning smelt spawning runs in the Big Bay de Noc area show that spawning has occurred from mid-April to early May in many of the smelt streams as well as along the shores of Green Bay and Big Bay de Noc ("Smelt", 1951). Information gathered during this study also showed that smelt spawn in most of the small rivers of this area; however, the runs were noted to be from later April to 1 May.

Only one smelt spawning location was noted for the Beaver Island area where spawning reportedly occurred over rock, sand, and mud during April and May (Appendix 3, Figure 80).

Smelt are reported to spawn in streams along the Northeastern Lake Michigan shoreline from April to early May ("Smelt", 1951), with some activity having been reported along the shoreline over gravel near Ludington, Michigan (Liston and Tack, 1975).

Smelt spawning appears to have occurred mostly along the beaches of Southeastern Lake Michigan, with activity having been reported along sandy beaches in 1 meter (2 to 3 feet) of water at night immediately after the ice has left the shoreline (Appendix 3, Figures 120 and 121B).

Lake Huron. No precise smelt spawning locations were reported for Northern Lake Huron. O'Gorman (1976), however, reports that smelt fry are abundant in these waters and that the littoral area from the Les Cheneaux Islands to St. Martin Bay is possibly a major nursery ground for smelt. Other data available for the northwestern shore of Lake Huron reported that spawning occurred in many of the smaller streams from mid-April to early May ("Smelt", 1951).

All of the reports for smelt spawning within Saginaw Bay were from the area of Wigwam Bay and Point Au Gres (Appendix 3, Figures 164A and B and 165C) where spawning occurred in shallow water over mud and stone during the spring (just after ice-out). O'Gorman

(1975) has also reported the Point Au Gres region as an area where smelt fry are abundant but notes that these fry may be migrating from the inner portions of the bay.

There were no specific smelt spawning sites located for the southwestern shore of Lake Huron. O'Gorman (1975 and 1976) has reported the presence of small numbers of smelt fry in these waters, and one other source noted that there used to be "lots" of smelt on the beaches during spring.

Detroit River. The only smelt spawning activity reported for the Detroit River occurred at night around Sugar Island (Appendix 3, Figure 198C) during mid to late April over rock and sand from shore to 2 meters (0 to 5 feet) of water.

Lake Erie. The Michgian waters of Lake Erie have been reported to contain few smelt spawning locations, and most of Lake Erie smelt spawning occurs in Ohio and Canadian waters. A few smelt have been reported to spawn in the Raisin River and Stony Creek during April over sand and rocks.

## ALEWIFE

The alewife, *Alosa pseudoharengus* (Wilson), was first reported for the State of Michigan from the Lake Huron waters in 1935 (Van Oosten, 1935). Competition by the alewife has since helped to reduce the numbers of more valuable commercial species (Smith, 1968a; Wells and McClain, 1972).

Spawning of the alewife is reported to start in the late spring when these fish begin a migration into rivers, streams and shallow waters of the Great Lakes (Smith, 1968b). Active spawning behavior has been reported to begin in late June or early July and continue into August (Joeris and Karvelis, 1962; Administrative Records, 1966-1968; Smith, 1968b). Eggs are not released, however, until the water temperatures reach 14 to 22°C (Administrative Records, 1966-1968). Spawning has been known to occur over various bottom types consisting of mud, sand, rock, boulders, and organic debris, in waters of 1 to 12 meters (2 to 39 feet) deep (Joeris and Karvelis, 1962). Alewife spawning activity has been reported to exhibit a diurnal periodicity, with the greatest activity occurring at night, peaking after midnight, and ending by early morning (Administrative Reports, 1966-1968).

<u>Lake Michigan</u>. Alewives have been reported to spawn in the northwestern parts of Lake Michigan from late spring to late July in 2 to 6 meters (6 to 20 feet) of water over sand and rock (Appendix 3, Figures 51B and 57). Alewife spawning has also been noted for Northeastern Lake Michigan, occurring anywhere along the shoreline

in 4 to 9 meters (15 to 30 feet) of water, wherever there is sand (Figure 12).

Reports of alewife spawning from Central and Southeastern Michigan indicated that spawning occurs earlier in the season, from April to late May, possibly due to temperature dependence. These areas have not been mapped due to the generalities of the information, most sources concurring that alewife spawning took place anywhere along the shoreline over sand, rock and gravel in waters 1 to 9 meters (2 to 30 feet) deep. Wells (1973 and 1974) also supports this general consensus, reporting that "the entire nearshore area from New Buffalo to Frankfort obviously is used by alewives as a nursery ground". One area that was mapped was located off Muskegon Lake (Appendix 3, Figure 121A).

Lake Huron. There were very few reports by the commercial fishermen of alewife spawning in the Michigan waters of Lake Huron, and all sources indicated that the alewife were disappearing or that there have been no specific alewife spawning locations mapped for Lake Huron. O'Gorman (1975 and 1976) has indicated that alewife spawning for Northern Lake Huron occurs in early July, and that spawning for inner Saginaw Bay probably starts a few weeks earlier. O'Gorman (1975 and 1976) also reports that the alewife is the dominant species of fry collected during mid-June and July, which suggests that spawning does occur in these areas. The collection of alewife fry in Southern Lake Huron again indicates the presence of an adult spawning stock in that area (O'Gorman, 1976).

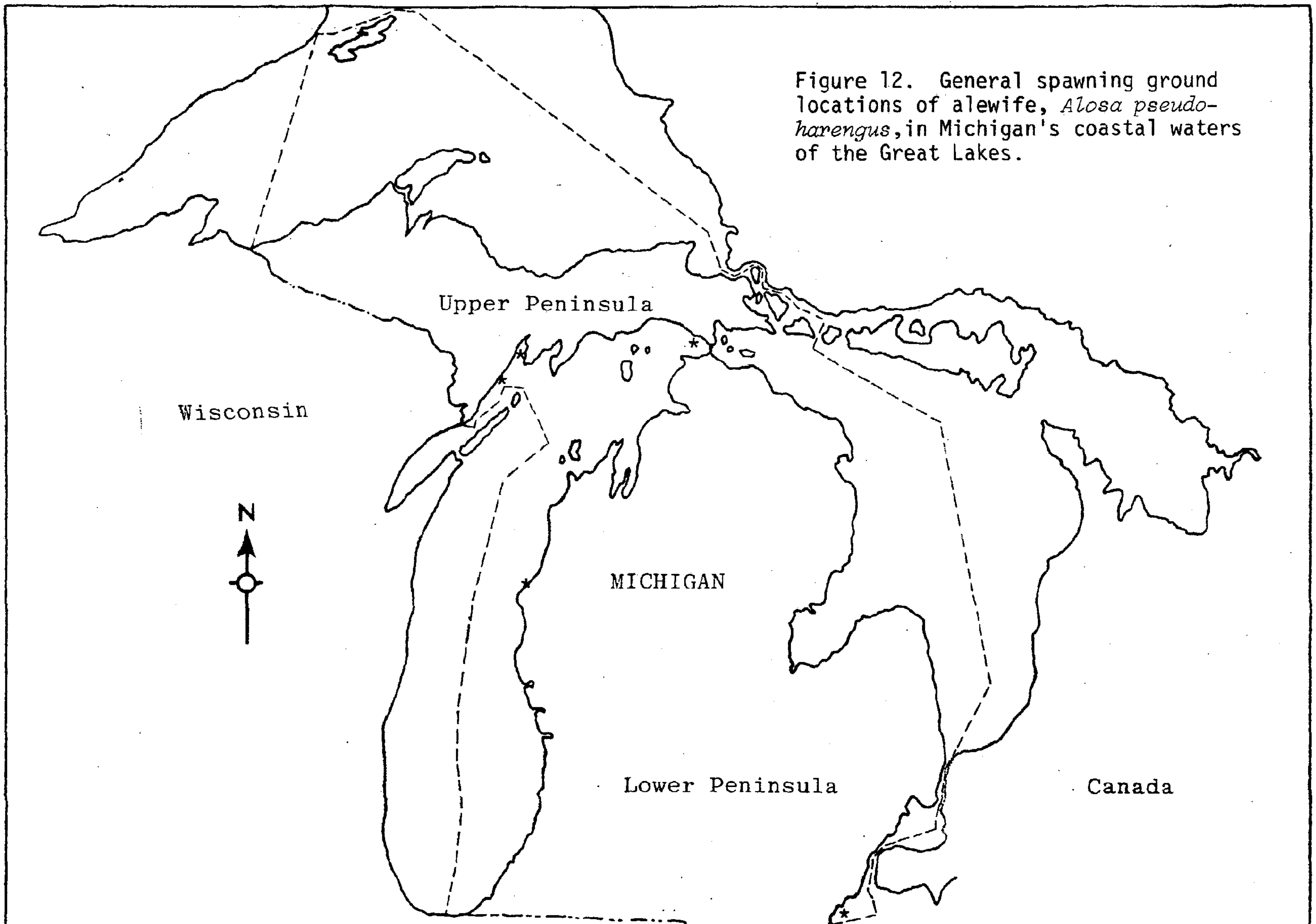


Figure 12. General spawning ground locations of alewife, *Alosa pseudoharengus*, in Michigan's coastal waters of the Great Lakes.

Lake Erie. There was only one report of alewife spawning for Lake Erie. This area is located at the mouth of the River Raisin and an early spring spawning date was indicated (Appendix 3, Figure 202A).

## WALLEYE, SAUGER, and BLUE PIKE

The walleye, *Stizostedion vitreum vitreum* (Mitchell), has been reported to spawn in the early spring just after the ice breaks up (Smith, 1969; Jovanovic, 1970) when the water temperature reaches 6.7 to 8.9°C (Scott and Crossman, 1973). Peak spawning activity has been reported to occur in mid-April (Wolfert et al., 1975). Walleye have been noted to spawn in rivers and creeks with gravel, rubble, and rock bottoms, after they undertake an upstream migration. The shorelines of lakes and shallow offshore reef areas have also been reported as suitable walleye spawning grounds. Both of the latter habitats again consisted of rock, rubble or gravel bottoms (Regier et al., 1969; Jovanovic, 1970). Males reportedly predominate the earliest portion of the spawning run (Hile, 1954; Jovanovic, 1970; Scott and Crossman, 1973).

The walleye does not spawn indiscriminately, but has been reported to return to a specific spawning site (Crowe et al., 1963; Smith, 1969). The Great Lakes probably contain discrete spawning stocks which generally remain spatially isolated, even during the non-spawning season (Crowe et al., 1963; Regier et al., 1969; Smith, 1969), but mixing of various spawning stocks may occur in more confined waters such as Green Bay (Crowe et al., 1963) (Figure 13).

The sauger, *Stizostedion canadense* (Smith), is reported to share the same basic spawning habitats and conditions as the walleye; however, spawning probably occurs over a two week period in the spring just after that of the walleye (Scott and Crossman, 1973).

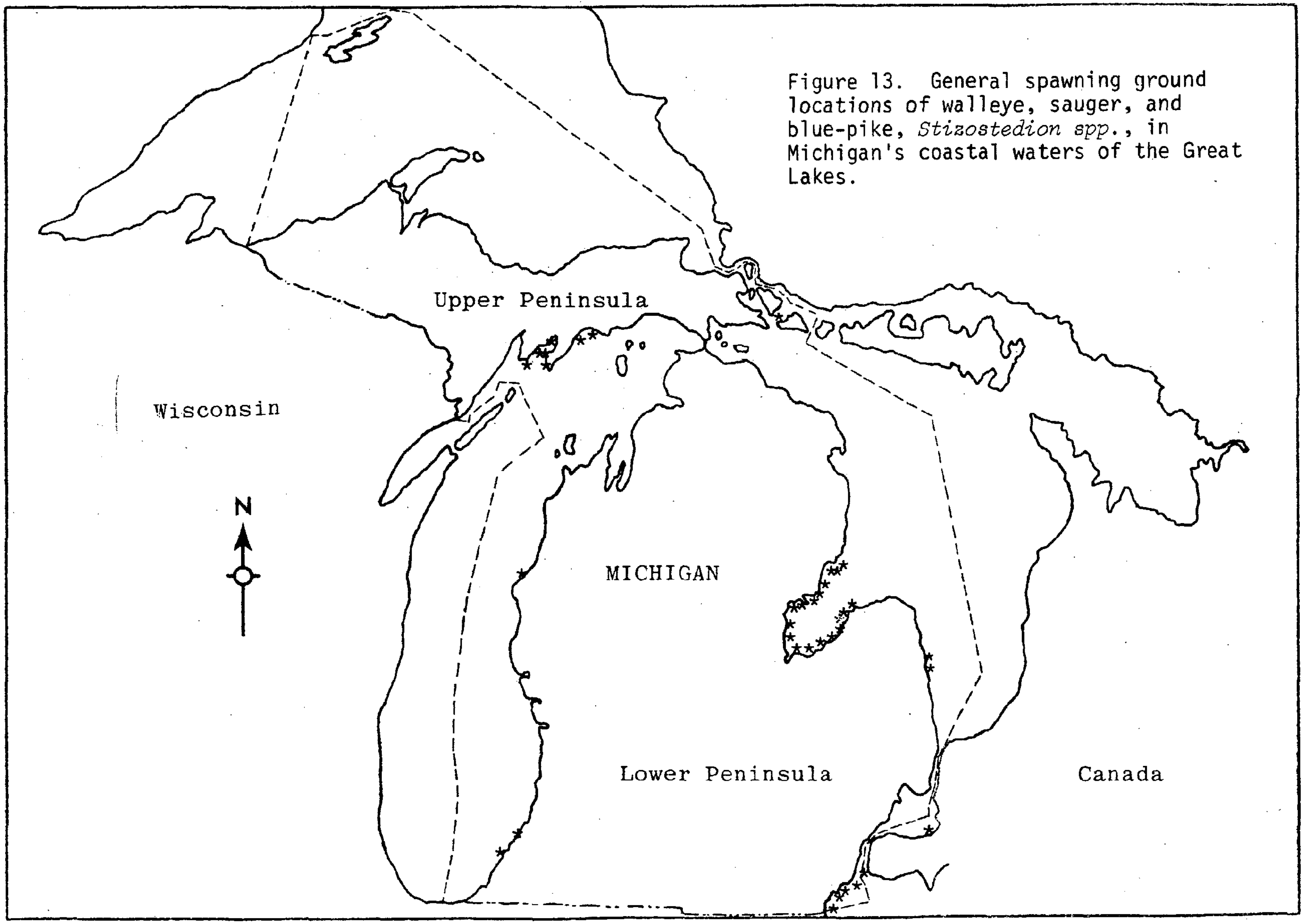


Figure 13. General spawning ground locations of walleye, sauger, and blue-pike, *Stizostedion spp.*, in Michigan's coastal waters of the Great Lakes.

All of the reported instances of spawning sites of blue pike, *Stizostedeon vitreum glaucum* Hubbs, were referenced by Lake Erie commercial fishermen. The general spawning conditions and areas reported were again very much the same as those reported for the walleye, but blue pike spawning probably occurs later in the spring.

St. Marys River. Eschenroder (1979), has reported the lower St. Marys River system to be one of the most important fisheries habitats in Michigan's waters of northern Lake Huron, and that walleye are likely to spawn in this region. Due to the closing of the St. Marys River fishery years ago, virtually no commercial fishermen are left in this region, and only one walleye spawning area could be identified. It was noted that a walleye spawning migration occurs in the Potagannissing River of Drummond Island (Appendix 3, Figure 49). Scott's Bay on Drummond Island has also been indicated as a walleye spawning area by the local conservation officer. This individual indicated that there is a congregation of walleye in the west end of Munuscong Bay after a migration from Lake Huron; and reported the occurrence of a peculiar fall run of walleye from the North Channel of the St. Mary's River and the Georgian Bay, towards the main shipping channel, but could not identify the final destination of these fish.

Lake Michigan. Reports of walleye spawning in Lake Michigan are primarily confined to the Big Bay de Noc region of Northern Lake Michigan. Spawning generally occurred during April in shallow waters along shoreline with sand and rock bottoms.

Walleye were reported to spawn, as were the sauger, near Valentine on East Bay de Noc, with walleye also spawning along the shoreline in 1 meter (3 to 4 feet) of water around the rest of the bay (Appendix 3, Figure 64A). The other reported walleye spawning areas for this region, where spawning took place in water less than 9 meters (30 feet) deep over rock and sand during April, were a 13 kilometer (8 mile) stretch southwest of Chippewa Point (Appendix 3, Figures 57 and 58) off the mouth of the Fisherdam River, and two locations in Ogantz Bay (Appendix 3, Figures 63A and B).

Only a few areas outside of Big Bay de Noc were noted for walleye spawning activity. The Cedar and Menominee Rivers of Northern Lake Michigan were reported to show walleye spawning activity during May and June over gravel. In Southern Lake Michigan, walleye were said to spawn west of the Portage Lake Channel in 12 to 18 meters (39 to 60 feet) of water (Appendix 3, Figure 115), about 6 kilometers (3 to 4 miles) north of South Haven in shallow waters (Appendix 3, Figure 129A and B); and from the end of April to early June off St. Joseph in 2 to 6 meters (7 to 20 feet) of water over gravel (Appendix 3, Figure 132A). At this last location, the female walleye was reported to be larger than the male, and spawning occurred closer to shore if the lake currents were strong.

Lake Huron. Virtually all reports of walleye spawning for Lake Huron were from Saginaw Bay. Most of the spawning grounds were reported to be from 2 to 7 meters (7 to 22 feet) (Commercial Fish Material, 1926-1946; Commercial Spawn, 1936 and 1939), with a depth of 2 meters (5 to 6 feet) probably being the average (Metzelaar, 1929). The bottom characteristics reported varied from mud and clay to hard sand

and fine gravel (Metzelaar, 1929), with most spawning reported to occur for approximately four weeks after ice-out (April). Metzelaar (1929) did note that the males arrived on the spawning grounds first, followed by the largest females, but one source stated that it was "hard to find a male walleye in the 1900's".

All of the shoreline and most of the shallow areas of Saginaw Bay have been reported to contain walleye spawning grounds (Appendix 3, Figures 163 through 169).

No sources referenced the Saginaw River as a walleye spawning area; however, Schneider and Crowe (1977) have reported that the Saginaw River was once an important walleye spawning area and that offshore reefs had to sustain the entire walleye spawning stock due to environmental changes within the river. Other reasons, from "chemical problems" to the closing of the hatchery in the 1930's, have been mentioned by the commercial fishermen to have caused the decline of the walleye in Saginaw Bay, and one commercial fisherman actually began raising and planting his own fry in 1923. Walleye production was noted to be poor (11,00 pounds) as late as 1968 from the Bay region (Subject Files, 1968-1969). Very few walleye spawning areas have been reported for southern Lake Huron (Appendix 3, Figure 177C).

Sauger were reported to spawn during the spring in the early 1920's and during the summers of 1934 and 1935 from Point Au Gres to Point Lookout (Appendix 3, Figure 164A).

Lake St. Clair and St. Clair River. The primary spawning grounds for walleye in Lake St. Clair were reported to be on the Ontario side of the lake (Subject Files, 1968-1969), with the Thames River in Ontario having been reported as the main Lake St. Clair walleye spawning region (Regier et al., 1969; Haas, 1978).

The only reported walleye spawning area for the St. Clair River was from the junction of the north and south canals north for approximately 5 kilometers (3 miles); it is not known if spawning still occurs in this stretch of the river (Appendix 3, Figure 185). It should be noted, however, that the St. Clair River was probably a very important walleye spawning area at one time. Downing (1905) reported that 17,500,000 eggs were taken from the St. Clair River near Robert's Landing, and indicated that the St. Clair River water was much clearer than that of Saginaw Bay. Individuals contacted during this study, indicated the presence of walleye migration through the St. Clair River, but did not report any spawning areas. Texas Instruments Ecological Services (1975) has also stated that, even though several walleye larvae were collected during a larval fish survey, there is only limited evidence to indicate that walleye spawn in the study area (St. Clair River near Detroit Edison Company, St. Clair Power Plant).

Detroit River. Walleye spawning in the Detroit River has been said to occur from March to May, over rock and gravel, in 2 to 6 meters (6 to 20 feet) of water (Appendix 3, Figures 197 through 200).

Only one occurrence of sauger spawning was reported for the Detroit River, where spawning occurred in the Hidden Lake Bay, east of the Livingstone Channel in 4 meters (14 to 15 feet) of water during late March and early April (Appendix 3, Figure 198C).

Lake Erie. The walleye has been reported to have always been an important commercial species in Lake Erie (Hartman, 1972), one that had supported a commercial fishery for 140 years (Regier et al., 1969). The decline of the walleye in Lake Erie during the 1950's has been attributed to overfishing and a degradation of the environment (Hartman, 1972). By 1968, only 842,000 pounds of walleye were taken from Lake Erie (Subject Files 1968-1969).

The walleyes of Lake Erie have been composed of a number of separate spawning stocks, those of Western Lake Erie basically being segregated from the walleye population of Eastern Lake Erie (Regier et al., 1969). Spawning reportedly occurs over a hard, clean bottom, rocky reefs, hard pan, or clean sand at the edge of weed beds (Regier et al., 1969) during the second or third week in April when the water temperature reaches 7.2°C (Parsons, 1972). Walleye spawning in Lake Erie has been reported to occur in April, over hard clay or rock and clay, in less than 5 meters (18 feet) of water (Appendix 3, Figures 201 through 203).

Many walleye spawning areas have also been reported for the Ohio waters of Western Lake Erie near Kelly Islands, Bass Islands, Checker Island group, and the Maumee River (Wolfert et al., 1975); and many of the commercial fishermen feel that most of the walleye production in Lake Erie is from these areas.

The sauger has been reported to spawn during April in shallow waters over hard clay and rock (Appendix 3, Figures 202A and C). The Bass and Sister Islands in Ohio have also been rated as areas with a high incidence of sauger spawning. The sauger was also reported to have "disappeared entirely in 1965" but supposedly, is increasing in numbers, along with the walleye, since the elimination of commercial exploitation and pollution sources.

The blue pike was reported to still be spawning off Point Aux Peaux (Appendix 3, Figure 201C) in late June when the water temperature is approximately 13°C. Most of the reports of blue pike spawning, however, were from Ohio waters where spawning reportedly occurred after the walleye, in April and May, over a gravel or hard bottom in 5 to 24 meters (18 to 80 feet) of water.

## SUCKERS

The group of fishes commonly referred to as the suckers includes ten genera of the family Catostomidae. The spawning characteristics are very similar among all species as they spawn in early spring, usually after the ice breaks up or before the water starts to warm. Four species of this family, the white sucker, *Catostomus commersoni* (Lacepede); longnose surker, *Catostomus catostomus* (Forster); quillback carpsucker, *Carpiodes cyprinus* (Lesueur); and bigmouth buffalo, *Ictiobus cyprinellus* (Valenciennes), have been found to be capable of spawning within the coastal waters of the Great Lakes.

White suckers and bigmouth buffalo are referenced in the literature as spawning from mid-May to early June when temperatures reach 10 to 15°C (Scott and Crossman, 1973). Longnose suckers and quillback carpsuckers spawn earlier in the spring, from April to May, when temperatures exceed 5°C (Scott and Crossman, 1973). Many small eggs are broadcast over the bottom during spawning, with the number deposited by white suckers ranging from 30,000 to 140,000 (Smith, 1969). Suckers in the Great Lakes were generally reported to spawn in shallow waters having a sand or gravel bottom (Figure 14).

Baily (1969) stated that suckers are commonly referred to as "mullet" by the Great Lakes commercial fishermen. This term, however, was used by only one fisherman interviewed during this survey, and few made any distinction between the various species they observed.

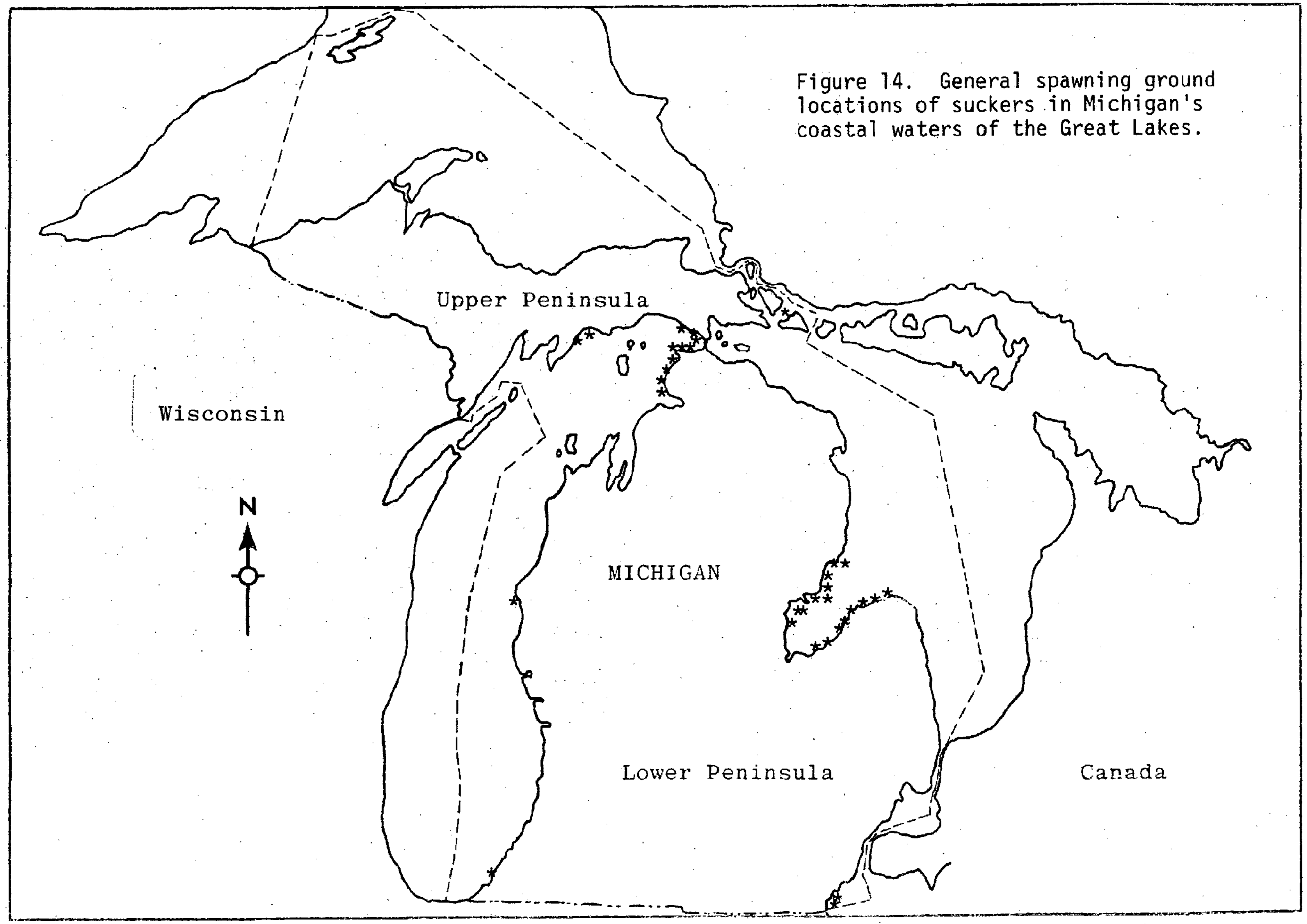


Figure 14. General spawning ground locations of suckers in Michigan's coastal waters of the Great Lakes.

Lake Superior. There was very little available information concerning the spawning characteristics of suckers in Lake Superior. Bailey (1969) reported white suckers to be in great abudance in these waters. Large numbers of white suckers were also found in the St. Marys River (Westerman and Van Oosten, 1937). Unfortunatley, these authors made no reference as to the exact locations of this spawning or to the spawning characteristics of these fish. The Potagannissing River of Drummond Island has been noted as exhibiting sucker spawning activity (Appendix 3, Figure 49) and Eschenroder (1979), has stated that the lower St. Marys River system is an important sucker habitat.

Lake Michigan. The stretch of shoreline extending from the mouth of the Cut River southeast to Brevort River was reported to be a spawning area for suckers in the northernmost waters of Lake Michigan (Appendix 3, Figures 74A, 75A and B). Spawning occurred here from late June to early July in water having a depth of approximately 1.5 meters (4 to 5 feet). The bottom in this area was reportedly composed of sand and rock. White suckers have also been reported to spawn in Springers Creek, a tributary to Green Bay, as well as other streams in this general area, around mid-May.

The shallow water areas to the north and south of Waugoshance Point, inclusive of Sturgeon Bay, and extending south to Good Hart were reported to be well-utilized sucker spawning grounds (Appendix 3, Figures 78 through 80). The bottom substrate in the region surrounding Waugoshance Island and Waugoshance Point was reportedly composed of rock and silt while that extending from Waugoshance

Point to Cross Village was primarily composed of sand and gravel. One source, however, stated that boulders composed the major bottom type along the northern edge of Waugoshance Point. Spawning was reported in these areas from May to mid-June at depths of 12 meters (40 feet) or less.

Spawning by suckers was reported to occur 8 kilometers (5 miles) south of Ludington in a circular region having an approximate 1.6 kilometer (1 mile) radius. This area was specifically located offshore from the southwest corner of the Ludington Pumped Storage Reservoir (Appendix 3, Figure 117C). Spawning occurred in water ranging from near shore to 30 meters (0 to 100 feet) deep over abottom composed of hard clay and rock. No dates were given for the occurrence of this activity.

One commercial fisherman referenced the existence of a small, sucker spawning ground offshore from St. Joseph (Appendix 3, Figure 132B) in shallow water having a sand bottom. Females were noted to occupy the spawning grounds first with males arriving 4 days after the females.

Even though little data concerning sucker spawning in Lake Michigan is available from the commercial fishermen, it should be noted that suckers utilize most streams tributary to Lake Michigan for spawning (Keller, 1979).

Lake Huron. Information provided by commercial fishermen indicated that sucker spawning activity in Lake Huron was confined to the Saginaw Bay area. As a general overview, spawning appeared to be quite extensive in this region (Appendix 3, Figures 162 through 165, and 167 through 170). In all cases, spawning activity was noted to occur during spring, usually in mid-April, May, or early June, depending on water temperatures. Suckers generally spawned at depths ranging from 1 to 5 meters (3 to 17 feet) over a bottom composed of clay, sand, gravel, stone, or a combination of these. One sucker spawning area was noted north of Saginaw Bay near Middle Island (Appendix 3, Figure 155B) (Eschenroder, 1979).

It should be noted that two areas were referenced as heavily-utilized spawning grounds by three or more commercial fishermen. These areas included the shallows from Point Au Gres to Saganing Bay and from Sand Point along the shore to Fish Point.

One fisherman reported spawning by the quillback carpsucker at four locations: in the bay just south of Sebewaing Delta, at the immediate north side of Sebewaing Delta, at a point beginning 2 kilometers (1 to 2 miles) north of the delta and extending 3 kilometers (2 to 3 miles) north along the shore, and from Fish Point south for 3 kilometers (2 to 3 miles) along the shore (Appendix 3, Figures 168A and B). This species spawned at a depth ranging from 0 to 2 meters (0 to 6 feet) over a bottom generally consisting of sand, silt or stone. It was further reported that quillback suckers spawned during the spring in these areas.

Lake Erie. Suckers spawned at two Lake Erie locations (Appendix 3, Figures 202B and C). The first area was reported to extend along the shoreline at Bolles Harbor and ocntained a gravel bottom. No depths for spawning were reported.

The other Lake Erie spawning ground, a pond formed by Otter Creek prior to its conjunction with Lake Erie, was characterized as being shallow with a mud bottom. Spawning in this pond occurred during early April.

Several commercial fishermen reported bigmouth buffalo spawning in Lake Erie. This species has been reported only from the southern areas of the Great Lakes, in Lake Michigan and Lake Erie (Smith, 1969). Smith (1969) further stated that the only commercial fishery for this species is in Lake Erie. Spawning generally occurs in shallow bays, and the eggs are broadcast over mud bottoms or vegetation.

The region extending along the coast from North Cape just past Whitewood Creek was indicated as one of three spawning grounds for bigmouth buffalo in Lake Erie (Appendix 3, Figure 203C). Spawning activity occurred here during May in shallow water abundant with cattails, marsh grass, and submerged aquatic plants.

The marshy area beginning north of Indian Island, at the mouth of Ottawa River, was also mentioned as being a spawning ground for bigmouth buffalo (Appendix 3, Figure 203B). Spawning occurred here during May and June over a bottom of weeds and mud.

One commercial fisherman referenced spawning by bigmouth buffalo to occur in an open-water region. This spawning ground, located approximately 6 kilometers (4 miles) east of Swan Creek (Appendix 3, Figure 201A), was characterized as having a water depth of from 2 to 3 meters (6 to 10 feet) and a bottom composed of hard rock and clay. Spawning occurred during May in this area.

## CARP

The carp, *Cyprinus carpio* (Linnaeus), was indigenous to Asia and parts of Europe but was introduced into the United States from Germany in 1876. Therefore, many people still refer to it as the German or European carp. Other common names applied to this species include mirror and leather carp. The term "carp" has been accepted as being the correct synonym for this species and will be used for this study.

Scott and Crossman (1973) reported that spawning does not occur extensively until temperatures reach 17°C and begins to decline when temperature reaches 26°C. Spawning ceases altogether at 28°C. If temperatures remain optimum, spawning may continue for several weeks. In the Great Lakes region, spawning may extend from May to August if temperatures permit (Swee and McCrimmon, 1966).

Bottom requirements for spawning are generally those which are conducive to plant growth. Spawning is accomplished by vigorous splashing when eggs are deposited in small patches and adhere to the weeds and other solid objects (Smith, 1969). Therefore, carp spawning activities would be expected to occur over a bottom type composed of silt, mud, or sand containing ample organic material and nutrients to sustain plant growth. Spawning was usually referenced by interviewed commercial fishermen to occur in shallow weedy areas and protected bays where carp gathered in numbers (Figure 15).

Lake Michigan. There was very limited information concerning carp spawning grounds in Lake Michigan as only two such sites could be

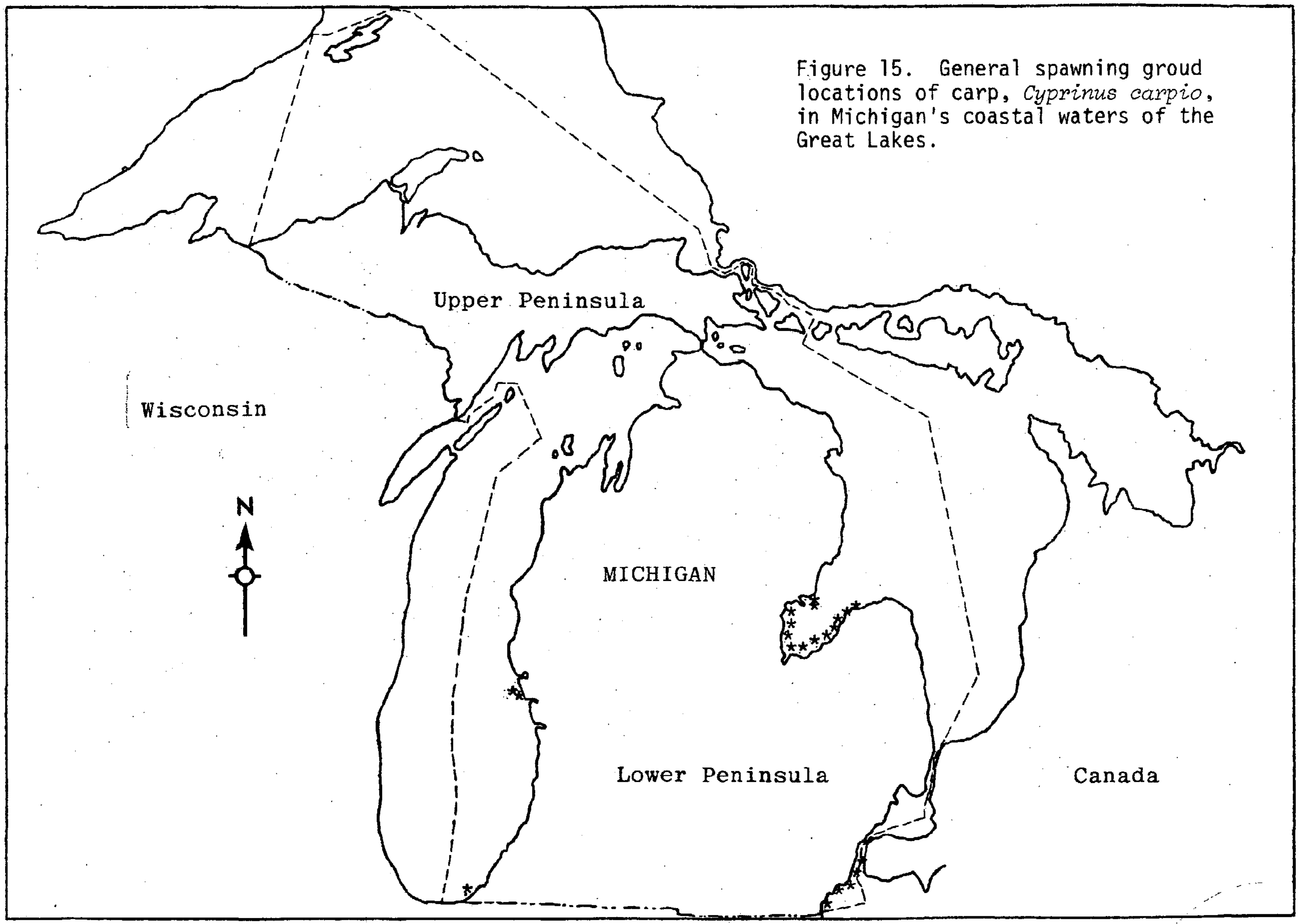


Figure 15. General spawning groud locations of carp, *Cyprinus carpio*, in Michigan's coastal waters of the Great Lakes.

identified. One area, reported to be rather small in size, was located offshore from the southwest corner of Muskegon Lake (Appendix 3, Figure 121B). Carp spawned at the surface in waters ranging in depth from 6 to 12 meters (20 to 40 feet). The bottom in this region consisted of sand and there was no indication of aquatic vegetation in the area. The observer noted spawning to occur in June and that "schools of carp knocked and bumped together to facilitate the release of spawn".

A small region offshore from lakeside was also referenced for carp spawning in Southern Lake Michigan. Additional information supplied by the fishermen precisely located the spawning grounds to be 9 kilometers (5 miles) north of New Buffalo (Appendix 3, Figure 134A), in waters ranging in depth from 3 to 6 meters (10 to 20 feet). Carp spawning activity occurred during May and over a bottom consisting of sand.

Lake Huron. The Saginaw Bay region of Lake Huron was cited by a number of commercial fishermen to be extensively utilized by spawning carp populations. Spawning grounds occurred mostly along the extensive Saginaw Bay shoreline; however, several fishermen indicated spawning to occur in open water areas or shallows around various islands (Appendix 3, Figures 163 through 170). Carp were generally observed to spawn during May, June, and July, depending on water temperatures, and over a variety of bottom substances. Most often referenced were bottom types consisting of sand, mud, stone, aquatic vegetation, or a combination of these. Depths for spawning were most often reported to be from near shore to 2 meters (1 to 6 feet).

Two areas were referenced by as many as eight commercial fishermen to be utilized for carp spawning grounds. These areas included the shallow waters extending from Point Au Gres to Saganing Bay, which encompasses Wigwam Bay (Appendix 3, Figures 164A and C, and 165A through C) and the waters east of a line extending from Sand Point to Fish Point (Appendix 3, Figures 168A through D). A small, open water area, termed "the Black Hole", was reported to be located 7.2 kilometers (4 miles) northeast of Nayanquing Point. Carp were reported to spawn in this area; however, neither spawning depth nor bottom characteristics were mentioned.

Detroit River. Information currently available concerning carp spawning grounds in the Detroit River indicates that carp spawning activity has been confined to a few regions. Two areas that were referenced by commercial fishermen are; the shallow waters around small islands and bays at the south end of Grosse Ile (Appendix 3, Figures 197A and 198A and C). and along the Detroit shoreline near Gibraltar (Appendix 3, Figures 199A and 200). All observations reported carp spawning in very shallow waters, less than 1 meter (3 feet) deep, and in weedy areas where mud and silt prevailed. Late May, June, and July were given as the dates during which most spawning activity was observed.

One commercial fisherman stated that the number of carp spawning at the Frenchman's Creek, Celeron Island, and Gibraltar Bay locations has decreased by approximately 50 percent from that which was observed during the 1920's.

Lake Erie. Many areas along the Lake Erie shoreline, extending from the mouth of the Detroit River to the Ohio border, were reported as carp spawning grounds (Appendix 3, Figures 201 through 203). Generally, spawning occurred from May to June at water depths less than 1 meter (3 feet) and in close proximity to shorelines or islands. One fisherman, however, noted spawning to occur during late April in these areas. Bottom compositions consisting of weeds and mud were reported in nearly all cases with only one individual indicating the presence of gravel.

Of special interest was the region extending from the mouth of the Huron River to Point Mouillee. Six Lake Erie commercial fishermen referred to this region as being utilized by spawning carp populations. The bottom in this area was marshy, and water depths were reported to be less than 3 meters (6 to 8 feet).

## GOLDFISH

In Michigan's coastal waters, goldfish, *Carassius auratus* (Linnaeus), have been reported from various sections of Lake Huron, the Detroit River, and Lake Erie (Figure 16). Goldfish and carp have similar spawning characteristics; both spawn in shallow, weedy areas during May and June; however, Battle (Scott and Crossman, 1973) found developing goldfish eggs as late as 17 August in Lake Erie. The eggs are adhesive and are released over submerged aquatic vegetation, usually during bright, sunny mornings (Scott and Crossman, 1973).

Lake Huron. Goldfish were reported to spawn at only one location in Lake Huron. This activity occurred in the area of Saginaw Bay, extending south from Wigwam Bay (Appendix 3, Figure 165B). Spawning depths were reported to range near shore to 3 meters (0 to 9 feet), and the bottom was marshy with some intermixed sandy areas.

Detroit River. Goldfish spawned at three locations in the Detroit River. Two areas along the southwest shoreline of Grosse Ile were specifically located, the bay south of Alba Island and the bay northwest of Meso Island (Appendix 3, Figure 198A). Aquatic vegetation and organic detritus were reported to compose the bottom substrate of these areas.

The bay area near Sturgeon Island was referenced by another commercial fisherman as being utilized by spawning goldfish (Appendix 3, Figure 199A). Spawning occurred here in shallow water and over a bottom composed of mud and gravel.

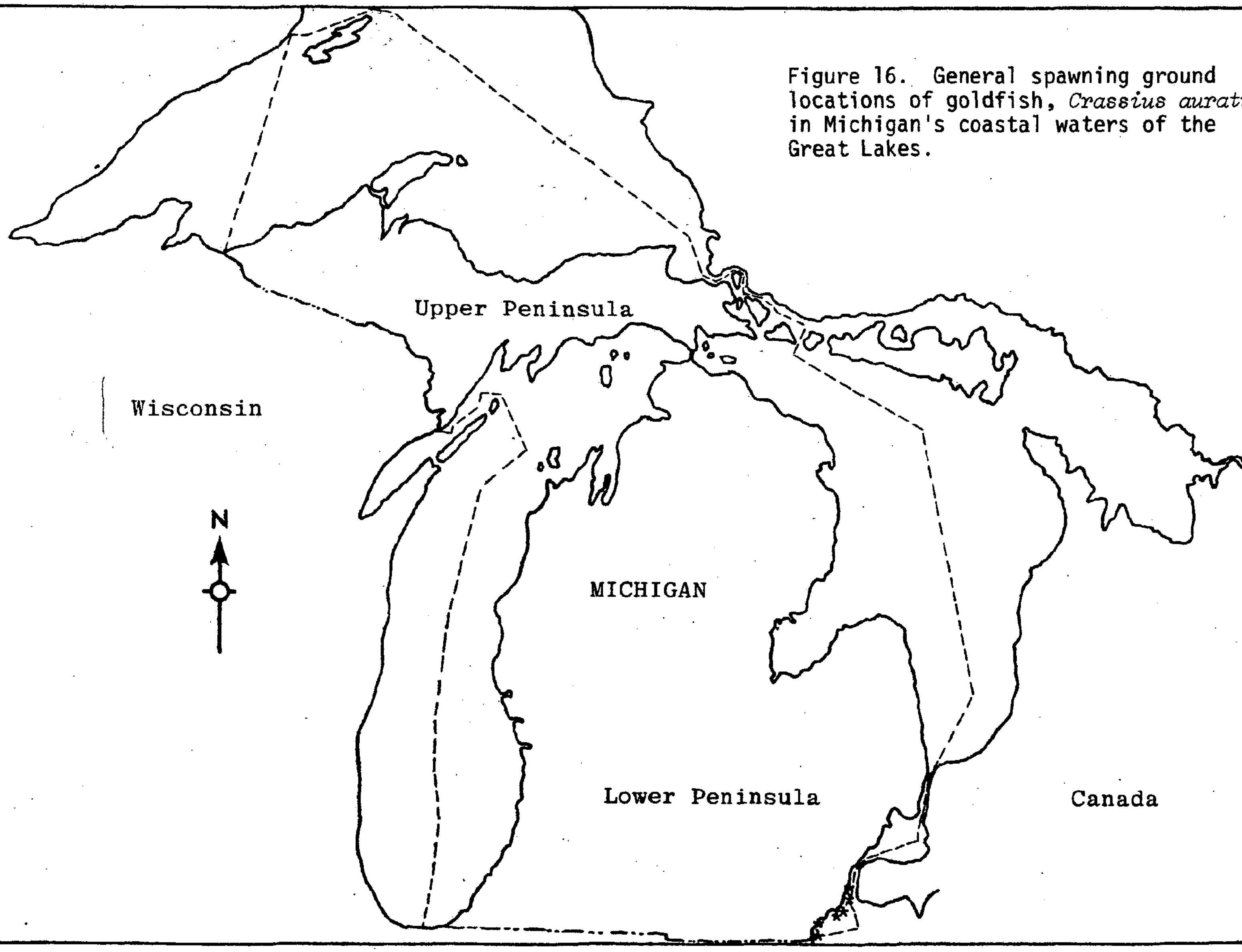


Figure 16. General spawning ground locations of goldfish, *Crassius auratus*, in Michigan's coastal waters of the Great Lakes.

Lake Erie. Goldfish in Lake Erie have spawned around Point Mouillee and in the shallow coastal waters extending from La Plaisance Bay southward for approximately 6.4 kilometers (4 miles) (Appendix 3, Figures 201B and 202B). Carp and goldfish were reported to spawn at the same time in these areas, during late June and early July, depending mainly on water temperature, with the optimum being 21°C. Spawning occurred in shallow water areas over a mud bottom.

## NORTHERN PIKE

The northern pike, *Esox lucius* Linnaeus, is known to be a spring spawner with spawning taking place immediately after the ice melts (Scott and Crossman, 1973). Spawning is reported to occur during daylight hours on heavily vegetated flood plains (Scott and Crossman, 1973). Breeder and Rosen (1966) also reported spawning to take place in early spring just as the ice leaves. In Ohio waters of Lake Erie, large numbers of northern pike spawn in late March or early April in marshes adjacent to the lake (Brown and Clar, 1965).

It is of interest to note that the early attitude of the "Michigan Fish Commission" toward the northern pike favored total extermination (Williams, 1951). Williams (1951) also noted that in 1921 it was legal to take pike with spears and dip nets during the spawning season. Few spawning areas were reported for Lakes Michigan and Superior waters with the majority of spawning reported for Lakes Huron and Erie (Figure 17).

Lake Superior. In Chassell Bay from near shore to a depth of 5 meters (16 feet) northern pike have been reported spawning from late April to mid-May. The northern pike in this area spawn on a sandy bottom with heavy growths of bulrush (*Scirpus spp.*).

Also in the Keweenaw Bay area, northern pike spawn in L'Anse Bay near Barage (Appendix 3, Figure 21B). Spawning in this area takes place in May over a "weed" bottom in areas commencing 18 to 24 meters (60 to 80 feet) from shore. Spring spawning of northern pike has been reported from the Potagannissing River, and the bays near Paw Point, on Drummond Island where spawning was noted to occur during April (Appendix 3, Figure 49). The Potagannissing Bay area, as well as the lower St. Mary's River system , is most likely an important northern pike habitat (Eschenroder, 1979).

Lake Michigan. The only information on northern pike spawning along the north shore of Lake Michigan came from MDNR spawn-taking records. Excerpts from a report on "Collection of Northern Pike Spawn in Little Bay de Noc during the Spring of 1960" follows:

April 14: Open water just beginning to appear near river mouths at end of Little Bay de Noc.

April 16: Enough open water to permit setting test net. Set one shallow trap net in water from 2 to 4 feet. Floating ice in area of open water and all the rest of the Bay ice covered. Water temperature 39°F.

April 17: Heavy snowstorm. Unable to check net.

April 18: Checked trap net. Found northern pike, walleyes, suckers, bullheads, and perch. Male northerns nearly all ripe but females green. Left fish in net and set one more. Water 40°F. Called Thompson Hatchery to send one man to assist the next morning. W. Crowe and I.F.H. crew arrived in evening.

April 19: Spear fishermen were observed in marsh on April 18 and several arrested with northern pike today. Checked nets with W. Crowe and N. Westers. Found some ripe females. Placed all back in nets and arranged for spawn taking equipment to be on hand for next day, also one extra man from Thompson. Water temperature 40°F.

April 20: Assisted by N. Westers and N. Brady. Handled about 75 pike of which 1/3 were females. Two ripe females yielded about a quart of eggs. Water temperature 42°F in lake. Water temperature at Thompson Hatchery 45°F. Demonstrated spawn taking technique to Westers and Brady.

I.F.H. crew set two nets in same area today.

April 21: Handled about 75 northern pike again and took 5 quarts of eggs. Male and female ratio about the same but more females ripe. Water temperature 43°F and air in sixties. Used ice from a vending machine to keep transportation tank cool. Suspected ice made from

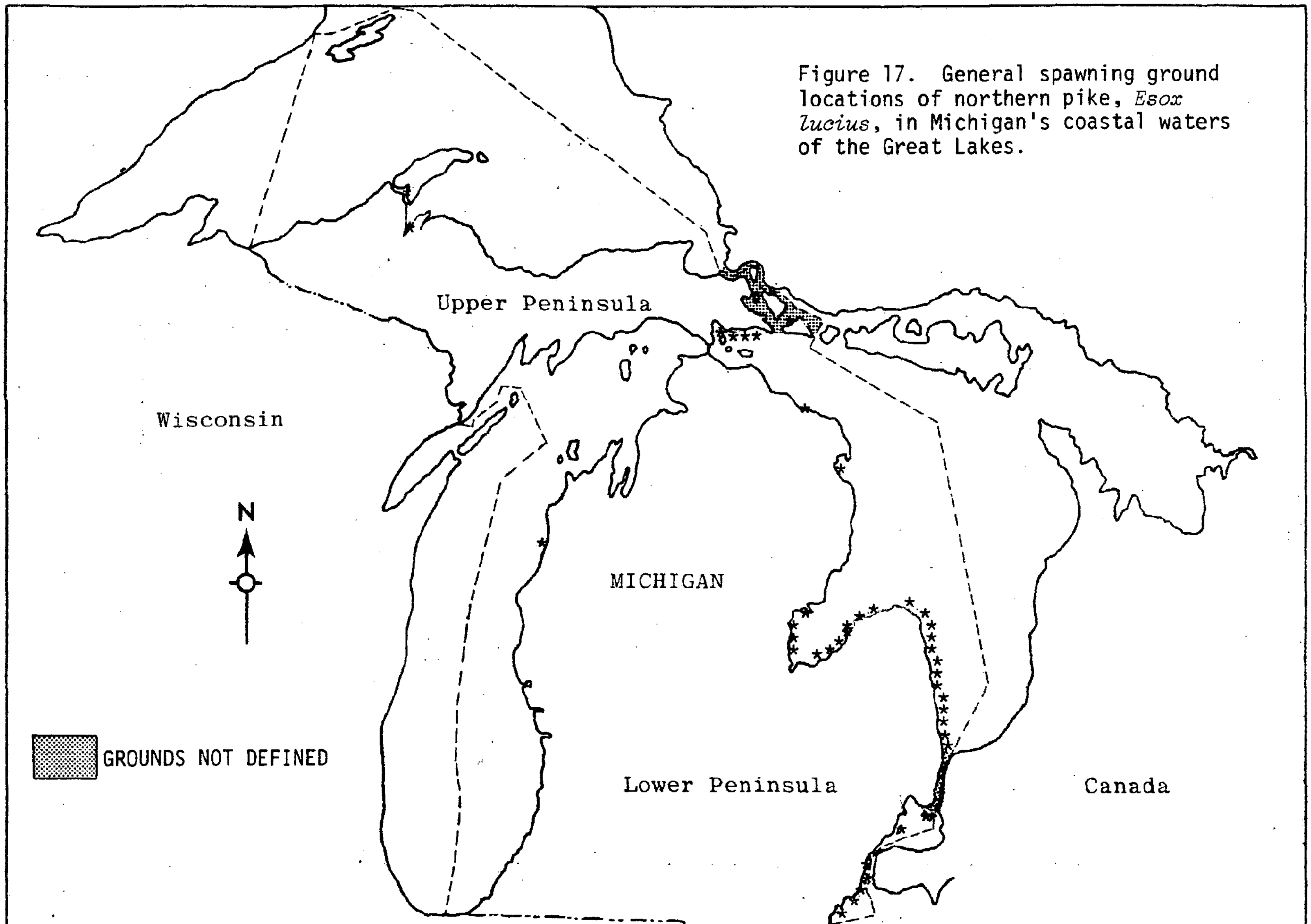


Figure 17. General spawning ground locations of northern pike, *Esox lucius*, in Michigan's coastal waters of the Great Lakes.

chlorinated water but no other available. Arranged for ice from well water for future. Ripe walleye females also appeared in nets.

Delivered six green northern pike females and 10 males to Thompson Hatchery tanks to see if they would ripen there.

Demonstrated spawn taking technique again and then let N. Westers and N. Brady take over. All the rest of the spawn taken by Westers and Brady from this date forward.

April 22: Water 44°F, air in 50's. Handled about 90 pike and took 7 quarts of spawn. Males still predominant but females increasing. Nearly half of the females ripe. Had to release some ripe females because transportation tanks not large enough to handle more eggs.

April 23: Water 46°F, air in low 50"s. Handled about 70 northern pike. Males and females about equal in number and half the females ripe. Took slightly more than 8 quarts of spawn. Some ripe females again released.

Drifting ice in the bay. First smelt taken in Escanaba River and No-See-Um Creek. Commercial nets taking a few and net setting just getting under way.

April 24: Water 46°F and air in high 40's to low 50's. Handled 46 northern pike and took 5 quarts of spawn. Net catches down and spent females begin to appear. Male and female ratio about one to one.

April 25: Water 42°F and air 39°F. Handled about 60 northern pike and took about 4 quarts of eggs. Only a few green females, the rest spent or partially spent. Slightly more females than males and average size of both down.

Also took 2.5 quarts of eggs from fish brought to the hatchery of April 21.

April 26: Water 42°F and air down to 35°F. Handled 40 northern pike and took 2.5 quarts of spawn. Slightly more males than females and females nearly all spent. Weather cold and water high in bay and all streams. Ripe walleyes abundant in area. Yellow perch moving in, in numbers and spawn deposited on net twine. Pulled out all nets and closed the operation.

Along the east shore of Lake Michigan, one spawning location north of Manistee in near-shore waters was reported (Appendix 3, Figure 115) over a rock bottom. Northern pike are known to spawn in shallow bays around Garden Island and Hog Island of the Beaver Island Group. (Keller, 1979).

Lake Huron. Northern pike were reported spawning in Northern Lake Huron from the Pine River east to Dudley Bay (Appendix 3, Figures 138 through 141). Spawning depth was reported as 2 meters (6 feet) or less, over a mud and weed bottom. The northern pike in this area make the spawning run in May.

Along Rogers City Harbor, northern pike were reported spawning in open gaps in rocks in the spring (Appendix 3, Figure 152).

In Saginaw Bay a number of shallow water spawning locations were indicated where spawning takes place just after ice-out (Appendix 3, Figures 165A and C, and 167 through 170). The shore areas to a 6 meter (20 feet) depth were indicated as northern pike spawning grounds from near Huron City, south to about 8 kilometers (5 miles) south of Port Huron (Appendix 3, Figures 172 through 174 and 177 through 179). Bottom composition in this area was not reported. It is also thought that pike spawning occurrs in most rivers or drainage ditches entering Saginaw Bay (Keller, 1979).

Lake St. Clair - Detroit River. On the east side of Anchor Bay (Goose Bay, Fisher Bay and Bouvier Bay) northern pike were reported to spawn in April over marsh area with sand and gravel bottom (Appendix 3, Figure 186). In the Detroit River, northern pike were reported spawning in a number of locations (Appendix 3, Figures 197 through 199). Spawning areas were generally indicated as sand and marshy near-shore areas.

Lake Erie. Northern pike were reported spawning in Lake Erie proper in 4 locations (Appendix 3, Figures 201 through 203). These areas were reported as shallow marshy areas with spawning taking place at ice-out and sooner.

The following feeder streams were also reported as spawning areas for norther pike along Lake Erie: Plum Creek, Stony Creek, Sandy Creek, Sulfur Creek, Otter Creek, Woodchuck Creek, LaPlaisance Creek, Muddy Creek, Pleasant Creek, and named and unnamed county drains. In one case it was reported that Woodchuck and Pleasant Creeks were only active spawning areas during the 1940's. In another case it was reported that most of the above mentioned areas were no longer active spawning areas.

MUSKELLUNGE

The muskellunge, *Esox masquinongy* (Mitchill), is endemic to the fresh waters of Eastern North America. Scott and Crossman (1973) reported that the muskellunge spawns shortly after the ice has melted, usually in late April or early May when water temperatures reach 9 to 15°C, the optimum being 12.8°C. Spawning takes place in water 38 to 51 centimeters (15 to 20 inches) deep in heavily vegetated and flooded areas (Scott and Crossman, 1973). During the spawning period, one female may be accompanied by one or sometimes two smaller males. The eggs are adhesive and are scattered in submerged vegetation. Scott and Crossman (1973) reported that both males and females reach sexual maturity between 3 and 5 years; mature males are smaller in size than the females. Information obtained from the interviews indicated that spawning by muskellunge was confined to areas in Lake St. Clair and the Detroit River (Figure 18).

Lake St. Clair. In 1951, Lake St. Clair was reported to contain the largest concentration of muskellunge in Michigan (Tri-State Fisheries Conference, 1951). Williams (1961) reported that during the spawning season of 1954-1956 both green and partly spent muskellunge were captured from weed-bed areas of Big Bay and off the mouths of tributary streams. Williams also reported that these areas were mostly 1.5 to 3 meters (5 to 10 feet) in depth. Great Lakes muskellunge were reported by Williams (1961) to prefer a lotic environment for spawning, in contrast to the quiet, stumpy bayous used by northern muskellunge. During Williams' three years of observation, muskellunge

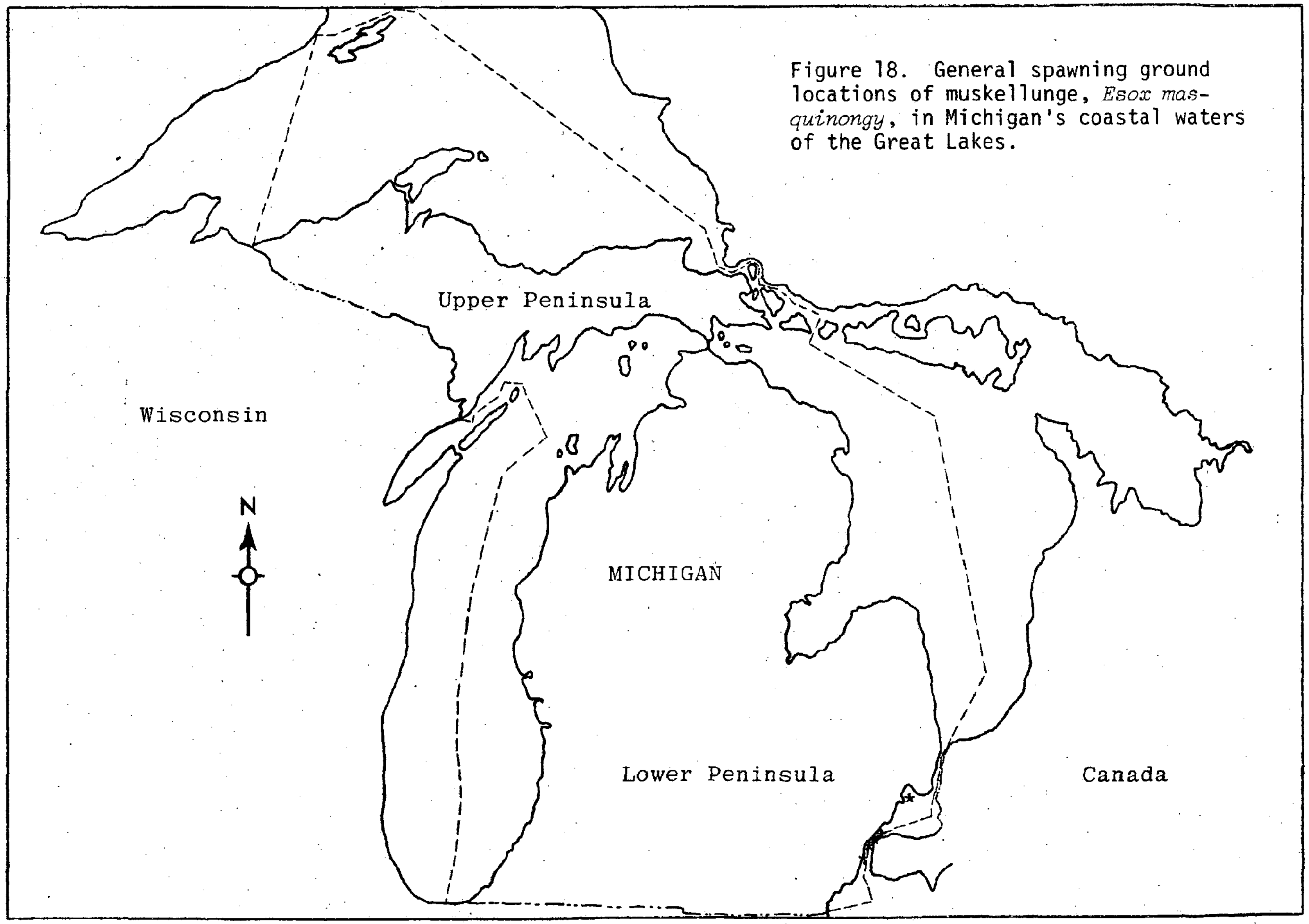


Figure 18. General spawning ground locations of muskellunge, *Esox masquinongy*, in Michigan's coastal waters of the Great Lakes.

spawning was completed by May 14 during the warm spring of 1955, but was delayed by cooler weather in 1954 and 1956 until the first week of June.

Individuals interviewed during this study, indicated the locations of several important muskellunge spawning grounds for Lake St. Clair. An extensive spawning ground was said to be located in the north half of the St. Clair River Delta and included Fisher and Bouvier Bays as well as Big and Little Muscamoot Bays (Appendix 3, Figures 186A and B). Spawning occurred from early to mid-June in shallow, marshy areas. In addition to aquatic vegetation, sand and gravel were reported to compose the bottom substrate of this region.

Two references indicated muskellunge to spawn in a portion of Anchor Bay located approximately 2.5 kilometers (212 miles) north of the Clinton River mouth (Appendix 3, Figure 187). This area was 2.4 kilometers (1.5 miles) in diameter and was said to have a bottom consisting of mud, clay, and sand. Spawning activities occurred from mid-May to early June at a depth of 1 to 4 meters (3 to 12 feet). Water temperature was noted to be the major factor controlling the exact time of spawning. Temperatures ranging between 12.7°C and 13.3°C were reported to be optimum at this location (Haas, 1978).

The shallow water region extending from St. Clair Shores to Grosse Point was referenced by one sport fishing guide to be utilized for spawning by muskellunge (Appendix 3, Figure 191A). Spawning occurred during the middle part of June at depths ranging from near shore to 4 meters (0 to 12 feet). The bottom composition was noted to be of sand, mud, and clay.

Detroit River. There were only two reports of muskellunge spawning grounds in the Detroit River. One reference indicated the existence of two spawning areas along the northern shore of Belle Isle (Appendix 3, Figure 193). Spawning was referenced at depths from near shore to 2 meters (1 to 6 feet) over a bottom composed of clay.

Spawning by muskellunge was also reported in a small area located near the south shore of Stoney Island (Appendix 3, Figure 198A). This spawning activity was observed during the period from 1973 to 1978 in water depth ranging between 1.5 and 3 meters (5 to 10 feet). The bottom in this area was characterized as being marshy.

# LAKE STURGEON

Habitat destruction, overexploitation, and pollution have caused many temporary and permanent changes throughout the waters of the Great Lakes; however, few populations have been so devastated as the Great Lakes sturgeon, *Acipenser fulvescens* (Rafinesque). Once considered to be an abundant species in the Great Lakes, the lake sturgeon population has become severely depleted (Van Oosten, 1956). Efforts to restore the sturgeon population in the Great Lakes have been unsuccessful mostly due to the above-mentioned factors and the reproductive characteristics of the species, specifically their maturation period.

Sturgeons mature very slowly and few spawn before they reach twenty years of age (Hartman, 1972). Spawning is reported to occur from early May to June when optimum temperatures range between 13°C and 18°C (Scott and Crossman, 1973). Spawning usually occurs at depths ranging from 1 to 5 meters (2 to 15 feet) in areas of swift-moving water or rapids. Scott and Crossman (1973) reported that Great Lakes sturgeon are known to spawn in wave action over rocky ledges or around rocky islands. Males generally reach the spawning grounds prior to the arrival of the females and, during spawning, one female may be accompanied by two or more males. Magnin (Scott and Crossman, 1973) reported that, depending on locality north to south, females spawned every 4 to 6 years and males every 1 to 3 years. Information gathered from commercial fishermen indicated that sturgeon have spawned or are spawning in parts of Lake Michigan, Lake Huron, Lake St. Clair, the Detroit River, and Lake Erie (Figure 19).

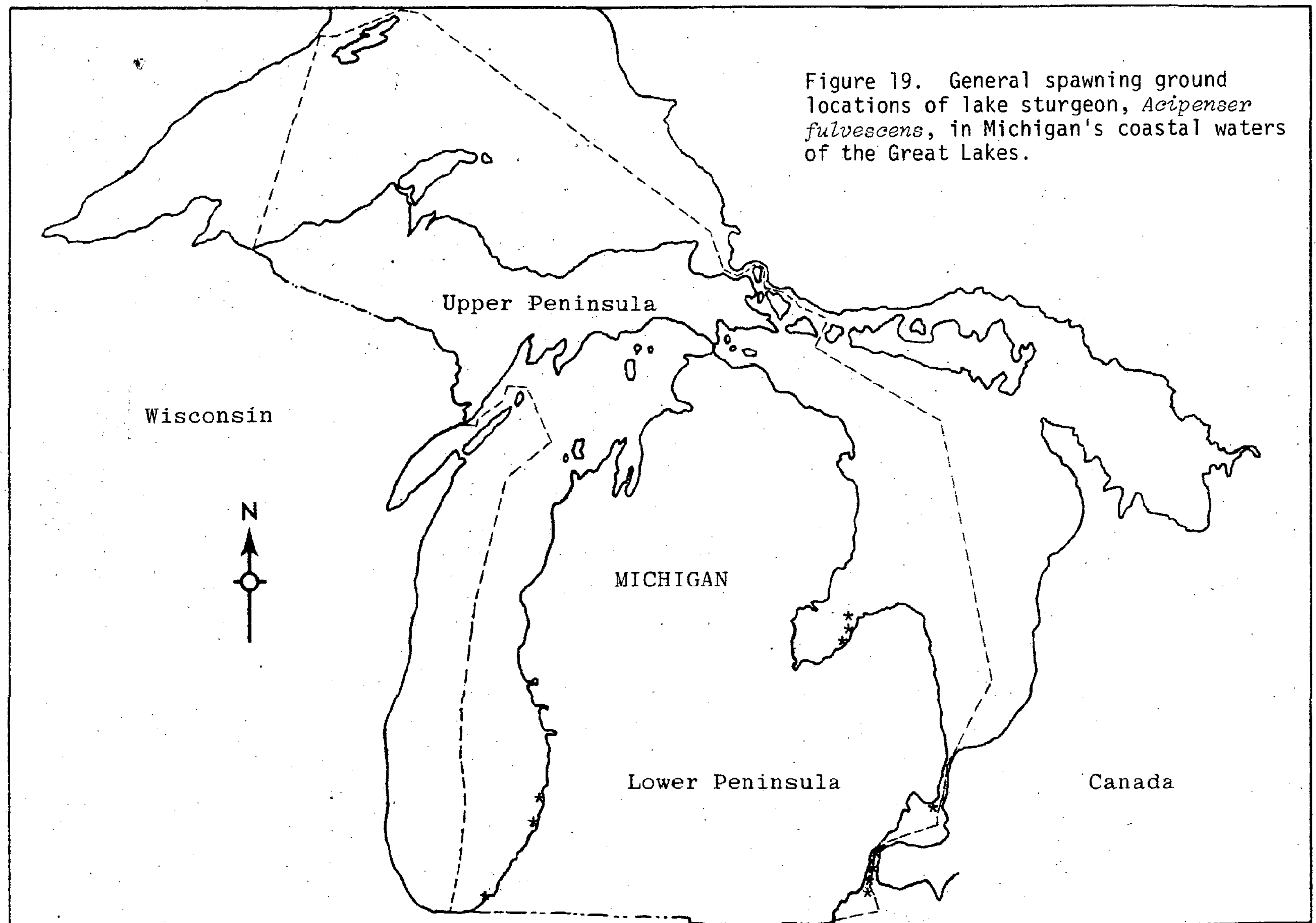


Figure 19. General spawning ground locations of lake sturgeon, *Acipenser fulvescens*, in Michigan's coastal waters of the Great Lakes.

Lake Michigan. Lake Sturgeon were reported to spawn in only two isolated locations within the coastal waters of Lake Michigan. One area occurred along the Lake Michigan shoreline at Ganges (Appendix 3, Figures 126B and 129B). This spawning ground extends for 3 kilometers (2 miles) in very shallow waters (stated as being "on shore"). Spawning occurred during June of 1978 over a gravel bottom.

Another offshore area located approximately 1.6 to 3 kilometers (1 to 2 miles) north of New Buffalo was referenced by one commercial fisherman as being utilized by spawning lake sturgeon (Appendix 3, Figure 134B). Spawning activity was said to occur in shallow depths, ranging from the surface to 2 meters (0 to 6 feet), over a sandy bottom inter-mixed with rock. Sturgeon are present in small numbers in Grand Traverse Bay, however, spawning areas are unknown (Keller, 1979).

Although not considered a part of the coastal waters of the Great Lakes, one commercial fisherman noted lake sturgeon to spawn in both the Galien and St. Joseph Rivers (not referenced on map). This activity was said to occur upriver as far as was possible during the months of June and July over a gravel bottom.

Lake Huron. Reports of lake sturgeon spawning grounds in Lake Huron were confined exclusively to the Saginaw Bay region, and only one location was cited as currently being in use. This area, located in the shallow waters east of a line extending from Sand Point to Fish Point (Appendix 3, Figure 168C), was reported to have a mud and sand bottom. No information was provided to indicate the years during which this activity was observed; however, it was mentioned that many more sturgeon spawned at this location during the early 1900's than do today.

<u>Lake St. Clair</u>. An area of the North Canal, north of Algonac, was cited by one individual to be utilized by spawning lake sturgeon (Appendix 3, Figure 185). Spawning activity occurred during mid- to late May over a bottom composed of hard clinkers (burned coal from ships). No indication was made as to the depths at which sturgeon spawned in this region.

<u>Detroit River</u>. Spawning by lake sturgeon occurred at several Detroit River locations, generally in the vicinity of Grosse Ile and Fighting Island.

One commercial fisherman referenced two Detroit River locations as spawning grounds for lake sturgeon; the northwest corner of Fighting Island and the northeast corner of Grassy Island (Appendix 3, Figures 195 and 196). Spawning occurred at these areas in water having a depth of 9 meters (30 feet) over a gravel river bottom.

Three small areas along the eastern side of Grosse Ile were also indicated as lake sturgeon spawning grounds (Appendix 3, Figures 197 through 199). Spawning was stated to occur at a depth ranging from 3 to 6 meters (10 to 20 feet) over a rocky bottom.

Information provided by one individual referenced the existence of lake sturgeon spawning grounds that were said to be very productive until the 1930's (Appendix 3, Figure 199A). Sturgeon once existed in large numbers here and were fished as a source of caviar. No indication was made as to common depths of spawning, bottom compostion, or the months during which spawning occurred.

Lake Erie. Scott and Crossman (1973) reported that Lake Erie has sustained heavy commercial fishing pressure for lake sturgeon since 1860. Only one lake sturgion spawning ground, located off Stony Point in waters ranging in depth from 3 to 6 meters (10 to 20 feet), was identified in the lake (Appendix 3, Figure 201B). Spawning in this area usually occurred during May over a bottom consisting of rock.

## LARGEMOUTH AND SMALLMOUTH BASSES

There is little published literature relating to the spawning grounds of the smallmouth bass, *Micropterus dolomieui* Lacepede or the largemouth bass, *Micropterus salmoides* (Lacepede), in Michigan's coastal waters. Scott and Crossman (1973) reported spawning in late spring and early summer over sand, gravel, and rocky bottoms. The highest reported incidence of spawning was in Saginaw Bay and Lake St. Clair (Figure 20).

Lake Michigan. Both largemouth and smallmouth basses (commonly termed black basses) were reported to spawn from mid-May through mid-June in the vicinity of Arthur Bay (Appendix 3, Figure 51B). The above mentioned areas were indicated to have rock bottoms with spawning taking place in 1 to 5 meters (3 to 15 feet) of water. Largemouth bass were reported to spawn in mid-May, over mud and weeds, on either side of Point Epoufette (Appendix 3, Figure 74B).

Smallmouth bass have utilized rock and silt spawning grounds on both the north and south side of Waugoshance Point and Waugoshance Island (Appendix 3, Figures 78C, 78D, and 80). The spawning season for this area was reported as late June and early July with spawning taking place in 1 meter (3 to 4 feet) of water. The vicinity of Hog Island was reported as having smallmouth beds on a primarily gravel bottom during the month of July (Appendix 3, Figures 81B, 81C and D).

Lenon (1978) reported smallmouth spawning in Beaver Harbor and along the shoreline at the southwest side of Garden Island (Appendix 3, Figures 82A, 82C and 83B). Spawning in these areas took place

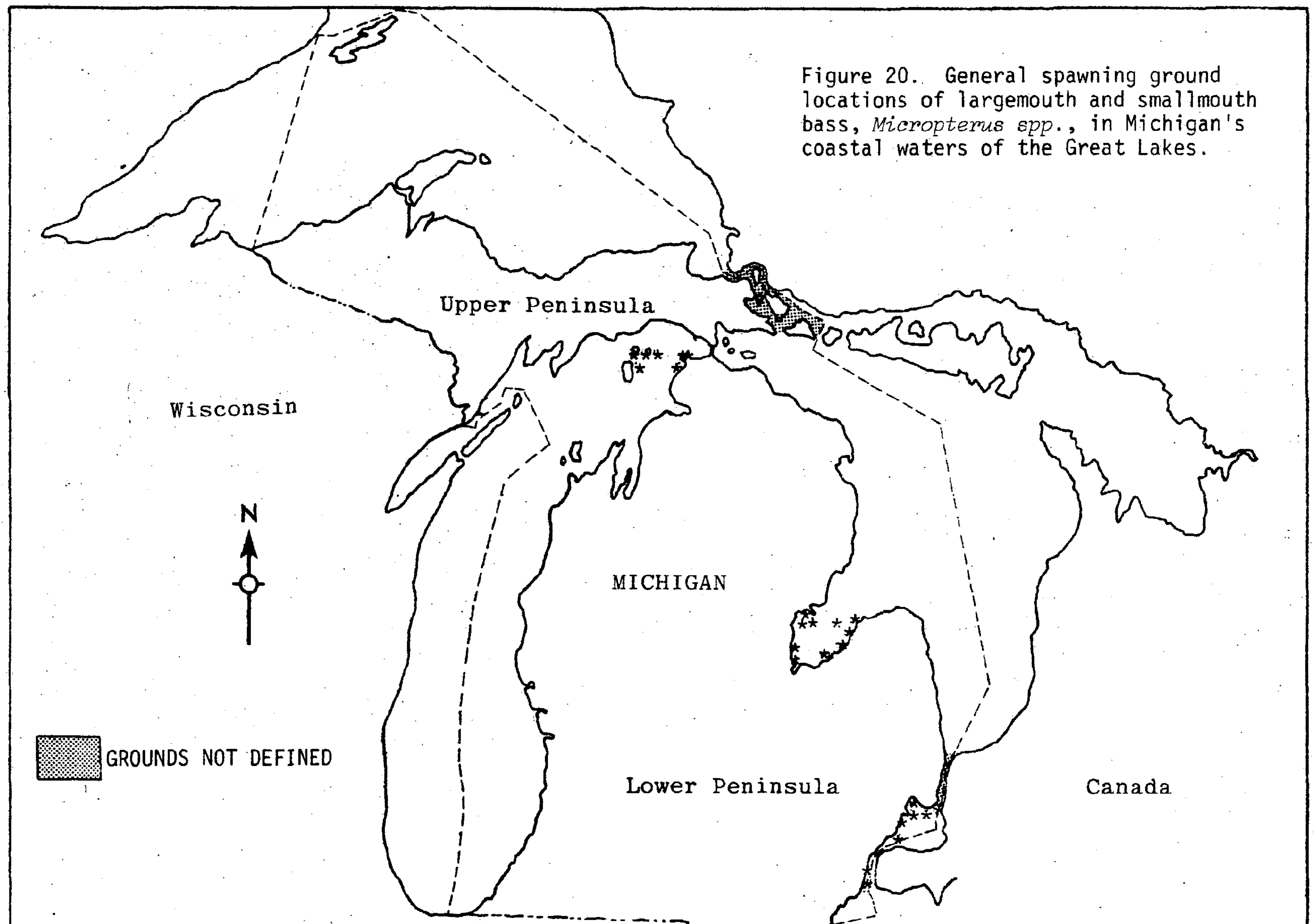


Figure 20. General spawning ground locations of largemouth and smallmouth bass, *Micropterus spp.*, in Michigan's coastal waters of the Great Lakes.

during the last two weeks of June in shallow depressions in coarse gravel (Lenon, 1978). One commercial fisherman reported spawning smallmouth in early June on the southeast shoreline of Garden Island (Appendix 3, Figure 82A). Keller (1979), reports that smallmouth bass spawn over rocky shoreline areas along the entire shoreline of Grand Traverse Bay (unmapped).

Lake Huron. The only black bass spawning areas for Lake Huron were reported in the Saginaw Bay and Thunder Bay areas. Reported spawning took place in the spring and generally in near shore waters (Appendix 3, Figures 157B, 157C, 165A, B, C, 167C, 168, and 169B). In one offshore location, black bass were reported spawning over the shallow shoal areas near Charity and Little Charity Islands (Appendix 3, Figure 163B).

Lake St. Clair. Smallmouth and largemouth bass were reported spawning throughout Michigan waters of Lake St. Clair (Appendix 3, Figures 186 through 188, and 191B). Bottom types in the spawning areas were primarily composed of rock. Spawning dates were generally reported as "spring" with the largemouth spawning earlier. All spawning depths were reported as shallow with no anomalous spawning reported for Lake St. Clair.

Detroit River. Smallmouth bass were reported to spawn in four locations in the Detroit River (Appendix 3, Figures 198A and 199B). Spawning grounds were rock and gravel or sand and gravel with the exception of one largemouth and smallmouth spawning area composed of mud and weeds (Appendix 3, Figure 198B). Reported spawning dates in these areas were from late April through June.

Lake Erie. Spawning was reported for black bass in Monroe Harbor and near the mouth of Stony and Plum Creeks (Appendix 3, Figure 202C). Stone and sand were reported as bottom types in this area with spawning occurring during April and May.

The following information was received from fishermen in the Lake Erie area; however, spawning locations were not specifically identified. Largemouth bass spawn from 1 June to 15 June over sand, clay, and mud bottoms in the Raisin River and along the shoreline of Lake Erie. Smallmouth bass spawn over weed and rock bottoms from 1 June to 15 June in the Raisin River. Black bass spawn over weedy bottoms, in one meter (3 to 4 feet) of water during May in the Raisin River.

## CHANNEL CATFISH

Smith (1969) reported that channel catfish, *Ictalurus punctatus* (Rafinesque), usually spawn during June or July when the water temperature is about 24°C. Scott and Crossman (1973) also stated that spawning occurs in late spring or summer at a water temperature of 24 to 30°C, with 27°C the apparent optimum. In this study, channel catfish spawning was reported from May through August, though the majority of sources referenced the June-July period. No differences in season of spawning were distinguished among the various Great Lakes locations.

Almost all catfish spawning was noticed in shallow waters of three meters (10 feet) or less, with mud the most commonly listed bottom type. Marsh, sand, gravel, and clay were also referenced. Scott and Crossman (1973) stated that holes, undercut banks, log jams, or rocks were prime spawning locales for channel catfish.

References for channel catfish spawning grounds were confined to the Saginaw Bay of Lake Huron, Lake St. Clair, the Detroit River, and Lake Erie; none were given for Lakes Superior and Michigan (Figure 21).

<u>Lake Huron</u>. All channel catfish spawning grounds referenced in Lake Huron were within Saginaw Bay. Many sources noted spawning along the west shore of Saginaw Bay between Point AuGres and Nayanquing Point (Appendix 3, Figures 164 through 166) in shallow water, less than 2 meters (7 feet) deep, over various bottom types, including sand, clay, mud, gravel, rock and marsh. The east shore of Saginaw Bay

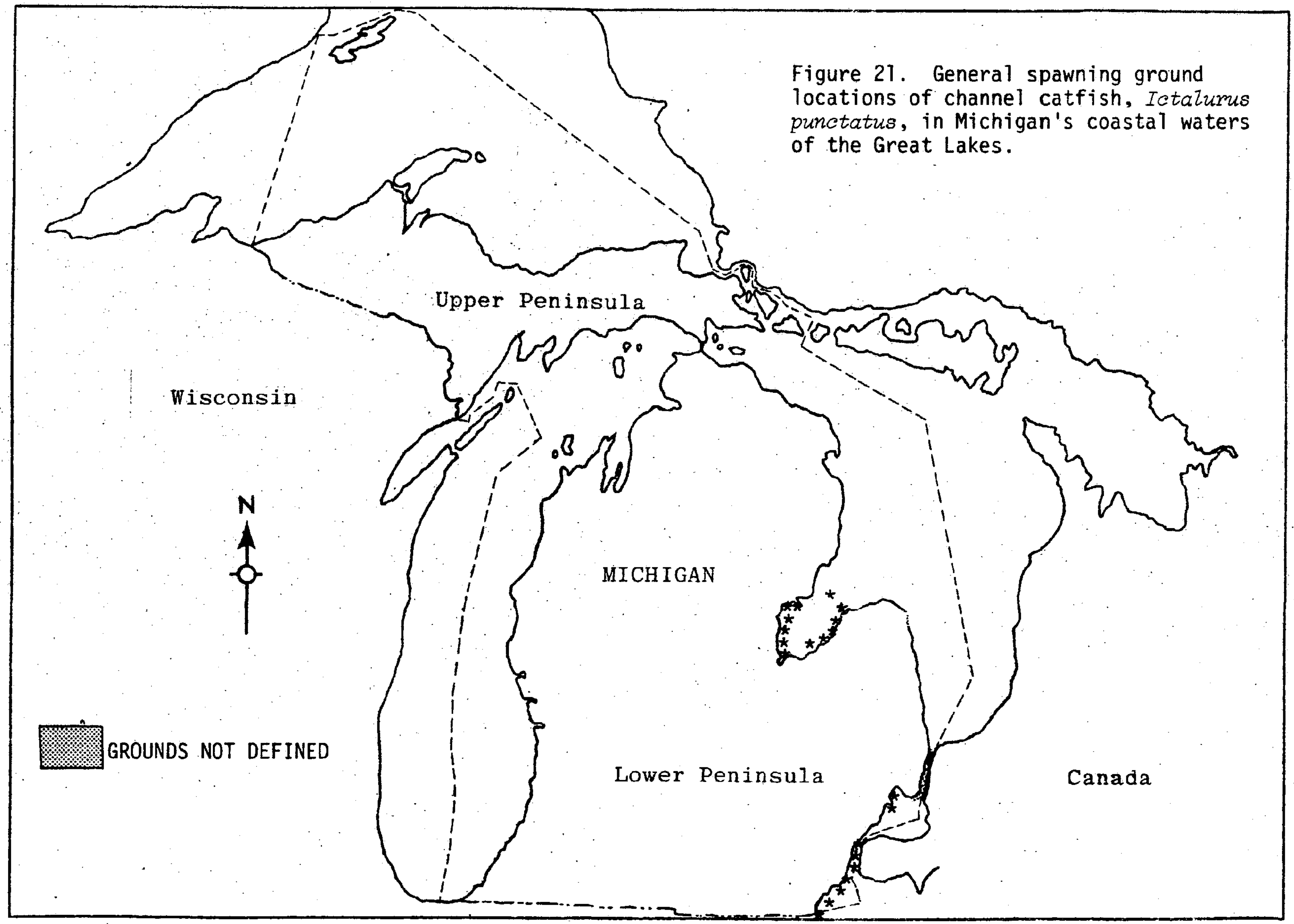


Figure 21. General spawning ground locations of channel catfish, *Ictalurus punctatus*, in Michigan's coastal waters of the Great Lakes.

between Sand Point and Fish Point was also well documented for catfish spawning (Appendix 3, Figure 168A through D). Activity usually occurred in shallow depths, less than 2 meters (7 feet), over mud or sand. One source stated that, in a mud and marsh area of the east shore, catfish look for a shallow spot with a stone or gravel bottom upon which to spawn. Three isolated spawning locations were noted in the southern area of Saginaw Bay (Appendix 3, Figures 166B and C and 167B), and one location was given around the Charity Islands (Appendix 3, Figure 163C). Four commercial fishermen remarked that the numbers of catfish in Saginaw Bay have been increasing over the past 3 to 10 years. One fisherman noted that catfish first appeared around Saganing Bar on the west shore (Appendix 3, Figure 165) in 1924, when large numbers of catfish were noticed.

Lake St. Clair and Detroit River. Spawning locations for channel catfish were referenced in Lake St. Clair near New Baltimore and Point Huron (Appendix 3, Figures 187 and 188A) over clay, sand and muck.

Catfish spawning grounds were given in the lower part of the Detroit River around Stony Island, along the southeastern shores of Grosse Ile, near Sturgeon Bar and off Pointe Mouillee (Appendix 3, Figures 198B, 199C, and 200). These spawning grounds generally occurred over mud bottoms at a depth of 1 to 3 meters (3 to 10 feet). One commercial fisherman remarked that channel catfish and bullhead spawned in the marshy Sturgeon Bar area in the 1940's and 1970's, but disappeared in the 1950's and 1960's. He attributed their period of absence to high water, temperature changes, and pollution.

Lake Erie. Several channel catfish spawning grounds were documented along the shore of Lake Erie, mostly in shallow muddy or marshy areas (Appendix 3, Figures 201 through 203). One source noted an offshore spawning bed, a discontinued dumping ground nine kilometers north of Cedar Point (Appendix 3, Figure 203), with a muck bottom and an average depth of five meters.

## BULLHEADS

Great Lakes bullhead species include the brown bullhead, *Ictalurus nebulosus* (Lesueur), the black bullhead, *I. melas* (Rafinesque), and the yellow bullhead, *I. natalis* (Lesueur). Commercial fishermen did not distinguish among bullhead species in all cases but one, brown bullhead identified in Saginaw Bay. Smith (1969) reported that bullheads usually spawn from April to June in nests excavated in shallow depths, less than 2.5 meters (8 feet), usually over mud bottoms, although marsh, sand, clay, and rock bottom types were also referenced.

Bullhead spawning grounds were given in the Saginaw Bay of Lake Huron, the Detroit River, and Lake Erie (Figure 22). No locations were referenced in Lakes Superior or Michigan. Many of the regions reported for bullhead spawning were also referenced for catfish, *Ictalurus punctatus*, spawning.

Lake Huron. All references for bullhead spawning in Lake Huron were limited to Saginaw Bay. Spawning grounds were documented along the shore of the Bay from Point Au Gres south to Nayanquing Point (Appendix 3, Figures 164 through 166) in shallow waters over sand, clay, mud, or rock. On the east shore of Saginaw Bay, spawning was noted between Sand Point and Fish Point (Appendix 3, Figures 168A, B, and C) in a predominantly mud and marsh area. Here, one fisherman pointed out three spawning beds for the brown bullhead, the only identification of bullheads at a species level in this study. Three commercial

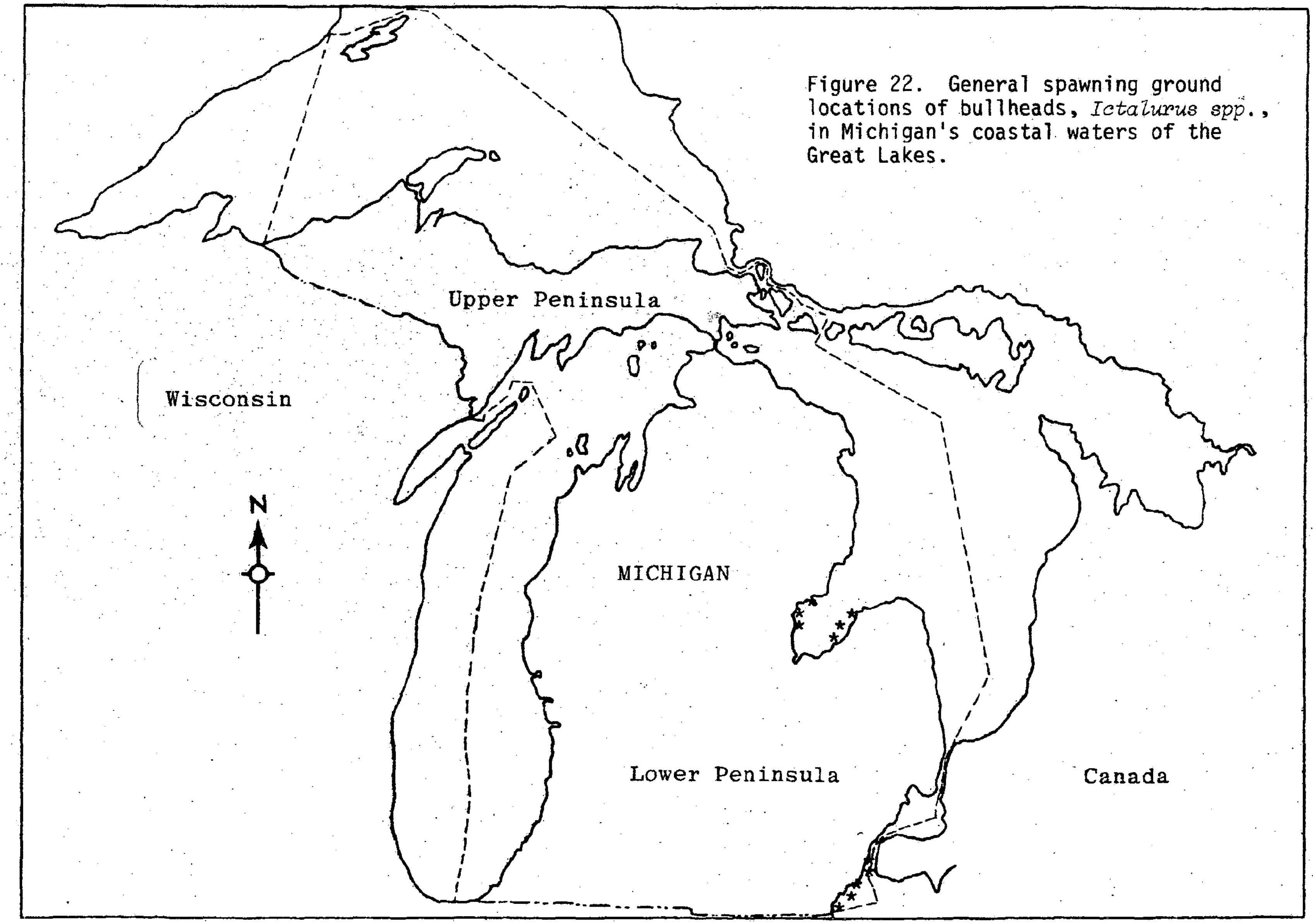


Figure 22. General spawning ground locations of bullheads, *Ictalurus spp.*, in Michigan's coastal waters of the Great Lakes.

fishermen noted that the bullhead population in Saginaw Bay had decreased in the past 2 to 10 years.

<u>Detroit River</u>. Bullhead spawning was reported in the lower Detroit River along the southeastern shores of Grosse Ile and around Stony Island (Appendix 3, 198B), and in the marshy areas around Sturgeon Bar (Appendix 3, 199C). One commercial fisherman noted spawning as early as March near Stony Island and Elba Island (Appendix 3, Figure 198B). Another source reported that bullheads and catfish spawned in the Sturgeon Bar area in the 1940's and 1970's, but were absent during the 1950's and 1960's. He attributed their disappearance to high water, temperature changes, and pollution during that period.

<u>Lake Erie</u>. Several near shore locations along Lake Erie were cited as bullhead spawning grounds. These were mostly in shallow mud or muck areas in bays or river mouths (Appendix 3, Figures 201 through 203). One fisherman commented that bullhead numbers have decreased in Brest Bay near Monroe since 1956 due to pollution destroying their food sources. Another fisherman noted that bullheads used to spawn in an area in La Plaisance Bay until a power plant was constructed nearby.

## MISCELLANEOUS SPECIES

Emerald Shiner. The emerald shiner, *Notropis atherinoides* Rafinesque, is a pelagic schooling species. In recent years the large aggregations of this species, which formerly were observed in the shallows of the Great Lakes, occur with less frequency (Scott and Crossman, 1973). In most Canadian waters, emerald shiners spawn in the late spring or early summer; however, in 1954, Langlois (Scott and Crossman, 1973) suggested that spawning in Lake Erie continued until at least mid-August.

In the present study, mention was made of large numbers of "silver shiners" which used to be "thick" along the beaches in Saginaw Bay in one meter (4 feet) of water during the 1940's and 1950's. This source also reported that bait dealers currently cannot find these shiners. These "silver shiners" may well have been emerald shiners, but no specific reference was offered.

Another fisherman reported that emerald shiners used to concentrate just off the shore of Port Sanilac during the spawning season (Appendix 3, Figure 177) but also noted that these concentrations have not appeared in recent years.

A large area was referenced as an emerald shiner spawning ground south of Celeron Island in Northern Lake Erie (Appendix 3, Figures 199A and 200). Other "minnow" spawning sites referred to in this area and in the Detroit River may possibly be emerald shiner spawning grounds (Appendix 3, Figures 198B and 199C). Generally, these locations have muddy bottoms and are located in 1 to 3 meters (2 to 10 feet) of water.

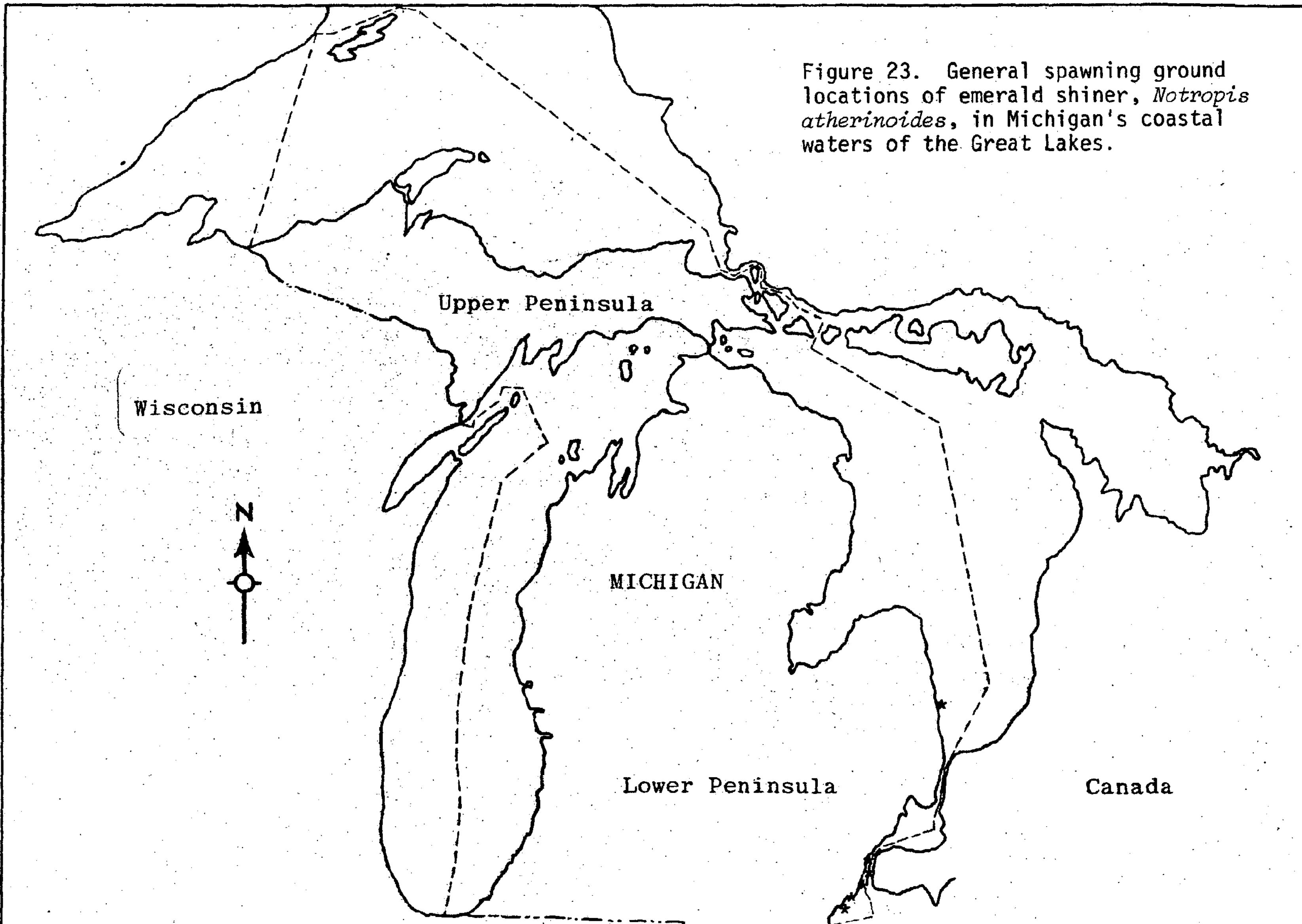


Figure 23. General spawning ground locations of emerald shiner, *Notropis atherinoides*, in Michigan's coastal waters of the Great Lakes.

Emerald shiners were reported as spawning from the 1950's to the present in La Plaisance Bay near Monroe (Appendix 3, Figure 202A). Bottom types were referred to as "hard" and spawning was said to occur in late June when the water temperature reached 21°C.

Spottail Shiner and Other Shiners. The spottail shiner, *Notropis hudsonius* (Clinton), is usually regarded as an inhabitant of relatively large lakes and rivers and is of considerable importance as a forage species (Scott and Crossman, 1973). This species usually spawns over sandy shoals, although spawning has been observed over algae, in depths from "near shore" to 9 meters (30 feet)(Wells and House, 1974). The spawning season in the Great Lakes region has taken place from June through August, the precise date depending upon latitude and seasonal weather (Scott and Crossman, 1973; Wells and House, 1974).

The capture of many ripe fish indicated spawning in Canadian waters of Eastern Lake Superior in mid-June to mid-July in 1967 (Wells and House, 1974). One Southeastern Lake Michigan spawning occurred in the first week of July in 1964 and continued until mid-August (Wells and House, 1974). The same authors reported that in 1972 spottail spawning in Southeastern Lake Michigan peaked in late July or early August and ended in late August or early September. In that study, evidence suggested that the majority of spottail shiners spawned in water less than 9 meters (30 feet) deep over sand.

One observation recorded by Door, Bottrell and Williams (Wells and House, 1974) revealed spottails spawning in 5 meters

(15 feet) of water in "patches" of *Cladophora*, a filamentous algae in Southeastern Lake Michigan.

The spottail spawning season in Lake Erie has been either prolonged or the time of spawning varies greatly from year to year as spawning times have been reported from mid-May to mid-July (Scott and Crossman, 1973; Wells and House, 1974). Scott and Crossman (1973) also stated that in one area of Lake Erie spawning occurred in one meter (3 to 4 feet) of water over a sand bottom.

Although no references were made in the present study to spottail spawning grounds, some references were made to "minnows" which are designated as unidentified minnows (Appendix 3, Figures 196, 198B and 199C). Some of these spawning grounds may have been used by golden shiners, *Notemigonus crysoleucas* Mitchill; blackchin shiners, *Notropis heterodon* (Cope); blacknose shiners, *Notropis heterolepis* Eigenmann and Eigenmann; spotfin shiners, *Notropis spilopterus* (Cope) or any of a number of other shiners or minnows. No specific references were made during the course of this study to any spawning by these species in Michigan's coastal waters and, therefore, they will not be individually considered in this report.

Brown Trout, Brook Trout, Splake and Rainbow Trout. In 1960, Eddy and Surber (Scott and Crossman, 1973) stated that although many brown trout, *Salmo trutta* Linnaeus, entered Lake Superior streams in October and November to spawn, some spawned on rocky reefs along the shore. In the current study one reference was made to brown trout spawning near the mouth of Norwegian Creek in Lake

Huron (Appendix 3, Figure 157). These fish were said to have just started to spawn on 10 November.

One other source referred to an area north of Whitestone Point in Lake Huron (Appendix 3, Figure 163B) as a brown trout spawning ground.

Brook trout, *Salvelinus fontinalis* Mitchill, have been known to spawn most often over gravel beds in the shallow headwaters of streams; however, spawning may be successful in the shallows of lakes on gravel if there is spring upwelling and a moderate current (Scott and Crossman, 1973).

A fertile hybrid of lake trout and brook trout, the "splake", *Salvelinus namaycush* X *fontinalis*, was reported to have spawned during October for the last three to four years on a small reef, 2 to 3 meters (6 to 10 feet) deep, located offshore of Rockport (Appendix 3, Figure 155). Scott and Crossman (1973) reported that splake tend to spawn during both night and day, whereas lake trout spawn at night and brook trout during the day. No data was given on spawning ground depths or characteristics.

The rainbow trout, *Salmo gairdneri* Richardson, is considered to be a stream spawner; however, one fisherman indicated that this species has spawned in Lake Michigan over two small rocky areas near White Lake Channel. Spawning was said to occur in 4 meters (12 feet) of water or less.

In Lake Huron, rainbow trout were noted as spawning in an area just north of Whitestone Point (Appendix 3, Figure 163B). This source also reported that the area was a salmon spawning ground; however, no specific data as to species, bottom type or depth were given. Another source noted that rainbow trout spawned in Lake Erie, in May, near the mouth of the Ottawa River (Appendix 3, Figure 203A) over a hard bottom.

<u>Black Crappie and White Crappie</u>. Both black crappie, *Pomoxis nigromaculatus* (Lesueur), and white crappie, *Pomoxis annularis* Rafinesque , spawn in late spring or early summer (Scott and Crossman, 1973). Crappie spawning was referenced from late April through August in this study, however. Species of crappie were not differentiated by the fishermen except for two cases of black crappie in Saginaw Bay and one case of white crappie in Lake Erie. Black crappie are much more abundant than white crappie in the Great Lakes area (Scott and Crossman, 1973).

Numerous fishermen referenced crappie spawning in the Saginaw Bay of Lake Huron (Figure 24) especially along the east shore from Flat Rock Point to 9 kilometers (5.7 miles) south of Fish Point (Appendix 3, Figures 167 through 170) where spawning was noted May to July over a diversity of bottom types including mud, sand, weed, clay, and rock. Two fishermen identified the species in this area to be black crappie. Crappie spawning was also noted on the east shore of Saginaw Bay, from Point Au Gres to Sanganing Bar (Appendix 3, Figures 165A and C), where August spawning was cited, and by Nayanquing Point (Appendix 3, Figure 166C).

In Lake St. Clair, crappie were found to spawn in Belvidere Bay (Appendix 3, Figure 187) in mid-June. In the lower Detroit River, crappie spawning was referenced in Sturgeon Bay in late April and May over muck, sand, and gravel (Appendix 3, Figure 199B)

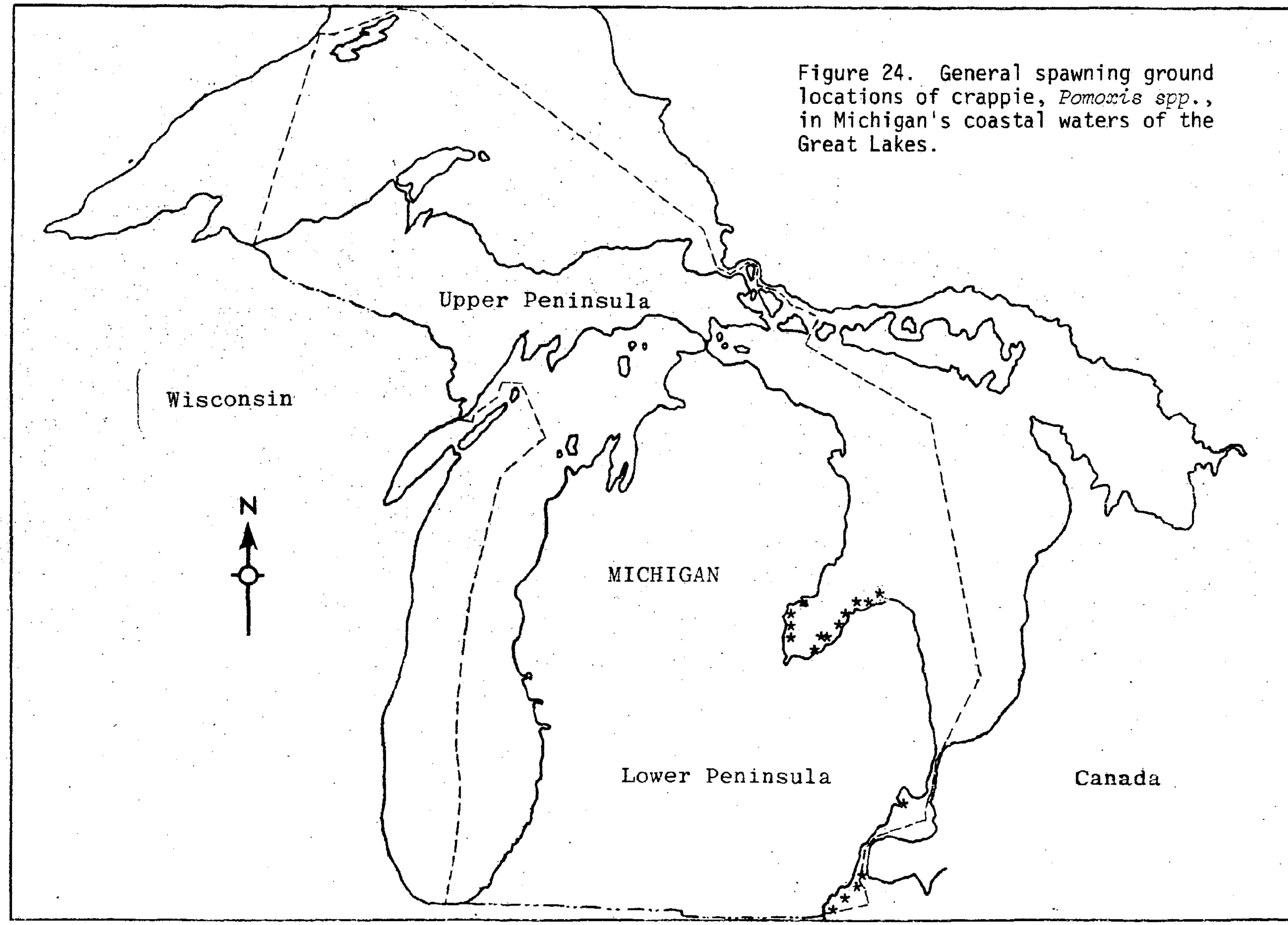


Figure 24. General spawning ground locations of crappie, *Pomoxis spp.*, in Michigan's coastal waters of the Great Lakes.

and also off Milleville Beach (Appendix 3, Figure 200). In Lake Erie, white crappie were noted spawning off Sterling State Park by Monroe in the spring (Appendix 3, Figure 202A and B). Another fisherman mentioned that crappie spawn in the canals and channels of the Lake Erie coast in grassy waters in May and June.

Pumpkinseed, Green Sunfish, and Longear Sunfish. Sunfish species of Michigan include the pumpkinseed, *Lepomis gibbosus* (Linnaeus), the green sunfish, *L. cyanellus* Rafinesque, and the longear sunfish, *Lepomis megalotis* (Rafinesque). Sunfish were not identified as to species level in this survey, except for one reference to the pumpkinseed in Lake St. Clair. Bluegills, *Lepomis macrochirus* Rafinesque were distinguished from other sunfish and are discussed in a separate section.

Sunfish spawn in late spring or summer. Scott and Crossman (1973) stated that pumpkinseeds begin building nests when the water temperature reaches 20°C at a 15 to 30 centimeter (6 to 12 inches) depth in areas of submerged aquatic vegetation. Hubbs (1927) noted that pumpkinseeds spawn in June in Southern Michigan and as late as mid-August in the northern lower peninsula. In a Wisconsin study in 1965, Hunter (Scott and Crossman, 1973) found that green sunfish underwent multiple spawnings every 8 to 9 days from mid-May through early August, with peak activity at 20 to 28°C. These green sunfish nested in sunlit water at depths of 4 to 35 centimeters (1 to 14 inches) in areas sheltered by rocks, logs, or clumps of grass. Hubbs (1927) reported that longear sunfish spawned from June through August in Southern Michigan.

In this study, sunfish spawning was referenced in Lake Huron's Saginaw Bay and in Lake St. Clair (Figure 25). Sunfish spawning areas were indicated along the coast of Saginaw Bay from Wigwam Bay on the west shore to Heisterman Island on the east shore (Appendix 3, Figures 165 through 168) over bottom types of weed, sand, gravel, and clay. Sunfish were noted spawning in the Bouvier Bay-Goose Bay area of Lake St. Clair in summer over "organic matter", sand, and gravel (Appendix 3, Figure 186). Pumpkinseed sunfish were identified spawning in Belvidere Bay, north of the mouth of the Clinton River (Appendix 3, Figure 187) over "organic matter".

Bluegill. Bluegill, *Lepomis macrochirus* Rafinesque , generally spawn in Michigan during June or early July (Hubbs, 1927). Bluegill nest in colonies, in waters about .7 meters (2.5 feet) deep, making shallow depressions in gravel, sand, or mud (Scott and Crossman, 1973).

Little information was gathered on bluegill spawning in this study, though a few sources referenced Lake St. Clair, the Detroit River, and Lake Erie as areas of activity (Figure 26). In Lake St. Clair, the bluegill spawned on marsh, sand, and gravel in the St. Clair River delta area (Appendix 3, Figure 186A and B) and on "organic matter" in Belvidere Bay (Appendix 3, Figure 187). Spawning bluegill were cited in three locations in the lower Detroit River (Appendix 3, Figures 198B, 199B, and 200). In the Sturgeon Bay location (Appendix 3, Figure 199B), bluegill were said to spawn from the end of May through June over muck, sand, and gravel. In Lake Erie, one fisherman recalled that bluegill used to

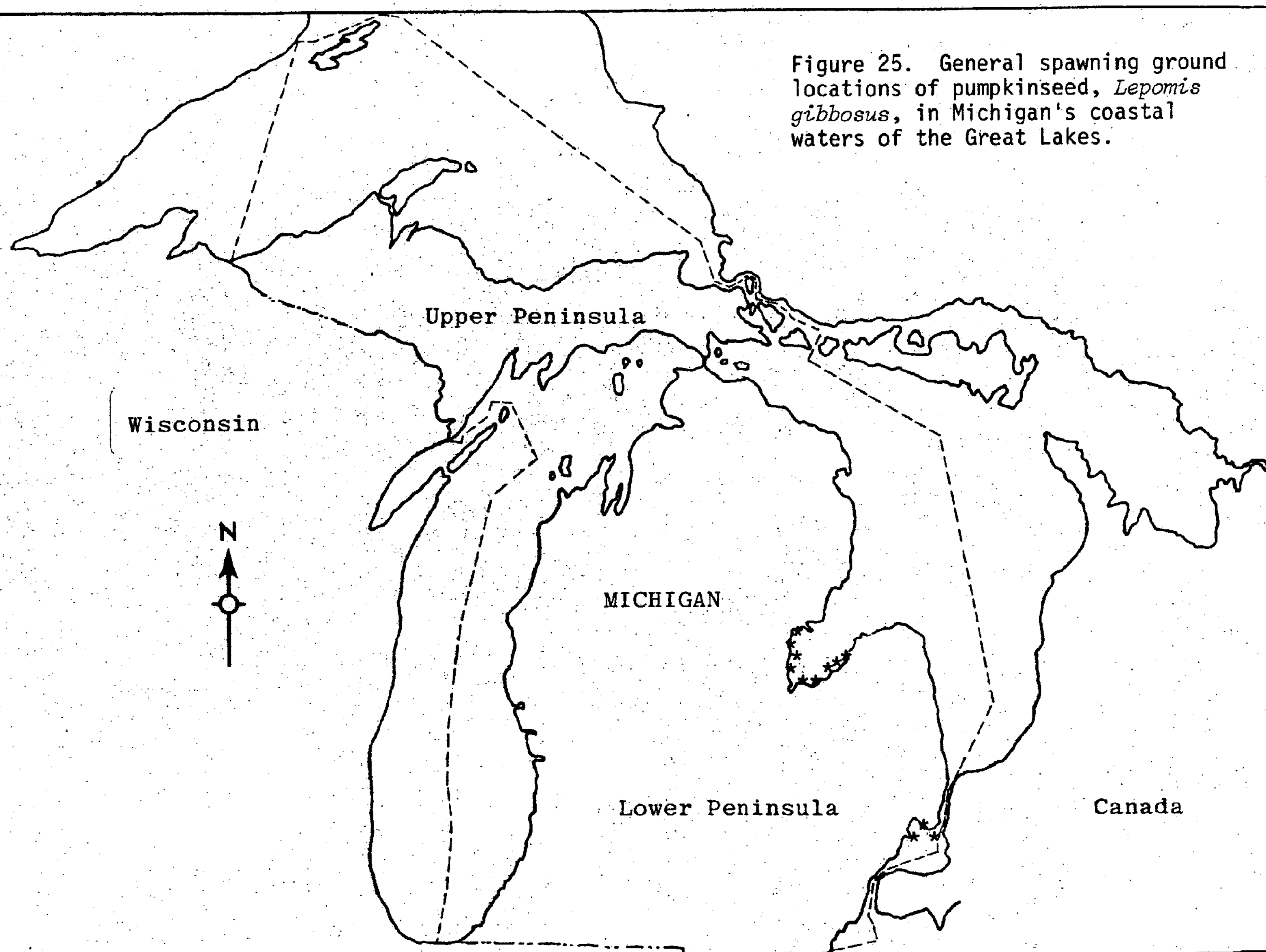


Figure 25. General spawning ground locations of pumpkinseed, *Lepomis gibbosus*, in Michigan's coastal waters of the Great Lakes.

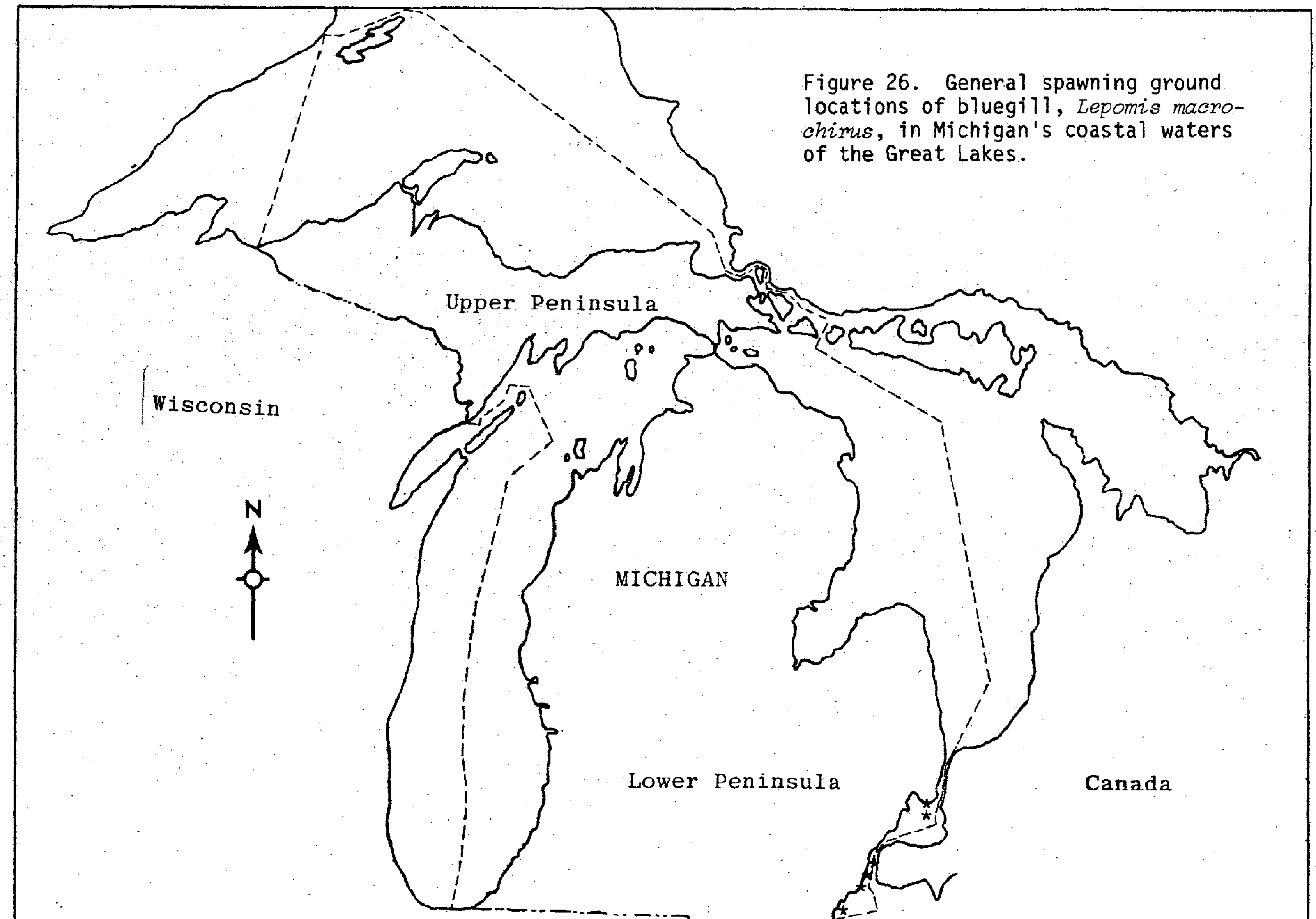


Figure 26. General spawning ground locations of bluegill, *Lepomis macrochirus*, in Michigan's coastal waters of the Great Lakes.

spawn in the mouth of the Ottawa River (Appendix 3, Figure 203C), but are no longer present due to increased water depth.

Rock Bass. Hubbs (1927) reported that the rock bass, *Ambloplites rupestris* (Rafinesque), spawned in Michigan during June and early July. Scott and Crossman (1973) stated that rock bass spawn in a diversity of areas, from swamps to gravel shoals.

In this study, rock bass spawning was referenced in four scattered areas (Figure 27): (1) in shallow, protected waters of Beaver Harbor, Beaver Island, and nearby Garden Island in Northern Lake Michigan (Appendix 3, Figures 82 and 83) during late June over gravel and rock, spawning at the same time and place as smallmouth bass; (2) near Sebewaing on the east shore of the Saginaw Bay of Lake Huron on a sand and muck bottom (Appendix 3, Figure 168B): (3) in a marshy area west of Meso Island in the Detroit River (Appendix 3, Figure 198B); and (4) on a rocky shoreline of Lake Erie's Brest Bay (Appendix 3, Figure 202A), where spawning was noted at the end of September.

White Bass. White bass, *Morone chrysops* (Rafinesque), support a small but important commercial fishery in Lake Erie (Scott and Crossman, 1973). White bass generally spawn in May or June, when they move into estuaries, upstreams, or onto gravel shoals (Smith, 1969).

All spawning grounds of white bass noted in this study were in Lake Erie and the lower Detroit River (Figure 28). White bass

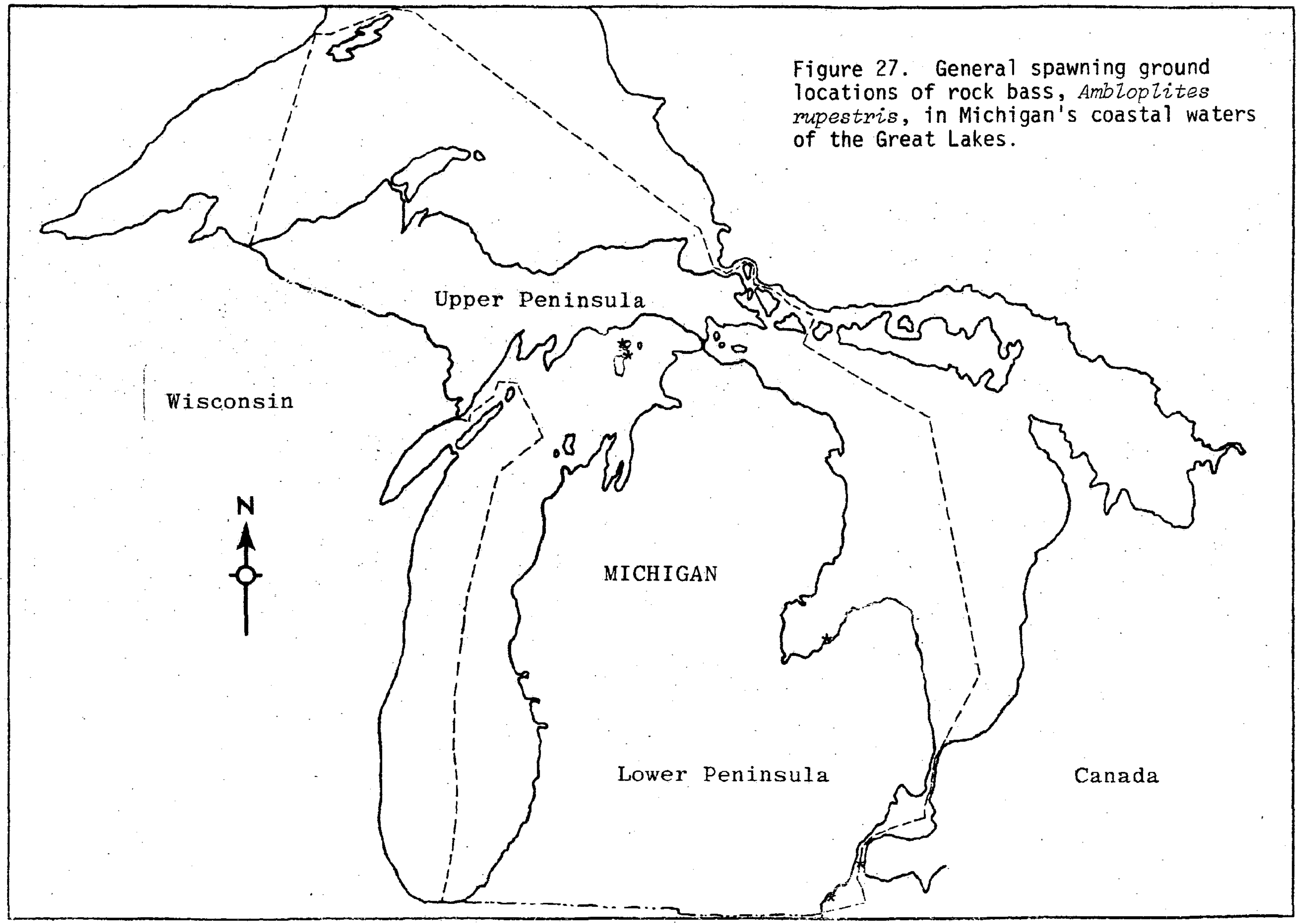


Figure 27. General spawning ground locations of rock bass, *Ambloplites rupestris*, in Michigan's coastal waters of the Great Lakes.

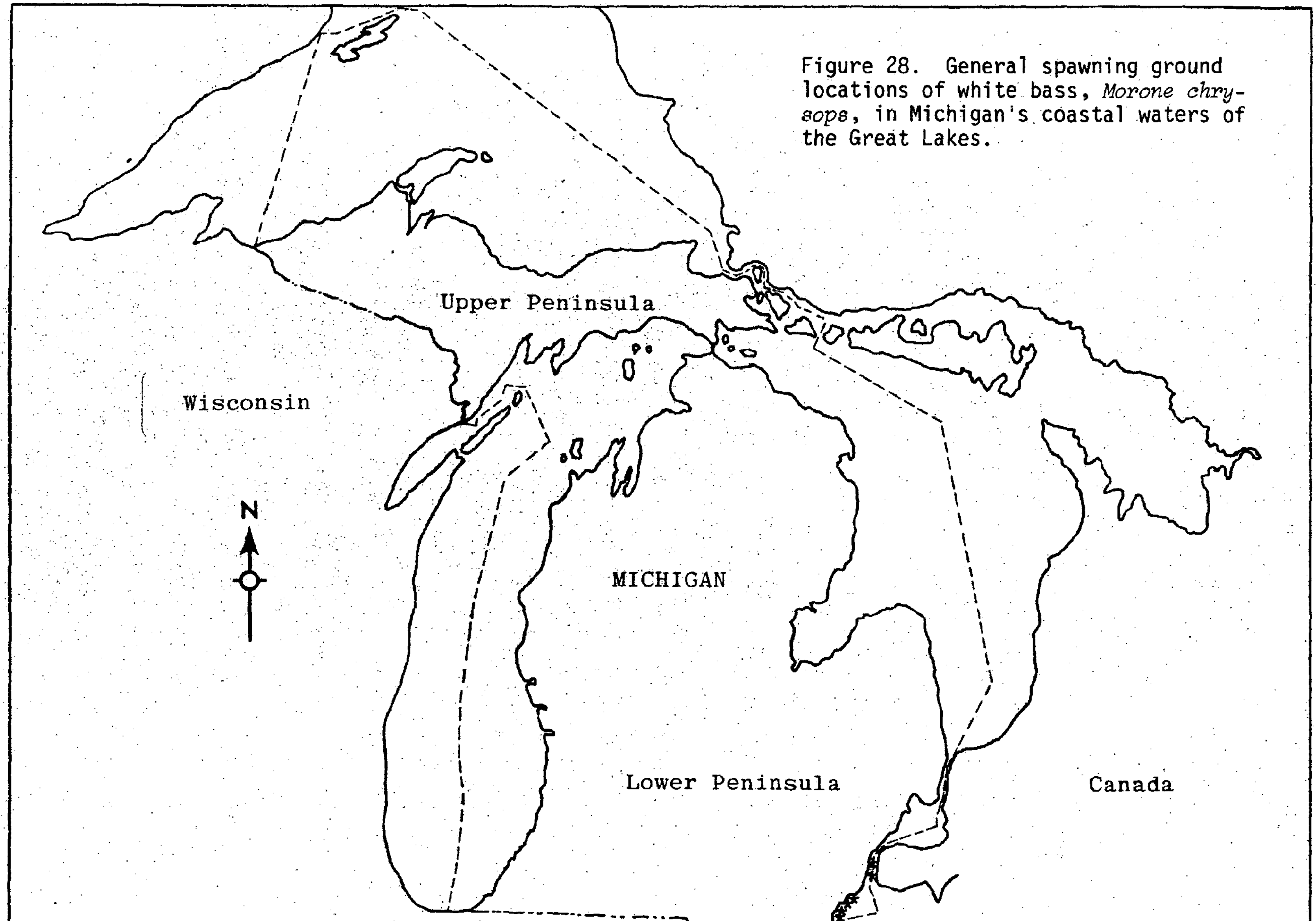


Figure 28. General spawning ground locations of white bass, *Morone chrysops*, in Michigan's coastal waters of the Great Lakes.

spawned along channel shorelines and islands off the southern half of Grosse Ile in the Detroit River (Appendix 3, Figures 197B, 198A, and 198B) in late May, June, and July. Spawning was indicated along the Lake Erie coast offshore from Swan Creek to the Ohio border (Appendix 3, Figures 201 through 203). Activity occurs reportedly from late April to July first, in depths of 1 to 4 meters (3 to 12 feet) over rock, gravel, clay, or sand. One fisherman noted that white bass spawned on a stony shelf running from Swan Creek to Turtle Island (Appendix 3, 201A, 202D, and 203C) at a 3 to 4 meter (10 to 12 feet) depth, during late April and early May.

Freshwater Drum. Spawning characteristics of the freshwater drum, *Aplodinotus grunniens* Rafinesque , are little known (Scott and Crossman, 1973), although the drum has become an important species in Lake Erie where it is fished commercially, primarily for animal food. Edsall (1967) found freshwater drum to be the second-most abundant fish species taken in bottom trawl studies made in western Lake Erie during 1958, comprising 21 percent by weight of the total catch (yellow perch comprised 55 percent).

In this study, spawning areas of freshwater drum were recorded only in Lake Erie, the lower Detroit River, and in one location in Saginaw Bay (Figure 29). Depths of these areas were generally shallow, 1 to 6 meters (3 to 20 feet), and bottom types included mud, gravel, and marsh. Late April to August were given as spawning dates for the drum, with June being most referenced. Edsall (1967) reported finding drum with ripe spawn between 24 June and 4 August in Western Lake Erie.

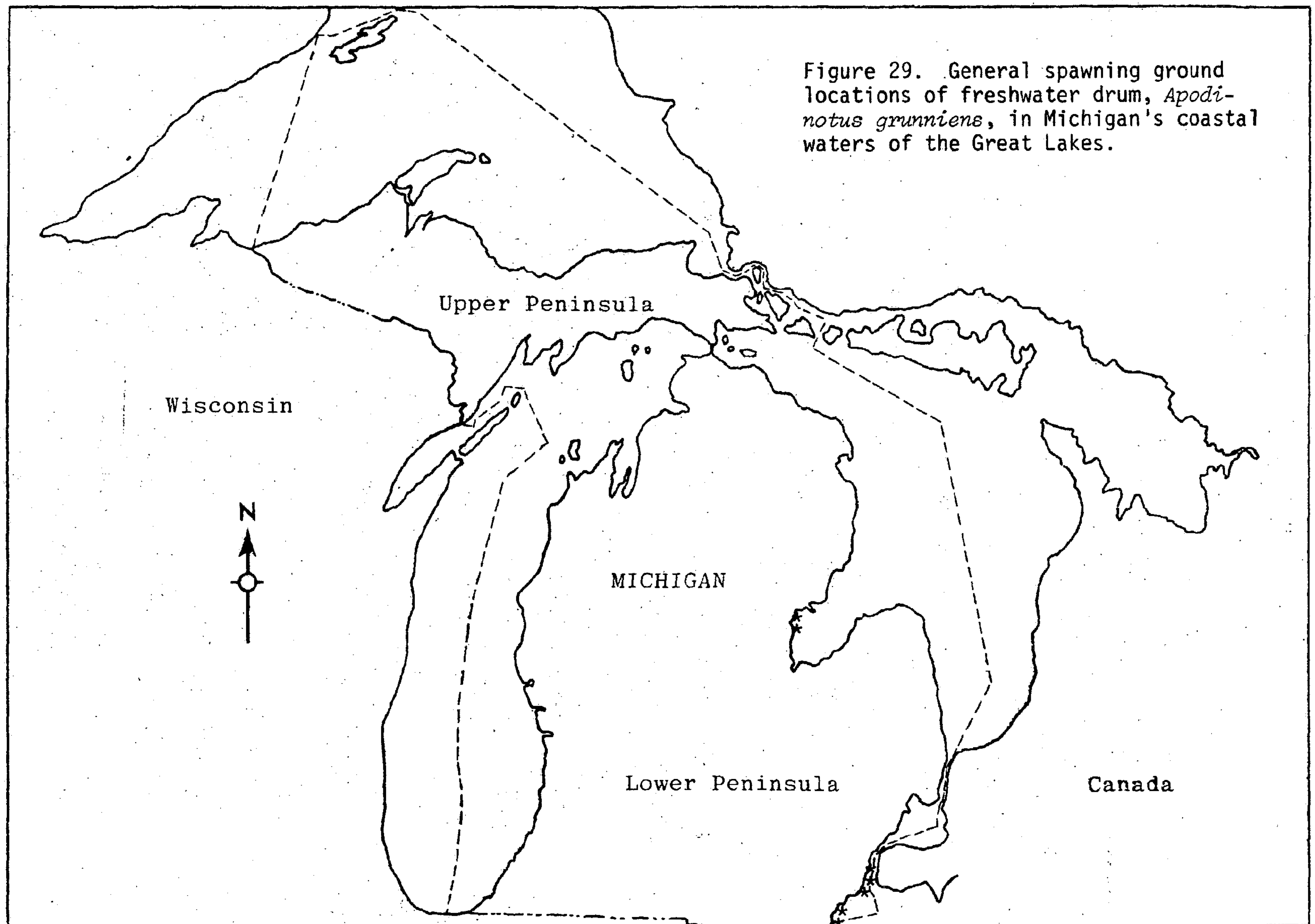


Figure 29. General spawning ground locations of freshwater drum, *Apodinotus grunniens*, in Michigan's coastal waters of the Great Lakes.

Within Lake Huron, one fisherman noted freshwater drum spawning on the west shore of Saginaw Bay from Wigwam Bay to Saganing Bar (Appendix 3, Figure 165C) in a marshy, sandy area. He remarked that freshwater drum populations have always been low in this region.

In the Detroit River, freshwater drum were noted spawning along the west side of the Livingstone Channel from above Stony Island to off Point Mouillee (Appendix 3, Figures 197A, 197B, 198A, and 200) in an area 13 kilometers (8 miles) long. Spawning occurred in depths less than 4 meters (13 feet) over a mud and gravel bottom. Another spawning ground was referenced west of Grosse Ile along the west shore of the river from the Detroit Edison Company south for 5 kilometers (3 miles) (Appendix 3, Figures 198A and B and 200). Walleye were also found to spawn on both of these Detroit River freshwater drum grounds.

The Lake Erie coast from Stony Point to the Ohio border was referenced for freshwater drum spawning sites, during late May through June, in shallow depths less than 5 meters (18 feet) (Appendix 3, Figures 202B and D and 203A). Spawning was said to occur in late April in an area about 3 kilometers (2 miles) southeast of Point Mouillee (Appendix 3, Figure 201A).

Bowfin. Bowfin, *Amica calva* Linnaeus, generally spawn in the spring in shallow, vegetated water (Scott and Crossman, 1973). Only four reports of bowfin spawning were referenced in this study (Figure 30). One area was Scammon Cove on Drummond Island (Appendix 3, Figure 145.1). Bowfin were noted to spawn on the west shore of Saginaw Bay between Point Au Gres and Saganing Bar in .5 meters (1 to 2 feet) of water over mud, at the end of May; and on the east shore of Saginaw Bay.

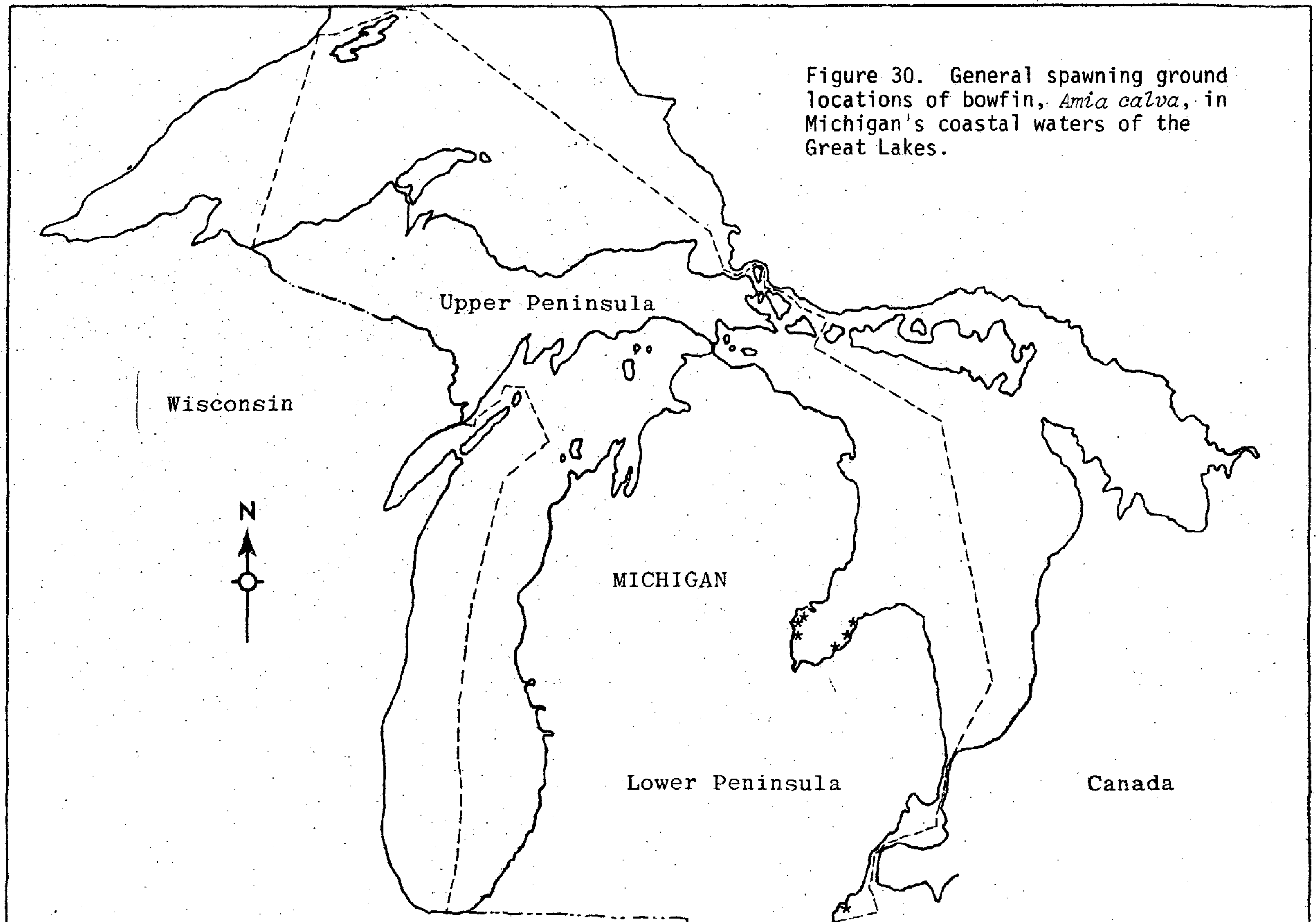


Figure 30. General spawning ground locations of bowfin, *Amia calva*, in Michigan's coastal waters of the Great Lakes.

from Fish Point to Sebewaing over sand and muck (Appendix 3, Figures 165A and 168B). One fisherman referenced bowfin spawning during July and August in a marshy area in La Plaisance Bay of Lake Erie (Appendix 3, Figure 202D) in 1 to 2 meters (4 to 6 feet), where he commented there were "still a few left".

Longnose Gar and Spotted Gar. The spotted gar, *Lepisosteus oculatus* (Winchell), and the more abundant longnose gar, *Lepisosteus osseus* (Linnaeus), inhabit southern waters of the Great Lakes, where they spawn in warm, weedy shallows (Scott and Crossman, 1973). Gar were noted spawning in Western Saginaw Bay from Point Au Gres to Saganing Bar in .5 meters (1 to 2 feet) of water over mud, at the end of May (Appendix 3, Figure 165C). In the Detroit River, spawning was cited east of Sugar Island in July in weedy waters 2 to 3 meters (7 to 10 feet) deep (Appendix 3, Figure 199B), and also off Milleville Beach (Appendix 3, Figure 200). One fisherman stated that gar spawned in streams and canals near Lake Erie in late May and early June (not mapped in Appendix 3). Referenced gar sites are shown in Figure 31.

Gizzard Shad. Bodala (1966) reported gizzard shad, *Dorosoma cepedianum* (Lesueur), spawning at a Western Lake Erie location in Ohio, on a shallow bar of sand, gravel, and rock, 60 meters (200 feet) long and covered by .6 to 1.2 meters (2 to 4 feet) of water, during June.

In this study, the spawning of gizzard shad was reported along the coast of Lake Erie (Appendix 3, Figures 201 through 203), and in a marshy area near Sturgeon Island in the Detroit River (Appendix 3, Figure 199C). One source noted that shad spawned in the

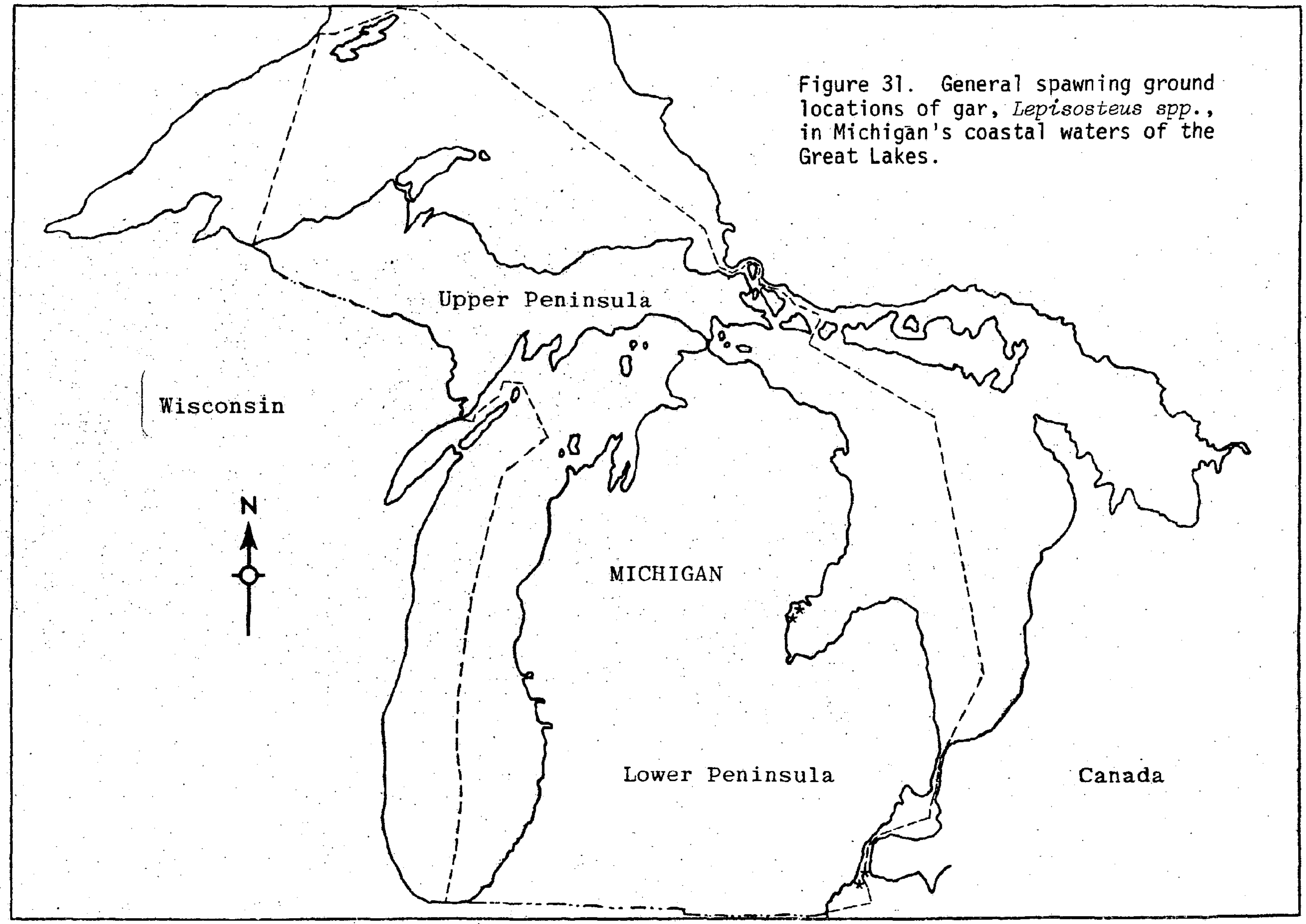


Figure 31. General spawning ground locations of gar, *Lepisosteus spp.*, in Michigan's coastal waters of the Great Lakes.

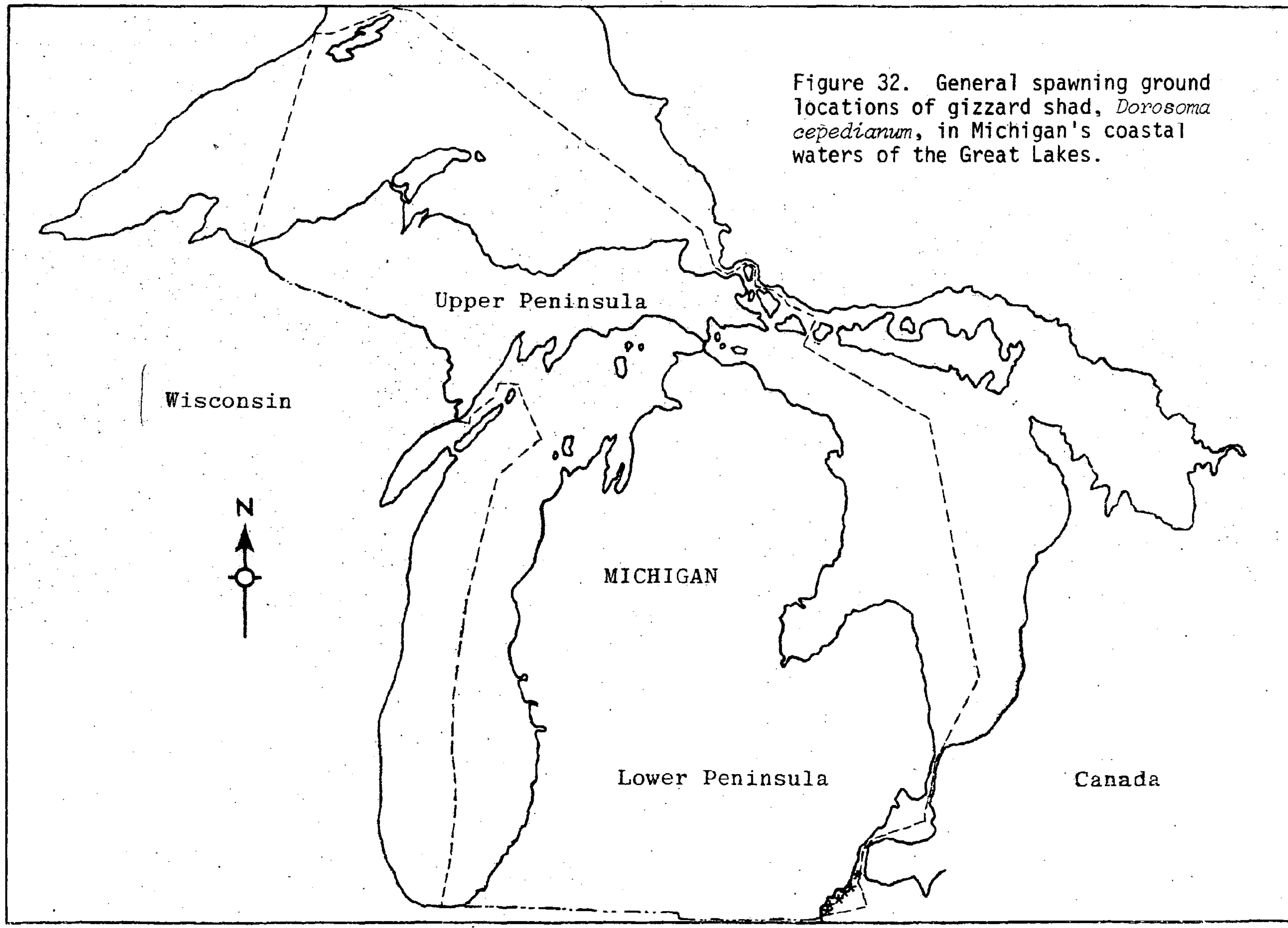


Figure 32. General spawning ground locations of gizzard shad, *Dorosoma cepedianum*, in Michigan's coastal waters of the Great Lakes.

warm discharge of power plants at the Enrico Fermi, Monroe Power, and Consumers Power site on the Erie coast (Appendix 3, Figures 201 through 203), during May and June. Shad locations are shown in Figure 32.

Trout-perch. House and Wells (1973) found trout-perch, *Percopsis omiscomaycus* (Walbaum), spawning from late June or early July until late September in Lake Michigan, with younger fish tending to spawn earlier than older ones. Scott and Crossman (1973) reported spawning had occurred over a sand and gravel bottom less than one meter (3 feet) feep on the Lake Erie shore, during May to August, 1946. Charles Liston (1978) noticed that trout-perch spawned from mid-May to late July, in studies of the waters off the Consumers Power Pumped Storage Reservoir south of Ludington, Michigan. No specific sites were given.

Sculpin. Charles Liston (1978) reported slimy sculpin, *Cottus cognatus* Richardson, and mottled sculpin, *Cottus bairdi* Girard, spawning mid-April to mid-May over gravel pebbles in Lake Michigan shore waters off the Consumers Power Pumped Storage Reservoir, south of Ludington. No specific locations were referenced. In Northwestern Lake Huron samples, O'Gorman (1978) caught larval fourhorn sculpin, *Myoxocephalus quadricornus* (Linnaeus), in Hammond Bay during late April and near Alpena in May.

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# APPENDICES

## APPENDIX 1

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# APPENDIX 2

# STATE SECTIONAL MAPS

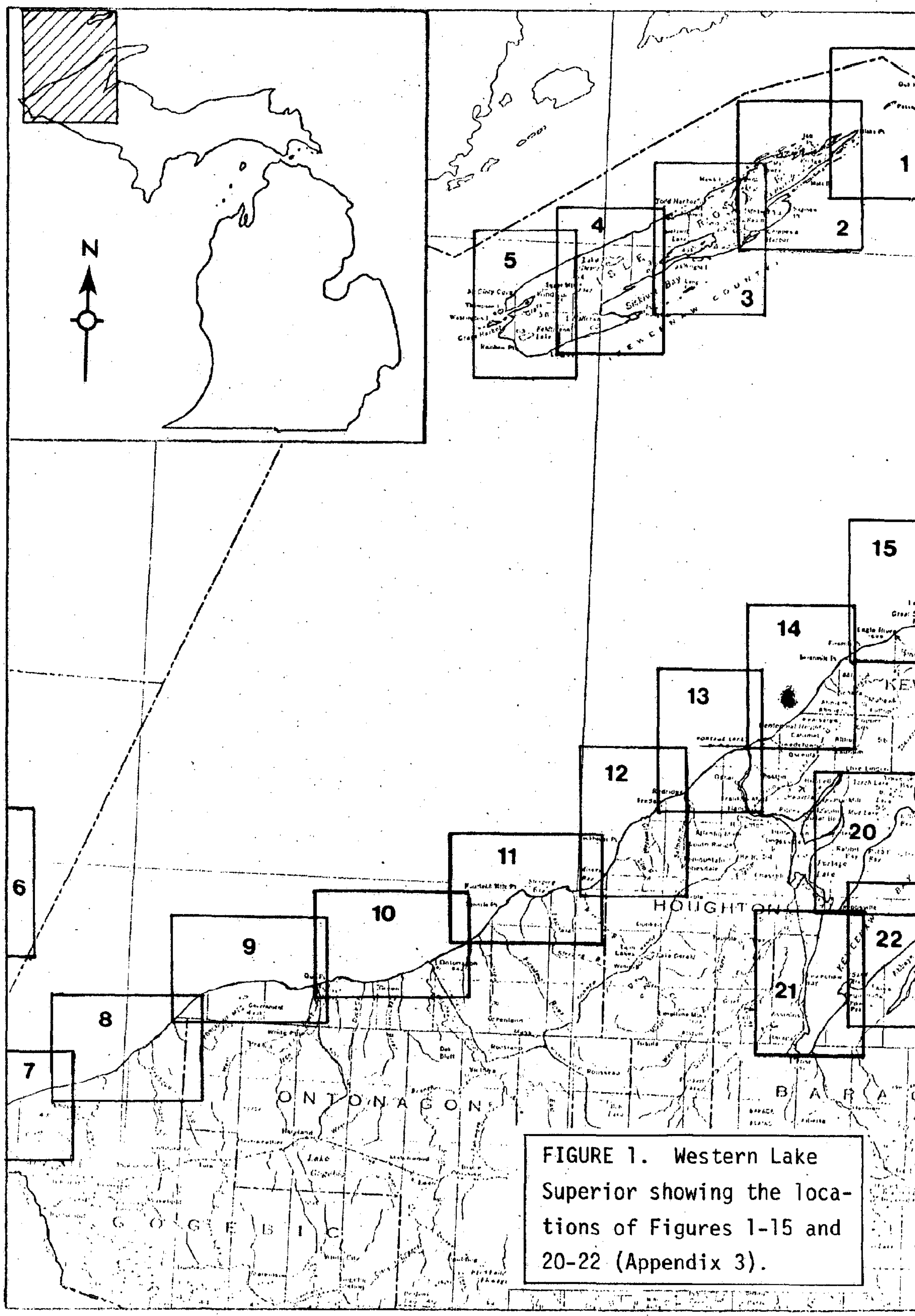



FIGURE 1. Western Lake Superior showing the locations of Figures 1-15 and 20-22 (Appendix 3).

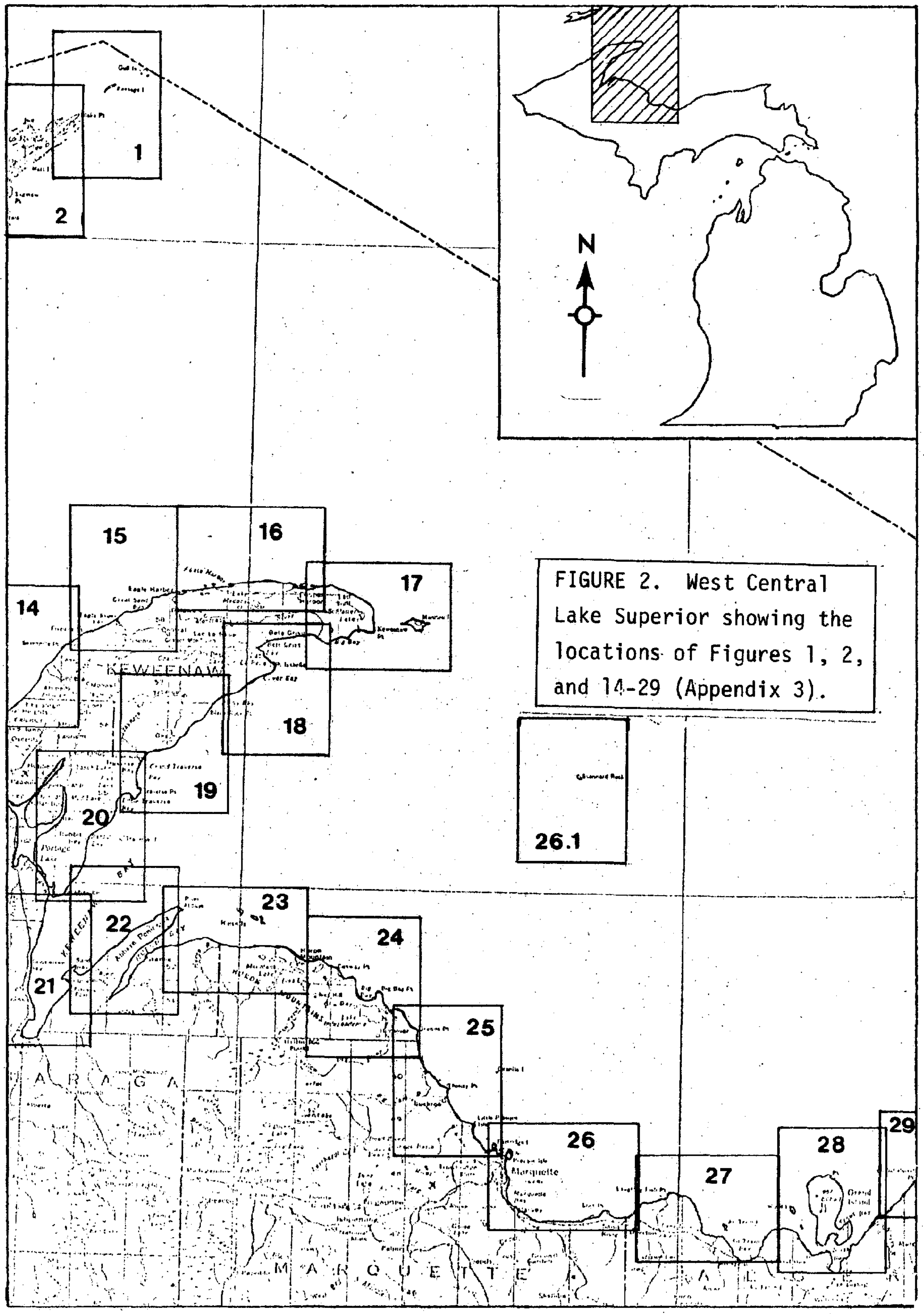



FIGURE 2. West Central Lake Superior showing the locations of Figures 1, 2, and 14-29 (Appendix 3).

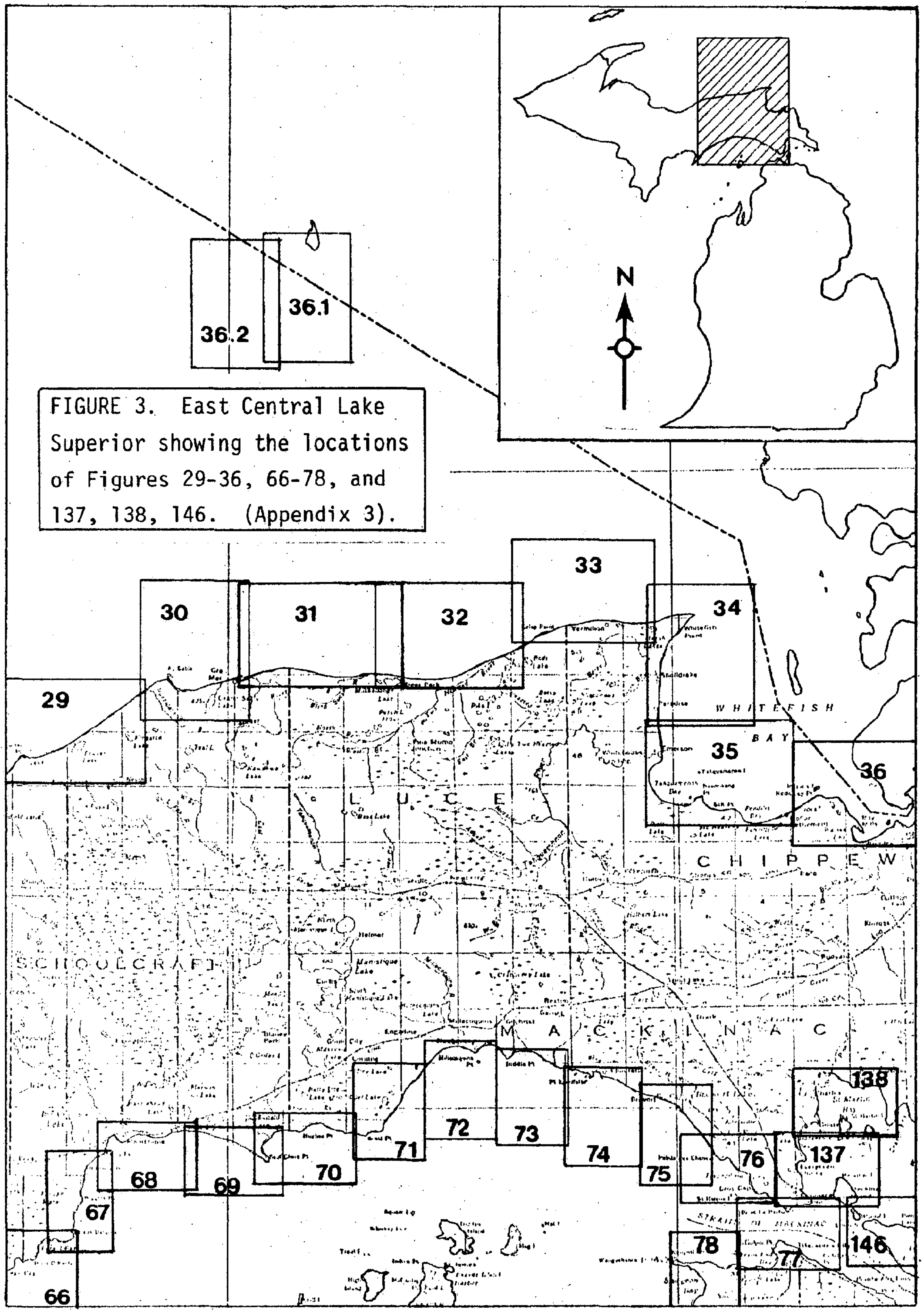



FIGURE 3. East Central Lake Superior showing the locations of Figures 29-36, 66-78, and 137, 138, 146. (Appendix 3).

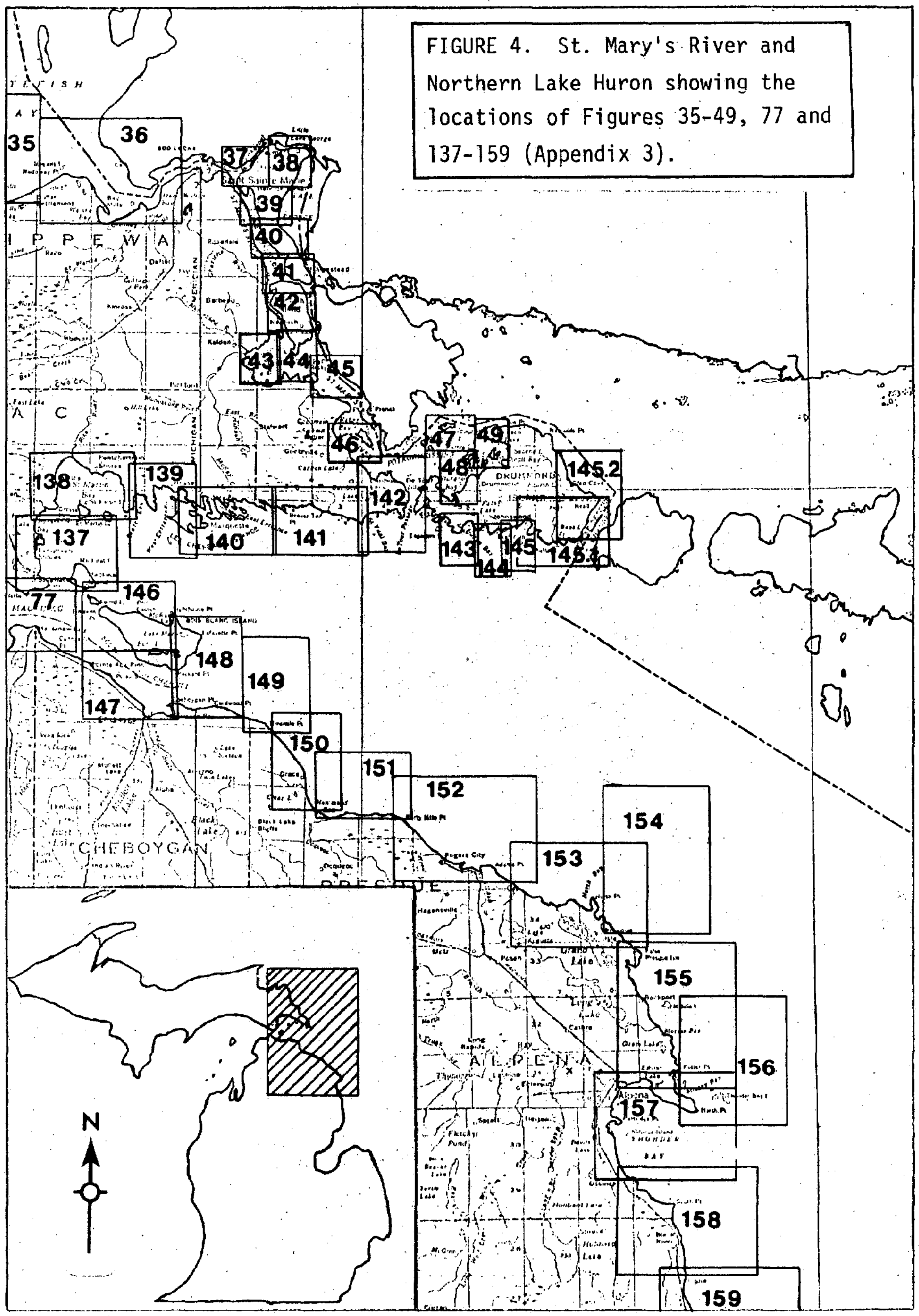



FIGURE 4. St. Mary's River and Northern Lake Huron showing the locations of Figures 35-49, 77 and 137-159 (Appendix 3).

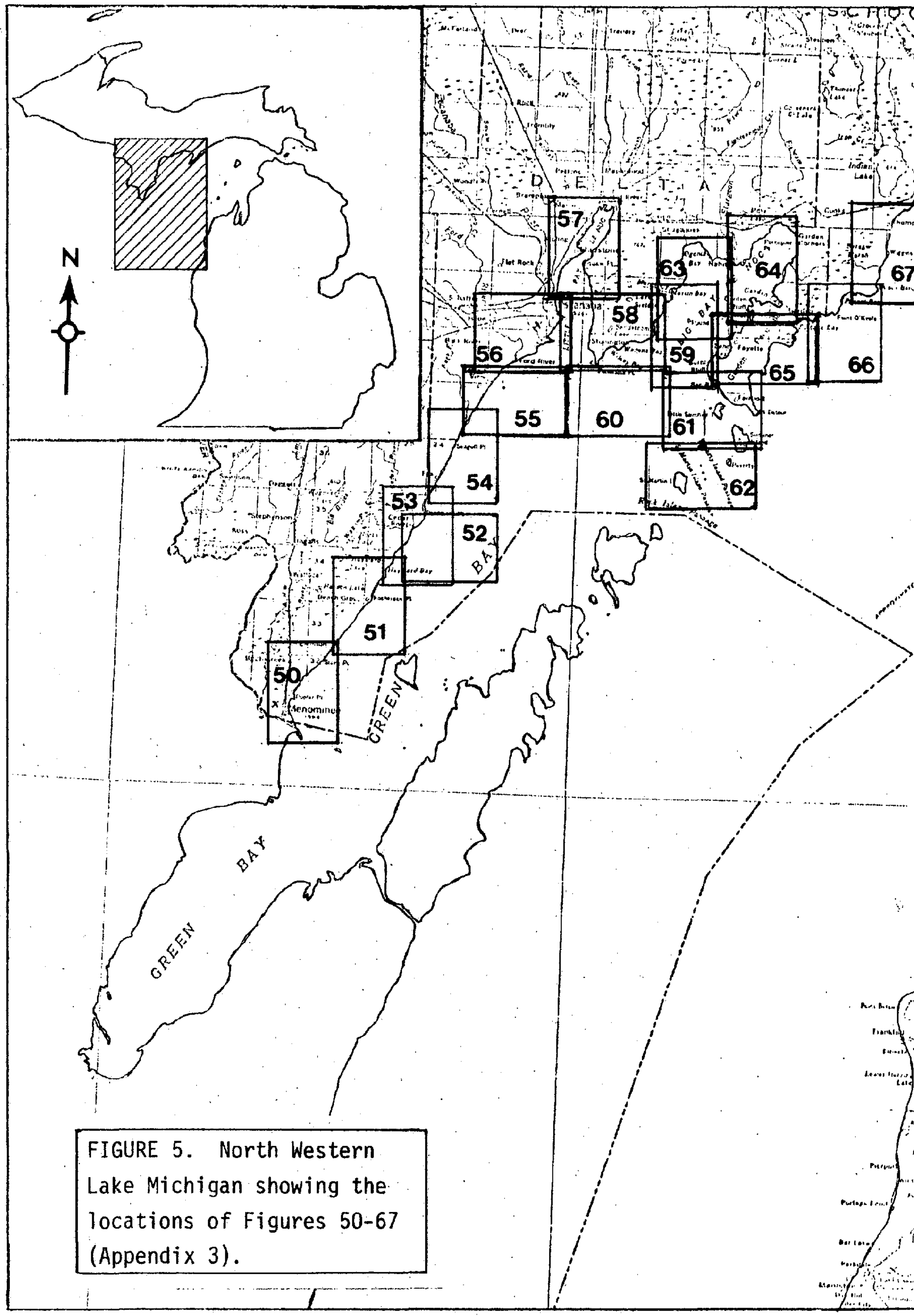



FIGURE 5. North Western Lake Michigan showing the locations of Figures 50-67 (Appendix 3).

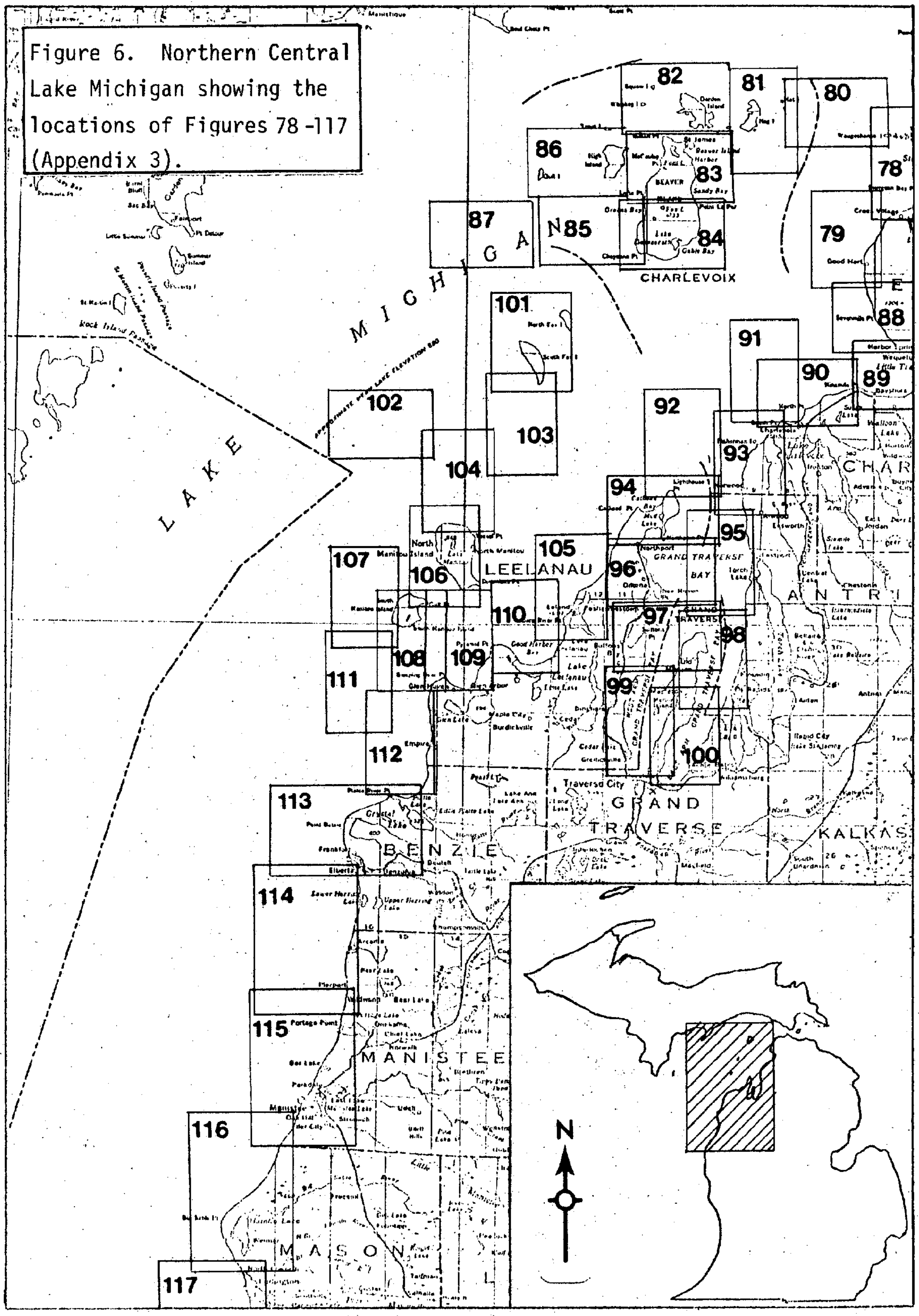



Figure 6. Northern Central Lake Michigan showing the locations of Figures 78-117 (Appendix 3).

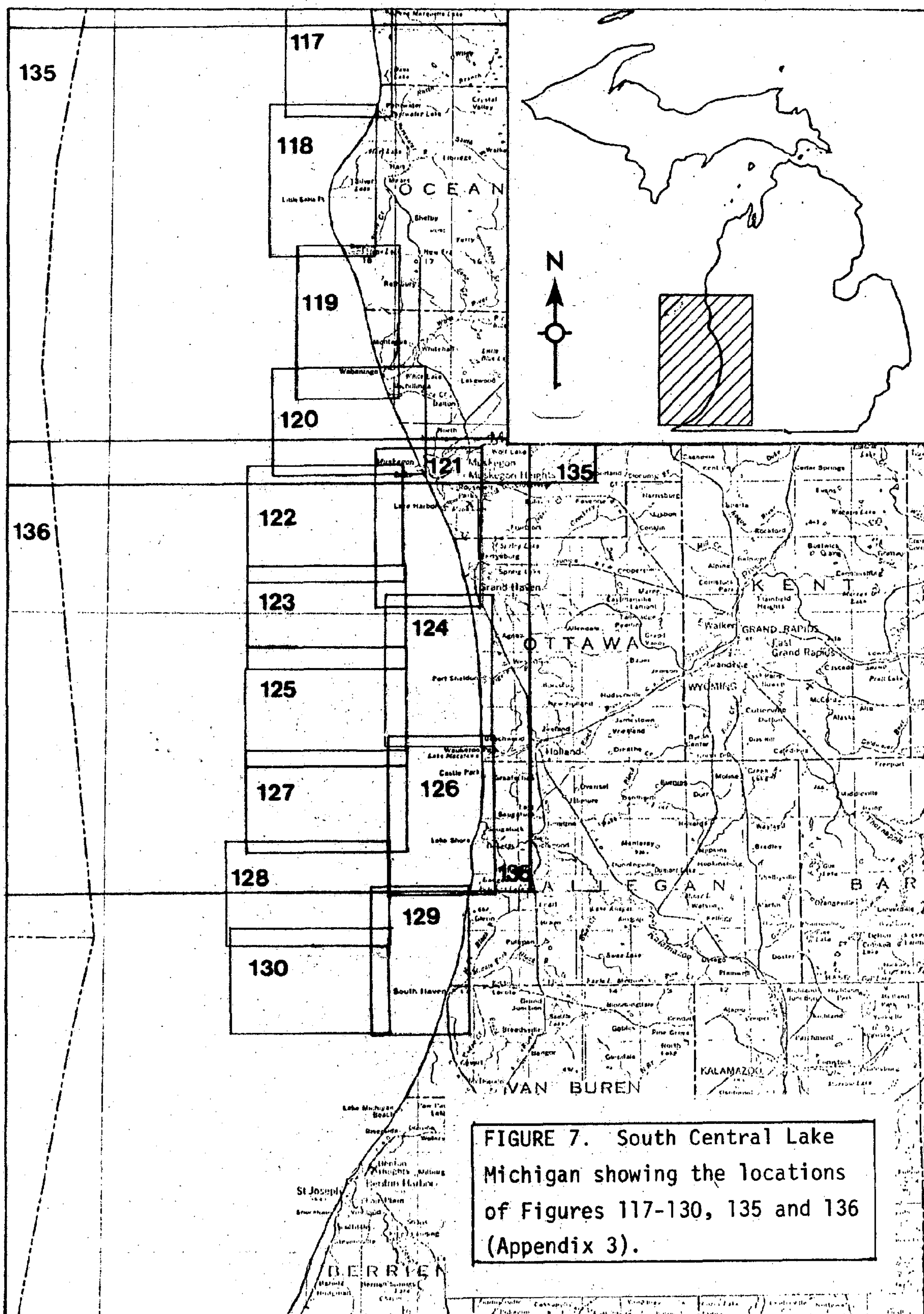



FIGURE 7. South Central Lake Michigan showing the locations of Figures 117-130, 135 and 136 (Appendix 3).

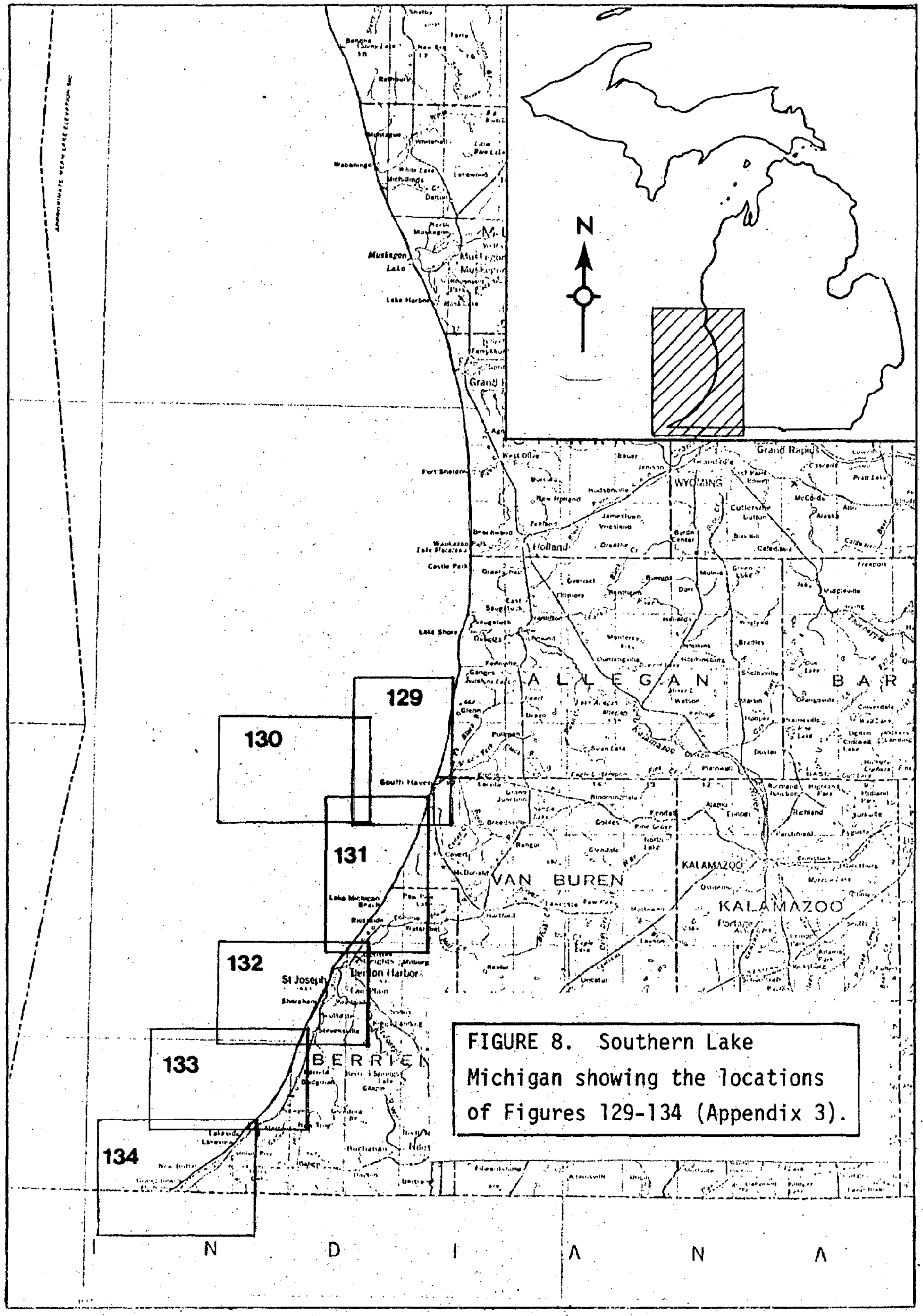



FIGURE 8. Southern Lake Michigan showing the locations of Figures 129-134 (Appendix 3).

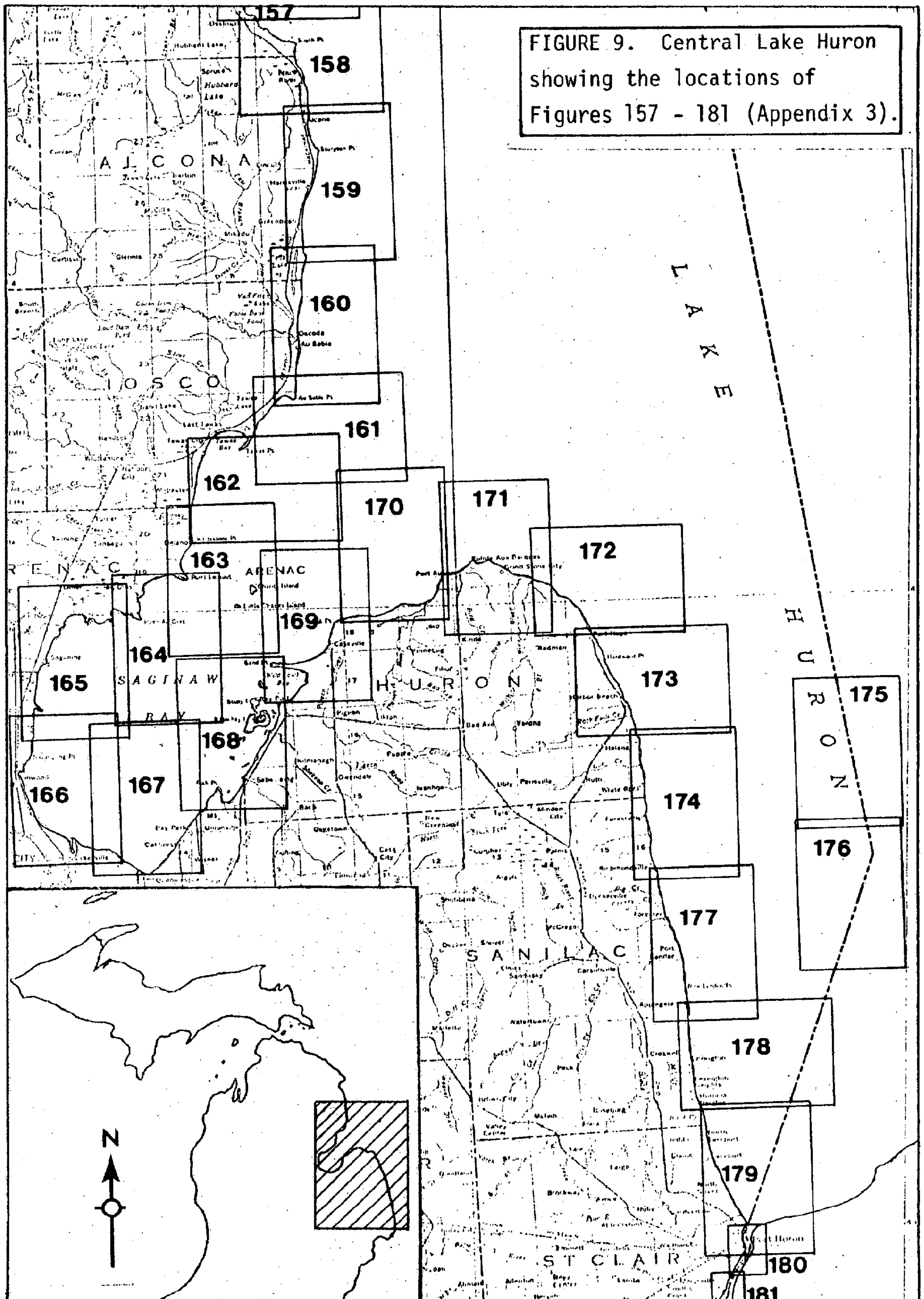



FIGURE 9. Central Lake Huron showing the locations of Figures 157 - 181 (Appendix 3).

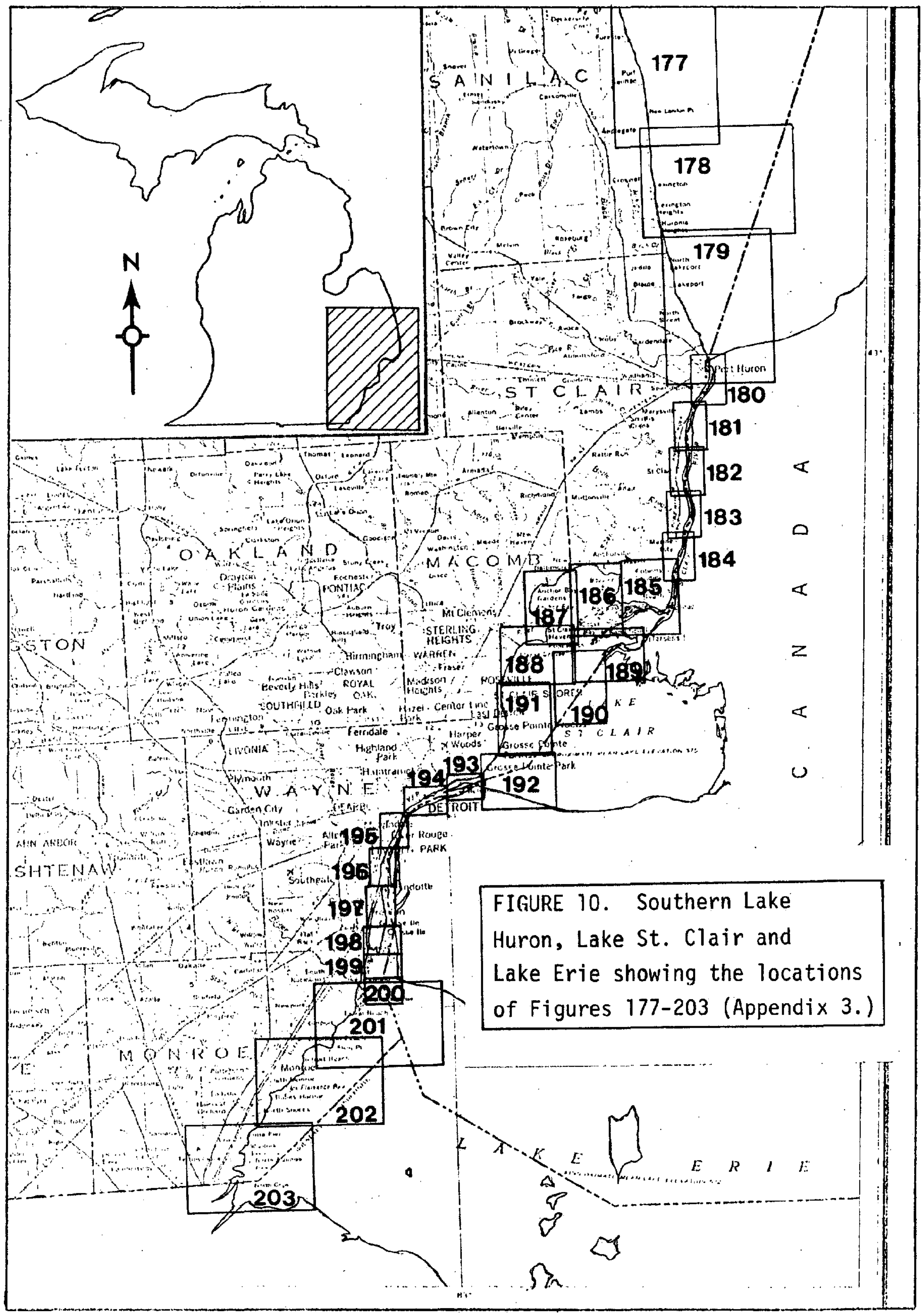



FIGURE 10. Southern Lake Huron, Lake St. Clair and Lake Erie showing the locations of Figures 177-203 (Appendix 3.)

APPENDIX 3

LAKE CHART SECTIONAL MAPS

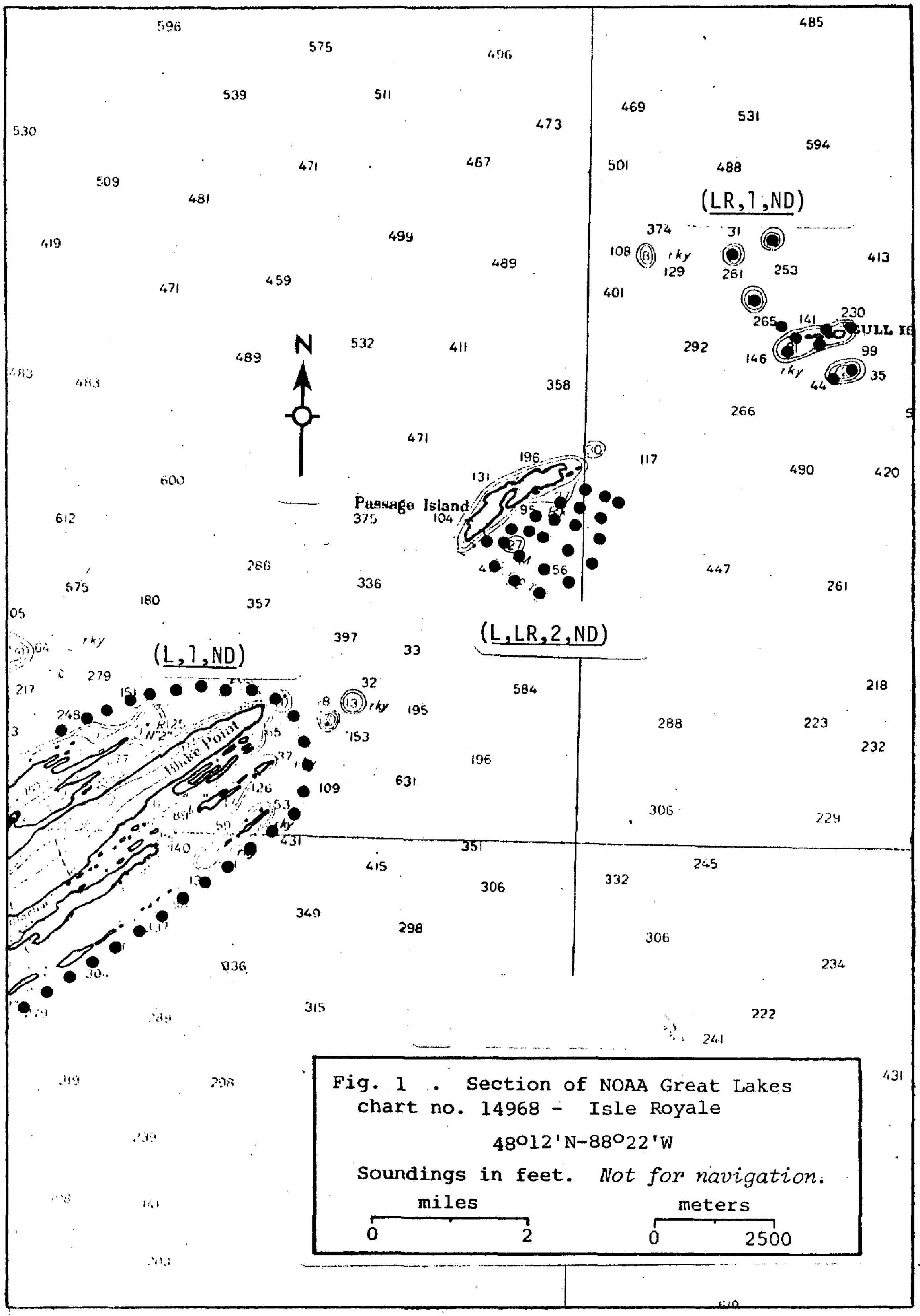



Fig. 1 . Section of NOAA Great Lakes chart no. 14968 - Isle Royale

48°12'N-88°22'W

Soundings in feet. *Not for navigation.*

miles 0 2

meters 0 2500

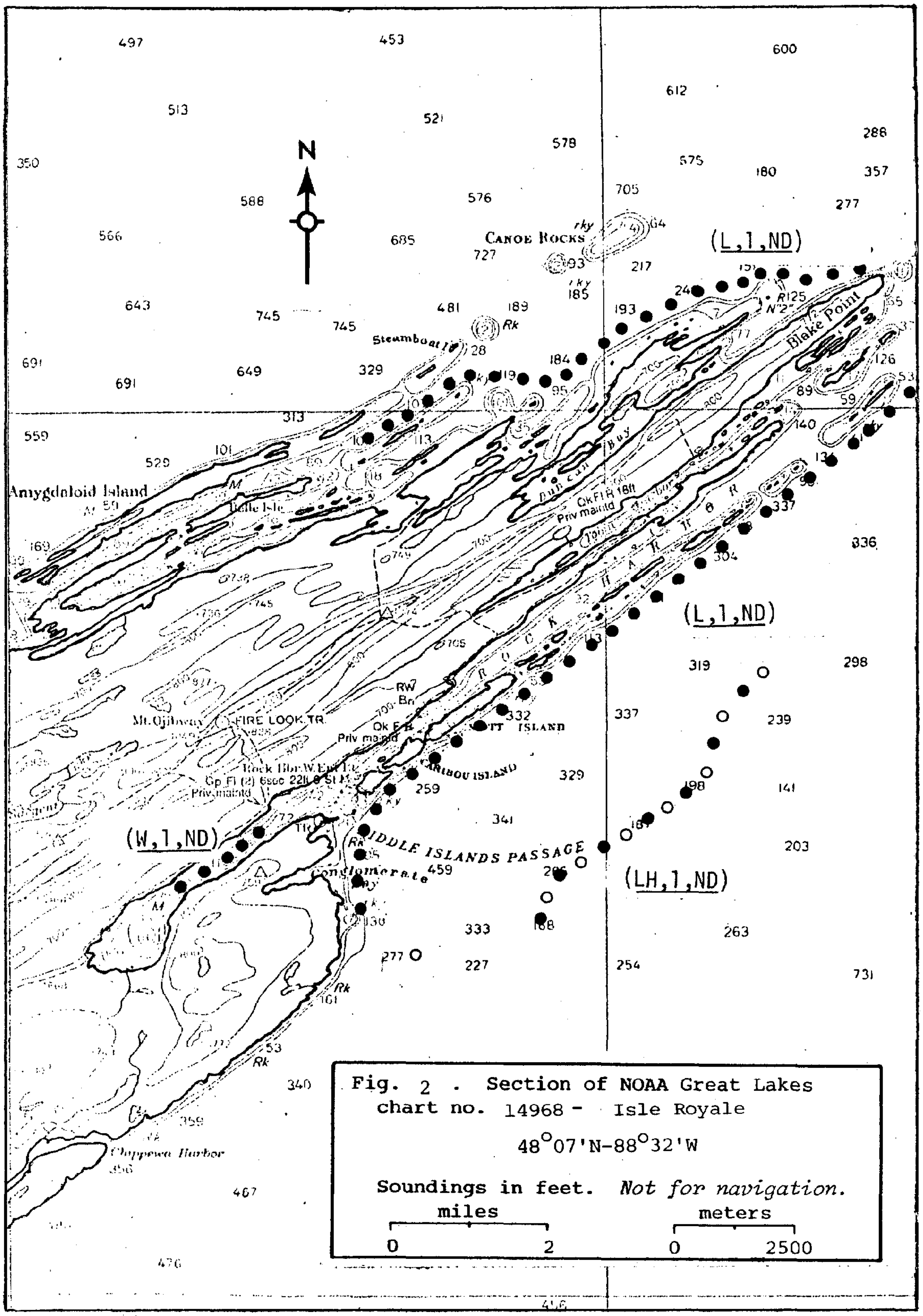



Fig. 2 . Section of NOAA Great Lakes chart no. 14968 - Isle Royale

48°07'N-88°32'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

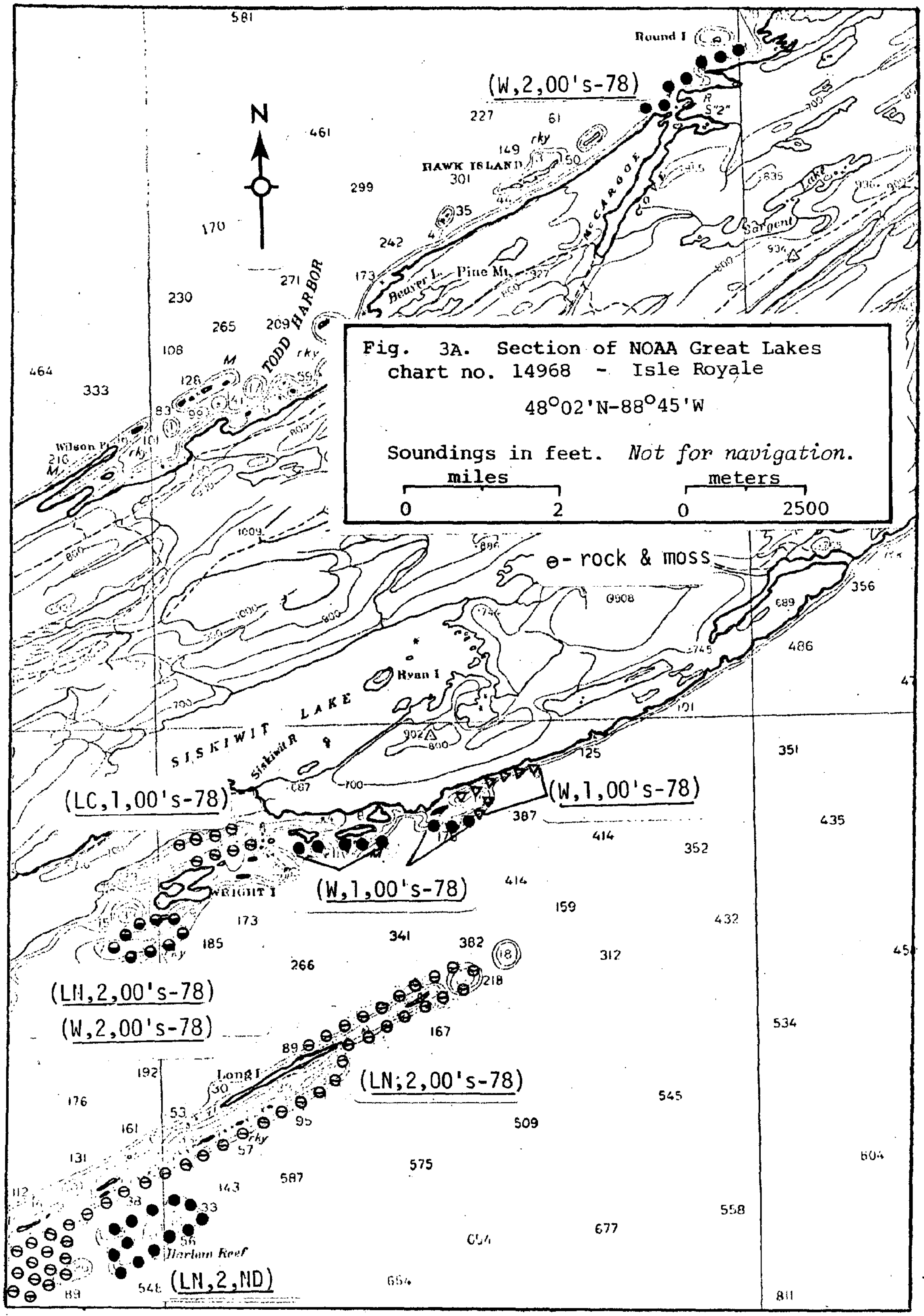


Fig. 3A. Section of NOAA Great Lakes chart no. 14968 - Isle Royale
48°02'N-88°45'W
Soundings in feet. Not for navigation.
miles
0
2
meters
0
2500
⊖- rock & moss
N
(W,2,00's-78)
Round I
HAWK ISLAND
TODD HARBOR
Wilson Pt
Pine Mt
Beaver L
Sargent
SISKIWIT LAKE
Siskiwit R
Ryan I
(LC,1,00's-78)
(W,1,00's-78)
(W,1,00's-78)
WRIGHT I
(LN,2,00's-78)
(W,2,00's-78)
Long I
(LN,2,00's-78)
Harlem Reef
(LN,2,ND)

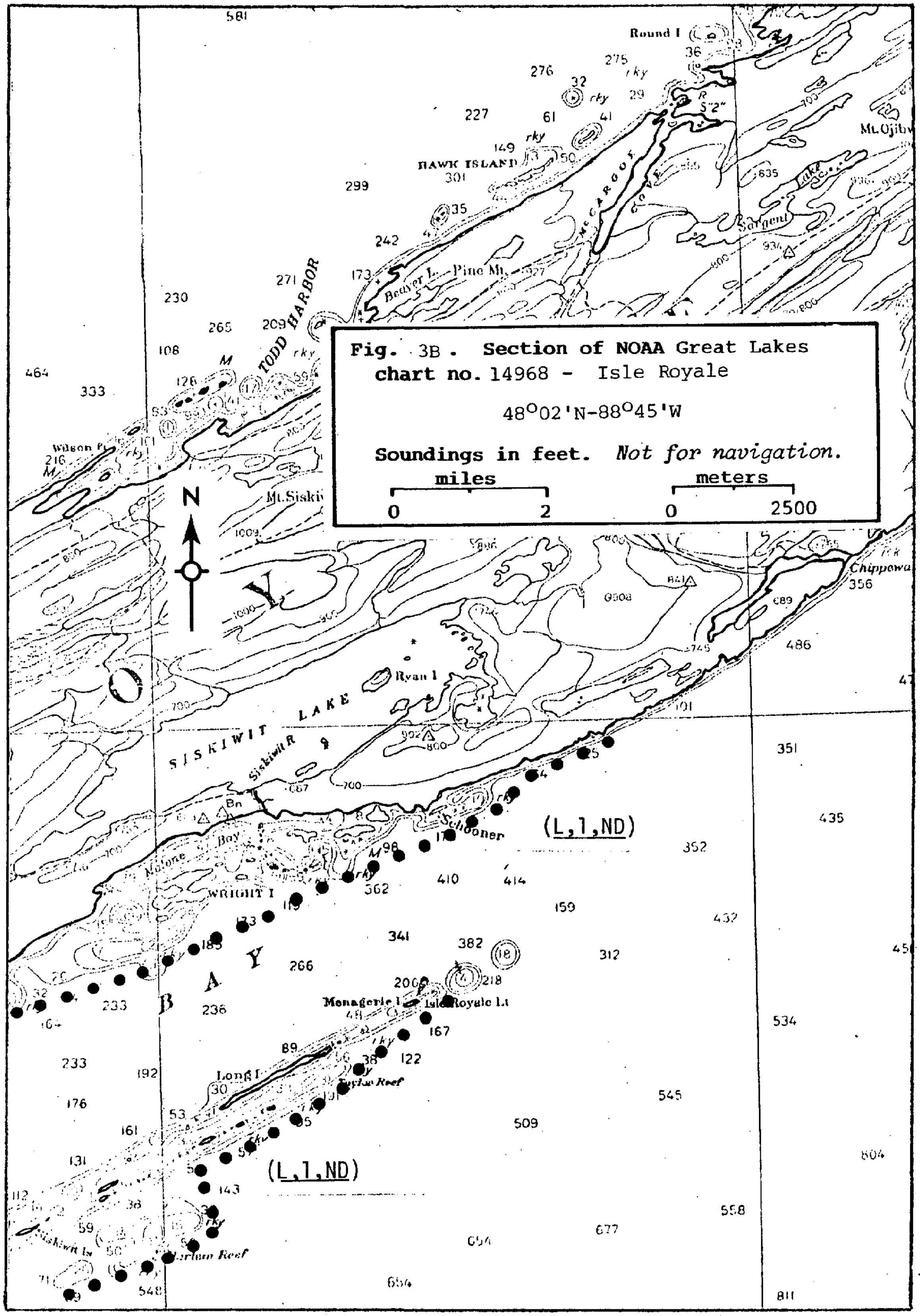



Fig. 3B . Section of NOAA Great Lakes chart no. 14968 - Isle Royale

48°02'N-88°45'W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

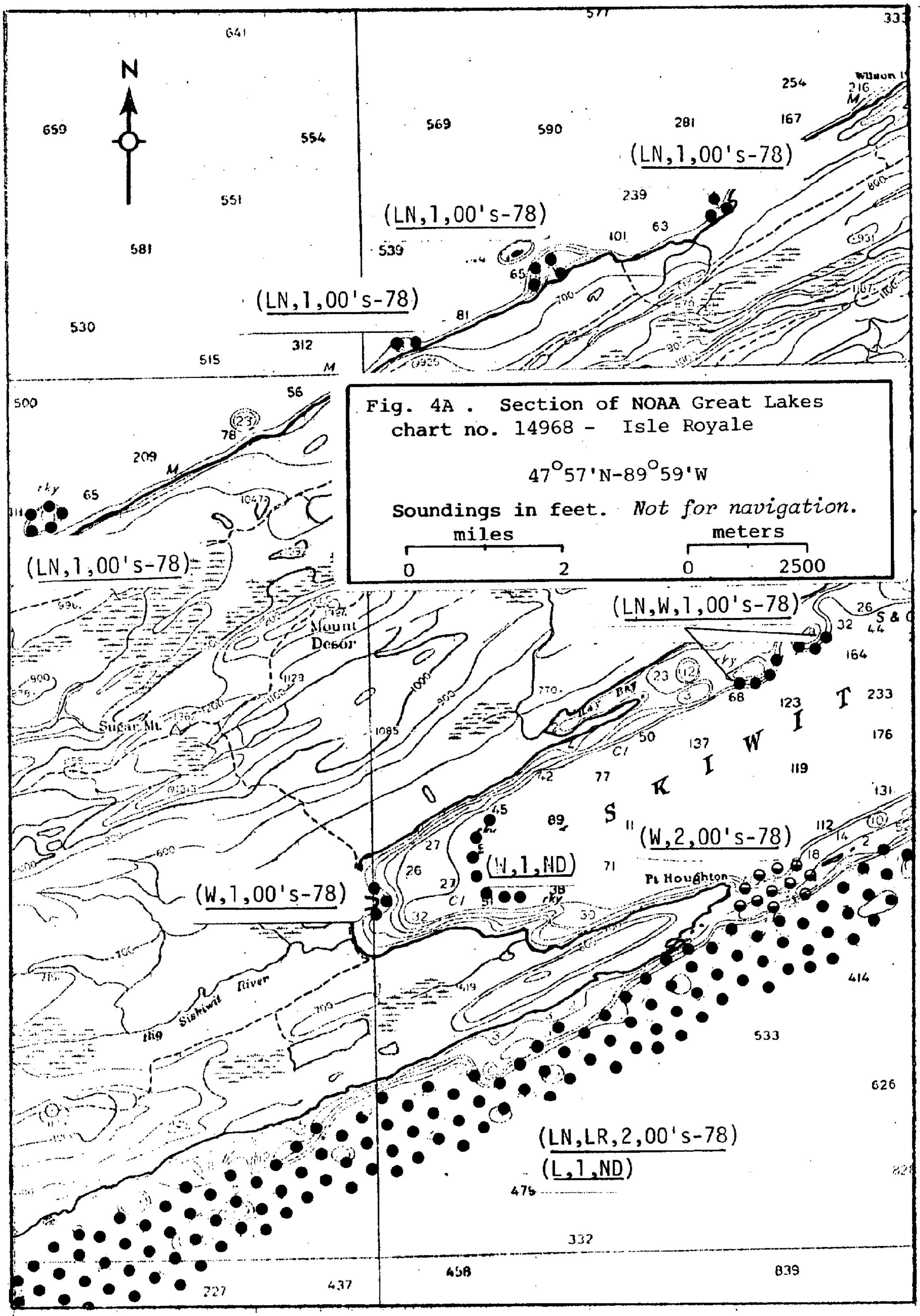



Fig. 4A . Section of NOAA Great Lakes chart no. 14968 - Isle Royale

47°57'N-89°59'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

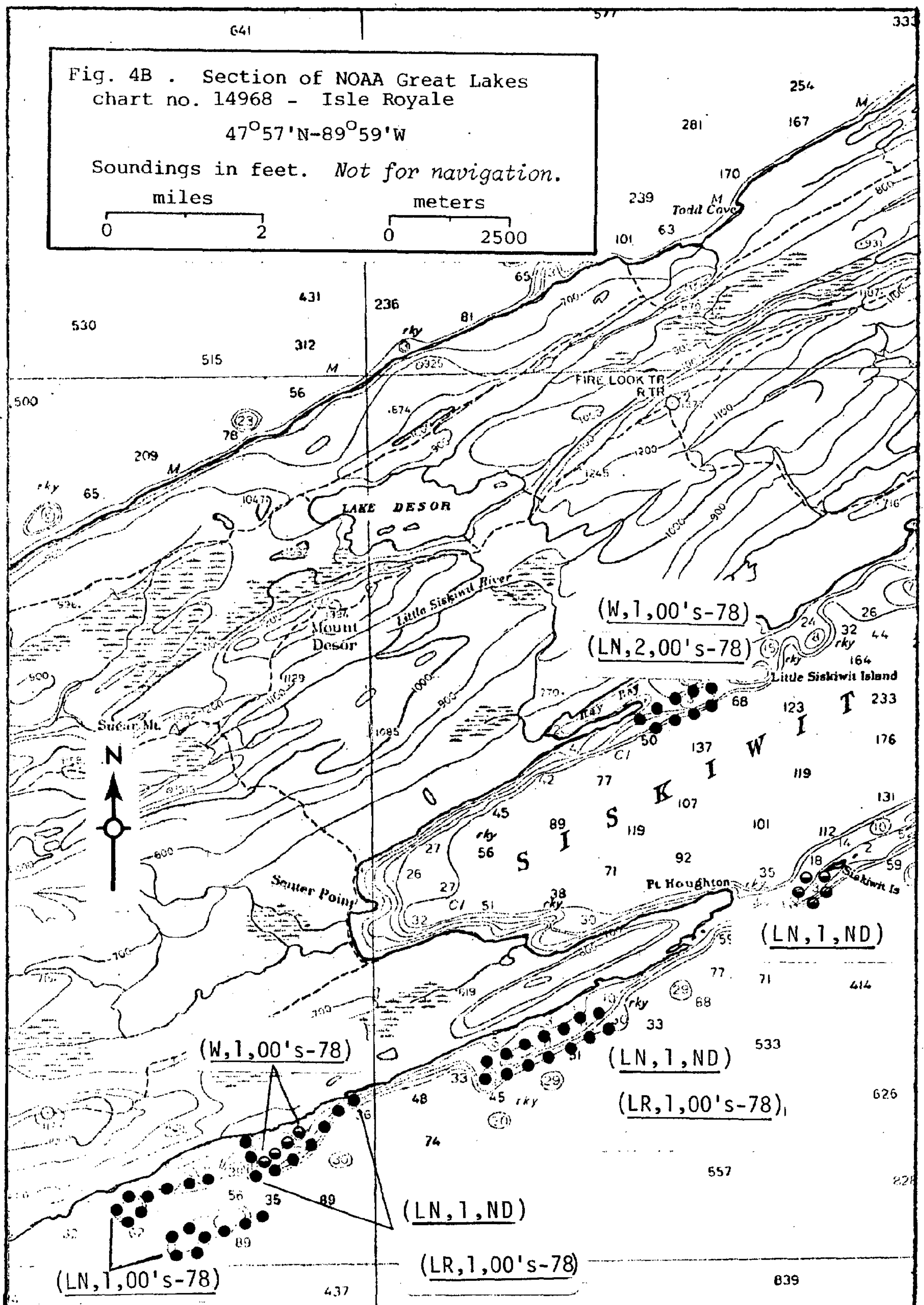



Fig. 4B . Section of NOAA Great Lakes chart no. 14968 - Isle Royale

47°57'N-89°59'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

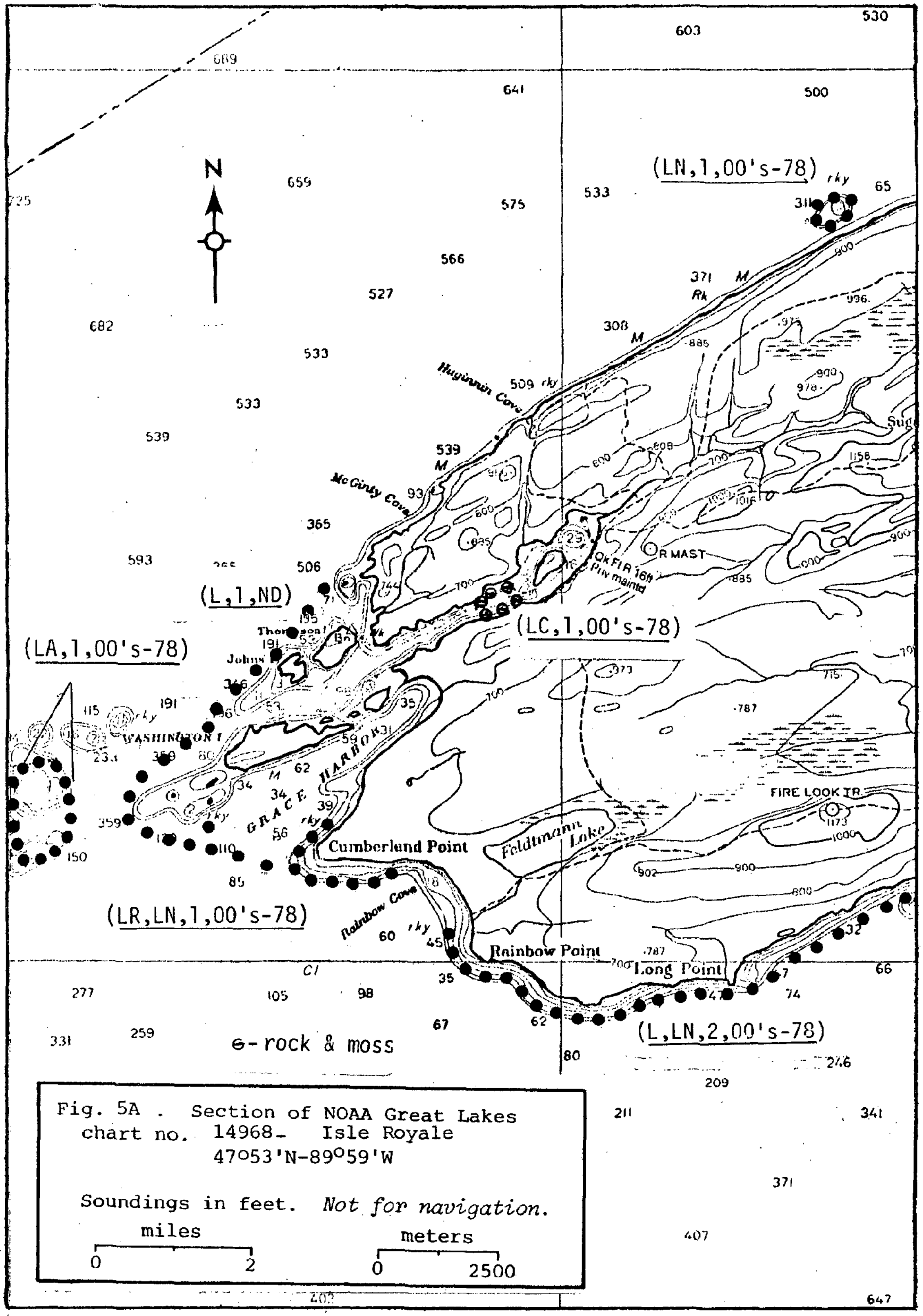



Fig. 5A . Section of NOAA Great Lakes chart no. 14968- Isle Royale 47°53'N-89°59'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

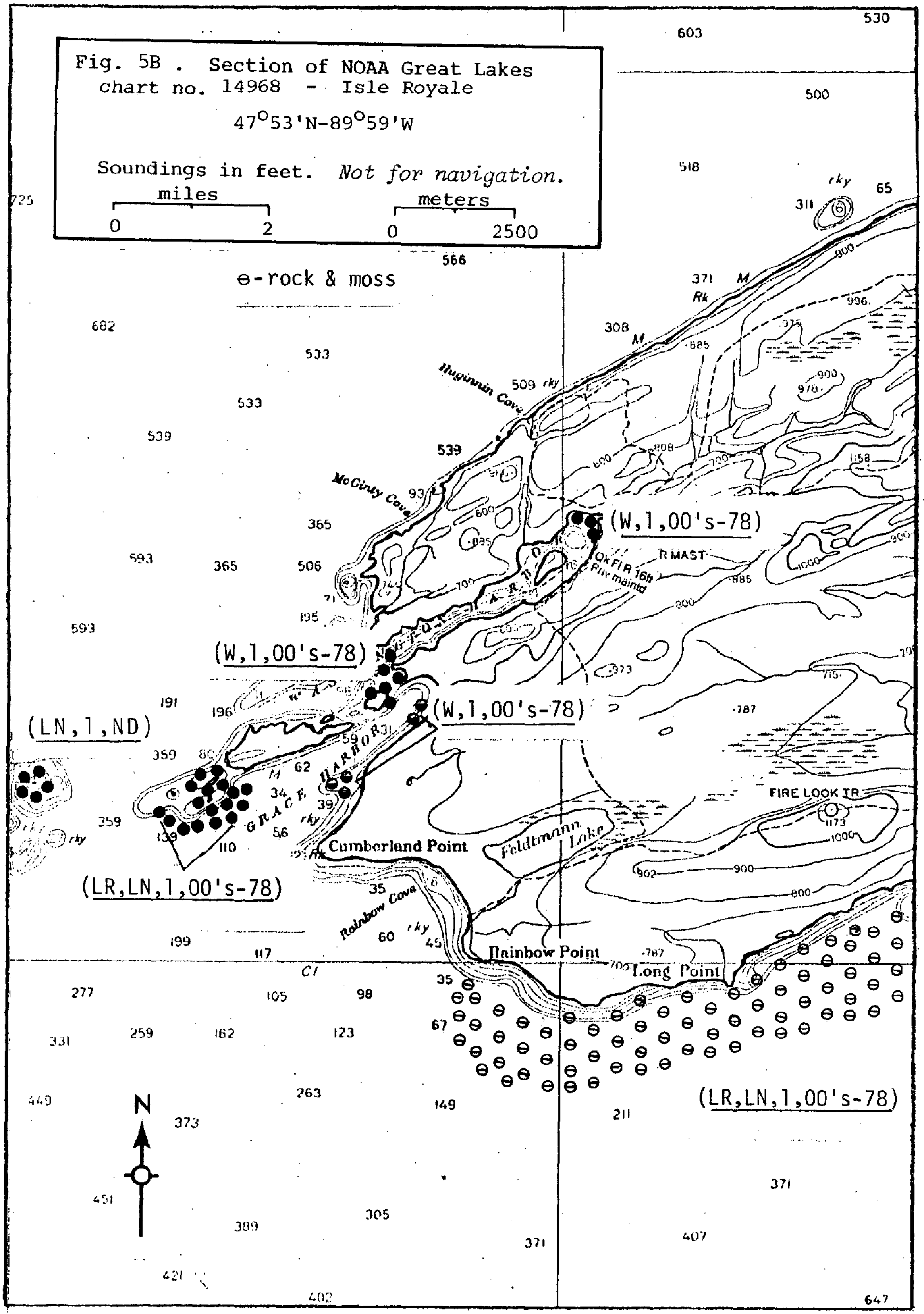


Fig. 5B . Section of NOAA Great Lakes chart no. 14968 - Isle Royale
47°53'N-89°59'W
Soundings in feet. *Not for navigation.*
miles
0 2
meters
0 2500
⊖-rock & moss
(W,1,00's-78)
(W,1,00's-78)
(W,1,00's-78)
(LN,1,ND)
(LR,LN,1,00's-78)
(LR,LN,1,00's-78)
Huginnin Cove
McGinty Cove
Grace Harbor
Cumberland Point
Feldtmann Lake
Rainbow Cove
Rainbow Point
Long Point
FIRE LOOK TR
R MAST
N

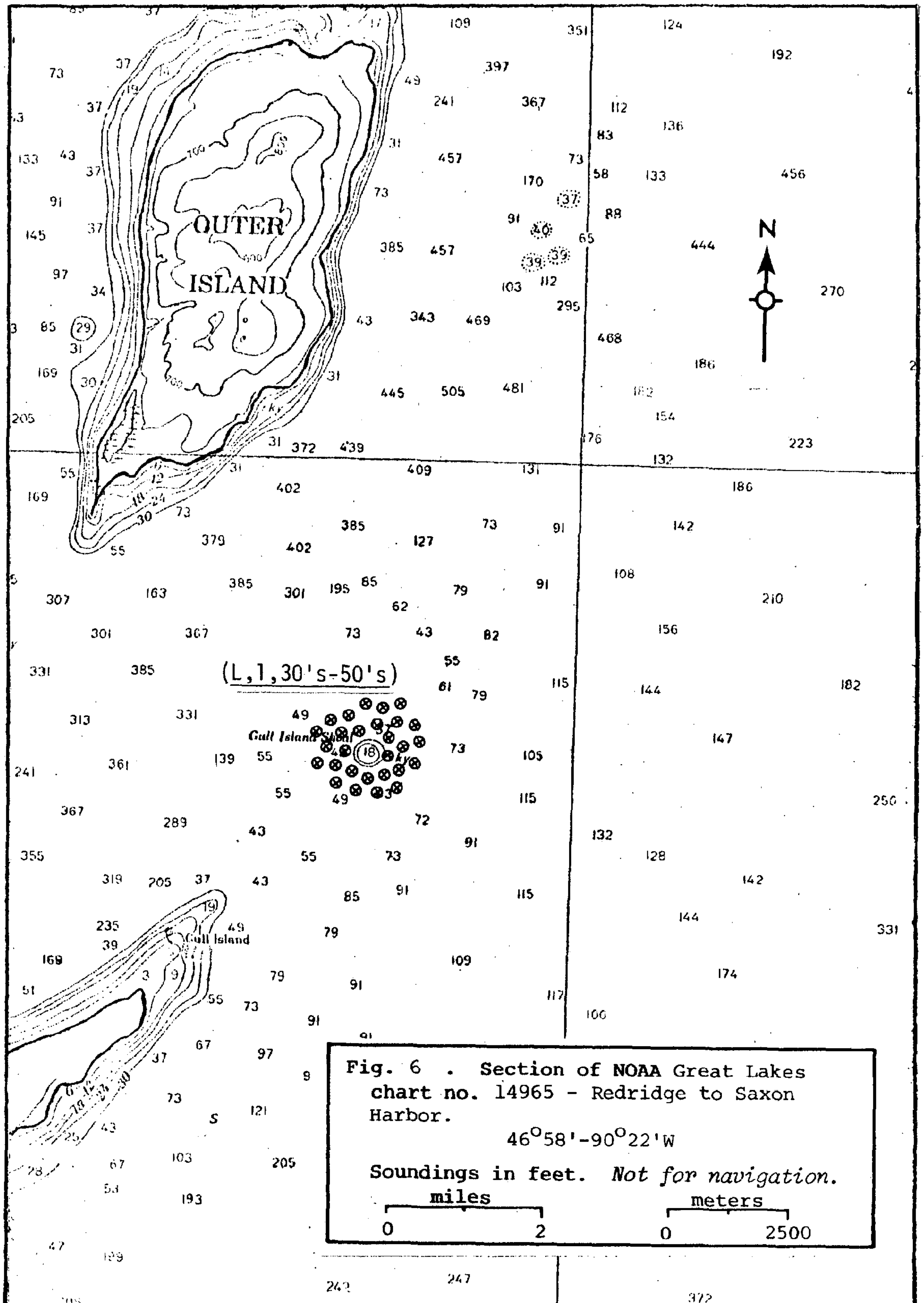



**Fig. 6 . Section of NOAA Great Lakes chart no. 14965 - Redridge to Saxon Harbor.**

46°58'-90°22'W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

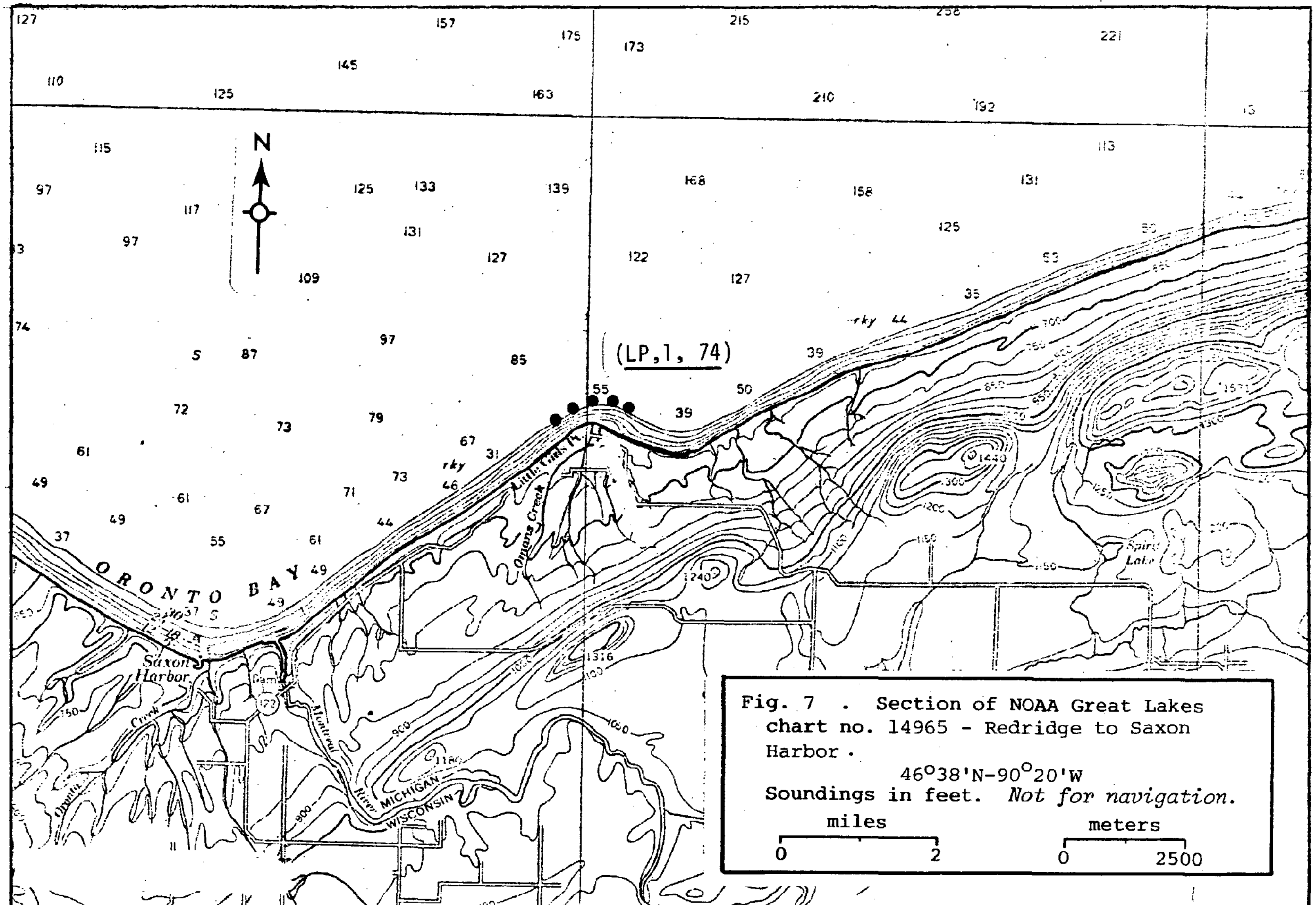



Fig. 7 . Section of NOAA Great Lakes chart no. 14965 - Redridge to Saxon Harbor.
46°38'N-90°20'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

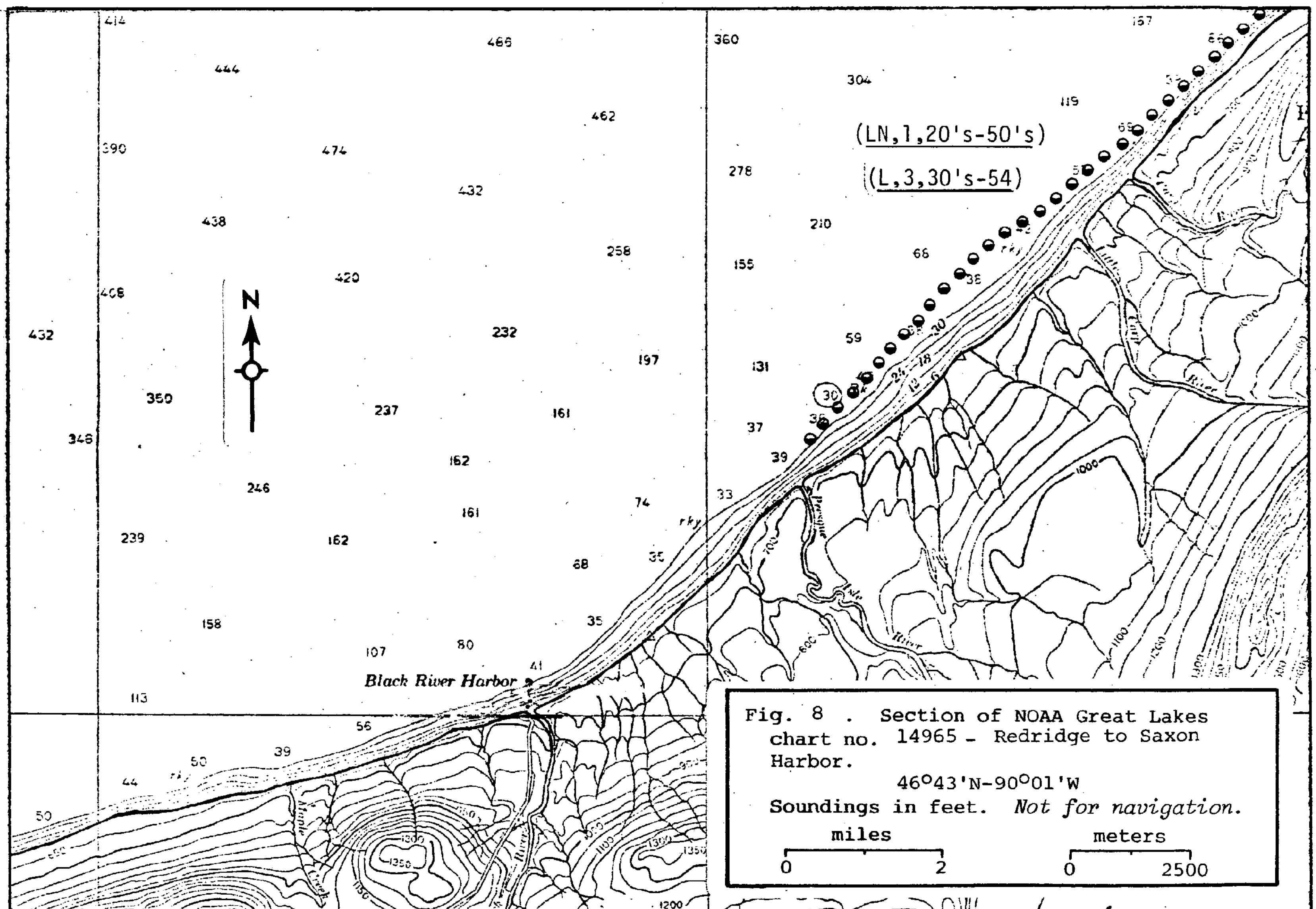



Fig. 8 . Section of NOAA Great Lakes chart no. 14965 - Redridge to Saxon Harbor.
46°43'N-90°01'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

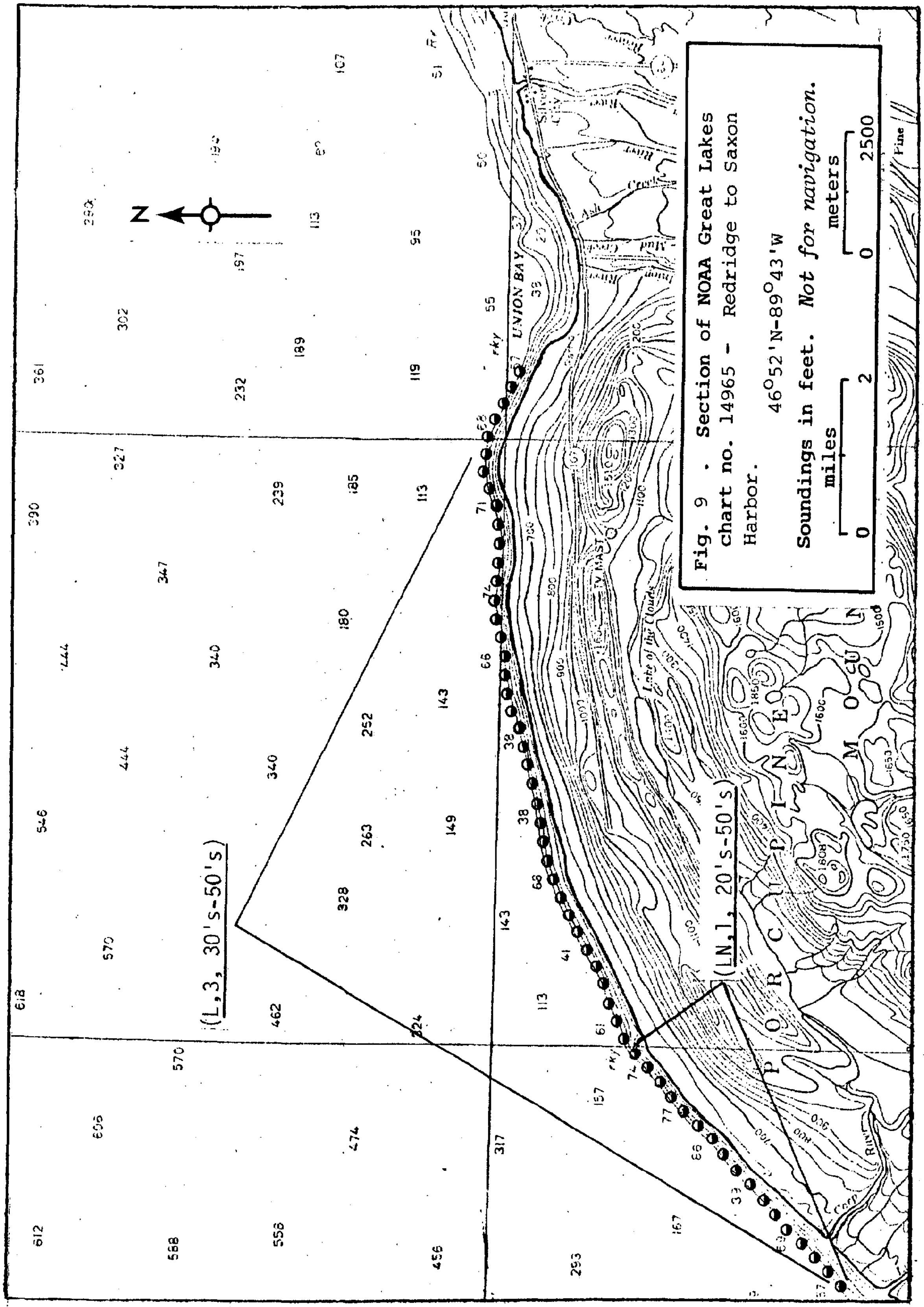



**Fig. 9 . Section of NOAA Great Lakes chart no. 14965 - Redridge to Saxon Harbor.**

$46^{o}52'N-89^{o}43'W$

**Soundings in feet.** ***Not for navigation.***

miles 0 — 2

meters 0 — 2500

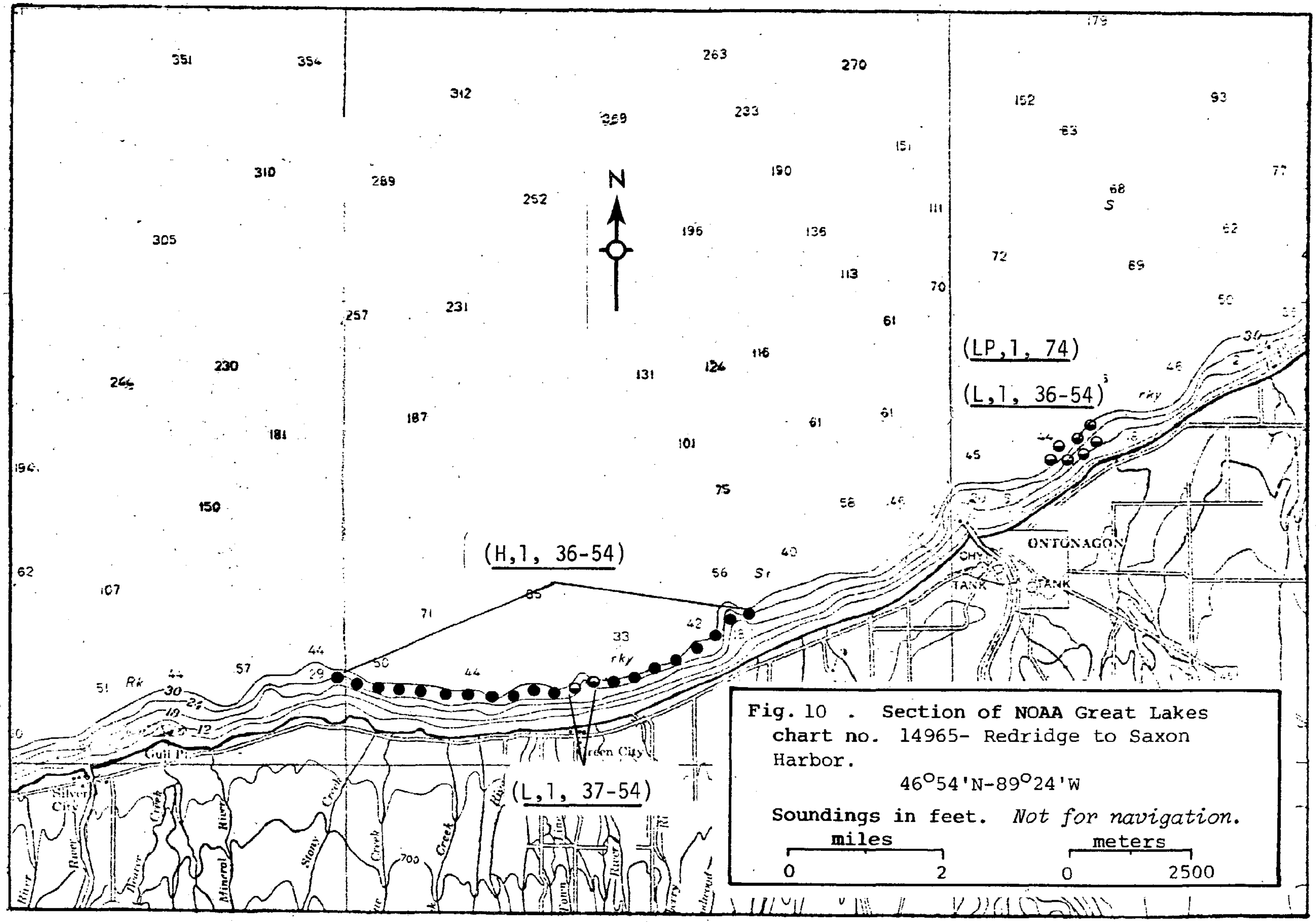



Fig. 10 . Section of NOAA Great Lakes chart no. 14965- Redridge to Saxon Harbor.

46°54'N-89°24'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

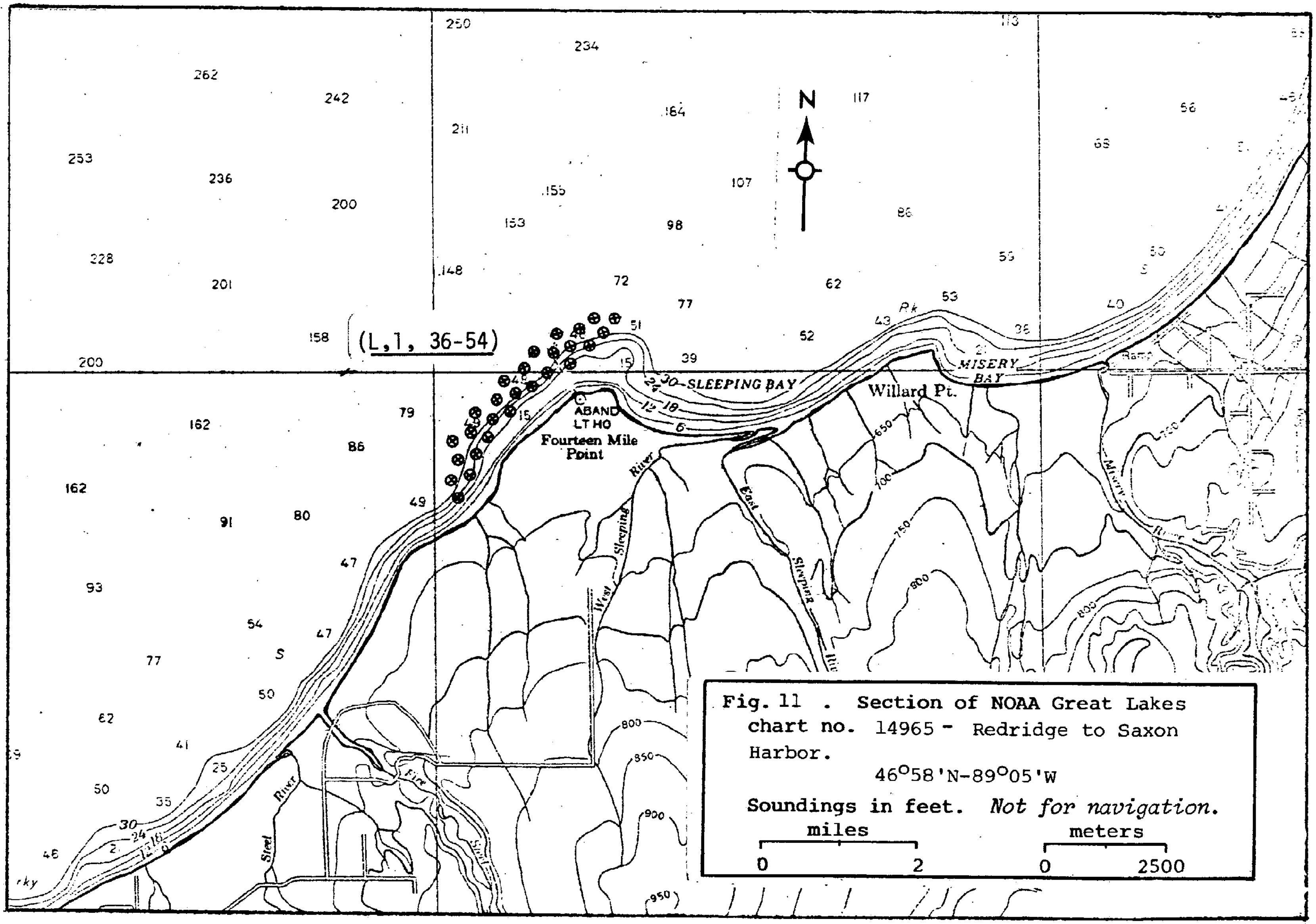



Fig. 11 . Section of NOAA Great Lakes chart no. 14965 - Redridge to Saxon Harbor.

46°58'N-89°05'W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

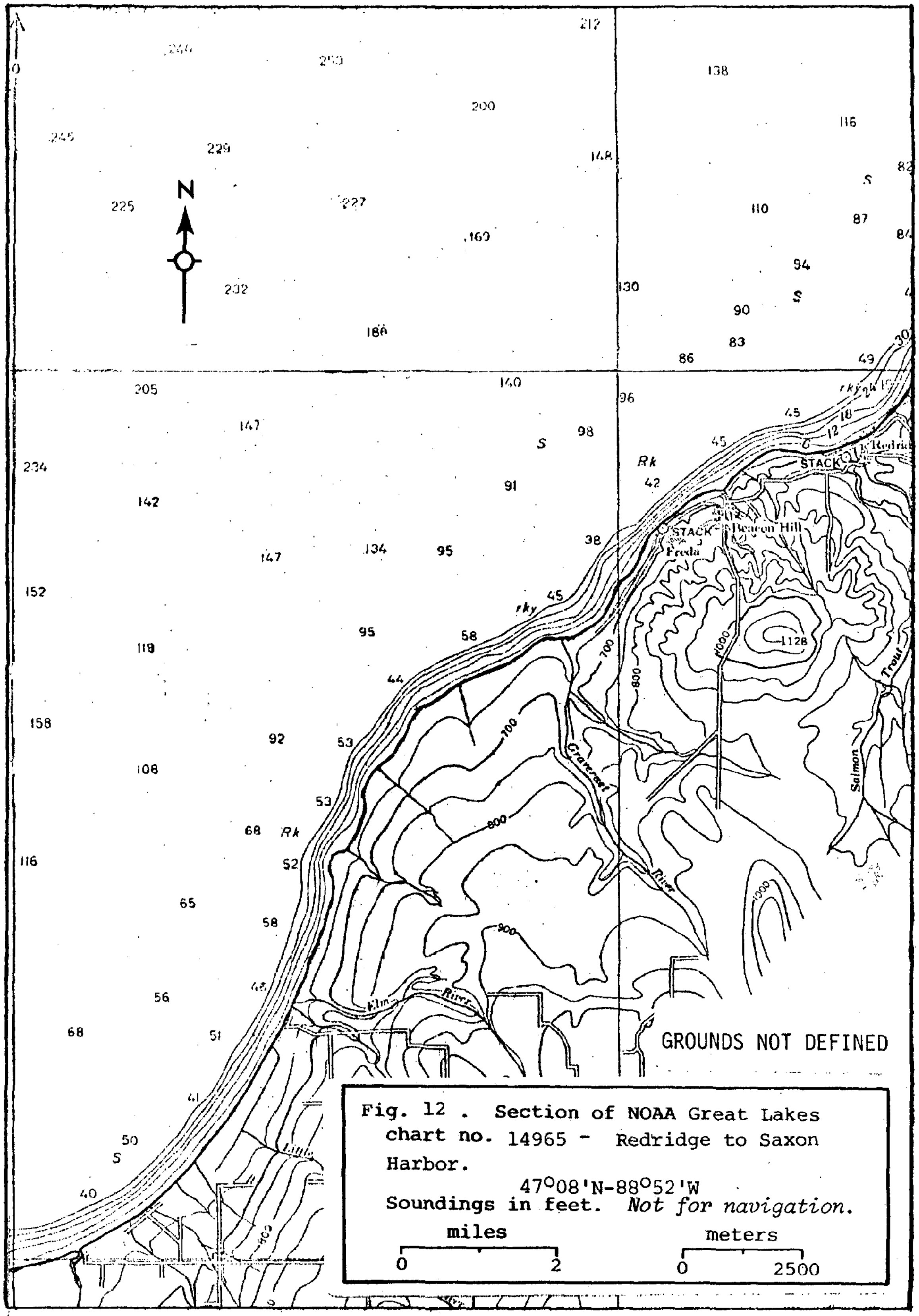


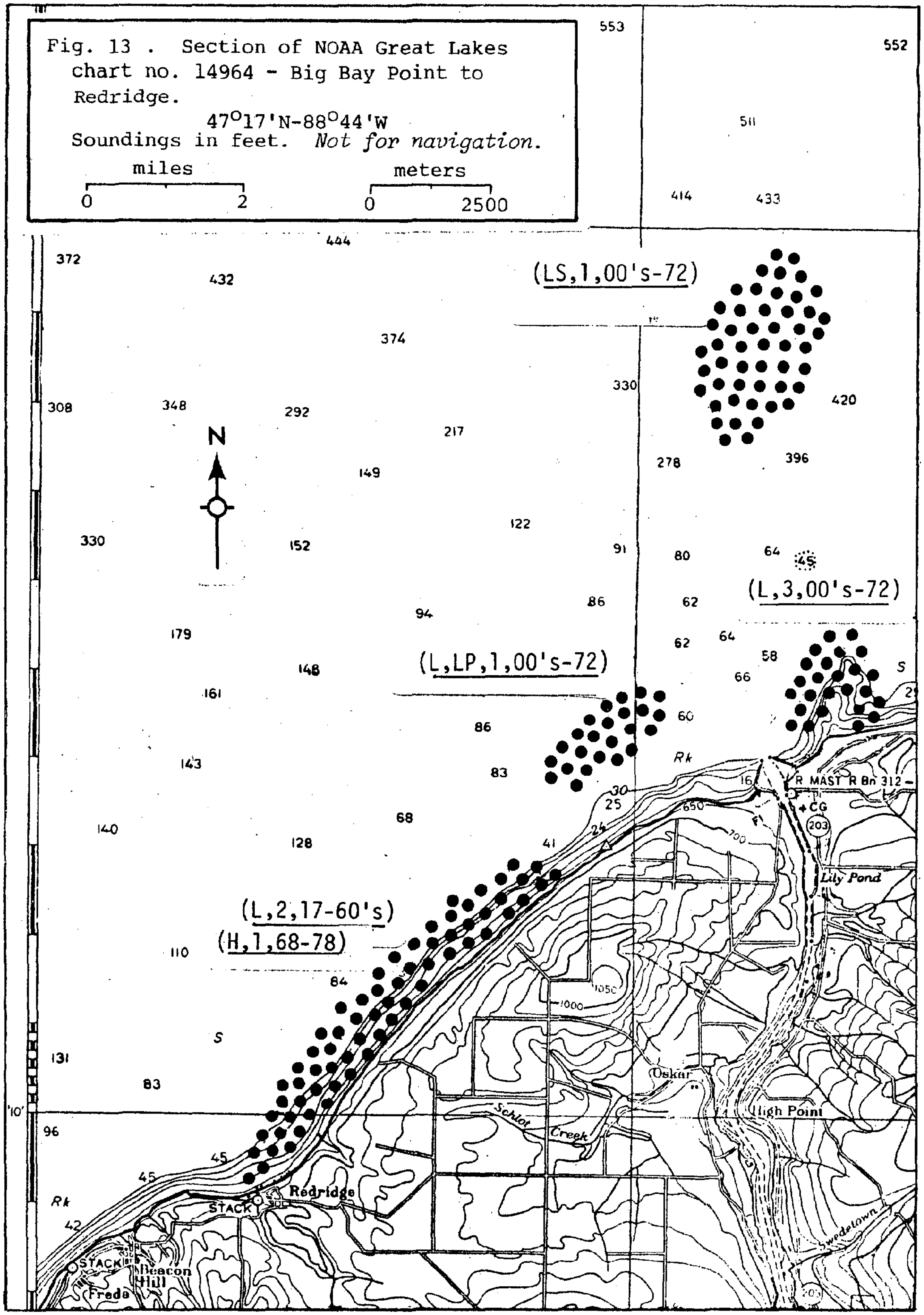

**Fig. 12 . Section of NOAA Great Lakes chart no. 14965 – Redridge to Saxon Harbor.**

47°08'N-88°52'W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

Fig. 13 . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°17'N-88°44'W
Soundings in feet. *Not for navigation.*



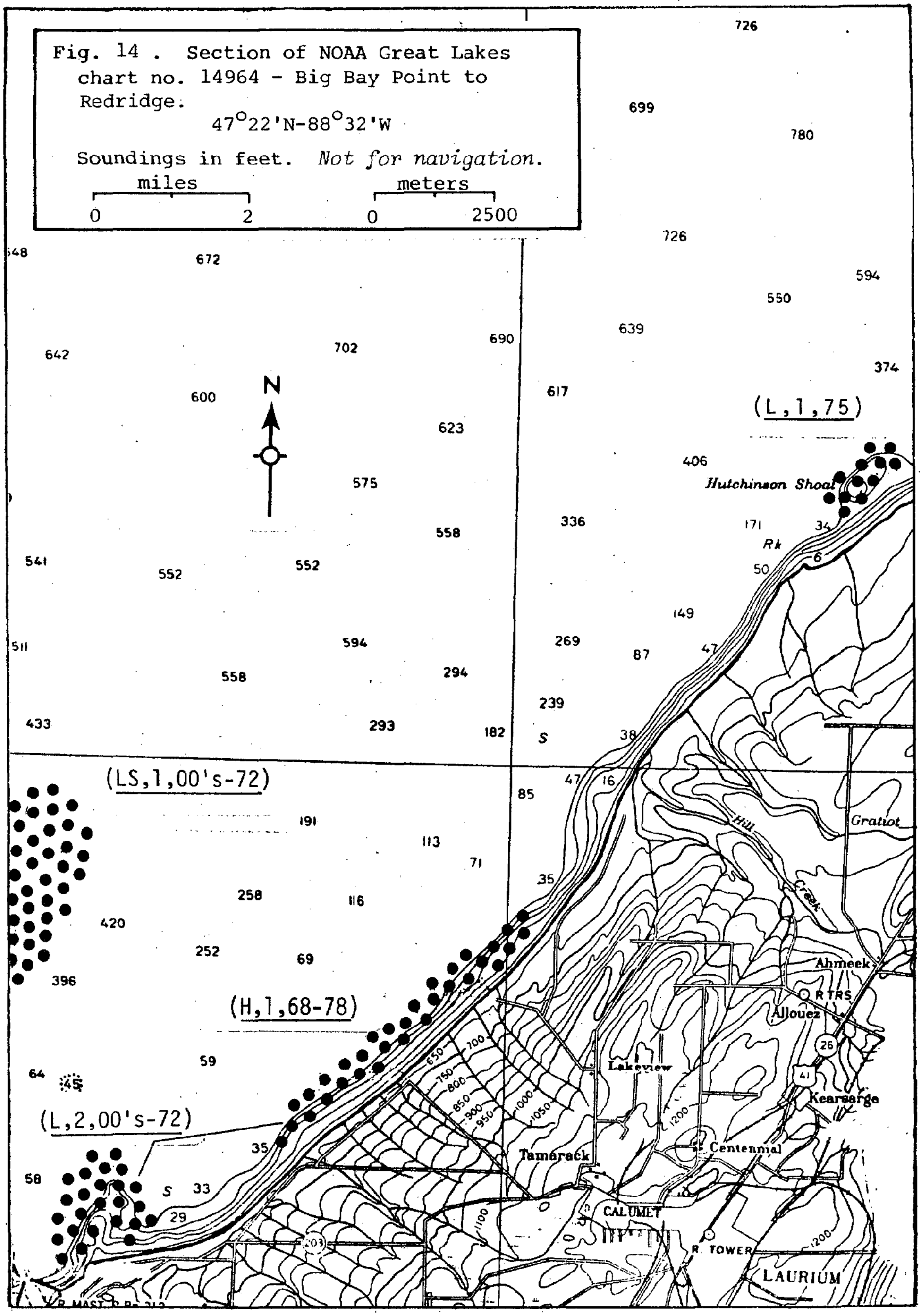



Fig. 14 . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°22'N-88°32'W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

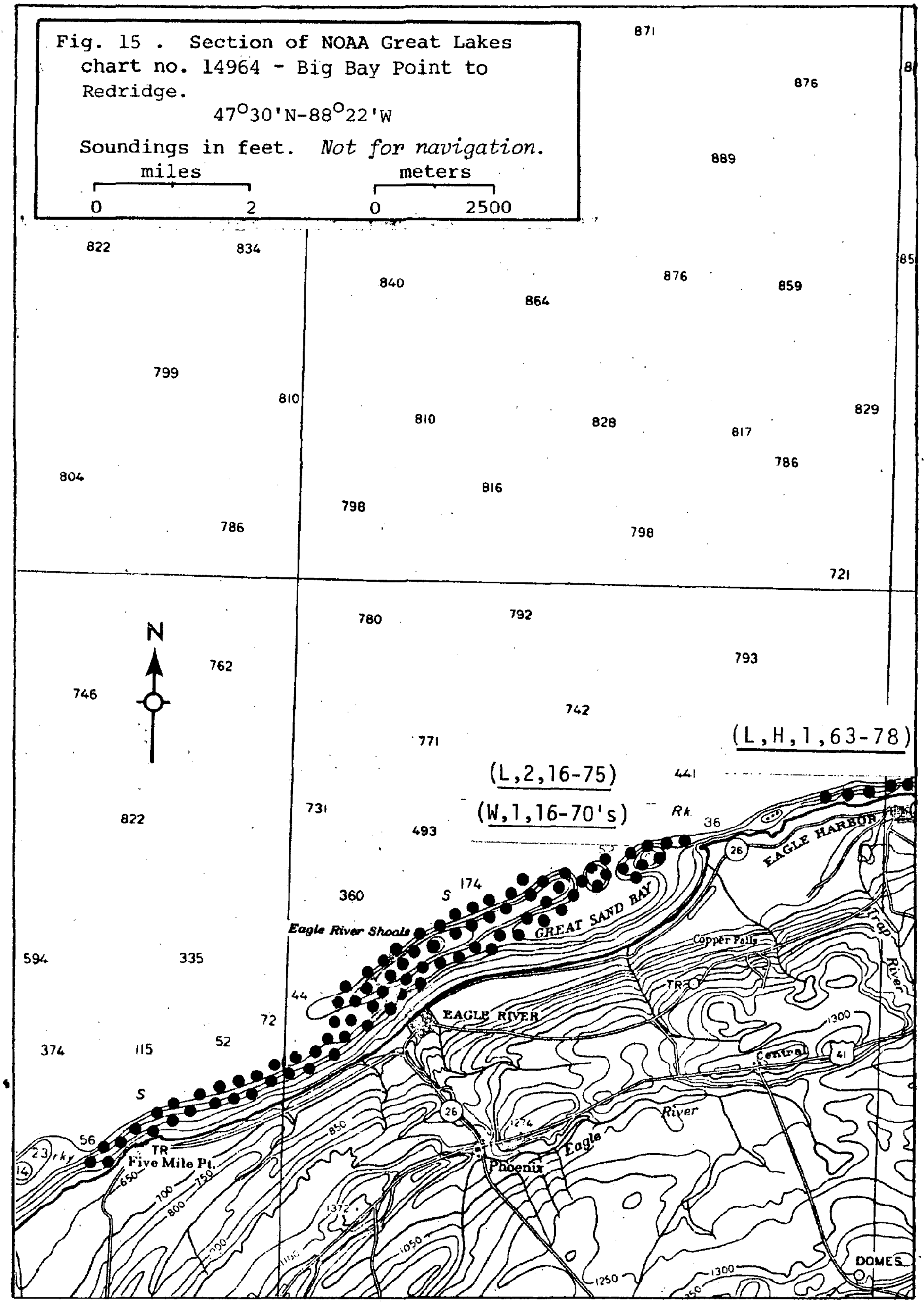



Fig. 15 . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°30'N-88°22'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

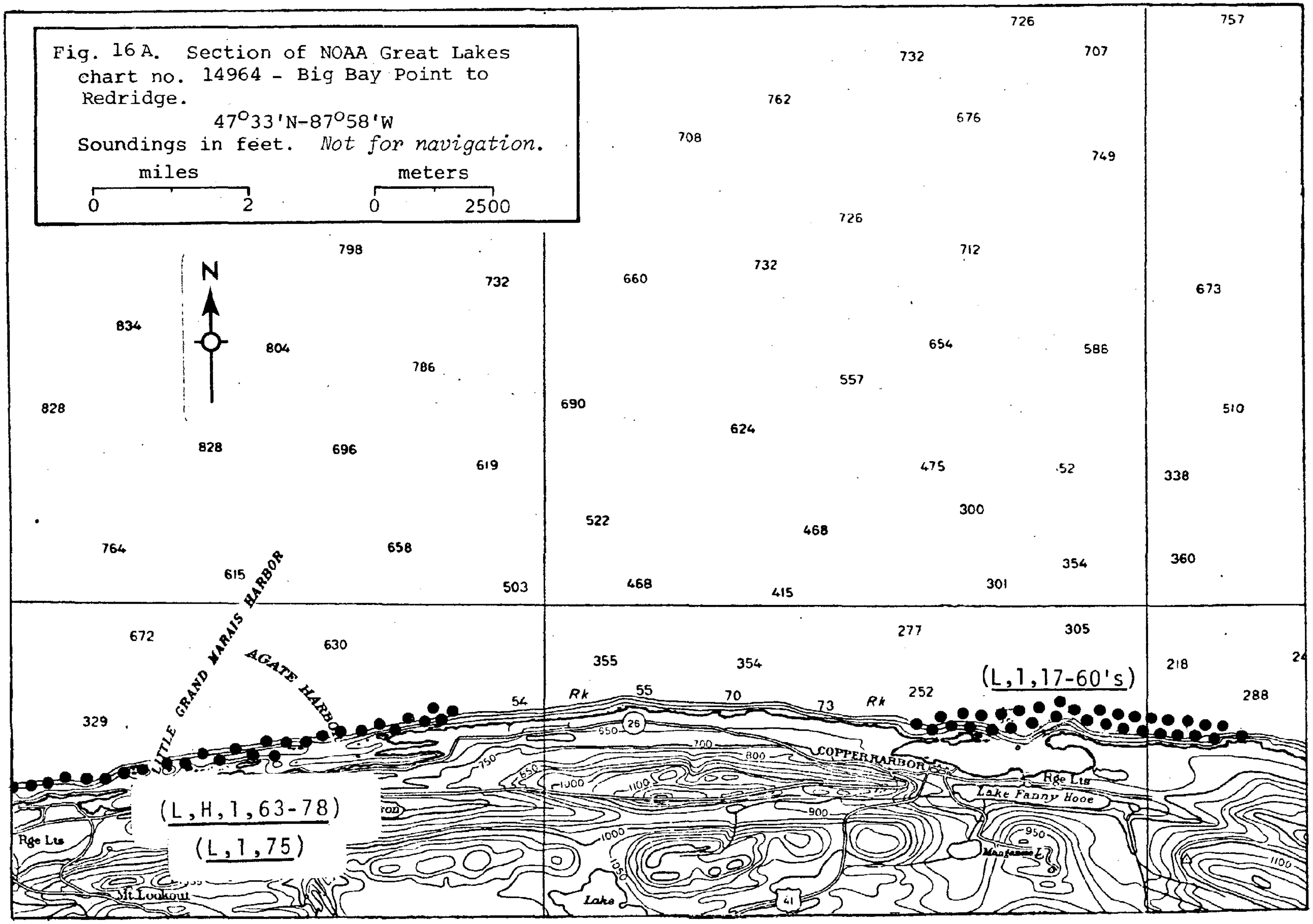



Fig. 16 A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°33'N-87°58'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

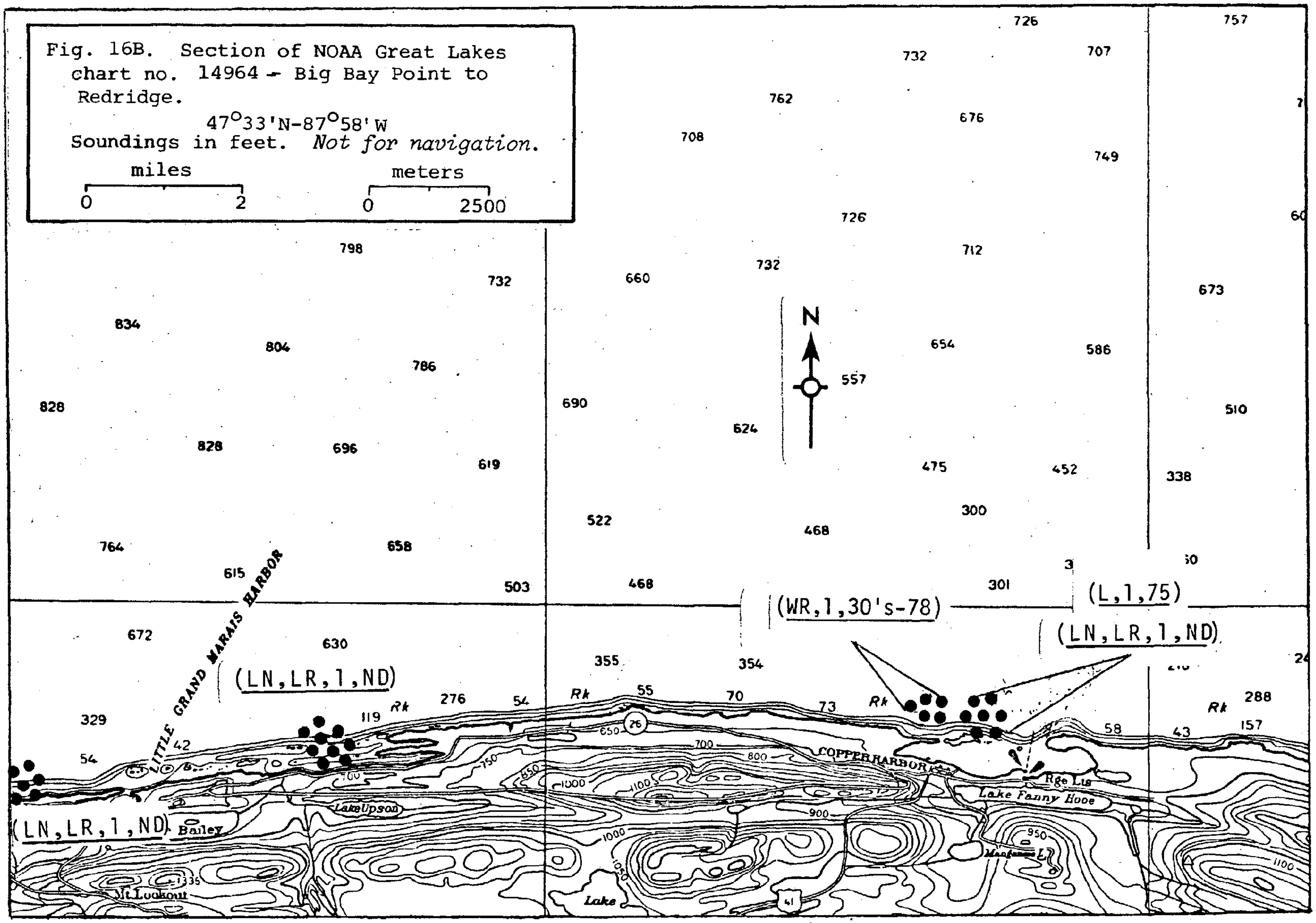



Fig. 16B. Section of NOAA Great Lakes chart no. 14964 – Big Bay Point to Redridge.
47°33'N-87°58'W
Soundings in feet. *Not for navigation.*
miles 0 2
meters 0 2500

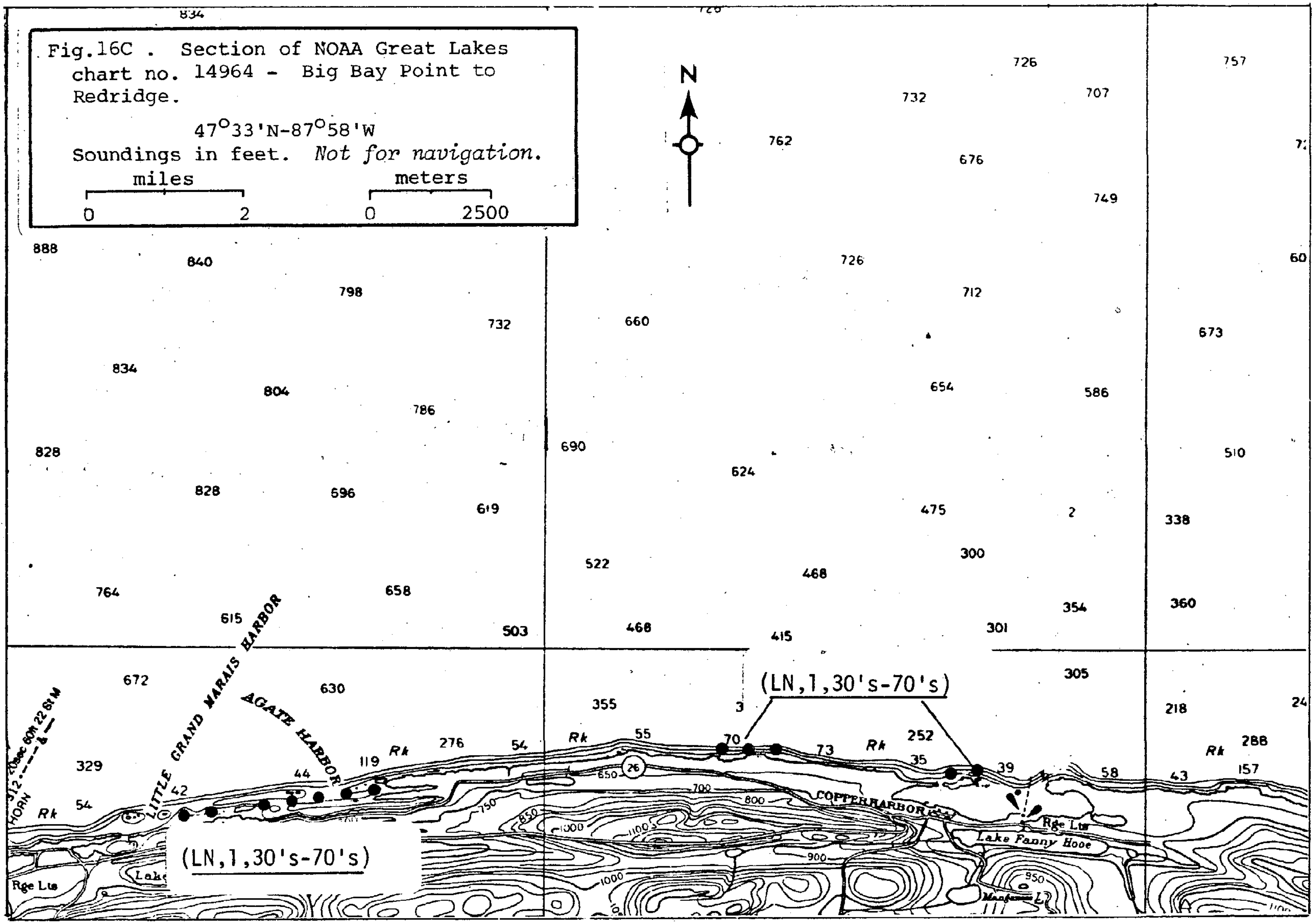



Fig.16C . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.

47°33'N-87°58'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

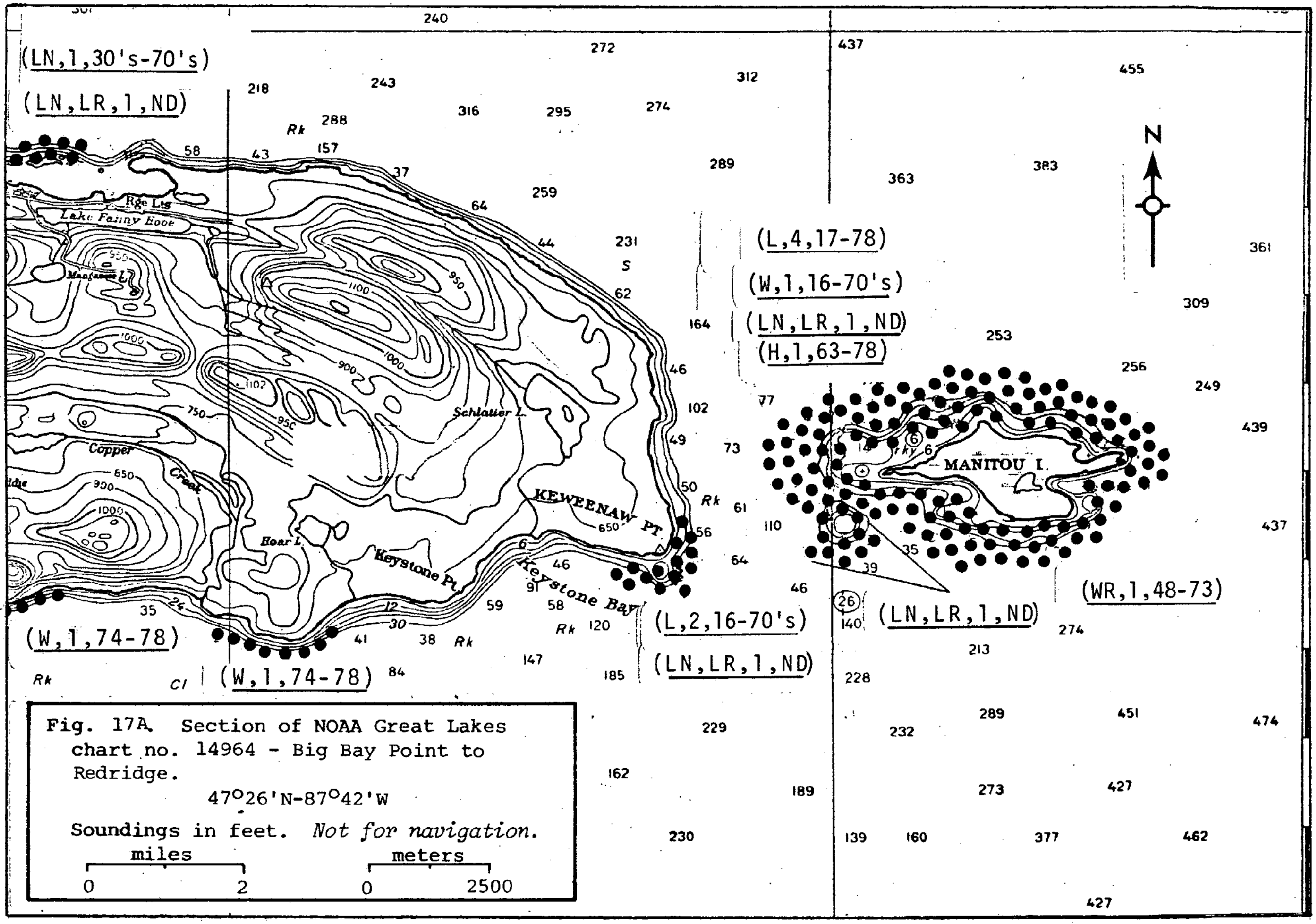



Fig. 17A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.

47°26'N-87°42'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

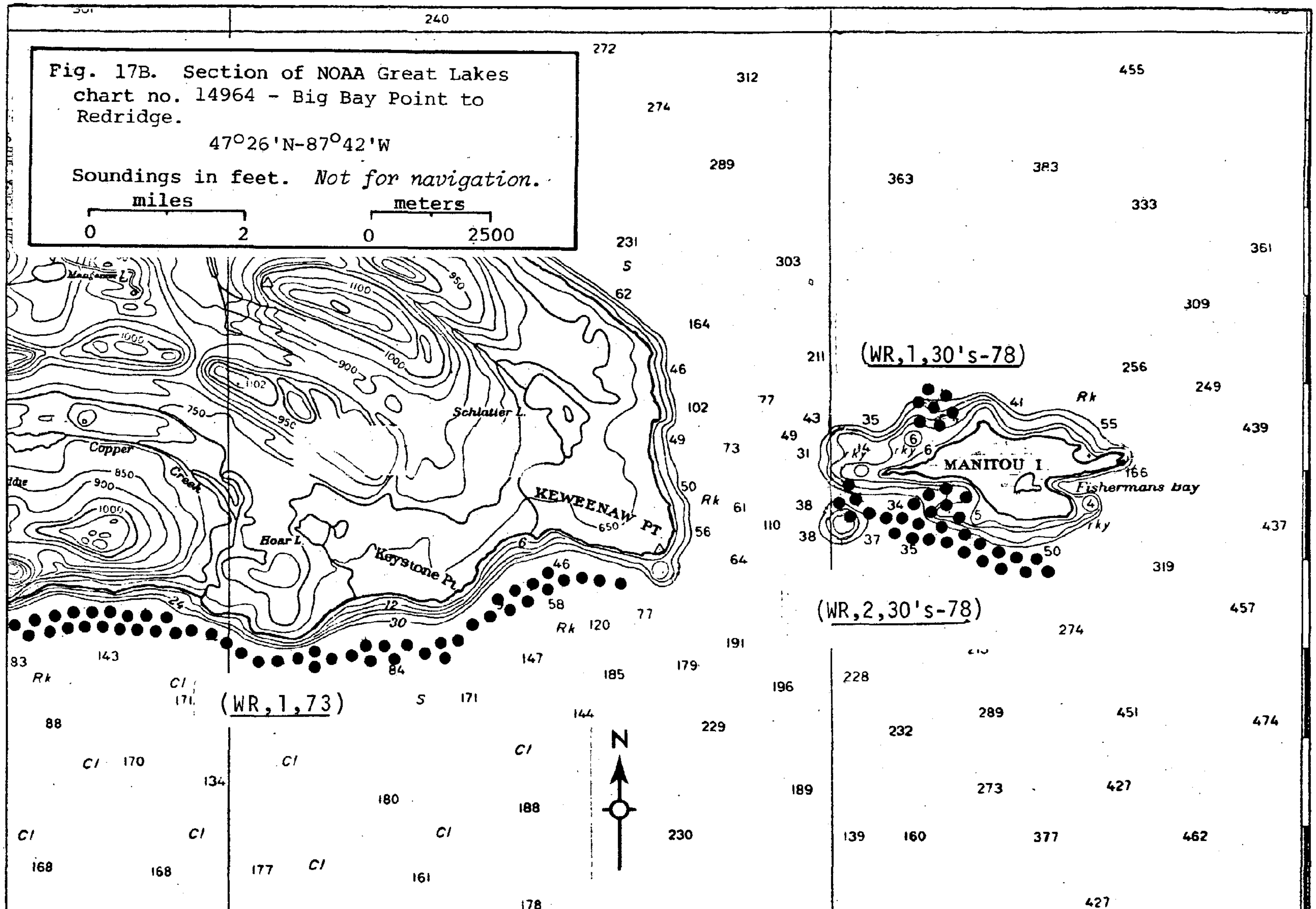



Fig. 17B. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.

47°26'N-87°42'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

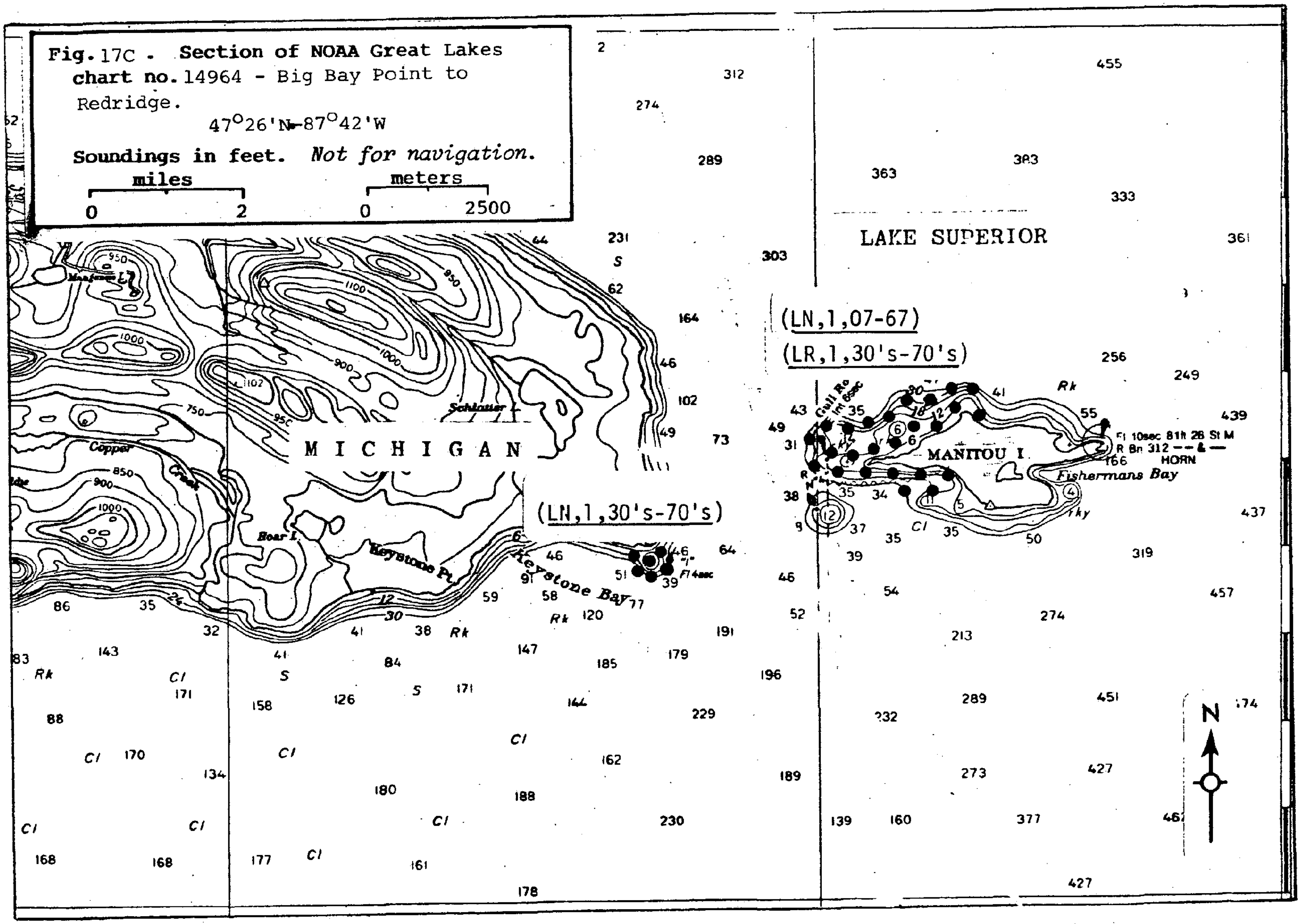



**Fig.** 17C . **Section of NOAA Great Lakes chart no.** 14964 - Big Bay Point to Redridge.

47°26'N-87°42'W

**Soundings in feet.** *Not for navigation.*

**miles** 0 2 **meters** 0 2500

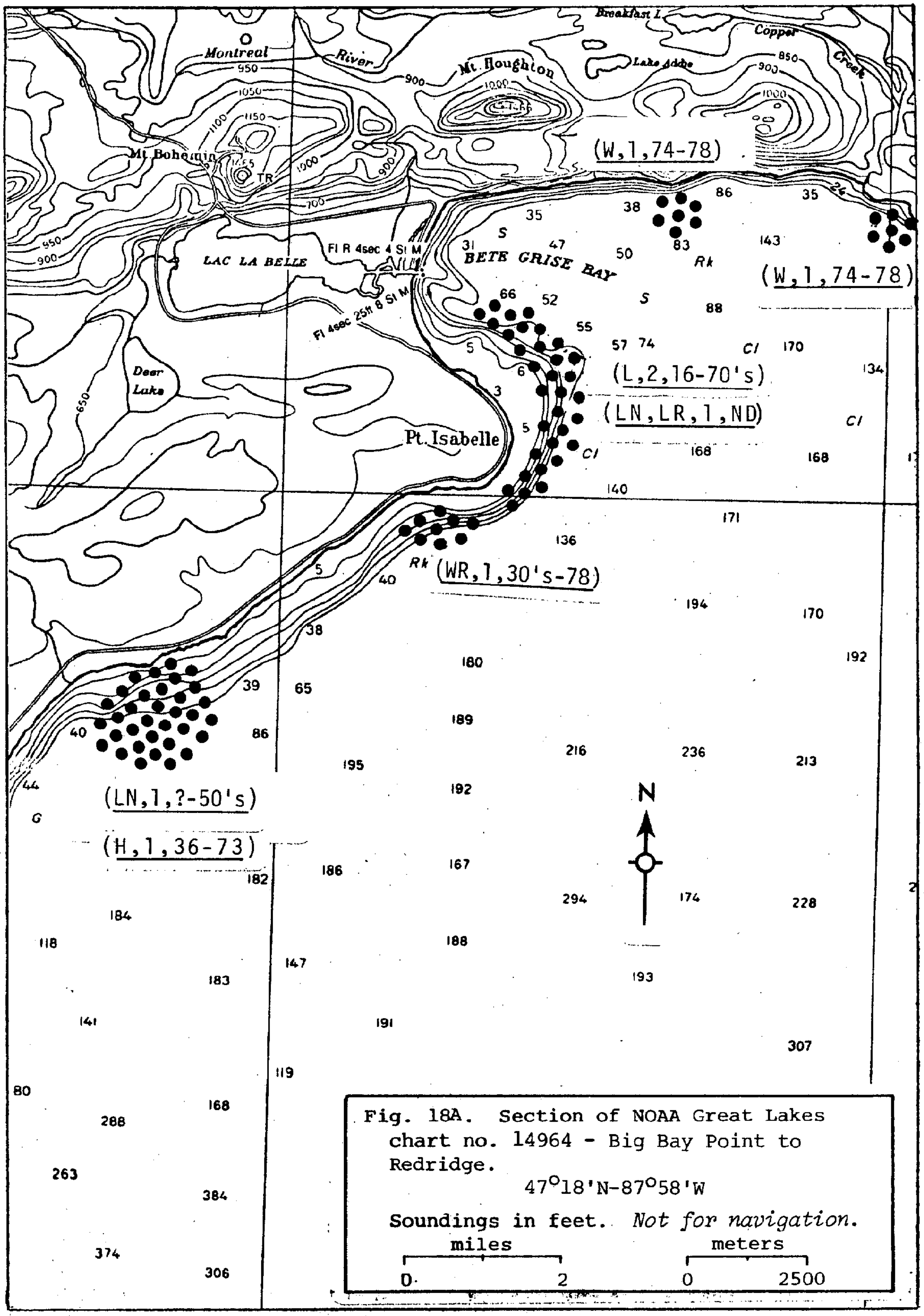



Fig. 18A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.

47°18'N-87°58'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

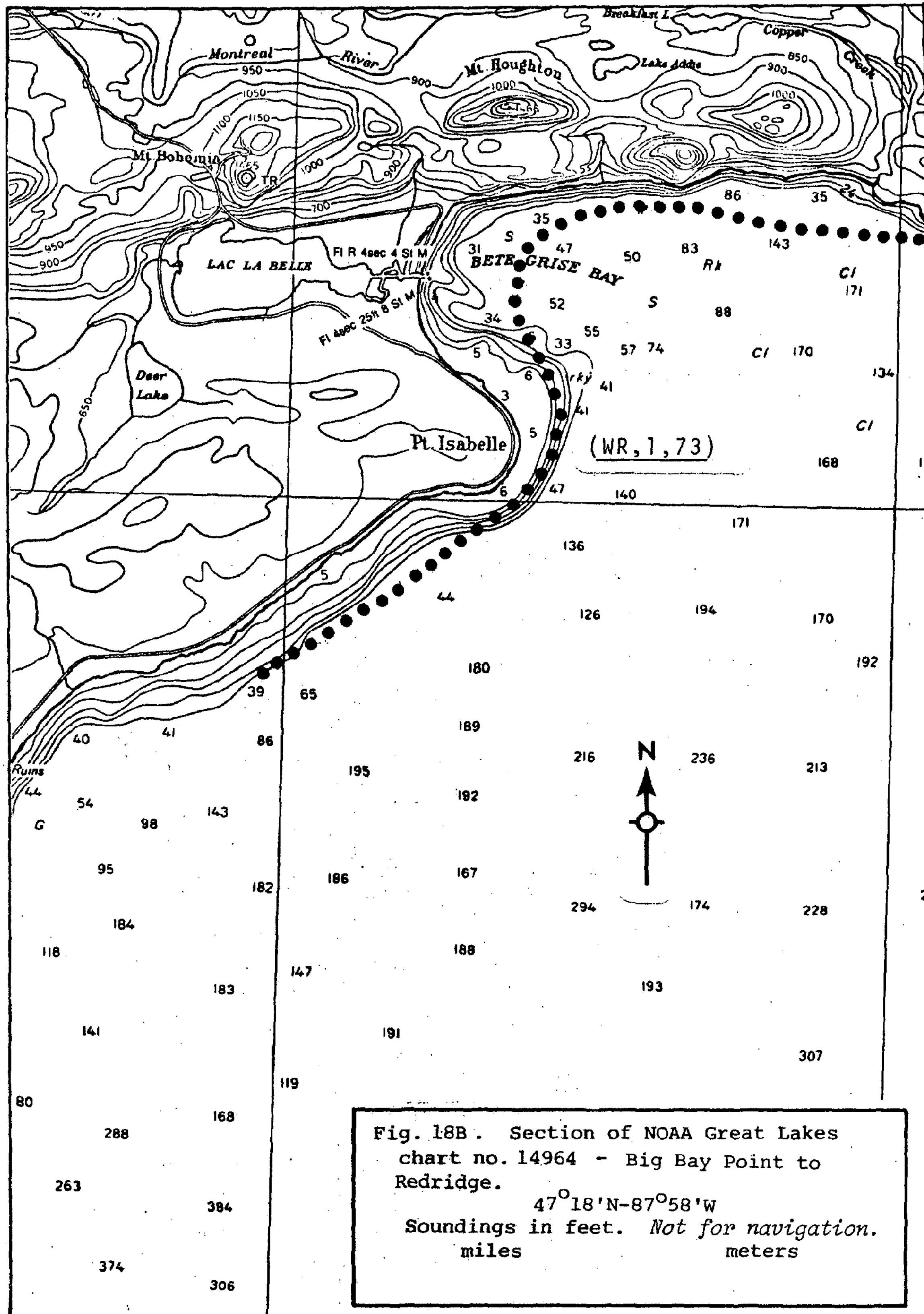



Fig. 18B . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
$47^{o}18'N-87^{o}58'W$
Soundings in feet. *Not for navigation.*
miles meters

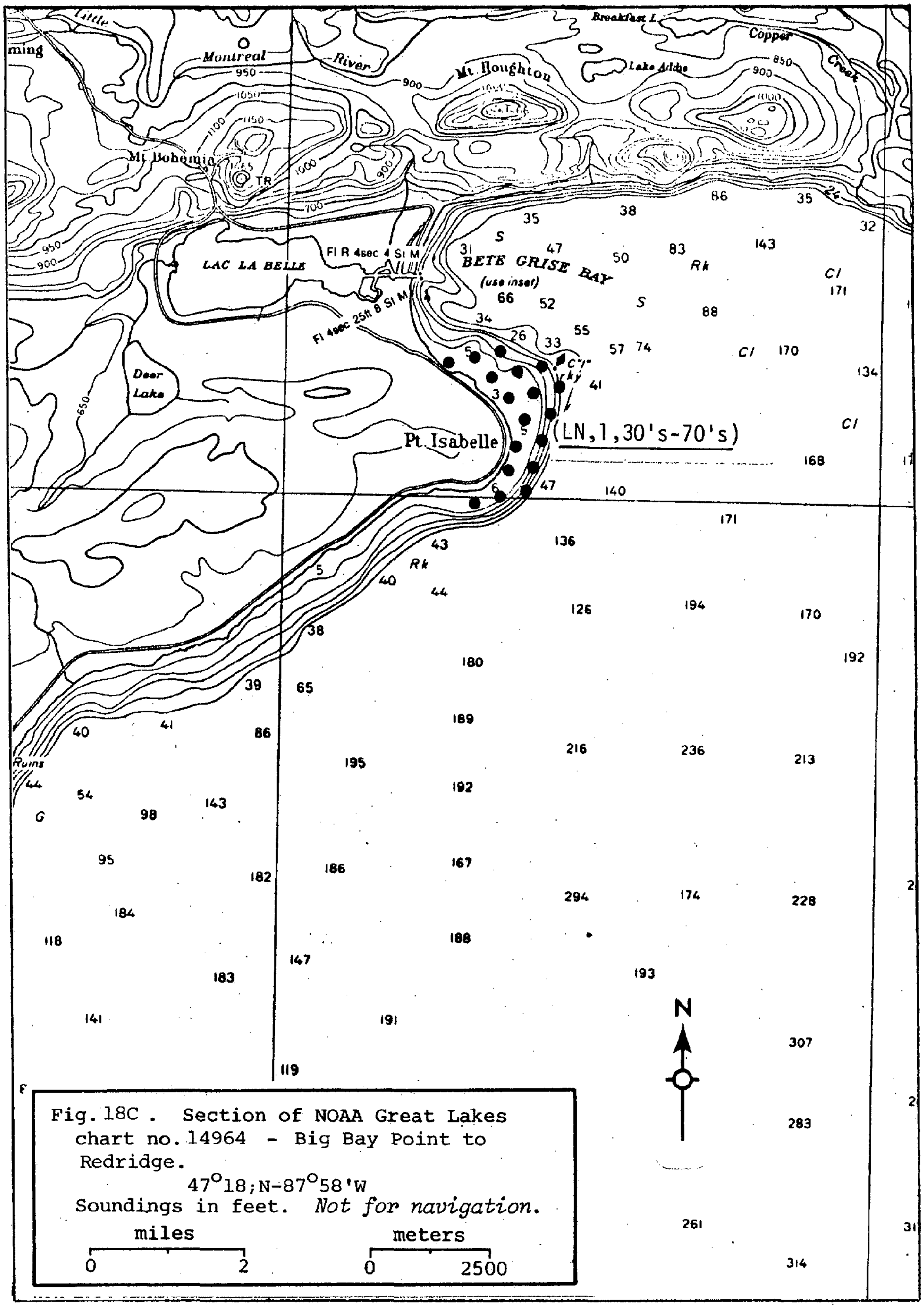
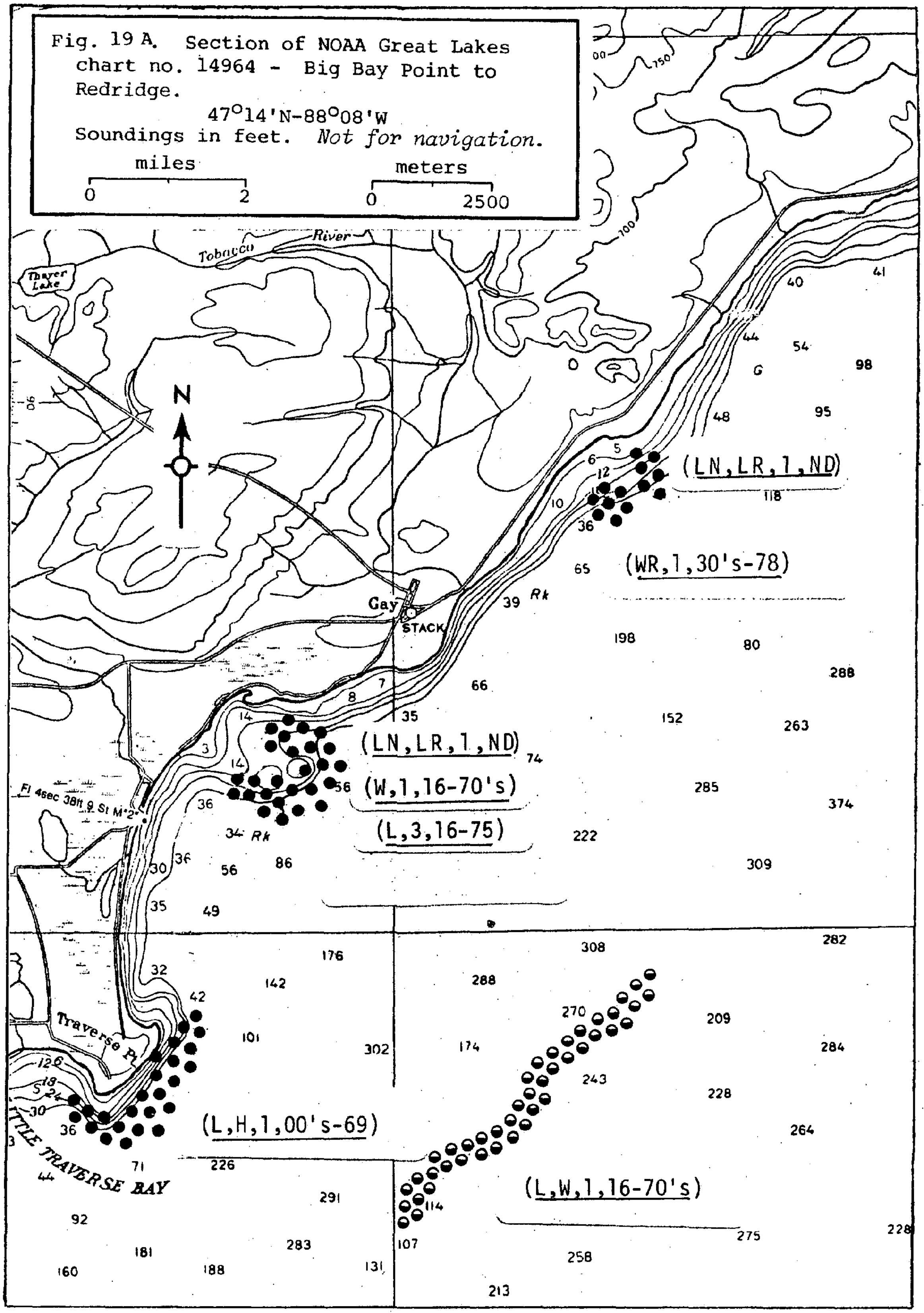



Fig. 18C . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
$47^{\circ}18;N-87^{\circ}58'W$
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

Fig. 19 A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°14'N-88°08'W
Soundings in feet. *Not for navigation.*



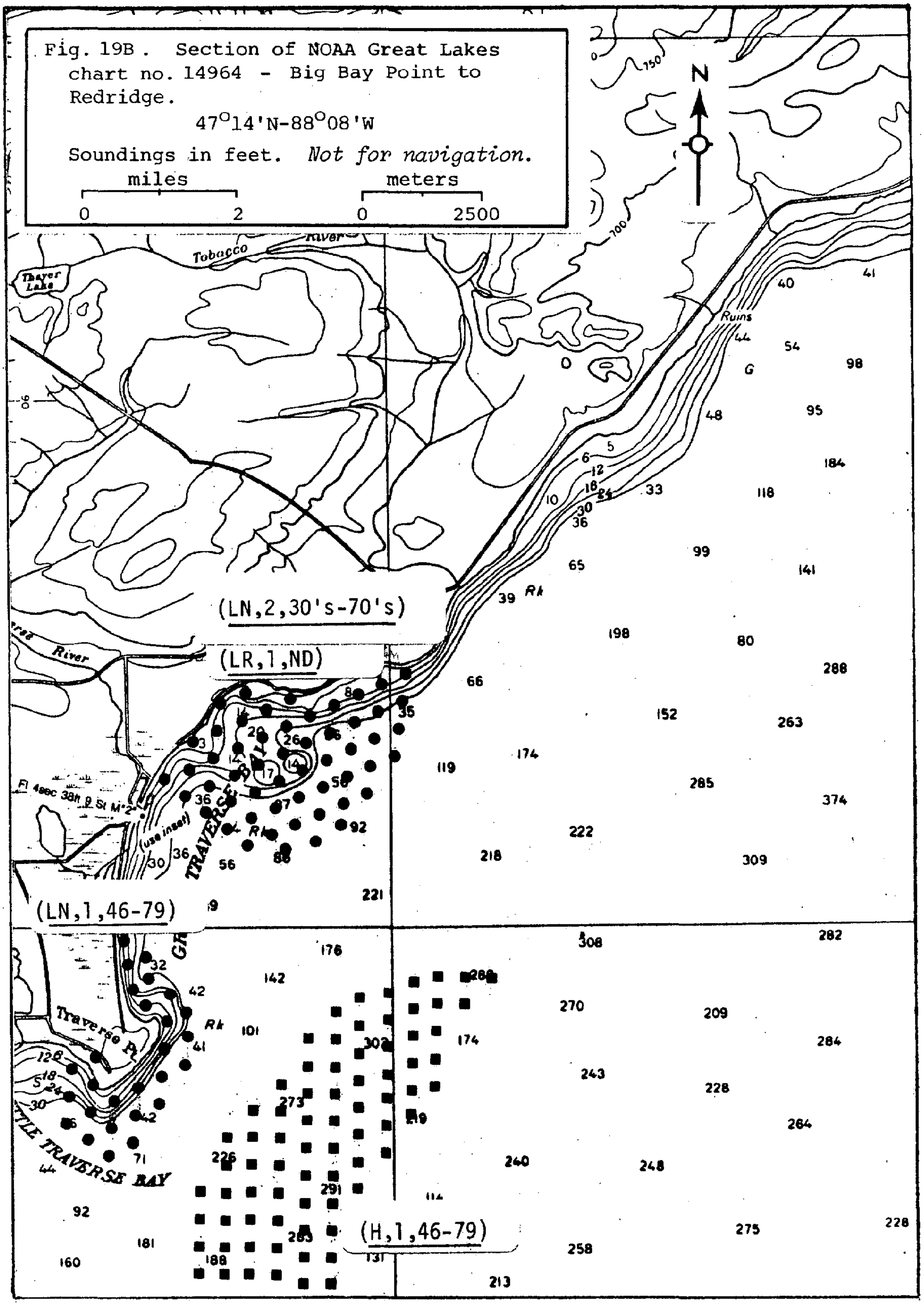


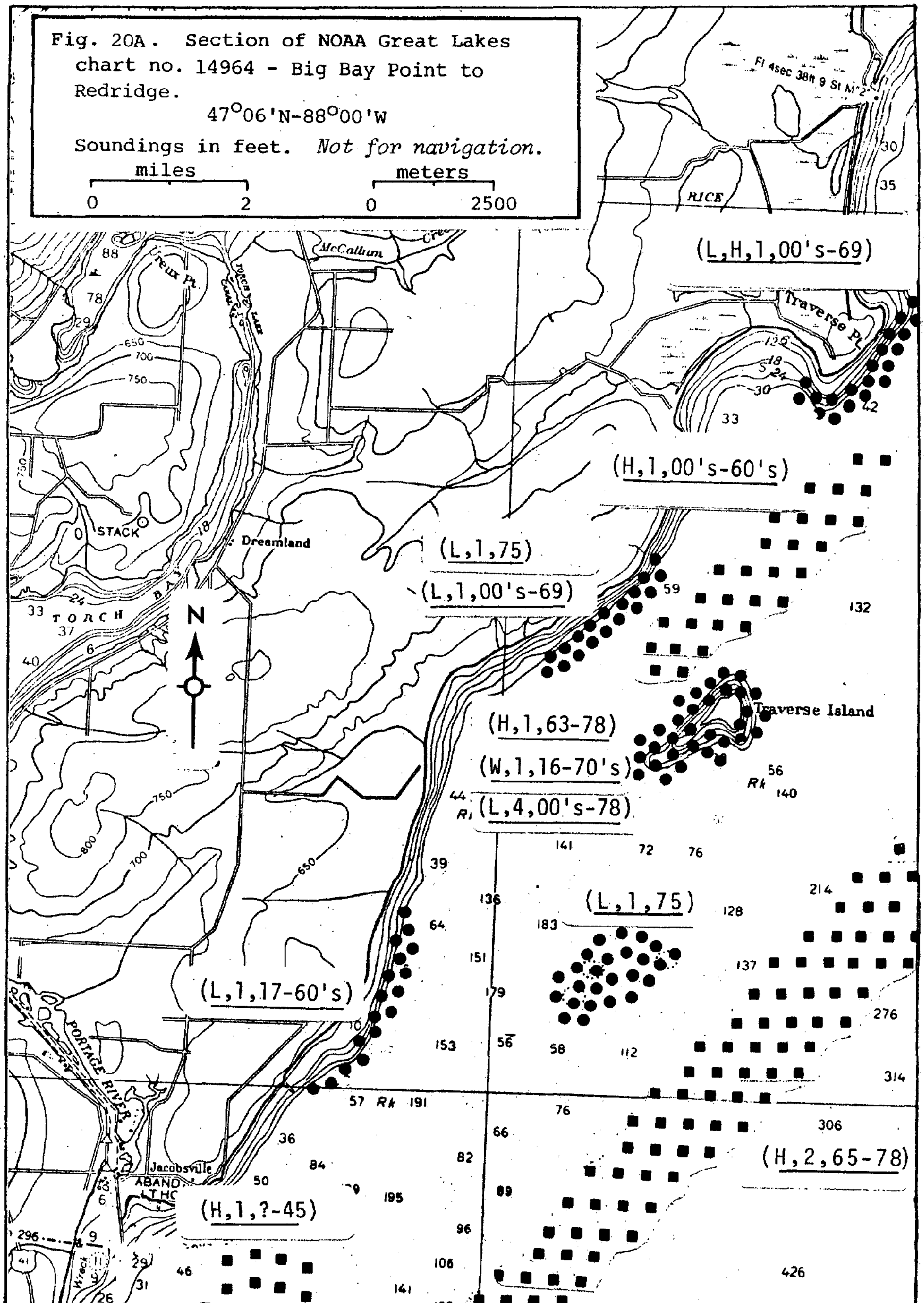

Fig. 19B . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°14'N-88°08'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

Fig. 20A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.

47°06'N-88°00'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500



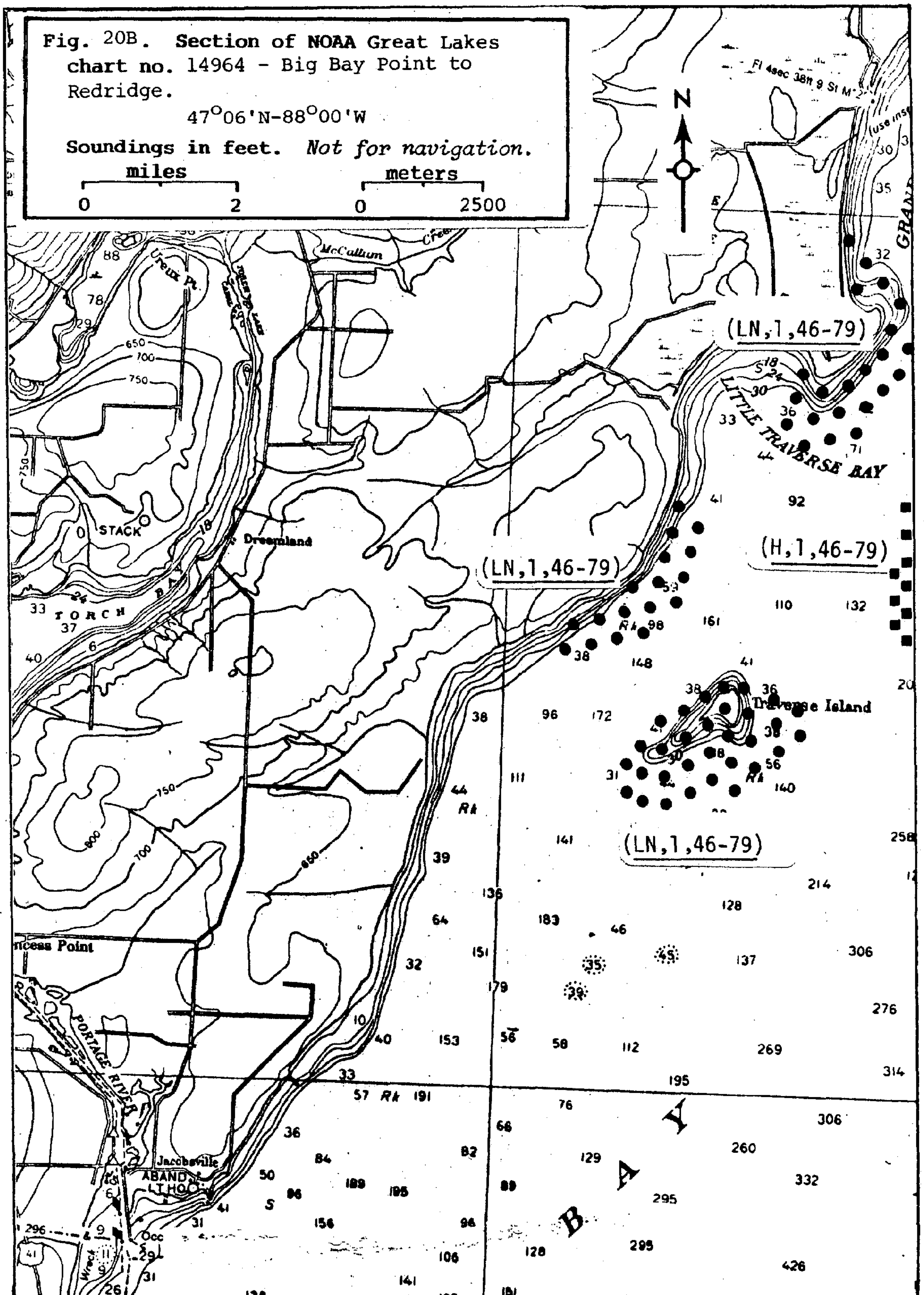



Fig. 20B. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°06'N-88°00'W
Soundings in feet. *Not for navigation.*

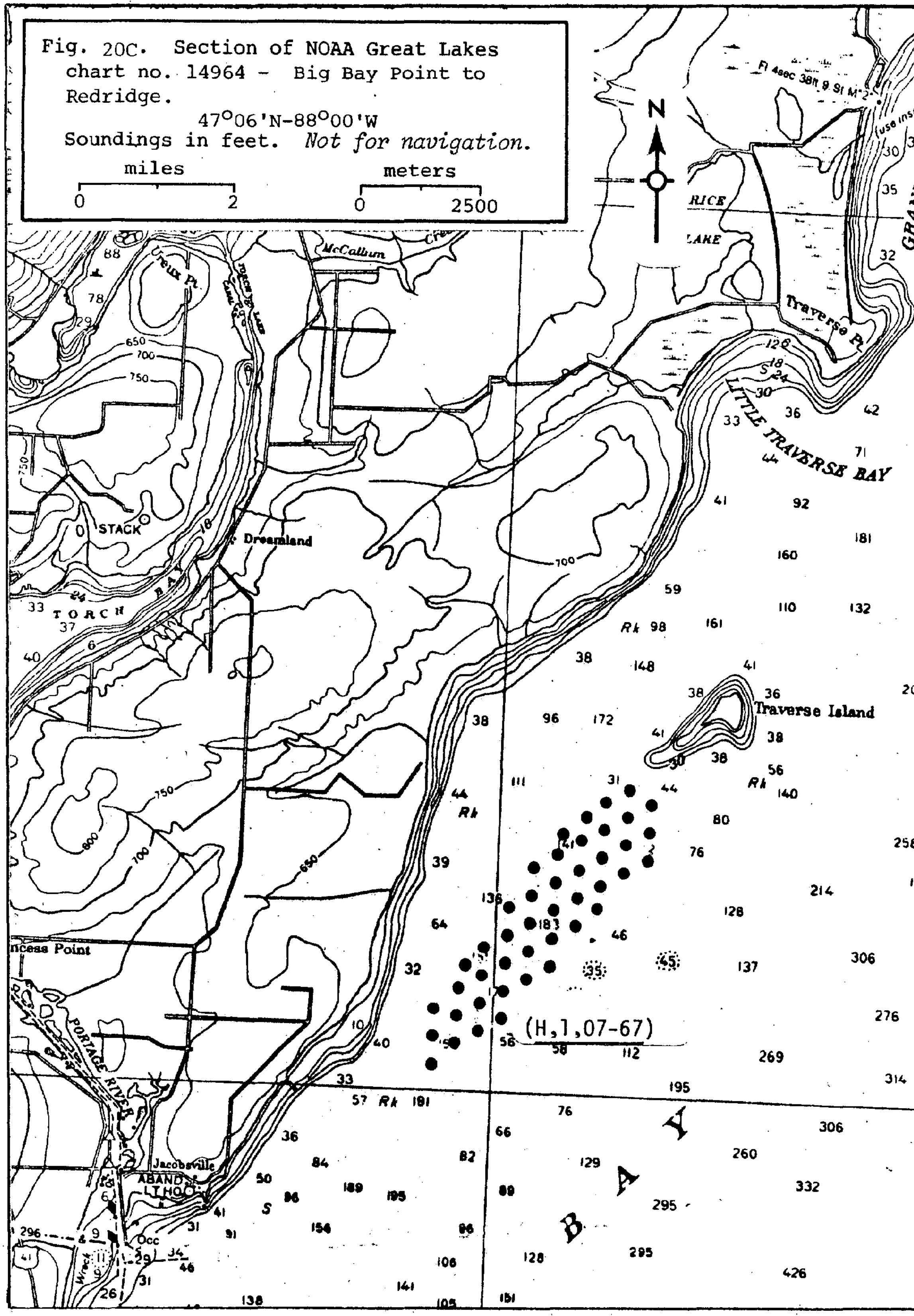



Fig. 20C. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
47°06'N-88°00'W
Soundings in feet. *Not for navigation.*

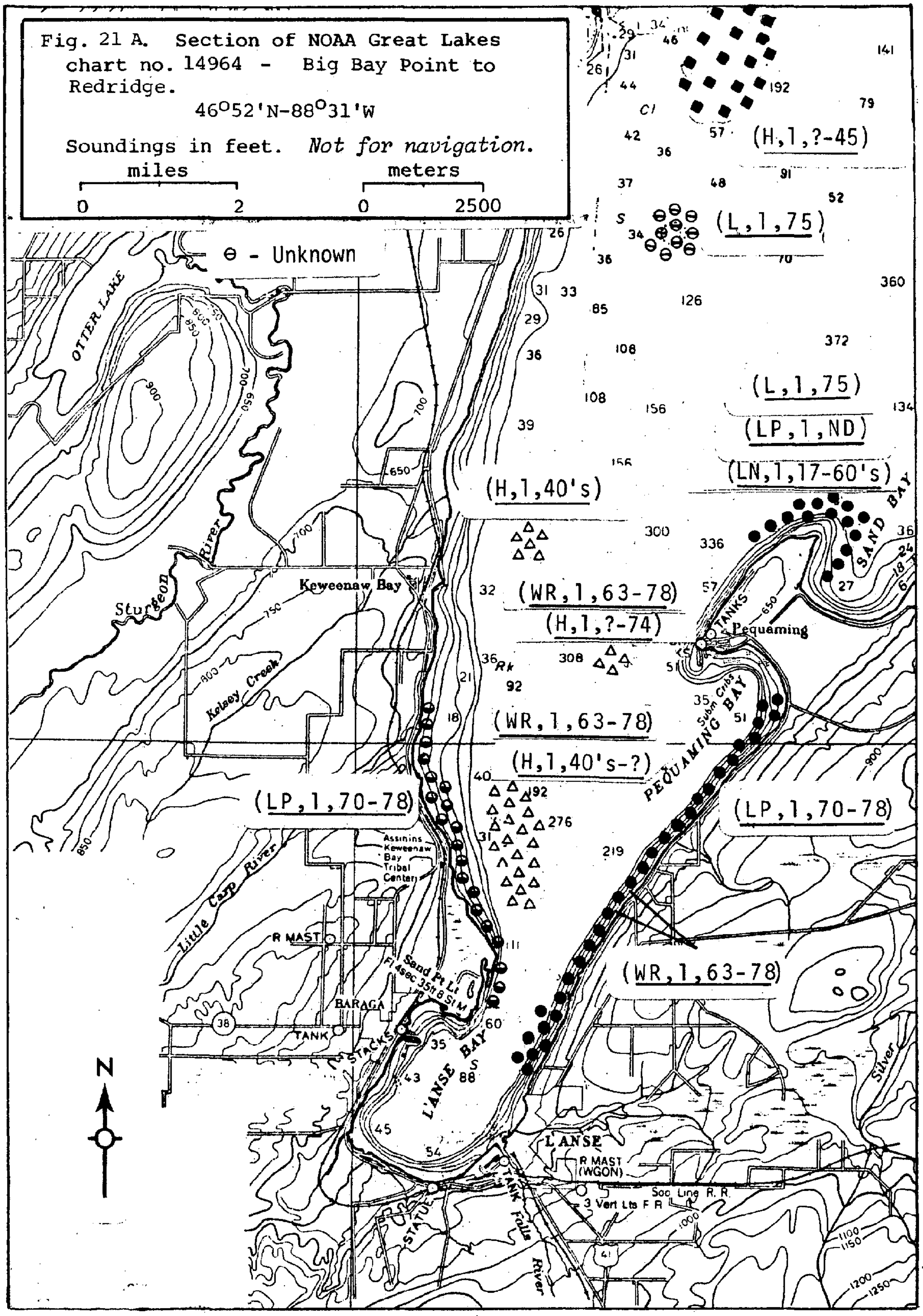


Fig. 21 A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
46°52'N-88°31'W
Soundings in feet. *Not for navigation.*
miles
0 2
meters
0 2500
ϴ - Unknown
(H,1,?-45)
(L,1,75)
(L,1,75)
(LP,1,ND)
(LN,1,17-60's)
(H,1,40's)
(WR,1,63-78)
(H,1,?-74)
(WR,1,63-78)
(H,1,40's-?)
(LP,1,70-78)
(LP,1,70-78)
(WR,1,63-78)
OTTER LAKE
Sturgeon River
Keweenaw Bay
Kelsey Creek
Little Carp River
Pequaming
PEQUAMING BAY
SAND BAY
L'ANSE BAY
BARAGA
L'ANSE
Sand Pt Lt
Assinins Keweenaw Bay Tribal Center
R MAST
TANK
STACKS
TANKS
Soo Line R. R.
3 Vert Lts F R
R MAST (WGON)
Falls River
Silver
N

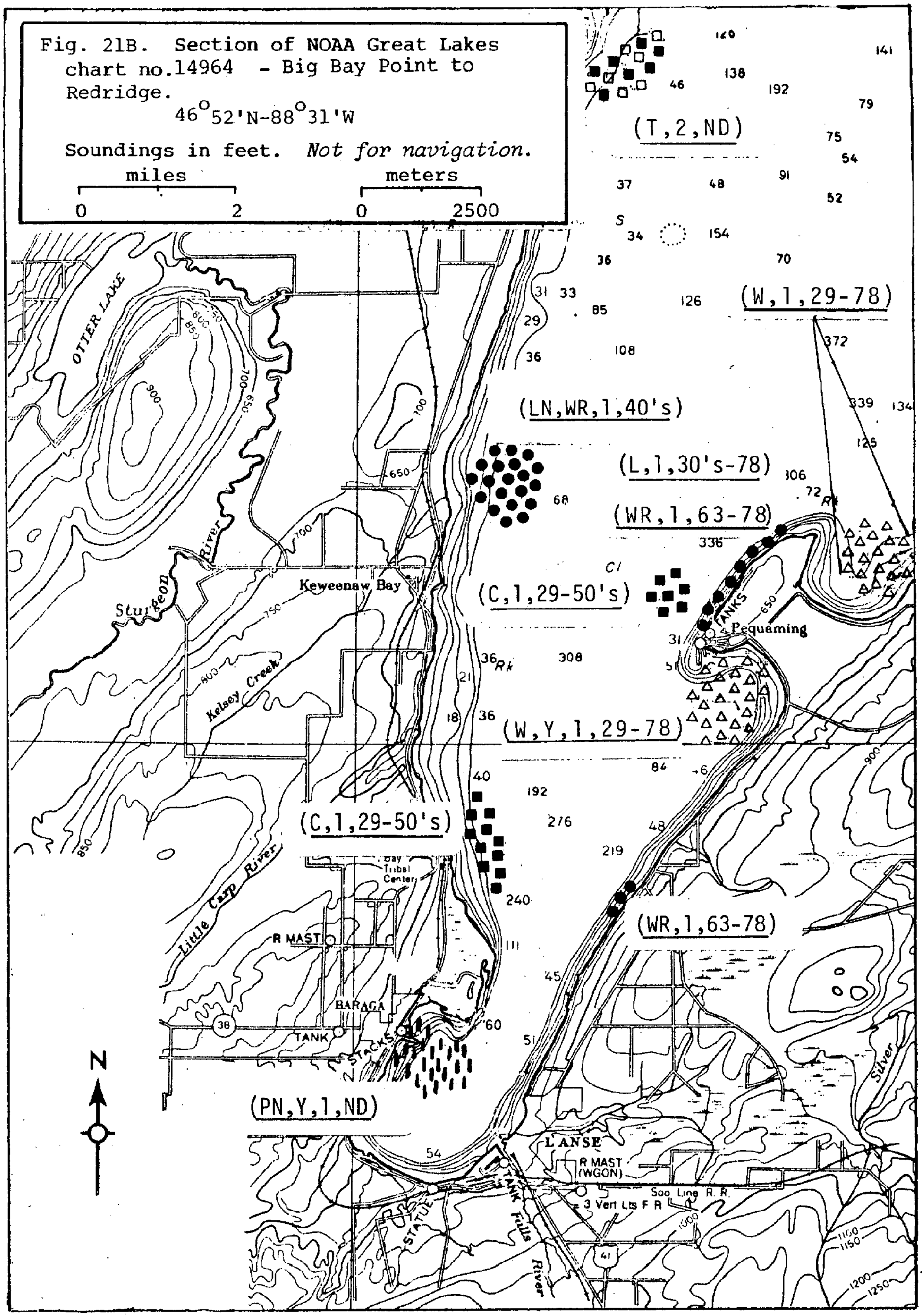



Fig. 21B. Section of NOAA Great Lakes chart no.14964 - Big Bay Point to Redridge.

$46^{\circ}52'$N-$88^{\circ}31'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

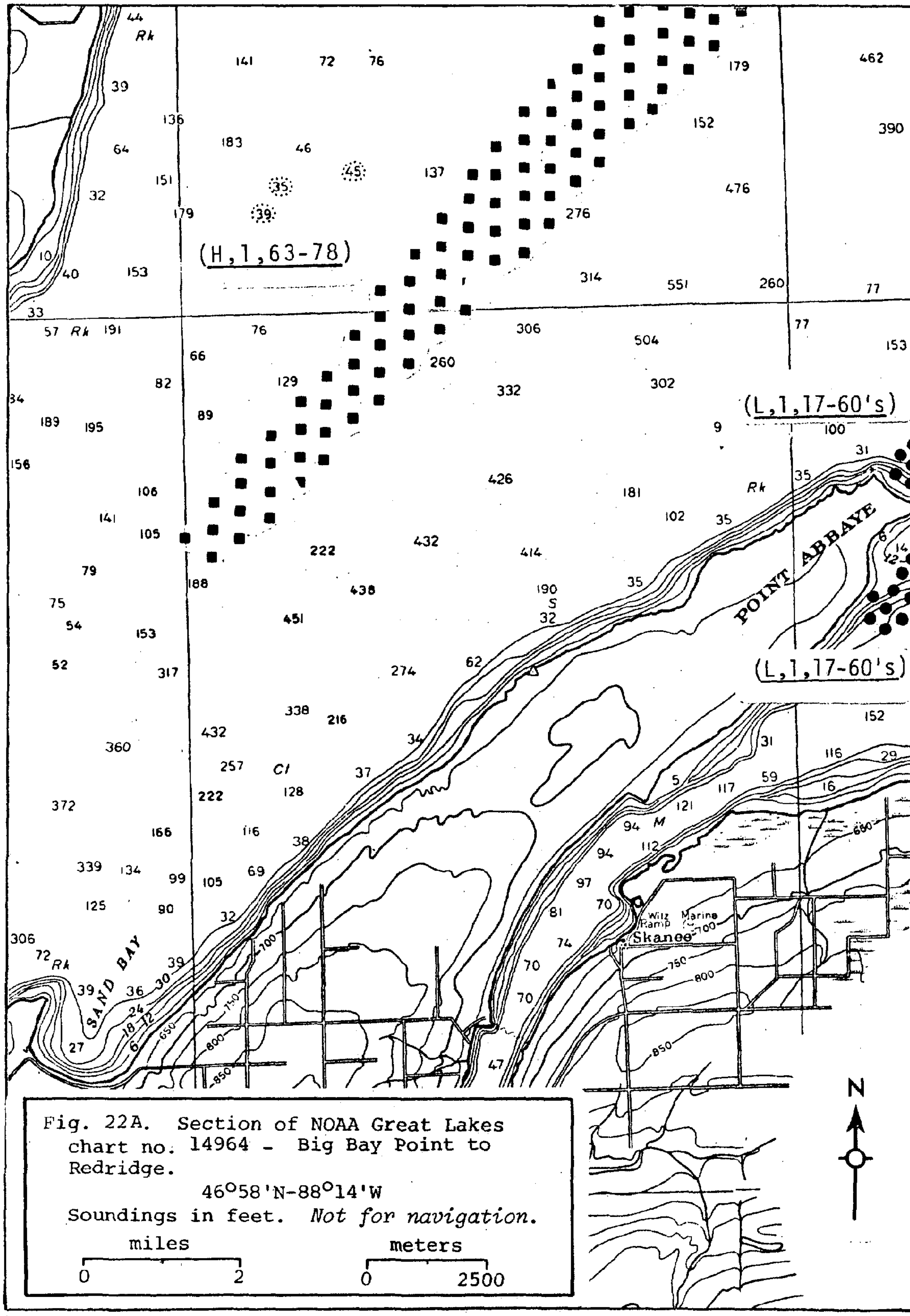



Fig. 22A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
46°58'N-88°14'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

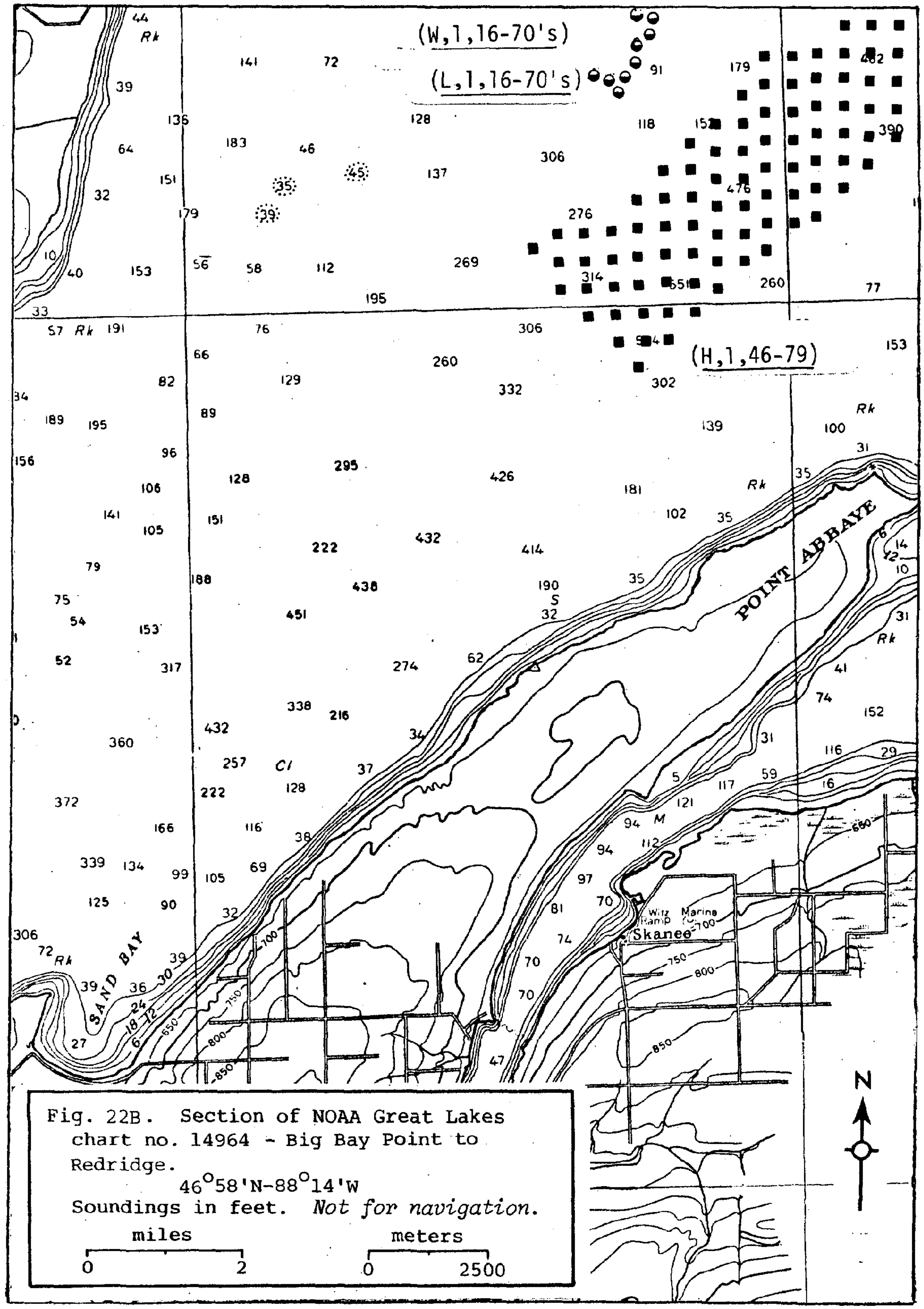



Fig. 22B. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
46°58'N-88°14'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

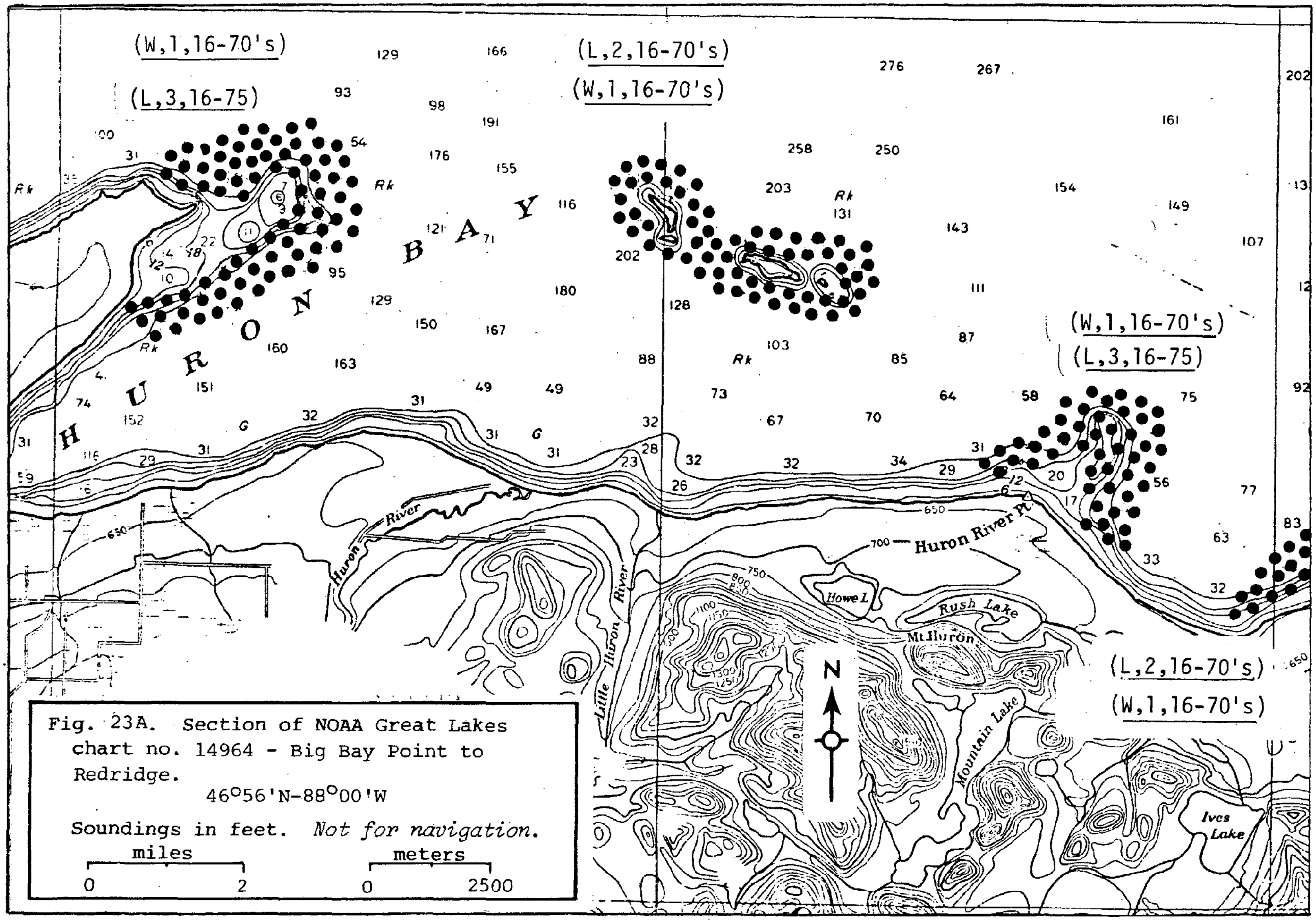



Fig. 23A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
46°56'N-88°00'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

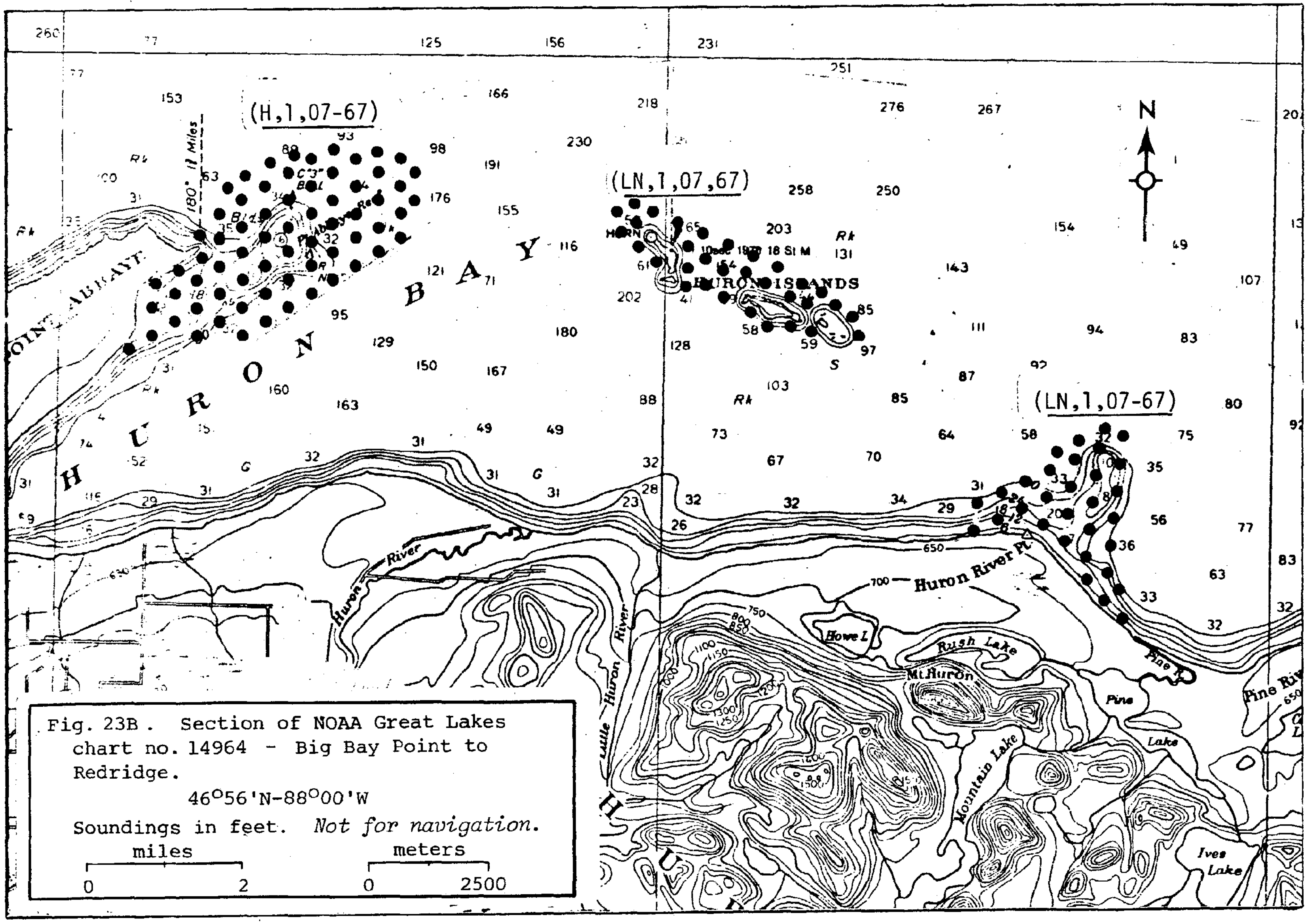



Fig. 23B . Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.

$46^{o}56'N-88^{o}00'W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

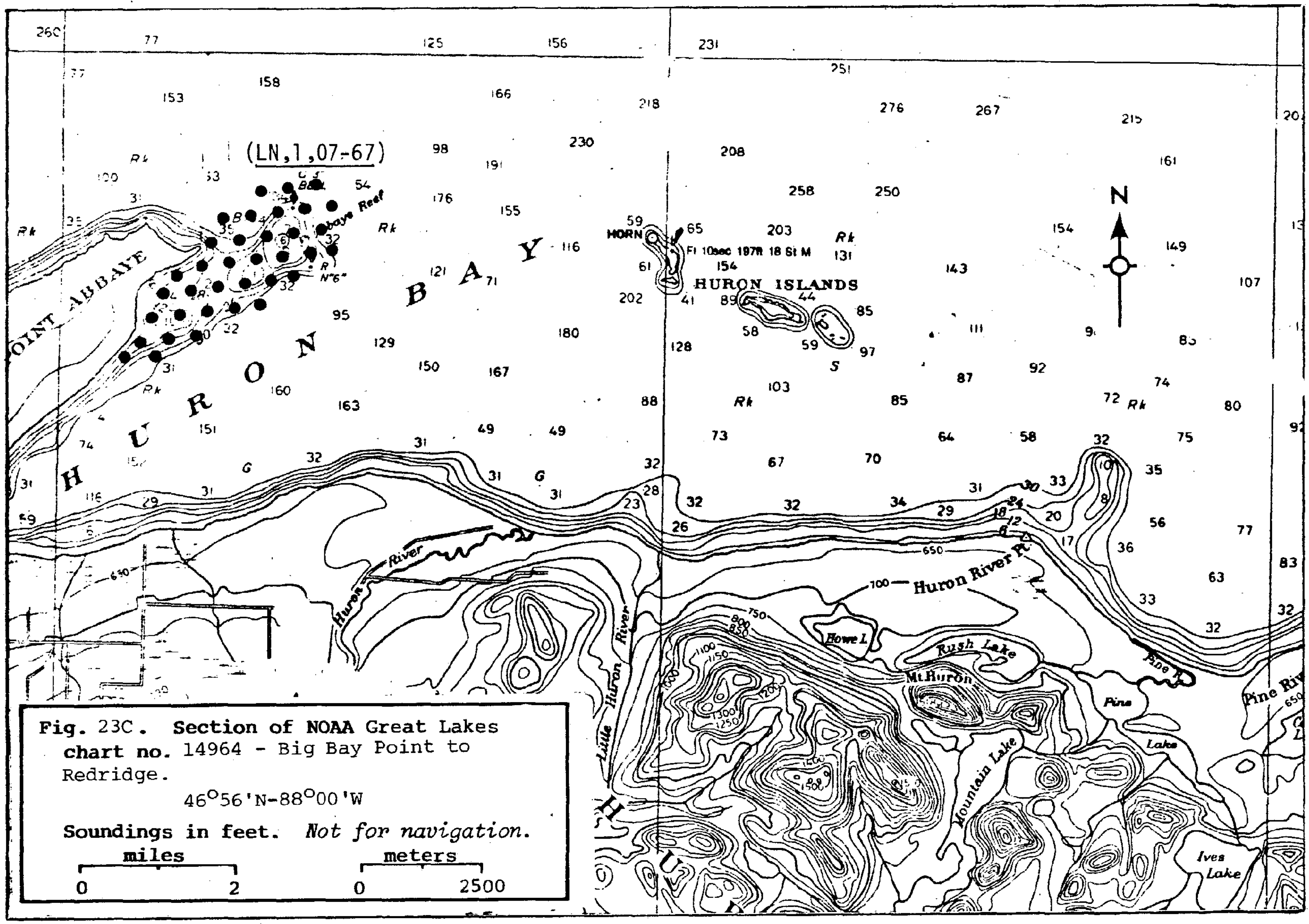



**Fig.** 23C. **Section of NOAA** Great Lakes **chart no.** 14964 - Big Bay Point to Redridge.

$46^{\circ}56'$N-$88^{\circ}00'$W

**Soundings in feet.** *Not for navigation.*

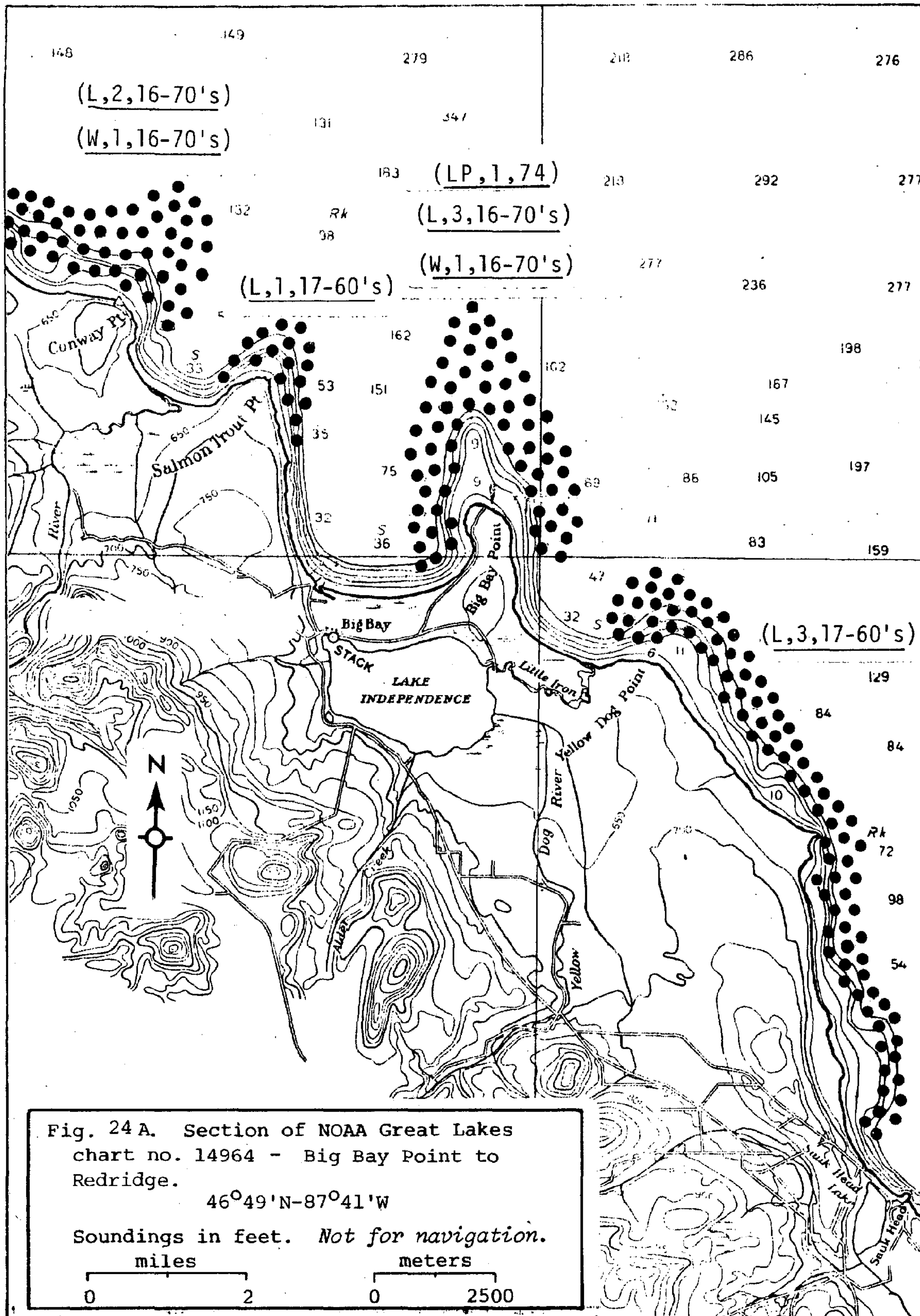



Fig. 24 A. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
46°49'N-87°41'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

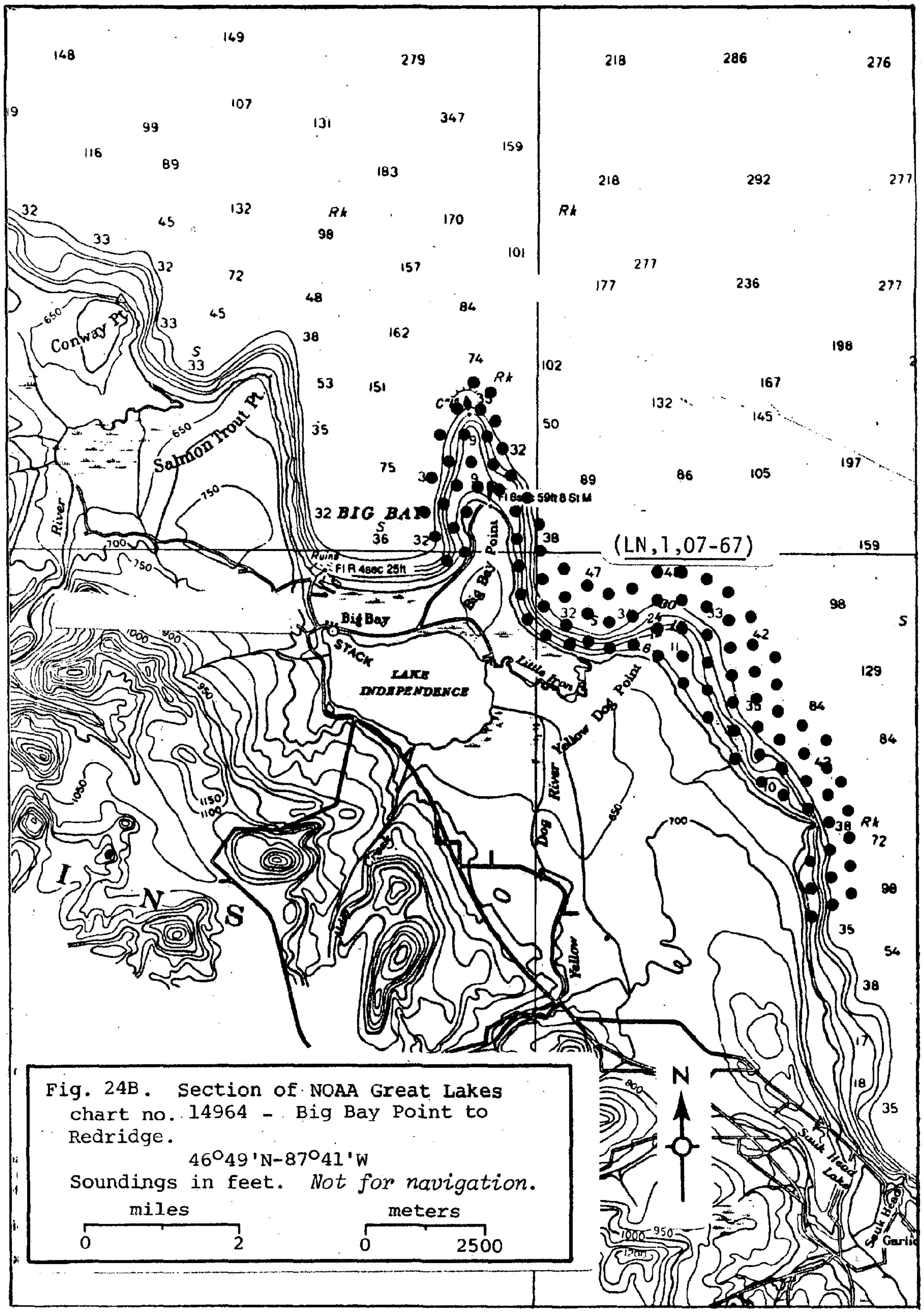



Fig. 24B. Section of NOAA Great Lakes chart no. 14964 - Big Bay Point to Redridge.
46°49'N-87°41'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

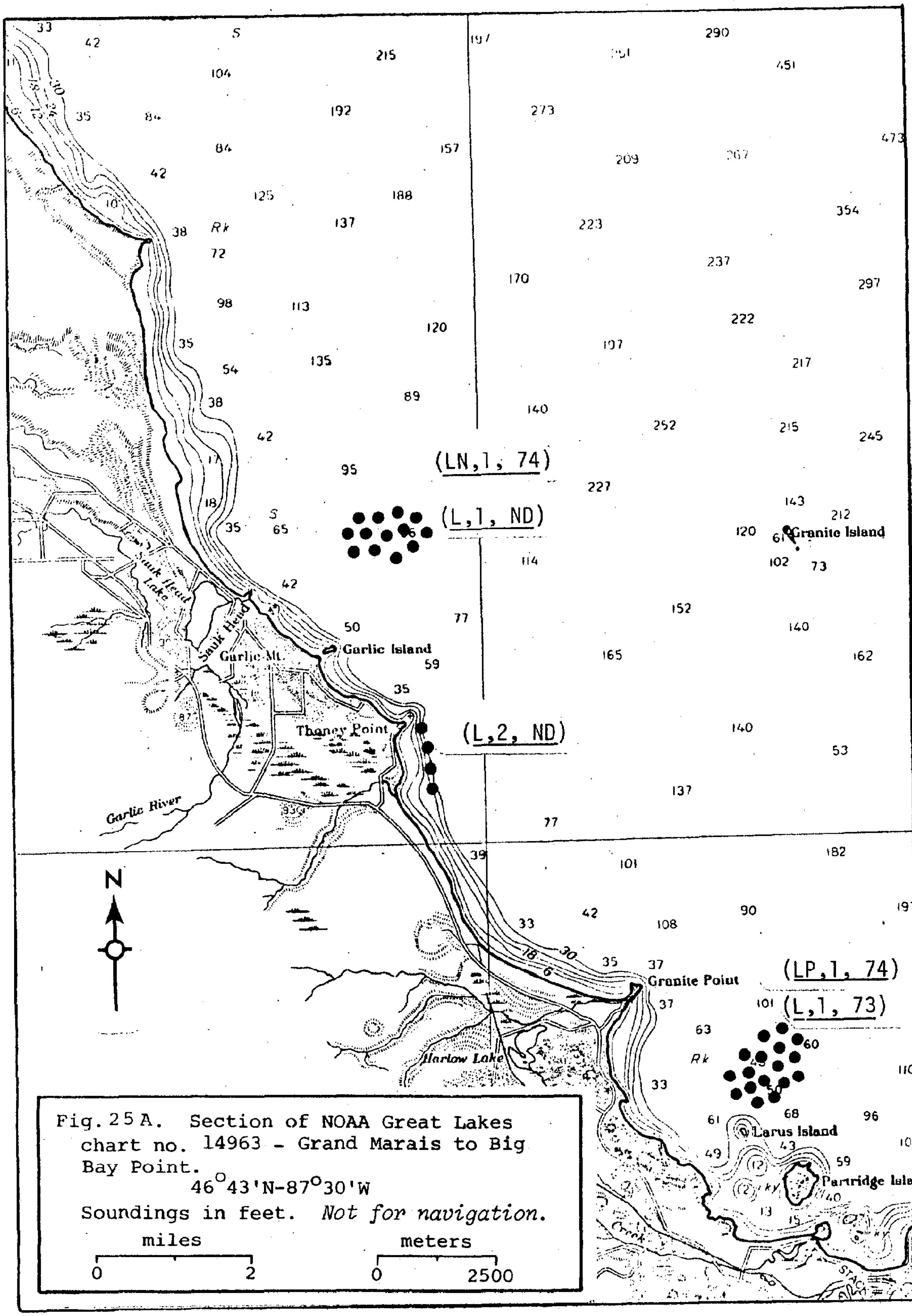



Fig. 25 A. Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
46°43'N-87°30'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

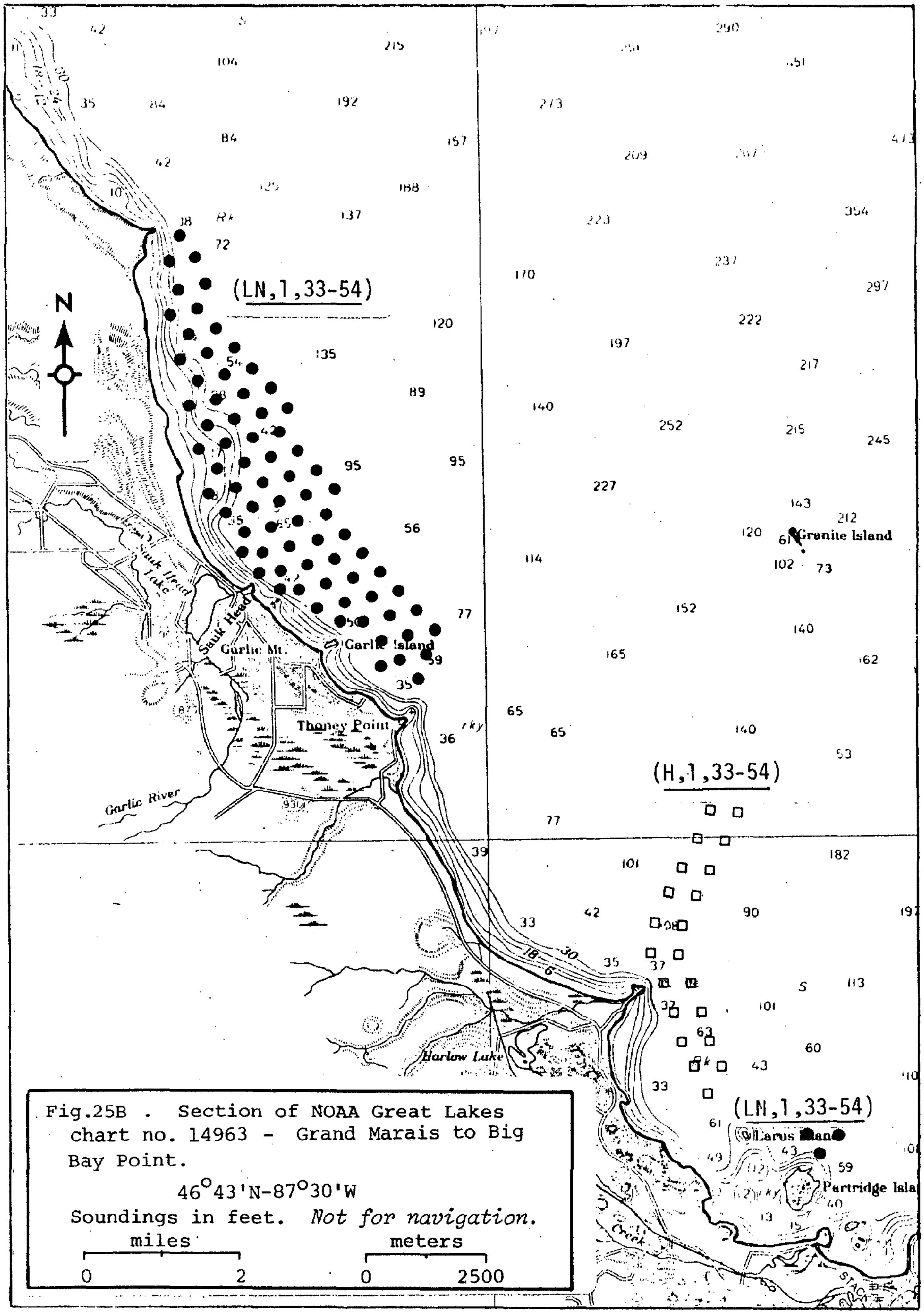



Fig.25B . Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.

46°43'N-87°30'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

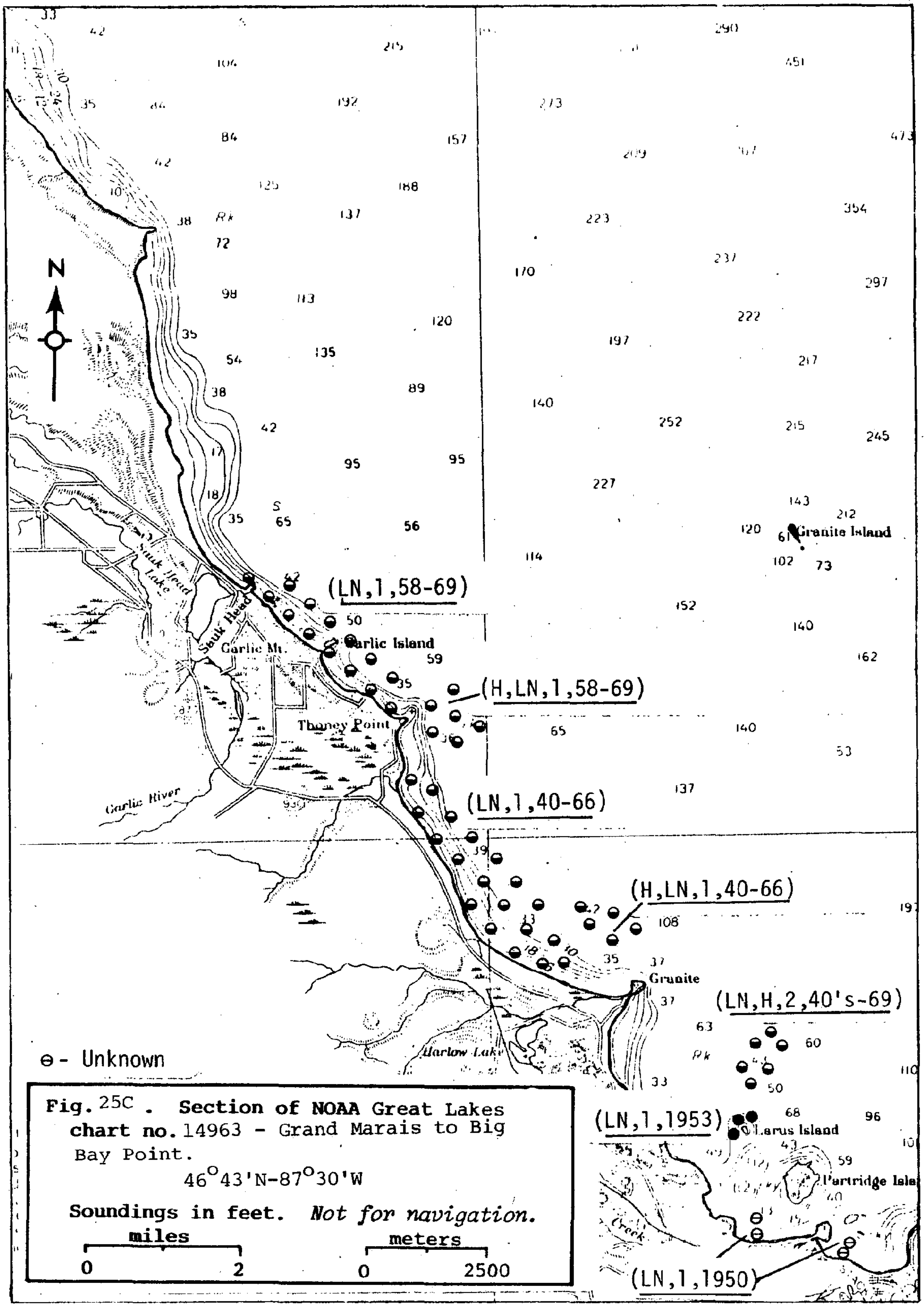



**Fig.** 25C . **Section of NOAA Great Lakes chart no.** 14963 - Grand Marais to Big Bay Point.
46°43'N-87°30'W

**Soundings in feet.** ***Not for navigation.***

miles 0 2 meters 0 2500

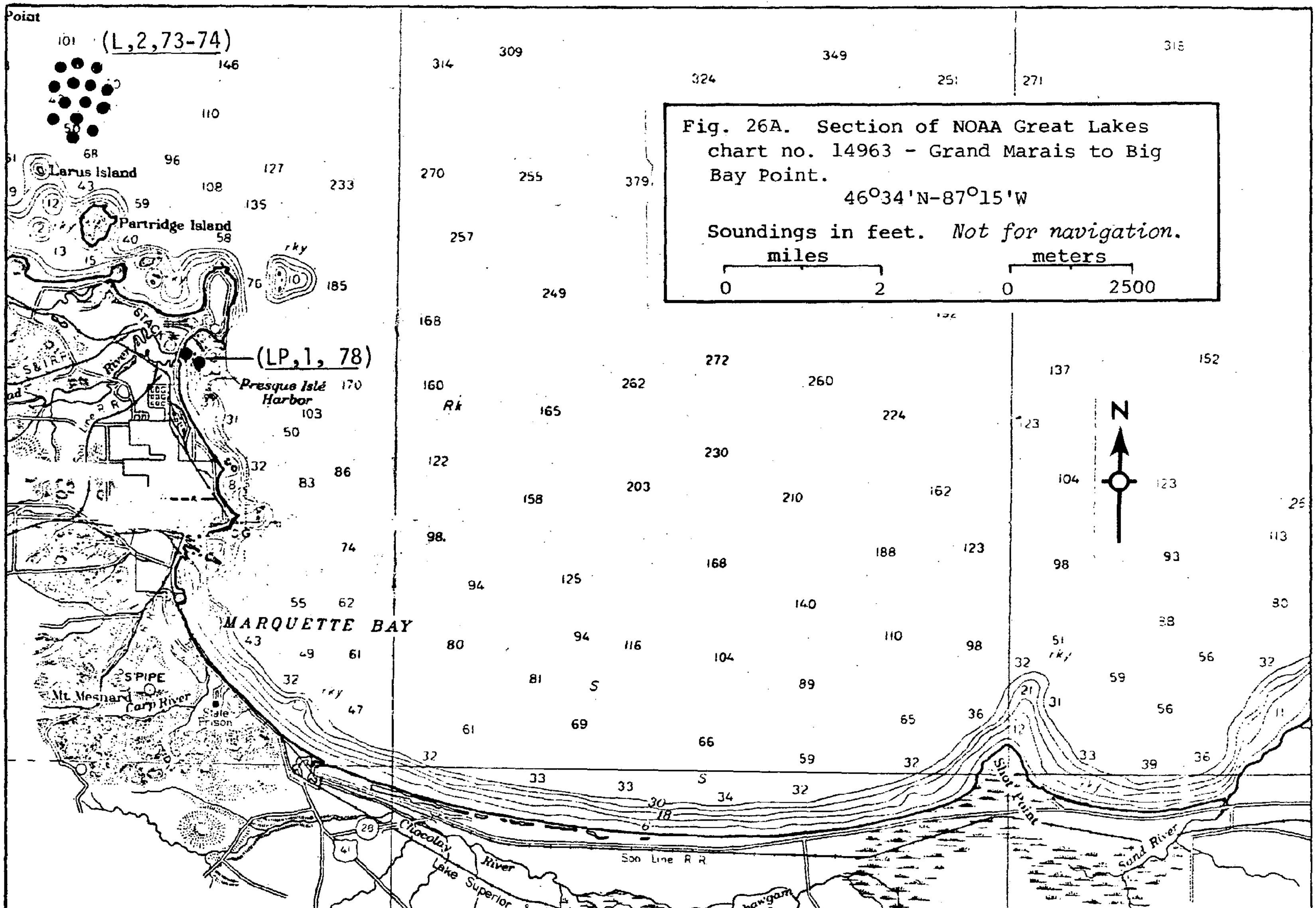



Fig. 26A. Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
46°34'N-87°15'W

Soundings in feet. *Not for navigation.*

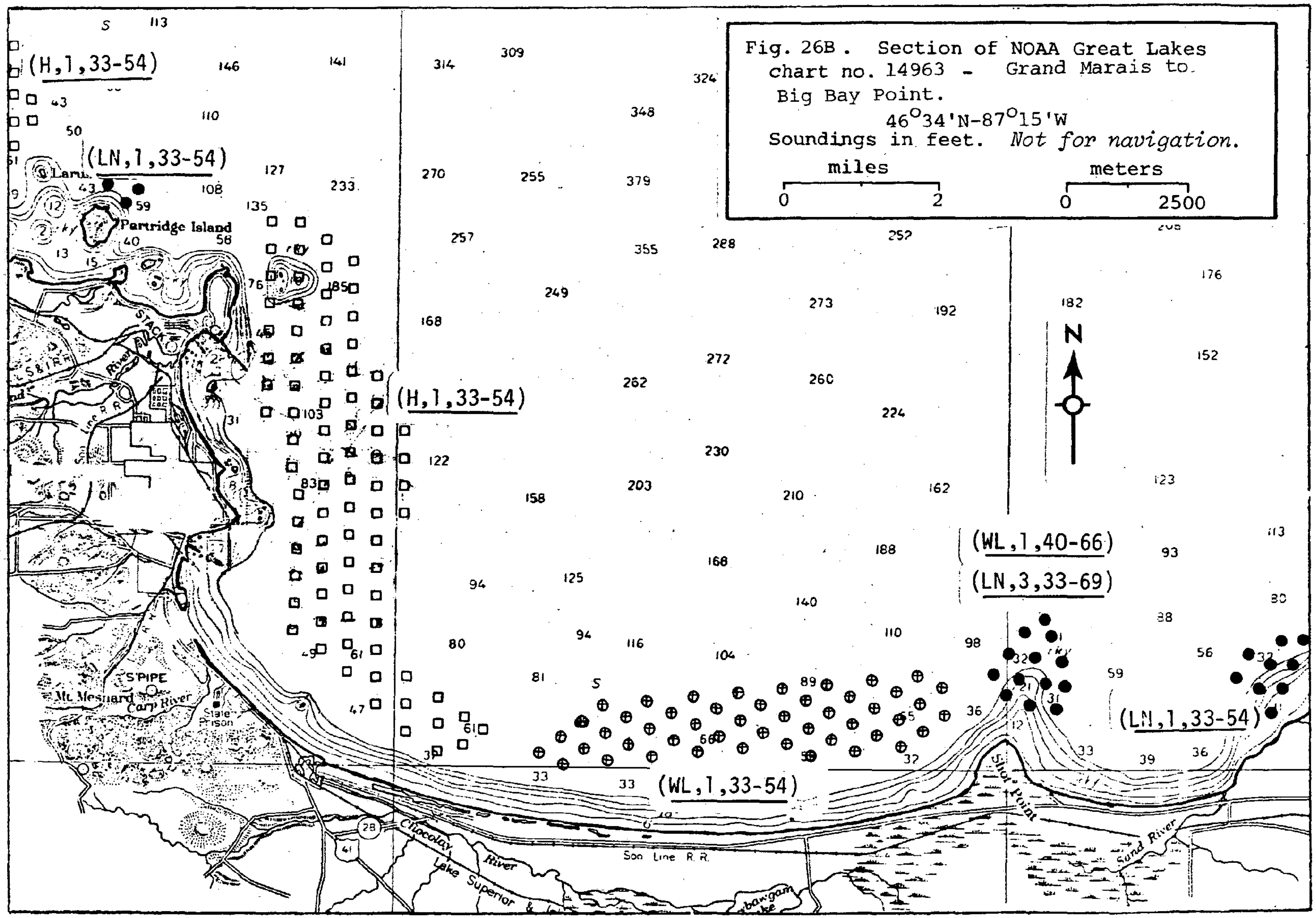



Fig. 26B. Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
$46^{o}34'N-87^{o}15'W$
Soundings in feet. *Not for navigation.*

miles 0 2
meters 0 2500

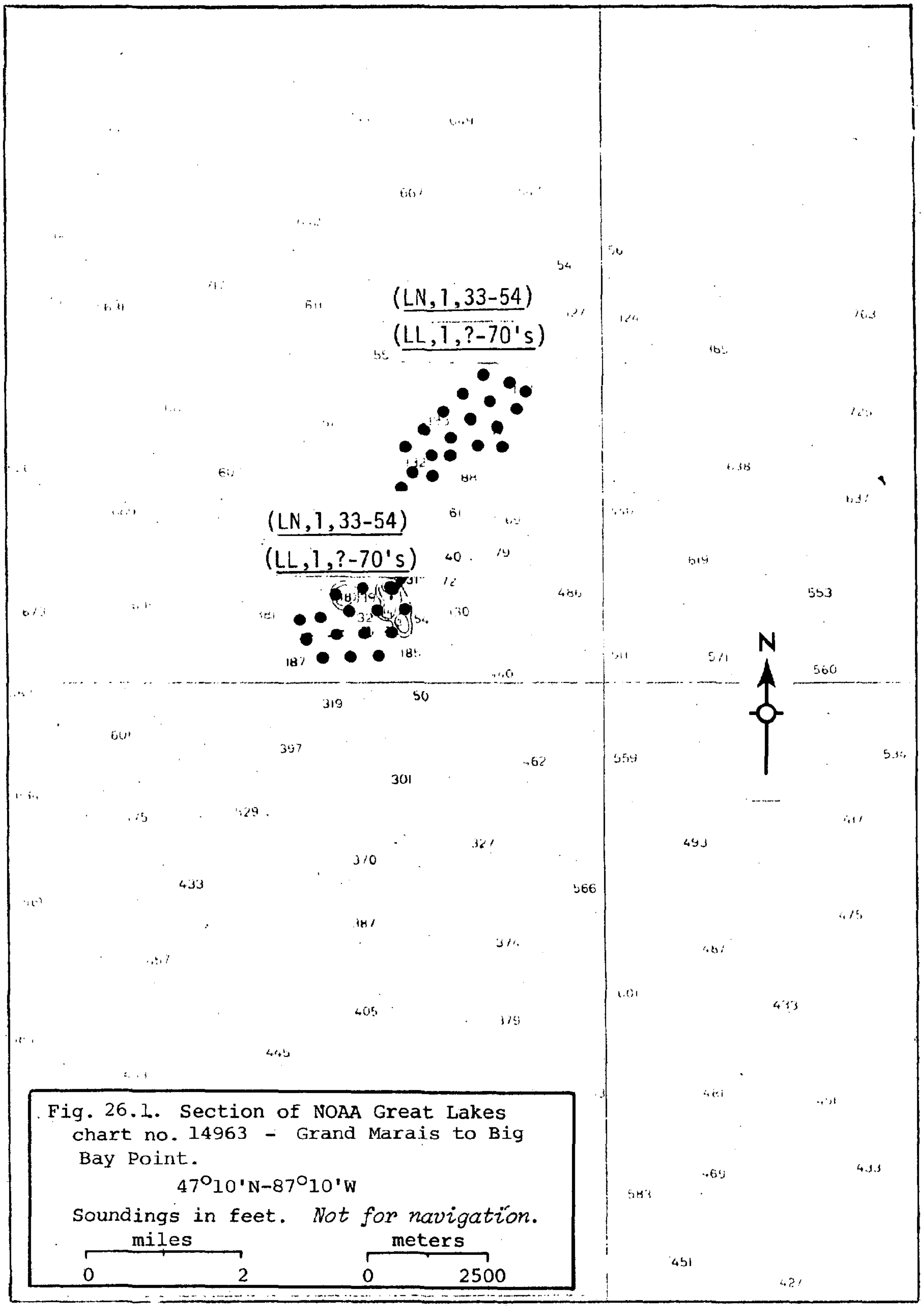



Fig. 26.1. Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.

47°10'N-87°10'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

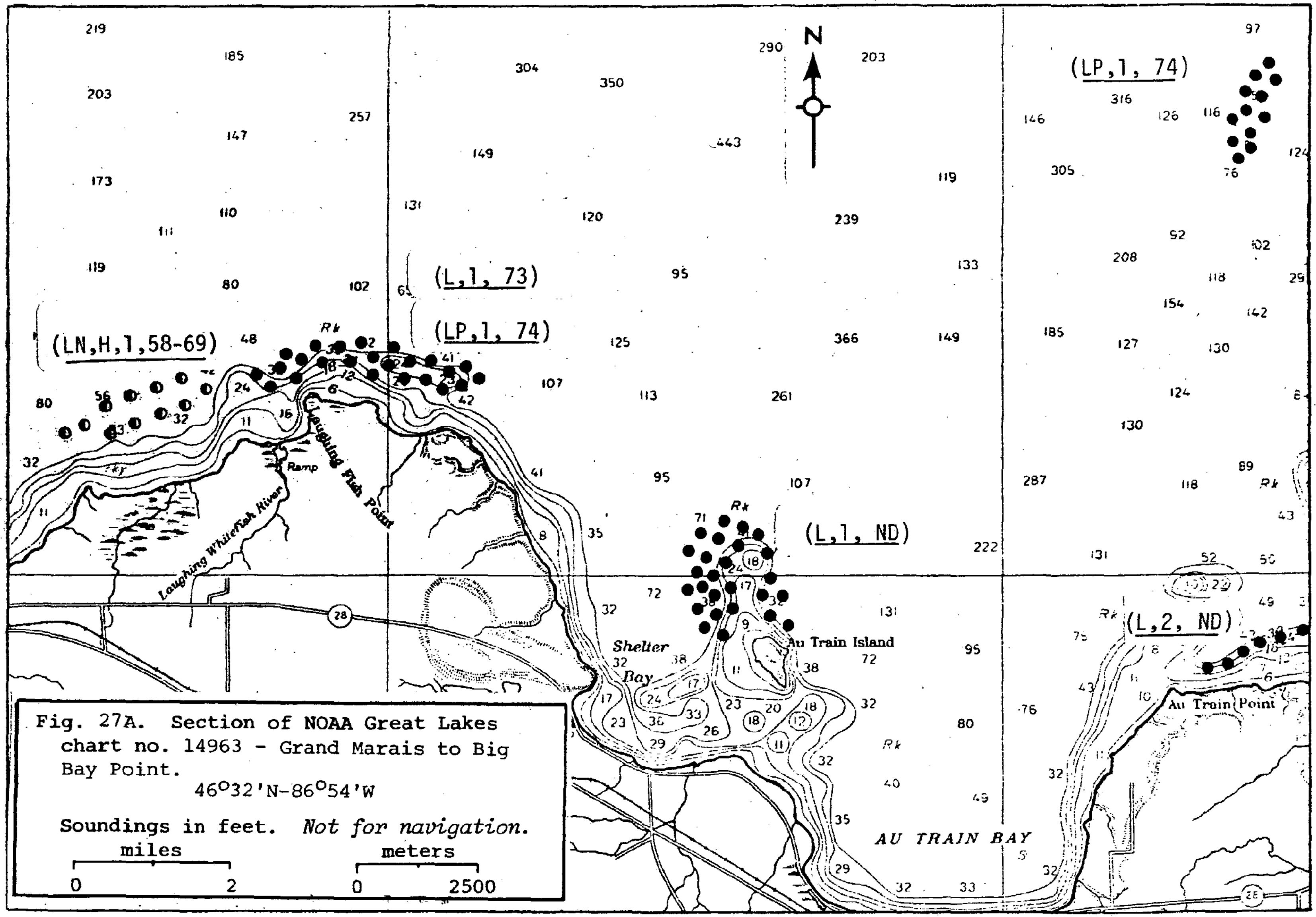



Fig. 27A. Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
46°32'N-86°54'W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

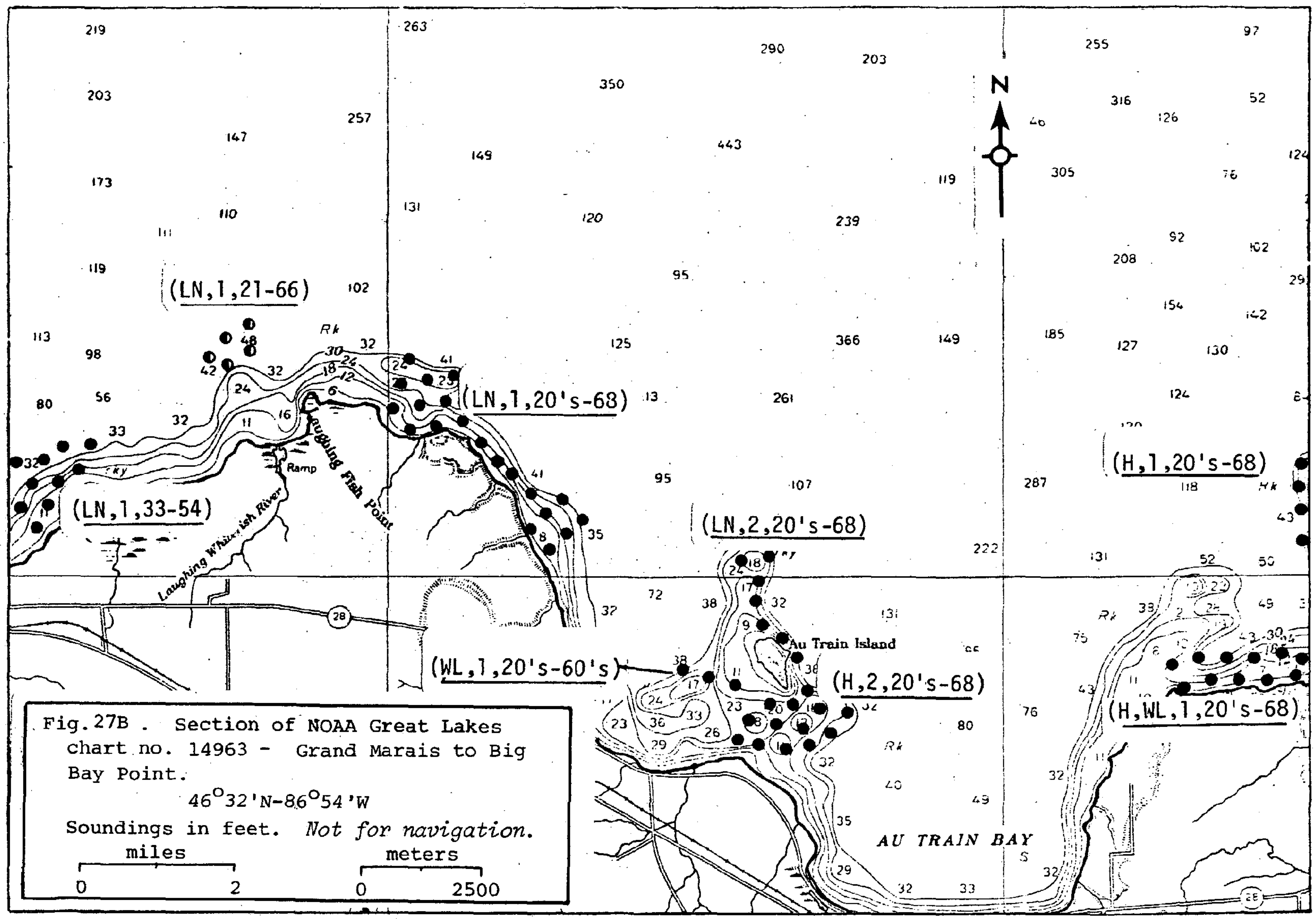



Fig. 27B . Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
$46^{o}32'N-86^{o}54'W$
Soundings in feet. *Not for navigation.*
miles 0 2
meters 0 2500

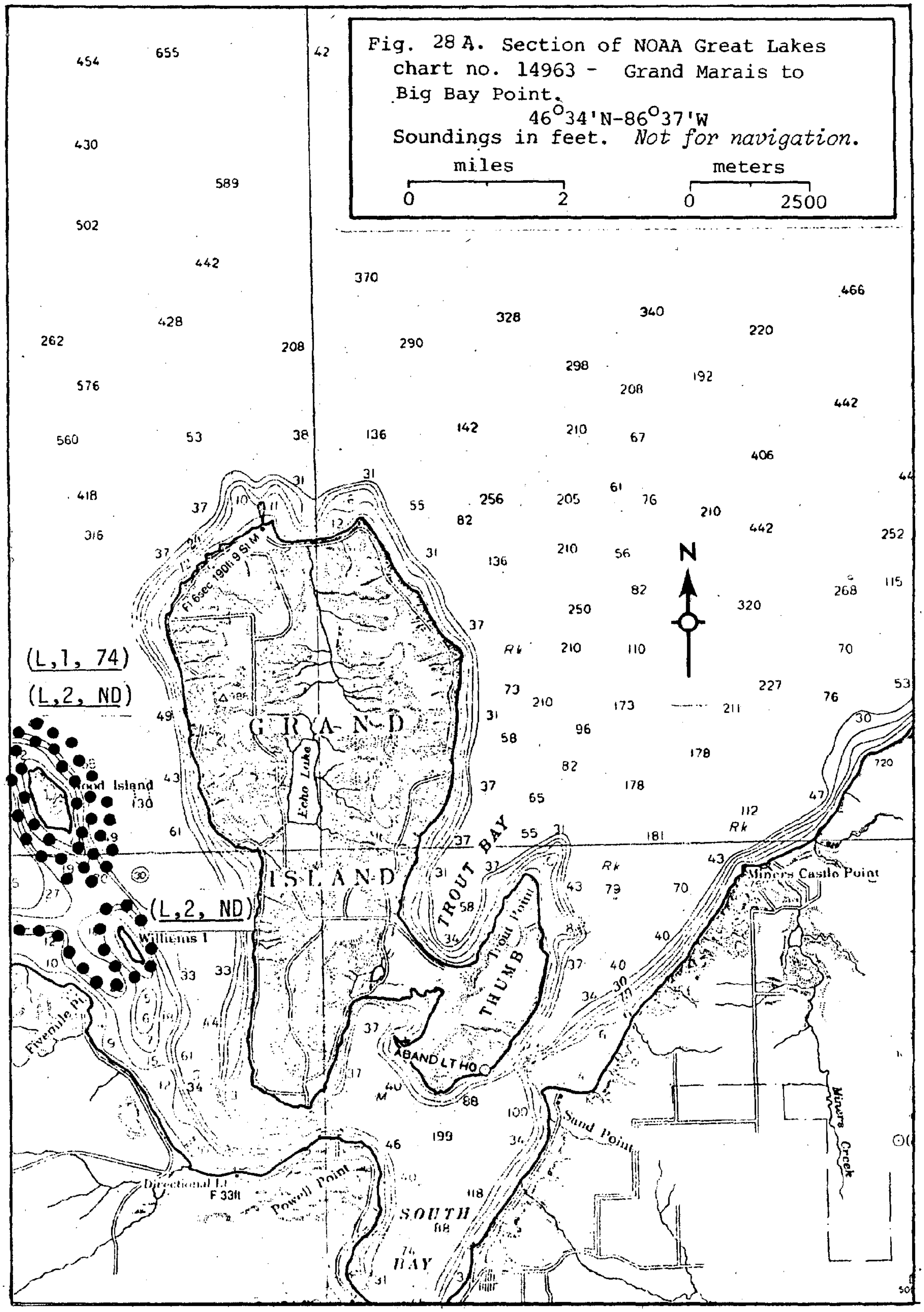



Fig. 28 A. Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
46°34'N-86°37'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

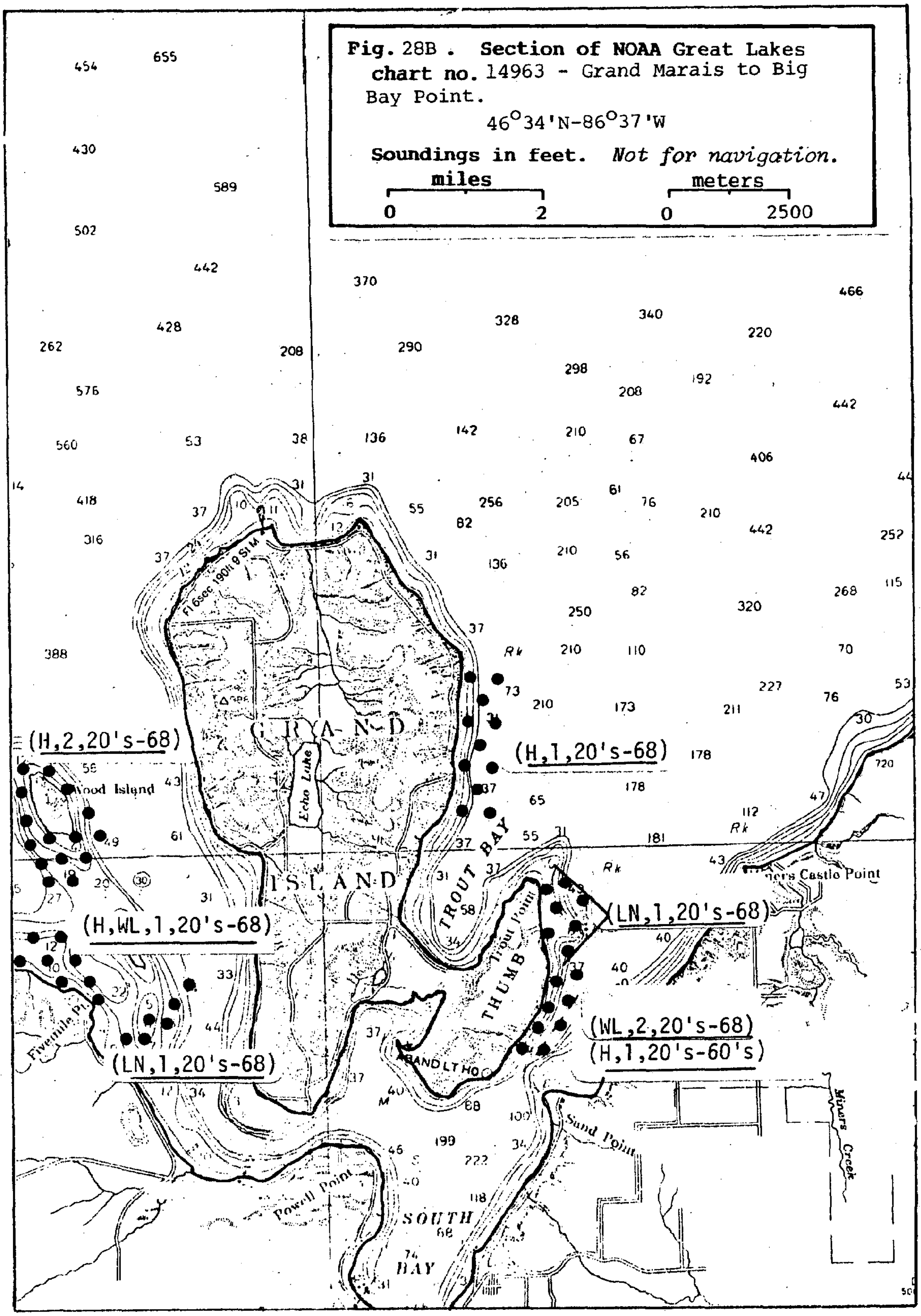



**Fig.** 28B . **Section of NOAA Great Lakes chart no.** 14963 - Grand Marais to Big Bay Point.

46°34'N-86°37'W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

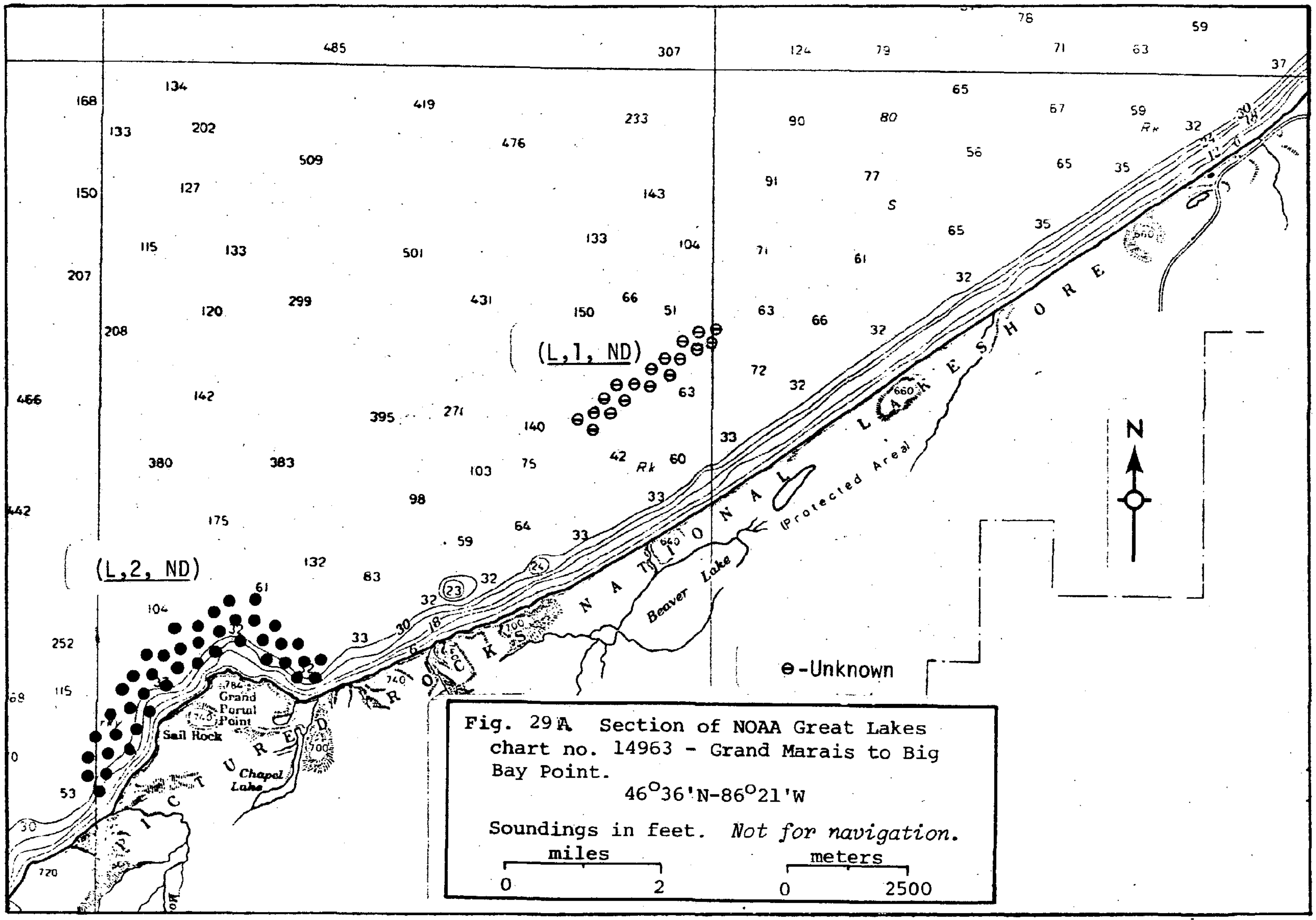



Fig. 29A Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
46°36'N-86°21'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

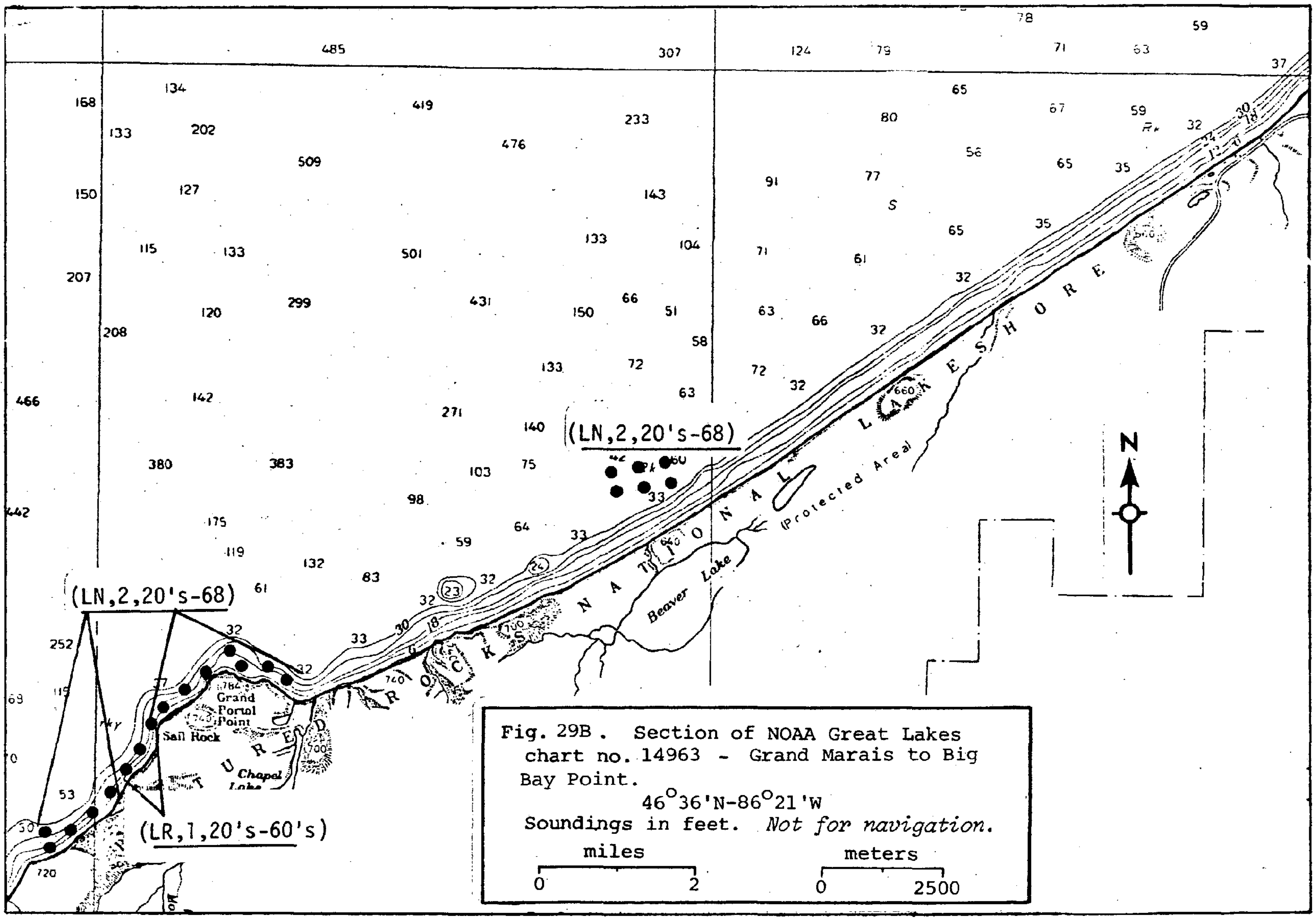



Fig. 29B . Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
$46^{\circ}36'N-86^{\circ}21'W$
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

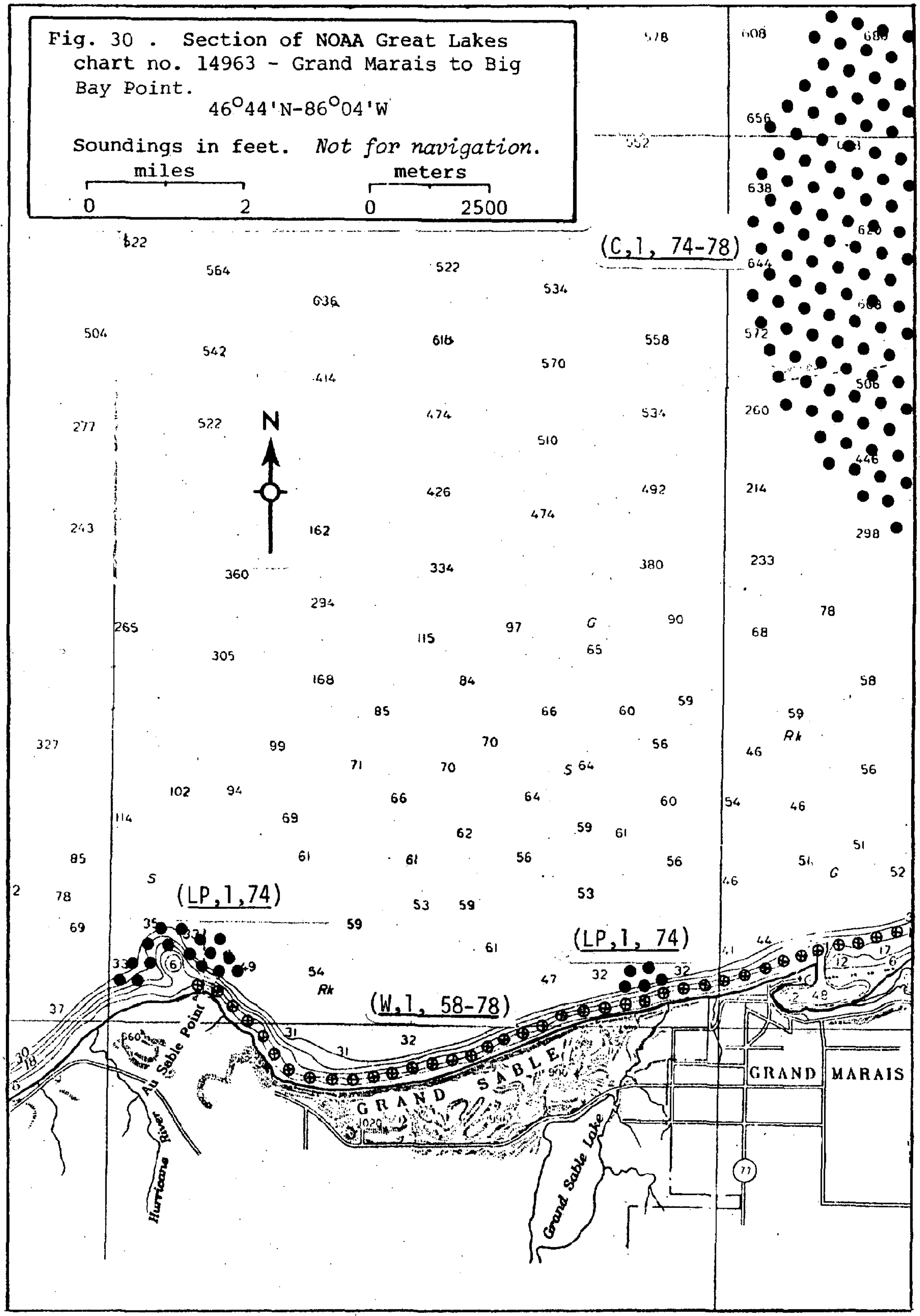



Fig. 30 . Section of NOAA Great Lakes chart no. 14963 - Grand Marais to Big Bay Point.
46°44'N-86°04'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

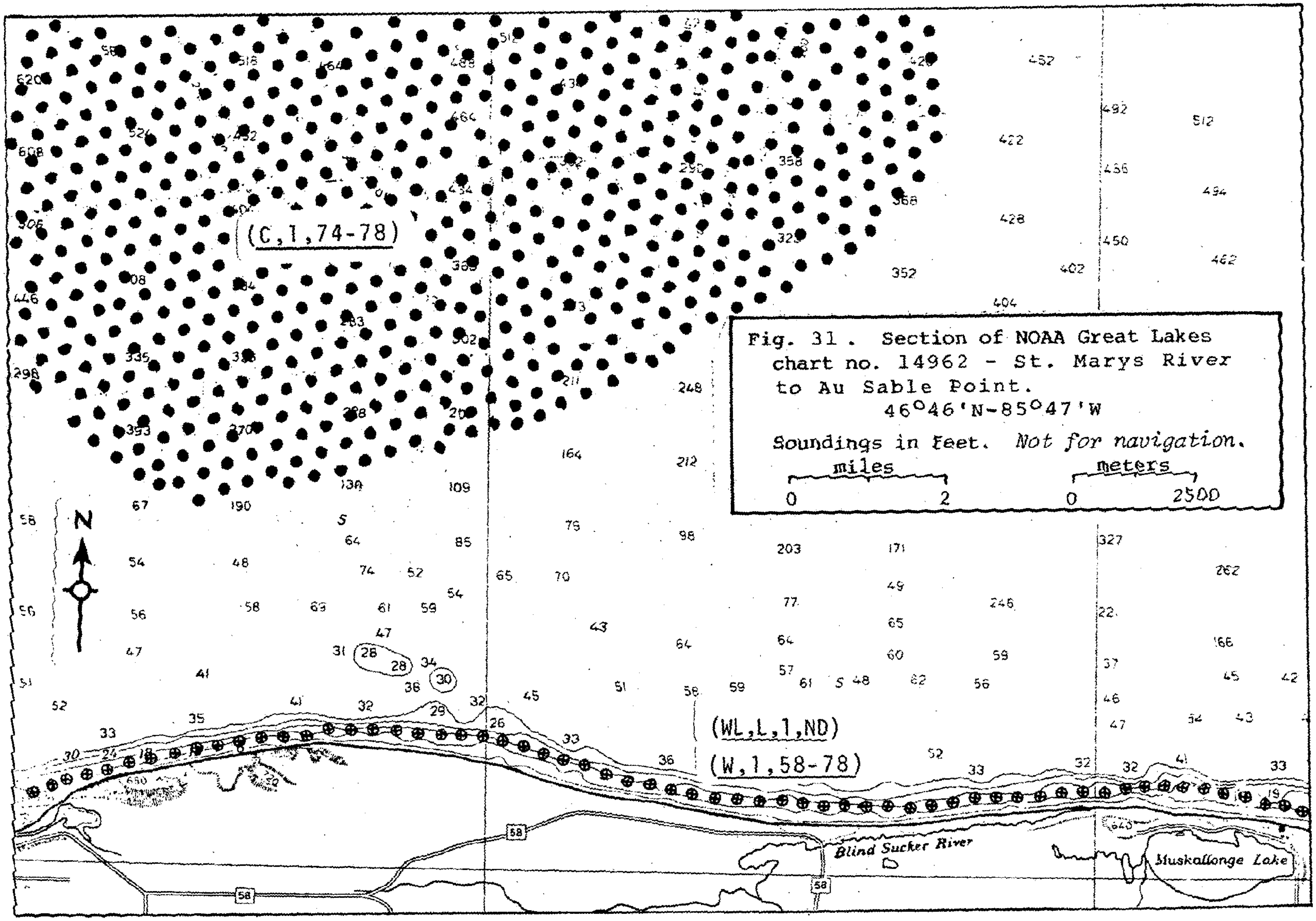



Fig. 31 . Section of NOAA Great Lakes chart no. 14962 - St. Marys River to Au Sable Point.
46°46'N-85°47'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

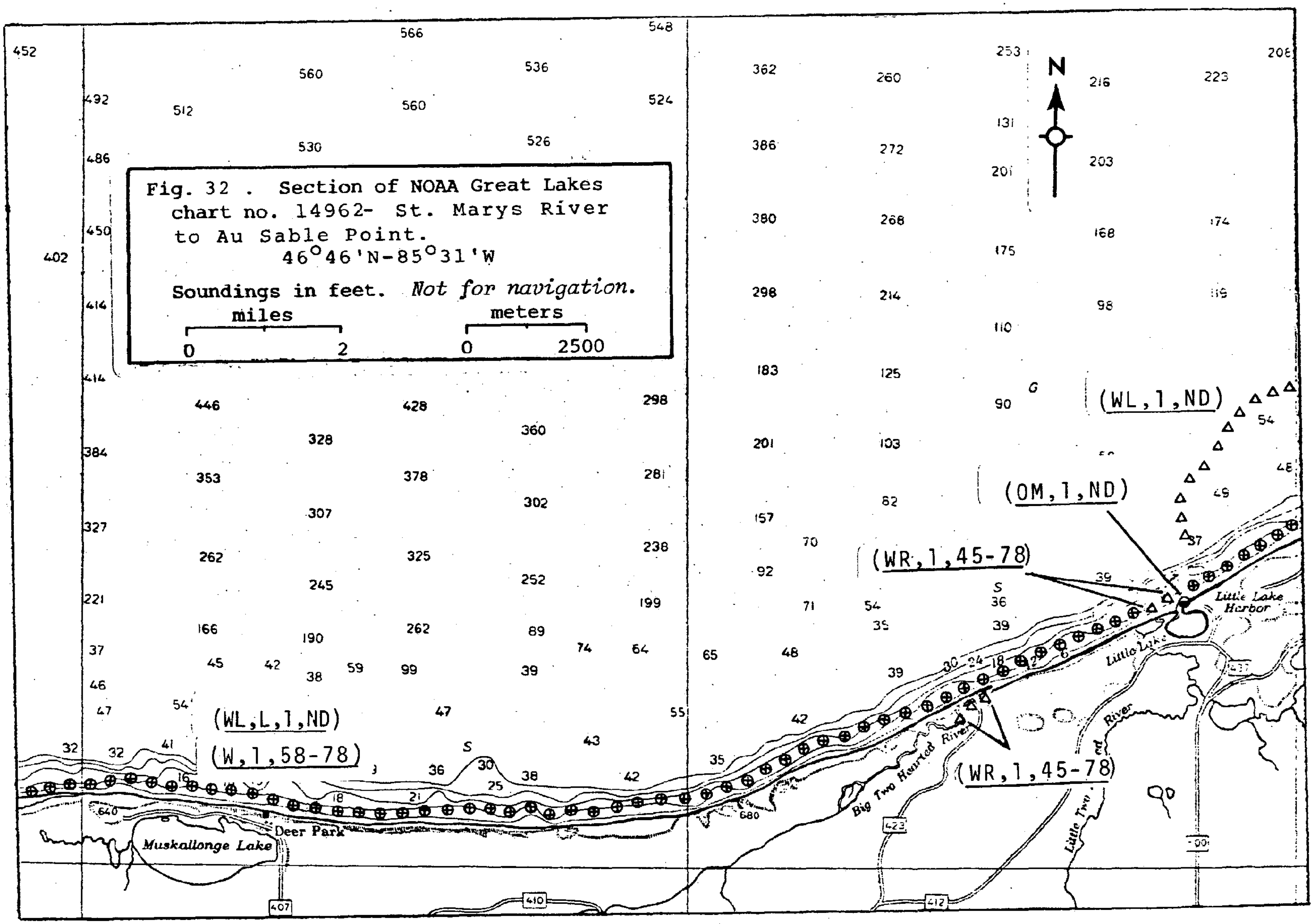



Fig. 32 . Section of NOAA Great Lakes chart no. 14962- St. Marys River to Au Sable Point. 46°46'N-85°31'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

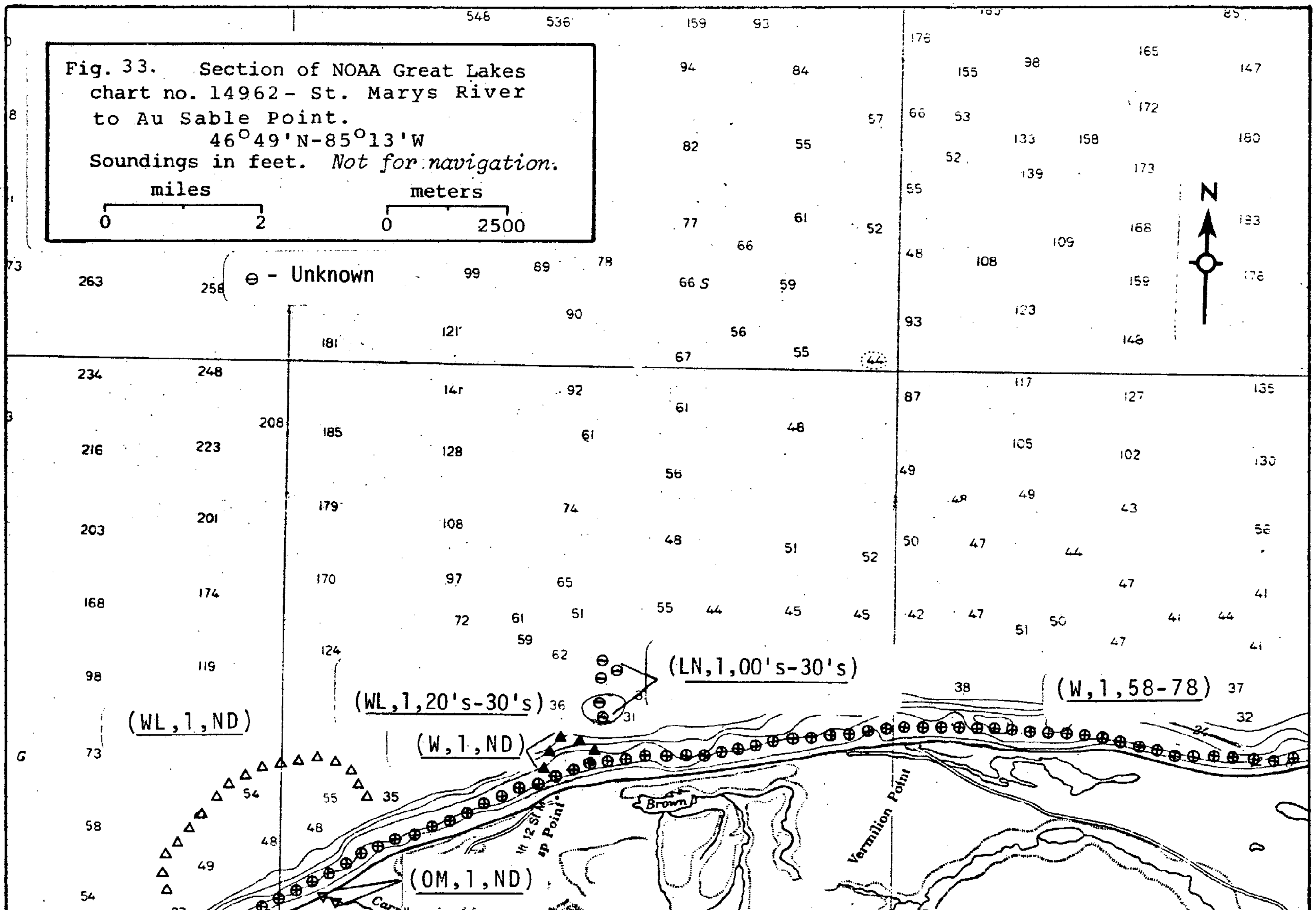



Fig. 33. Section of NOAA Great Lakes chart no. 14962 - St. Marys River to Au Sable Point. 46°49'N-85°13'W Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

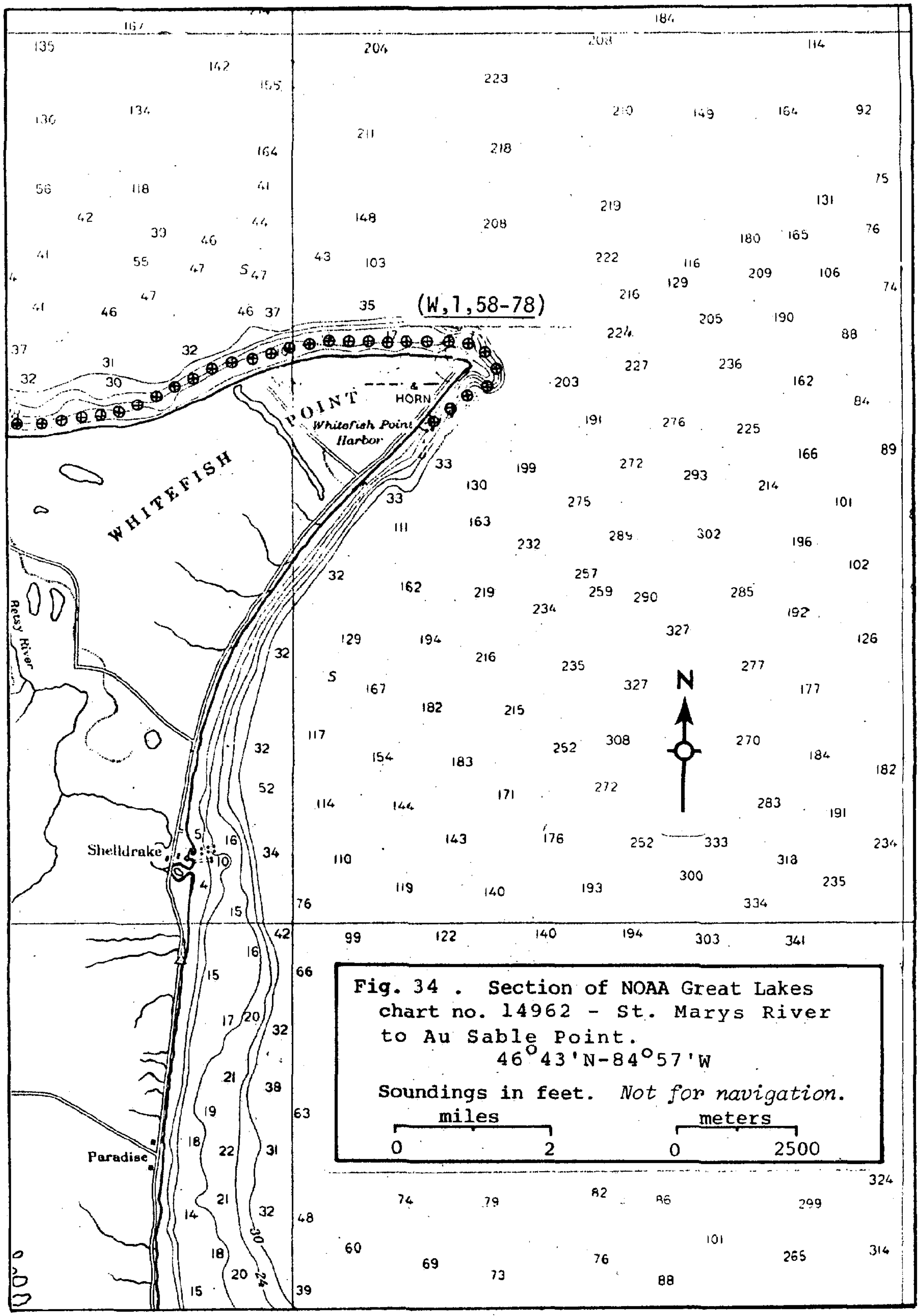



**Fig. 34** . Section of NOAA Great Lakes chart no. 14962 - St. Marys River to Au Sable Point.
46°43'N-84°57'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

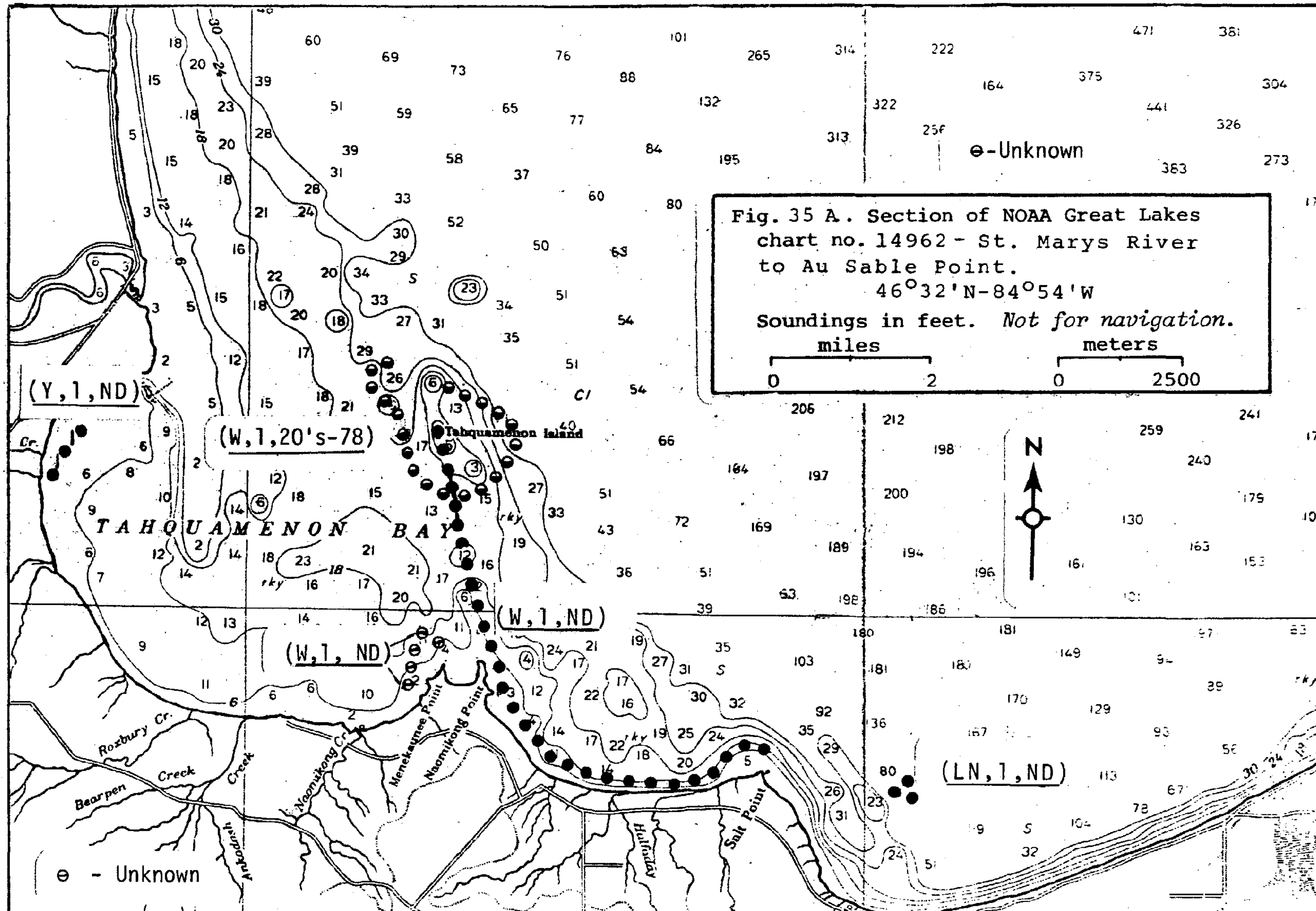



Fig. 35 A. Section of NOAA Great Lakes chart no. 14962 - St. Marys River to Au Sable Point.
$46^{o}32'N-84^{o}54'W$
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

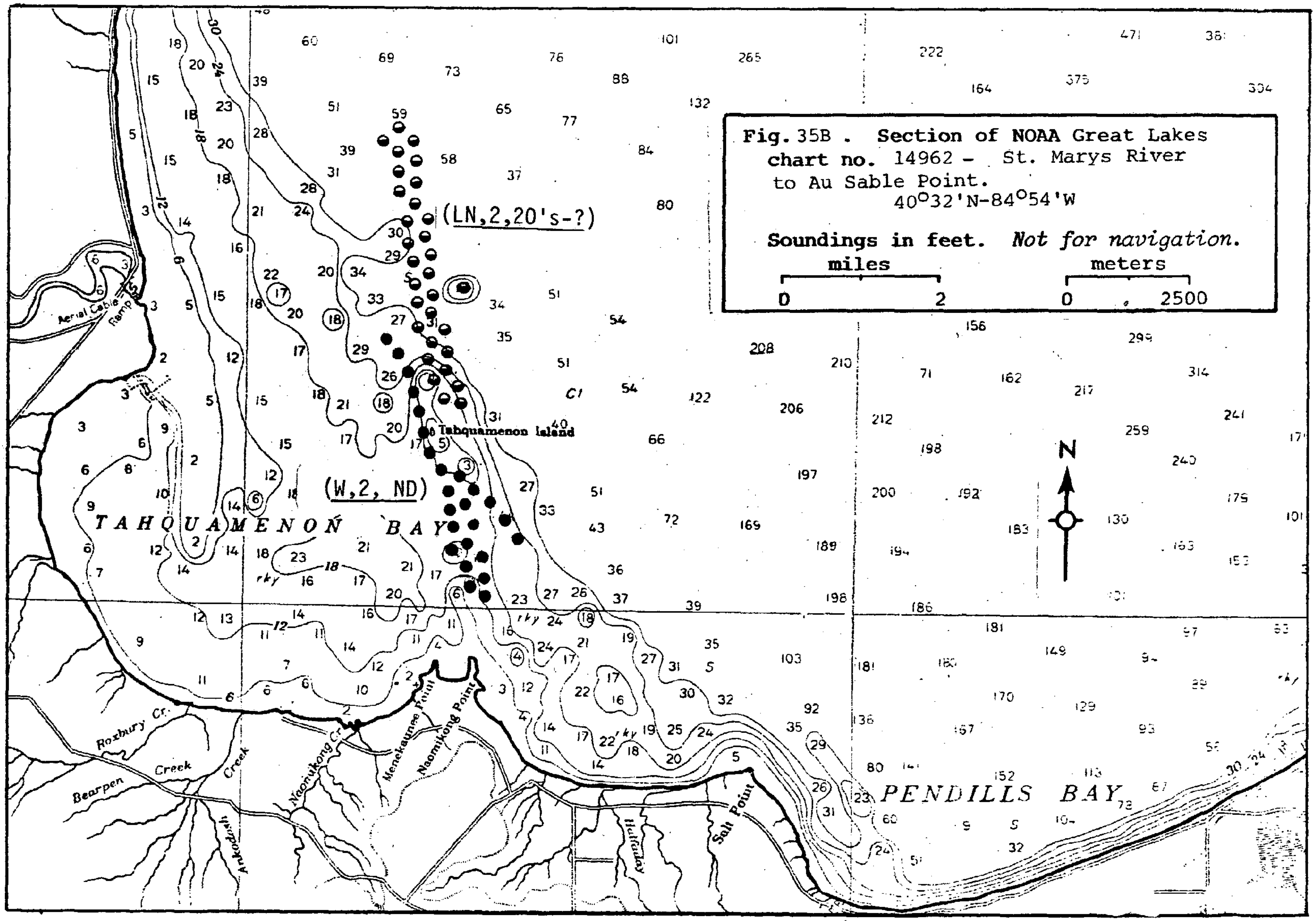



**Fig.** 35B . **Section of NOAA Great Lakes chart no.** 14962 - St. Marys River to Au Sable Point. 40°32'N-84°54'W

**Soundings in feet.** ***Not for navigation.***

**miles** 0 — 2 **meters** 0 — 2500

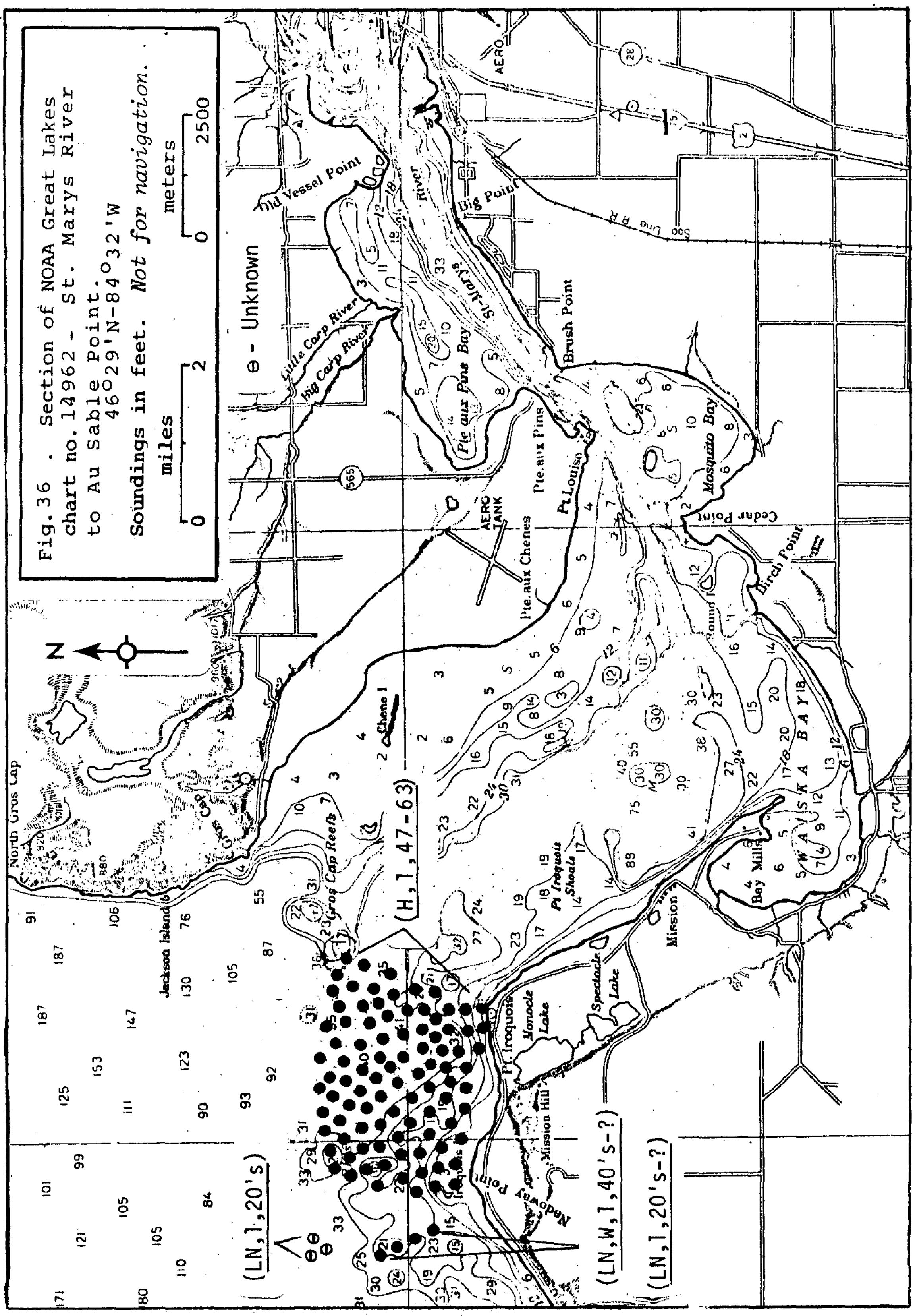



Fig. 36 . Section of NOAA Great Lakes chart no. 14962 - St. Marys River to Au Sable Point. 46°29'N-84°32'W

Soundings in feet. *Not for navigation.*

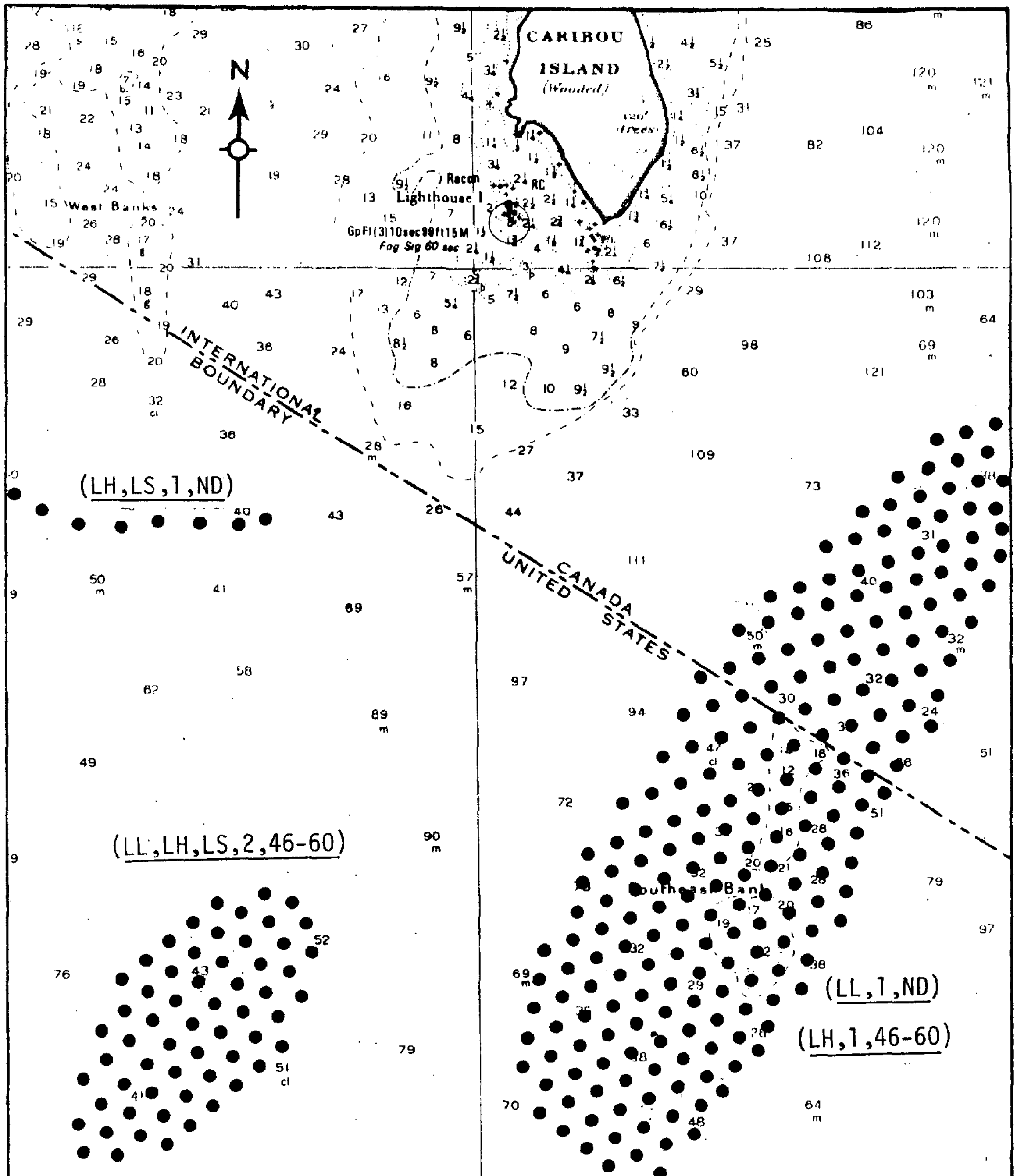



Fig.36.1. Section of CHS Great Lakes chart no. 2310 - Caribou Island to Michipicoten Island.
$47^{\circ}16'N-85^{\circ}50'W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

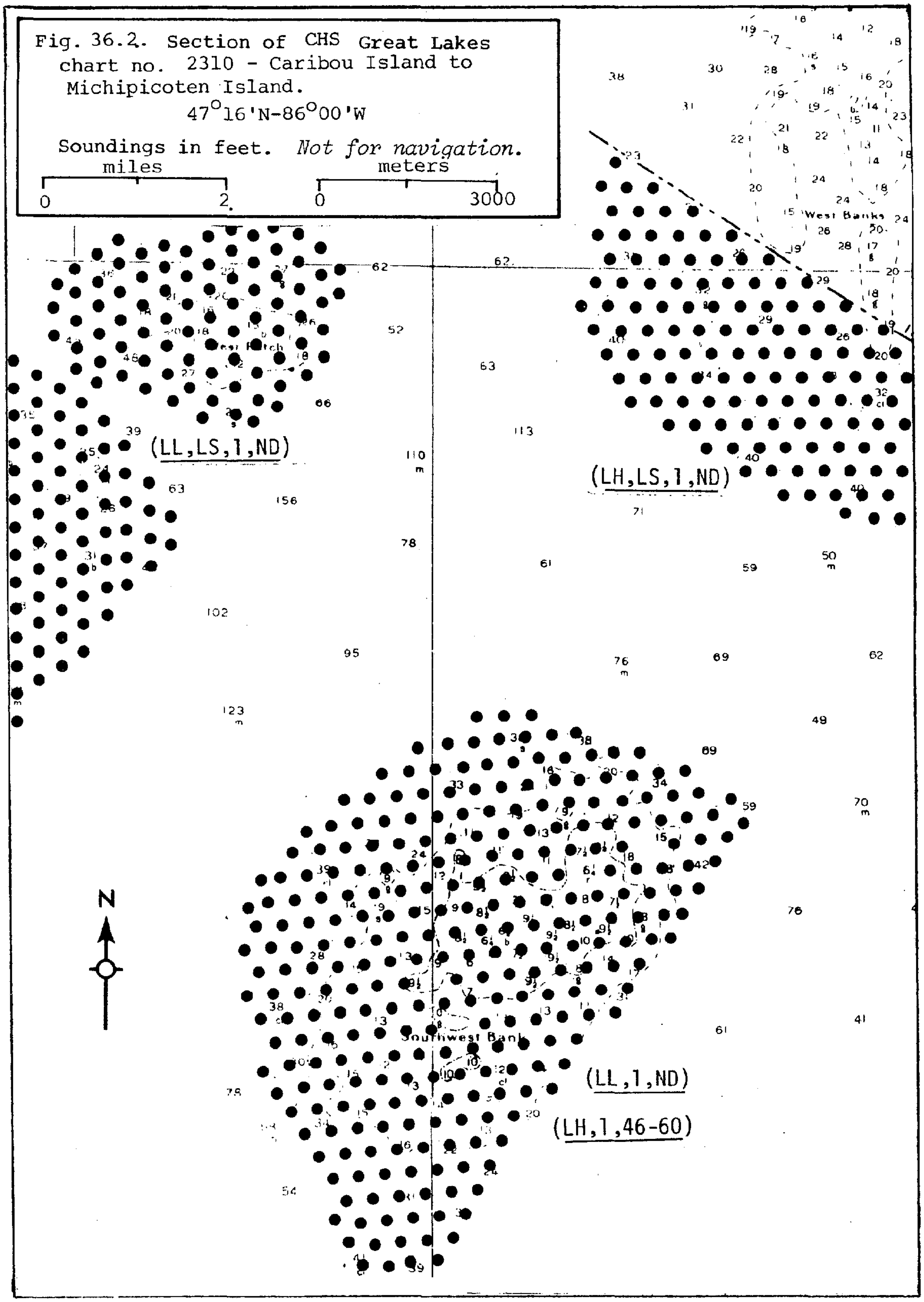



Fig. 36.2. Section of CHS Great Lakes chart no. 2310 - Caribou Island to Michipicoten Island.
$47^{\circ}16'$N-$86^{\circ}00'$W

Soundings in feet. *Not for navigation.*

miles 0 — 2  meters 0 — 3000

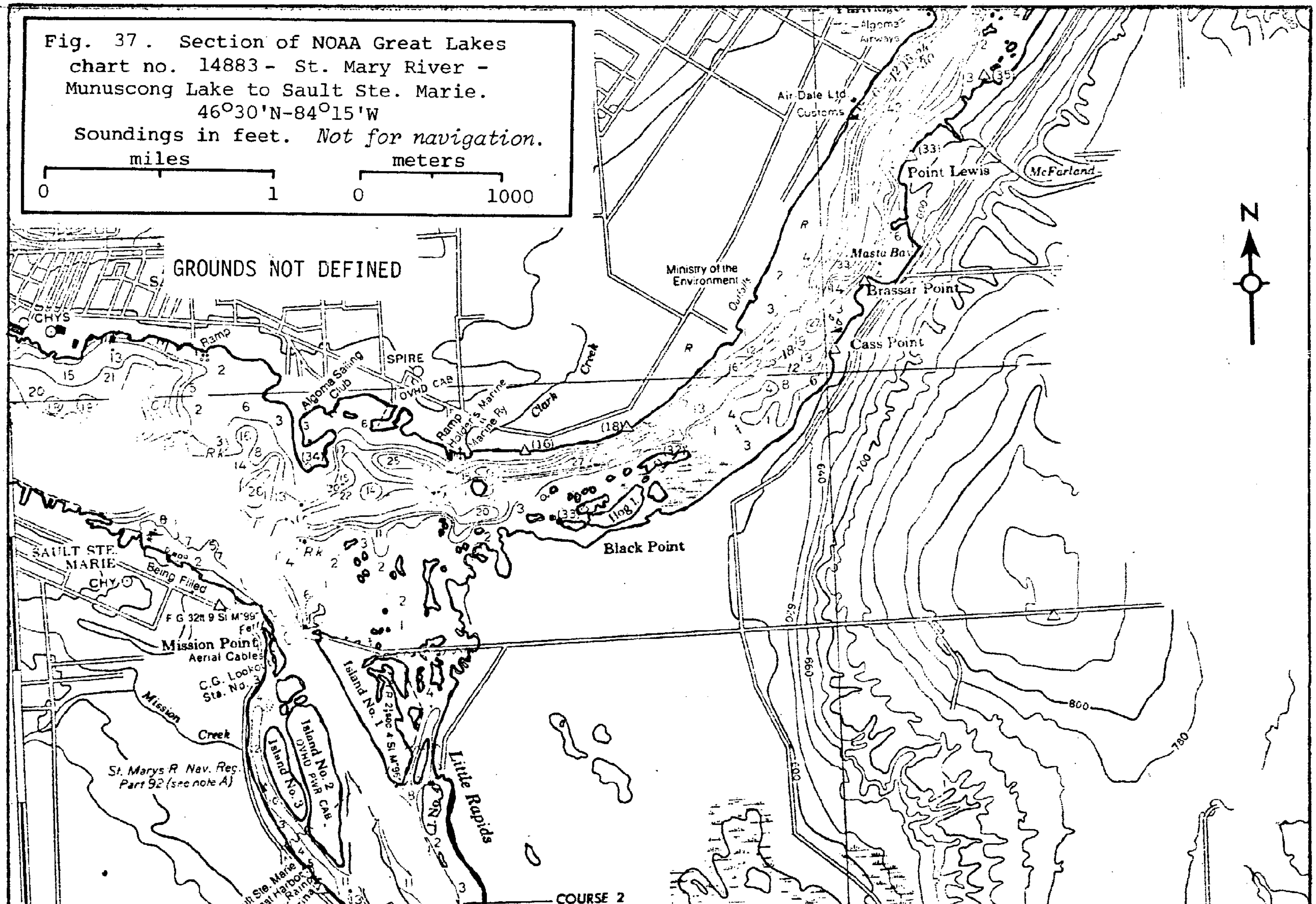



Fig. 37. Section of NOAA Great Lakes chart no. 14883 - St. Mary River - Munuscong Lake to Sault Ste. Marie. 46°30'N-84°15'W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

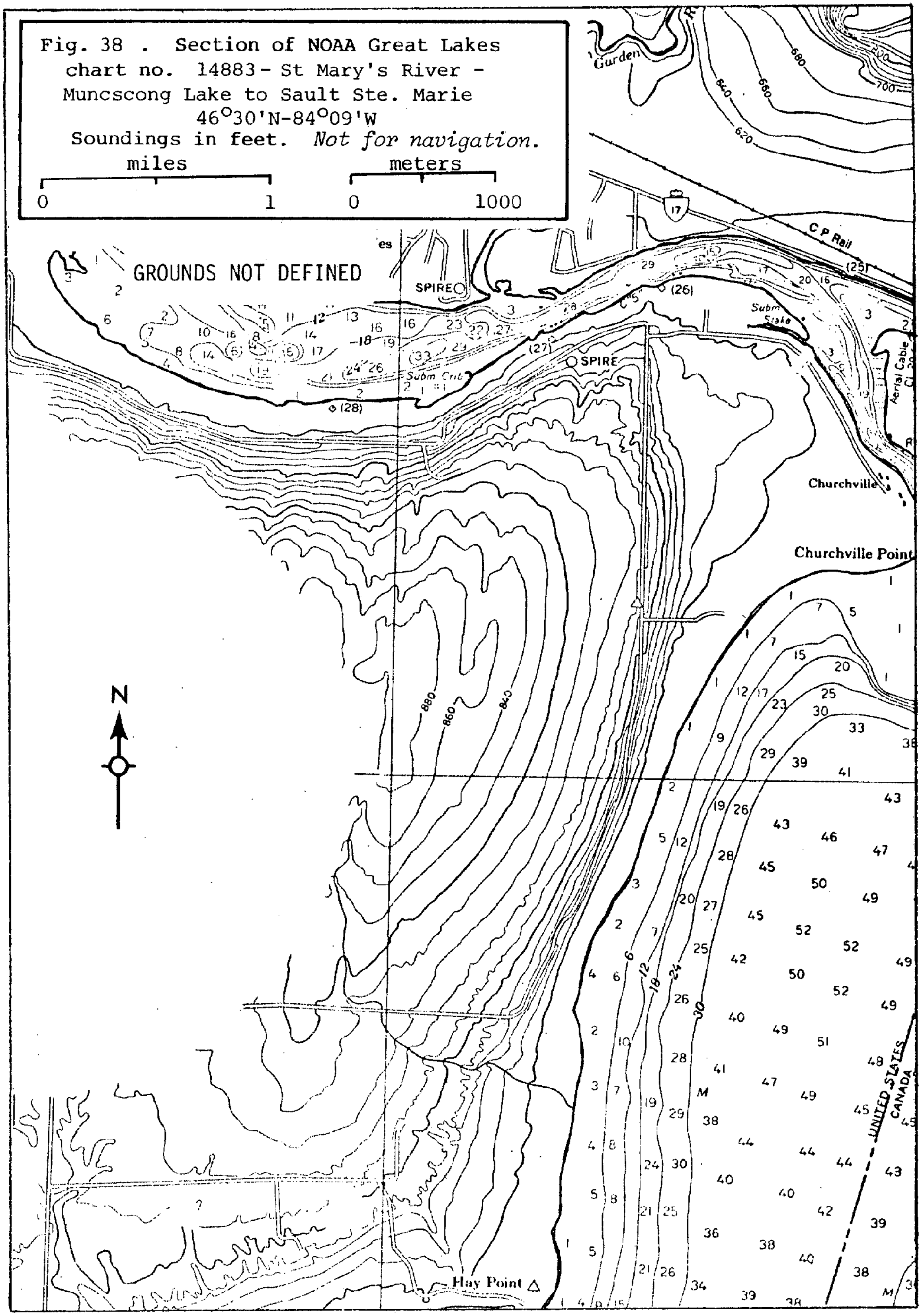



Fig. 38 . Section of NOAA Great Lakes chart no. 14883 - St Mary's River - Muncscong Lake to Sault Ste. Marie $46^{o}30'N-84^{o}09'W$
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

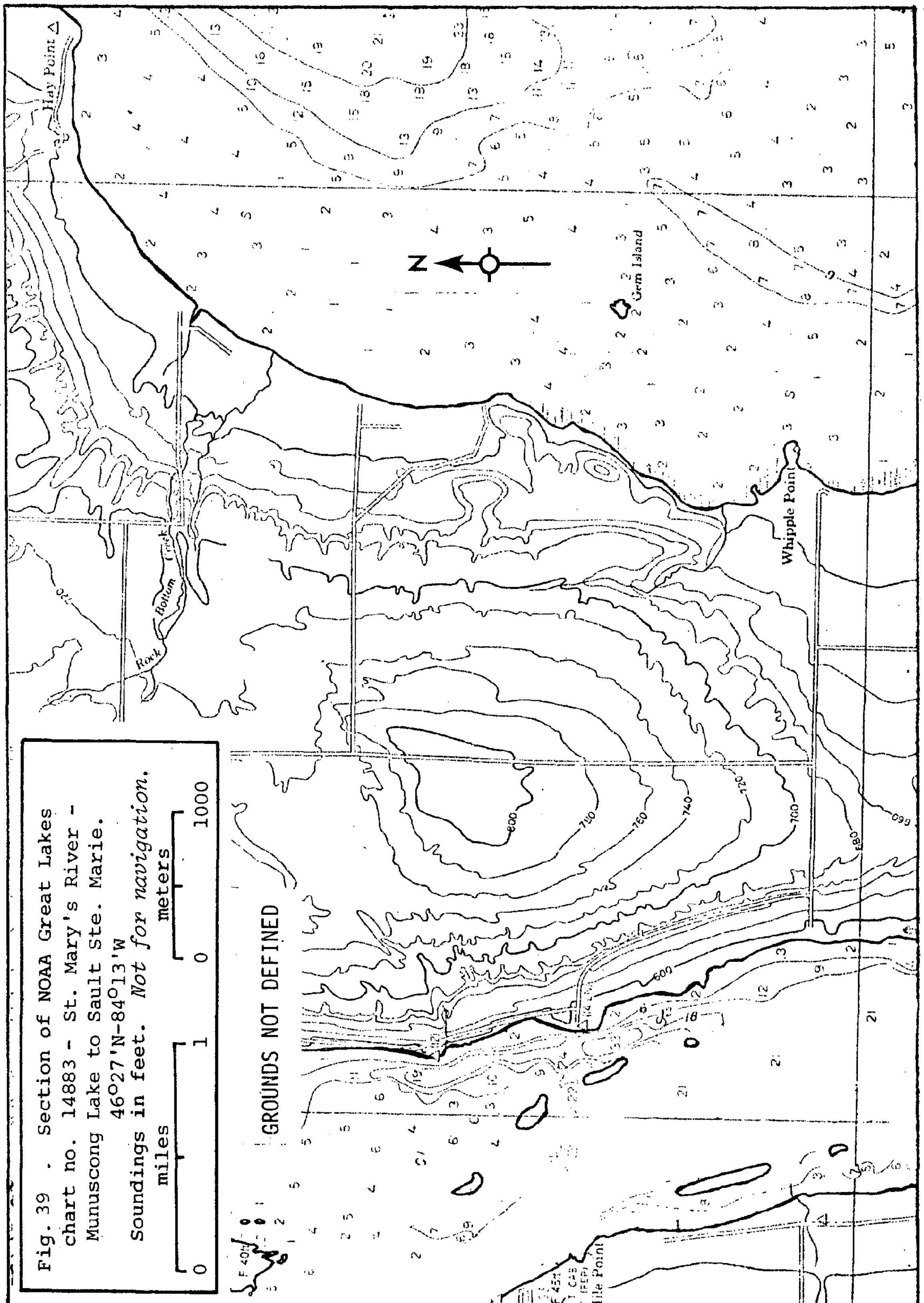



Fig. 39 . Section of NOAA Great Lakes chart no. 14883 - St. Mary's River - Munuscong Lake to Sault Ste. Marie. 46°27'N-84°13'W Soundings in feet. *Not for navigation.*

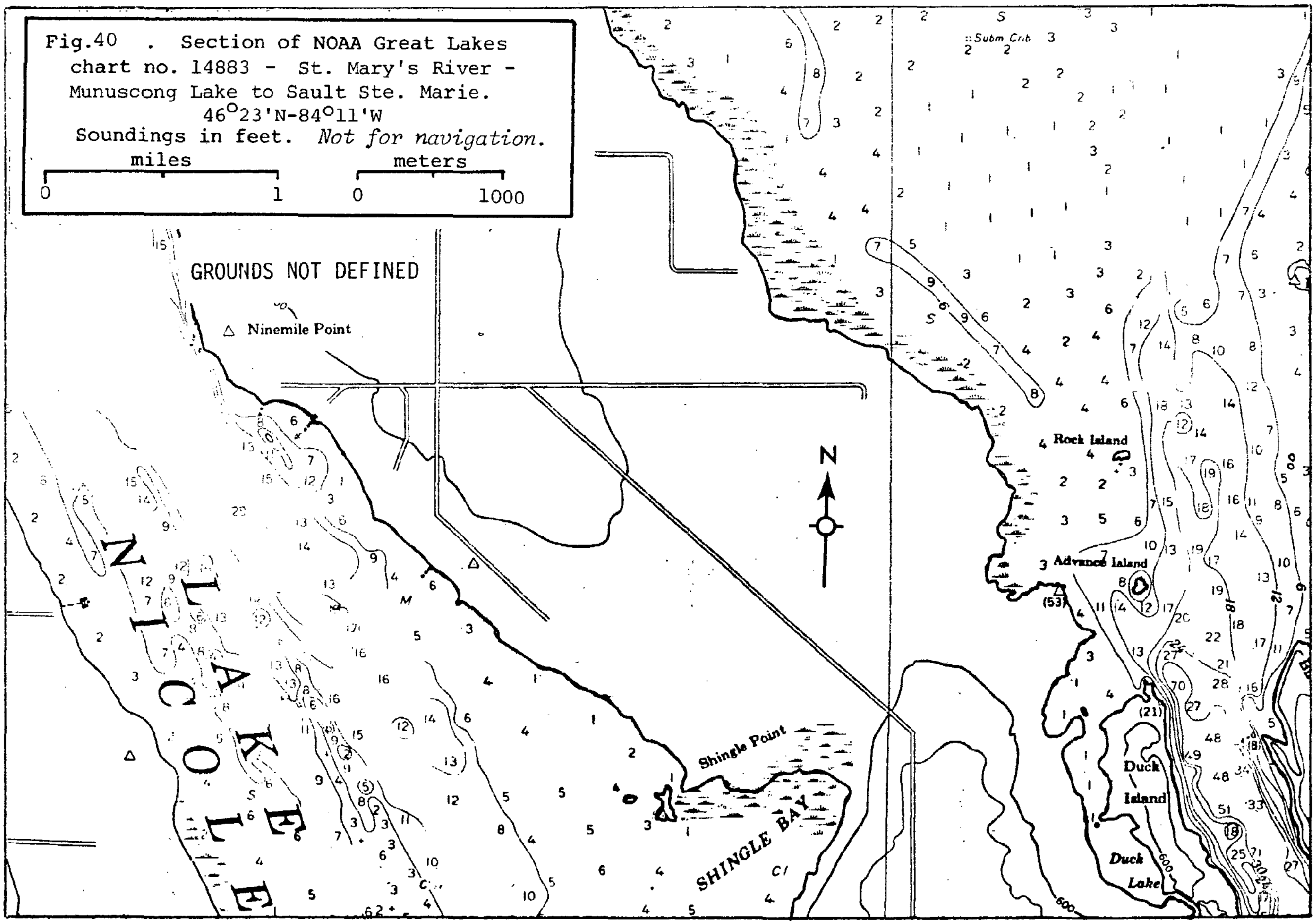



Fig.40 . Section of NOAA Great Lakes chart no. 14883 - St. Mary's River - Munuscong Lake to Sault Ste. Marie. 46°23'N-84°11'W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

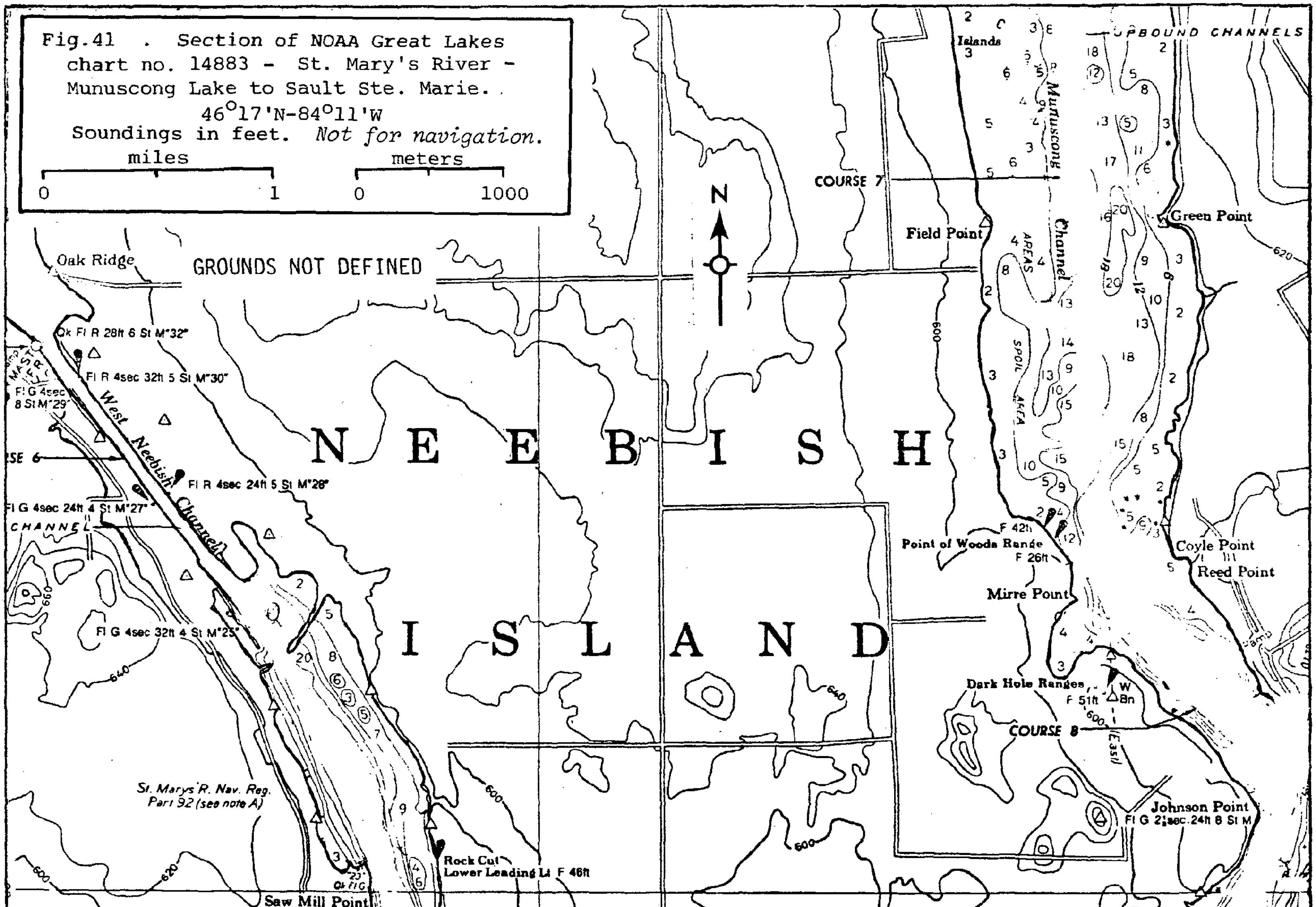



Fig.41 . Section of NOAA Great Lakes chart no. 14883 - St. Mary's River - Munuscong Lake to Sault Ste. Marie. $46^{\circ}17'$N-$84^{\circ}11'$W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

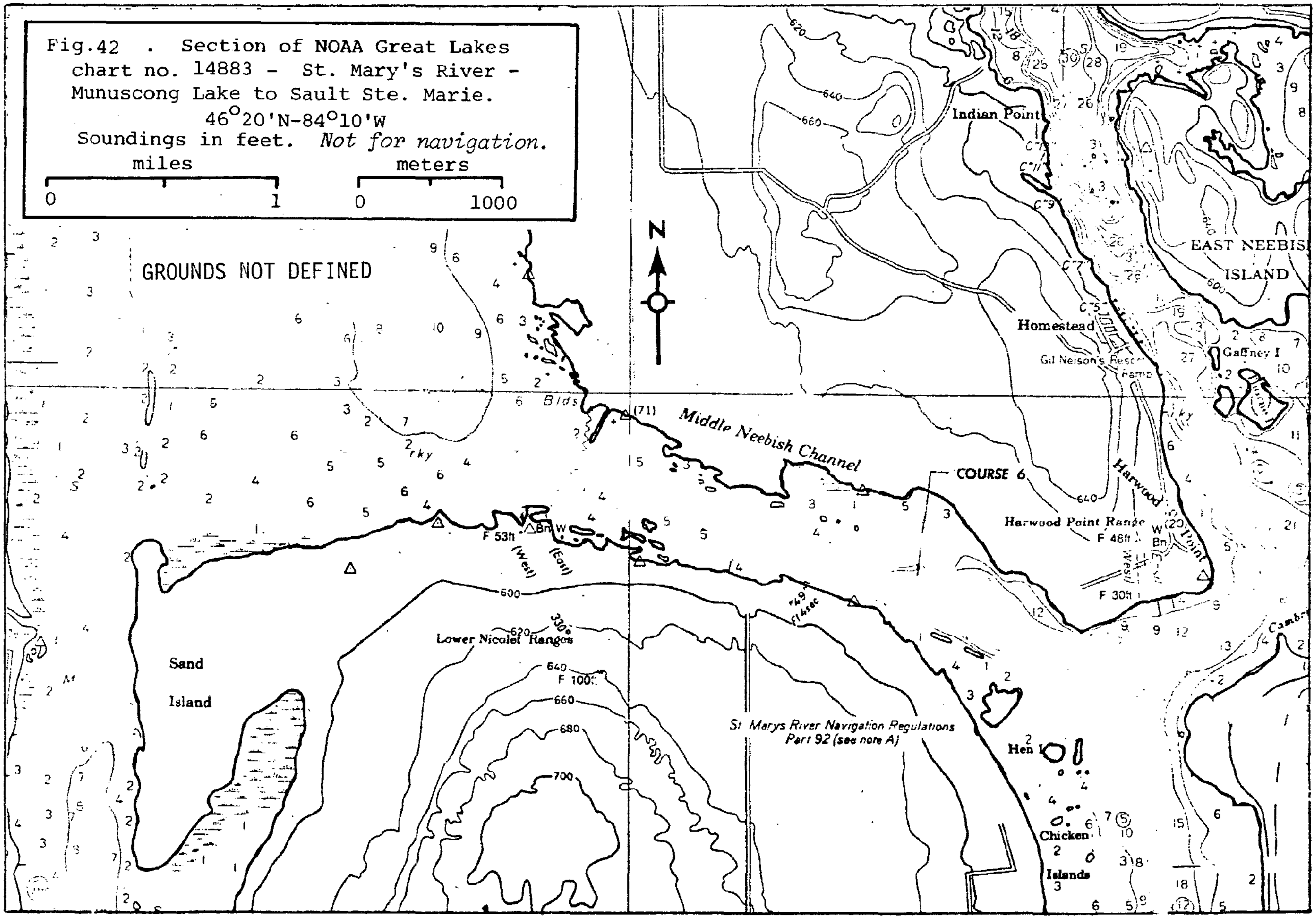



Fig.42 . Section of NOAA Great Lakes chart no. 14883 - St. Mary's River - Munuscong Lake to Sault Ste. Marie.
46°20'N-84°10'W
Soundings in feet. *Not for navigation.*

miles: 0 – 1 meters: 0 – 1000

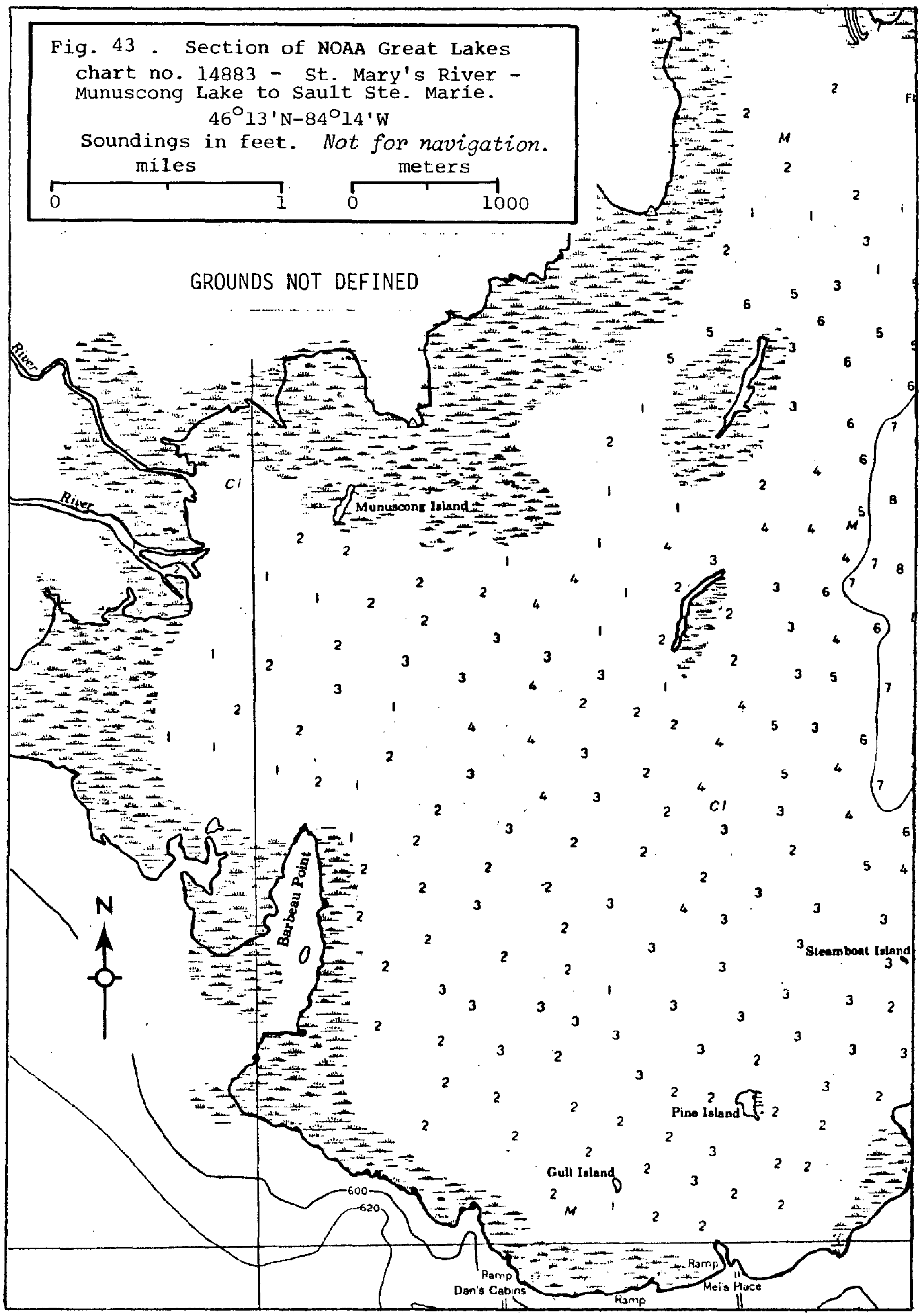


Fig. 43 . Section of NOAA Great Lakes chart no. 14883 - St. Mary's River - Munuscong Lake to Sault Ste. Marie.
46°13'N-84°14'W
Soundings in feet. Not for navigation.
miles
0
1
meters
0
1000
GROUNDS NOT DEFINED
Munuscong Island
Barbeau Point
Steamboat Island
Pine Island
Gull Island
River
River
N
Ramp
Dan's Cabins
Ramp
Ramp
Mel's Place
600
620

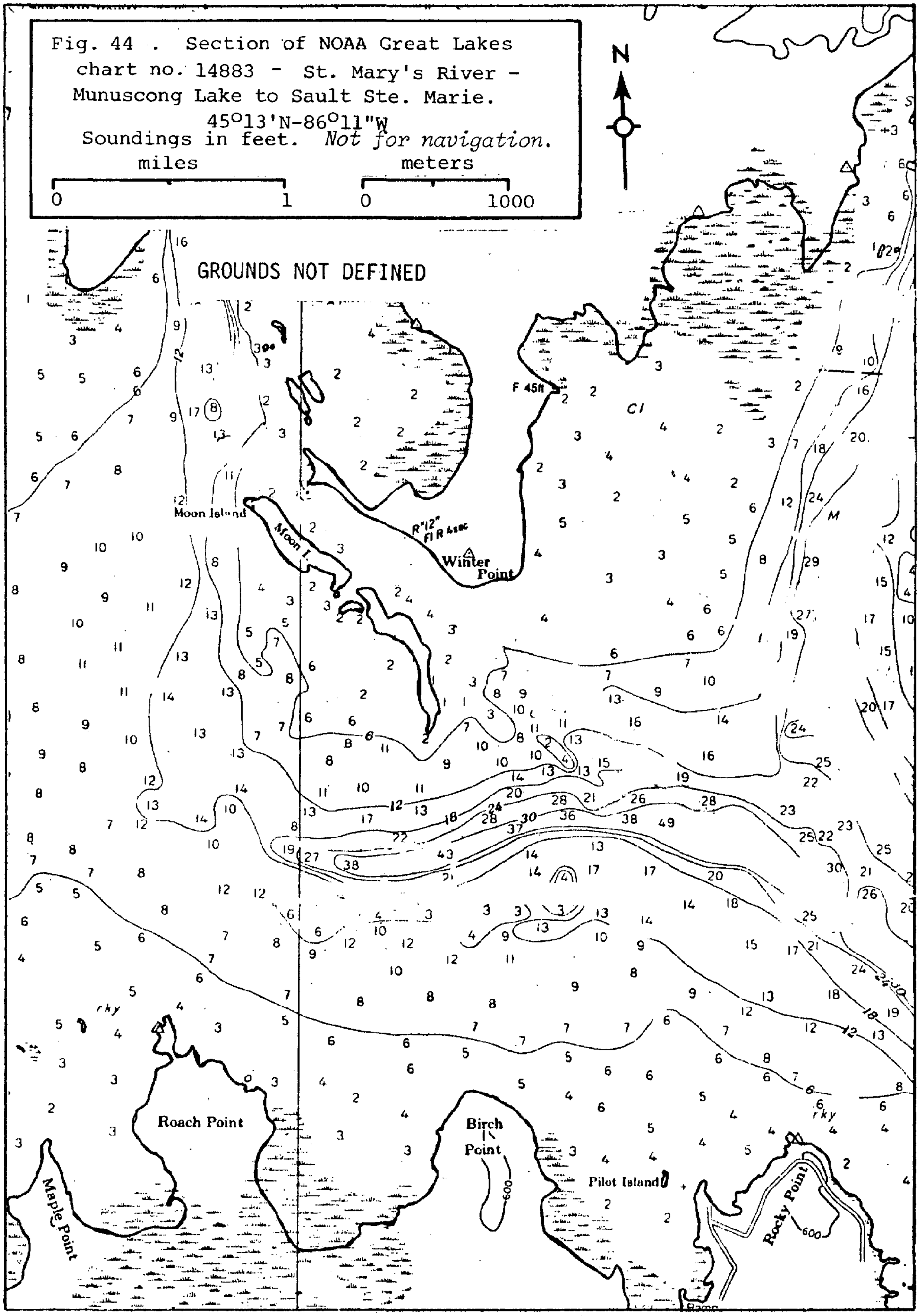



Fig. 44 . Section of NOAA Great Lakes chart no. 14883 - St. Mary's River - Munuscong Lake to Sault Ste. Marie. 45°13'N-86°11"W Soundings in feet. *Not for navigation.*

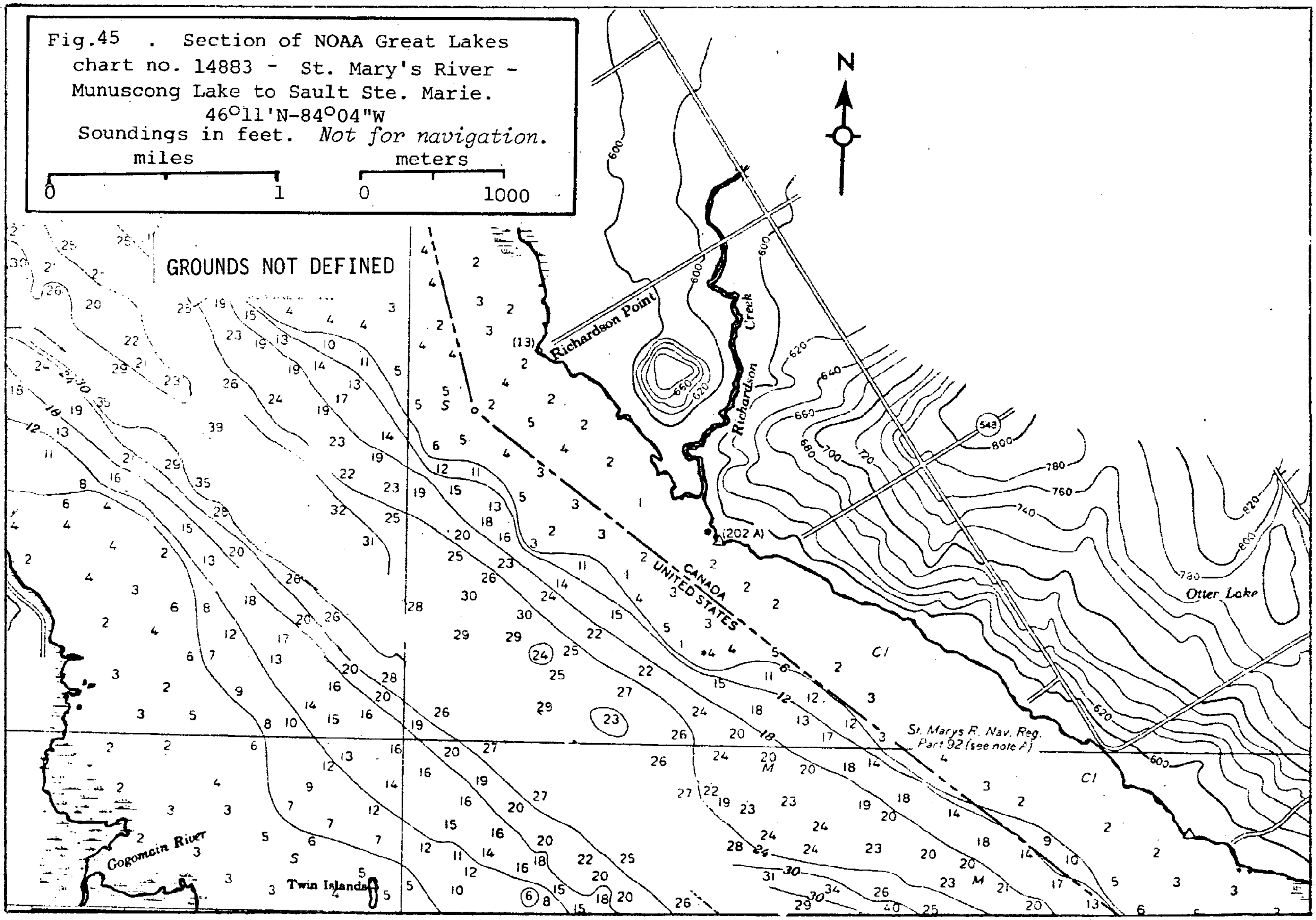



Fig.45 . Section of NOAA Great Lakes chart no. 14883 - St. Mary's River - Munuscong Lake to Sault Ste. Marie. 46°11'N-84°04"W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

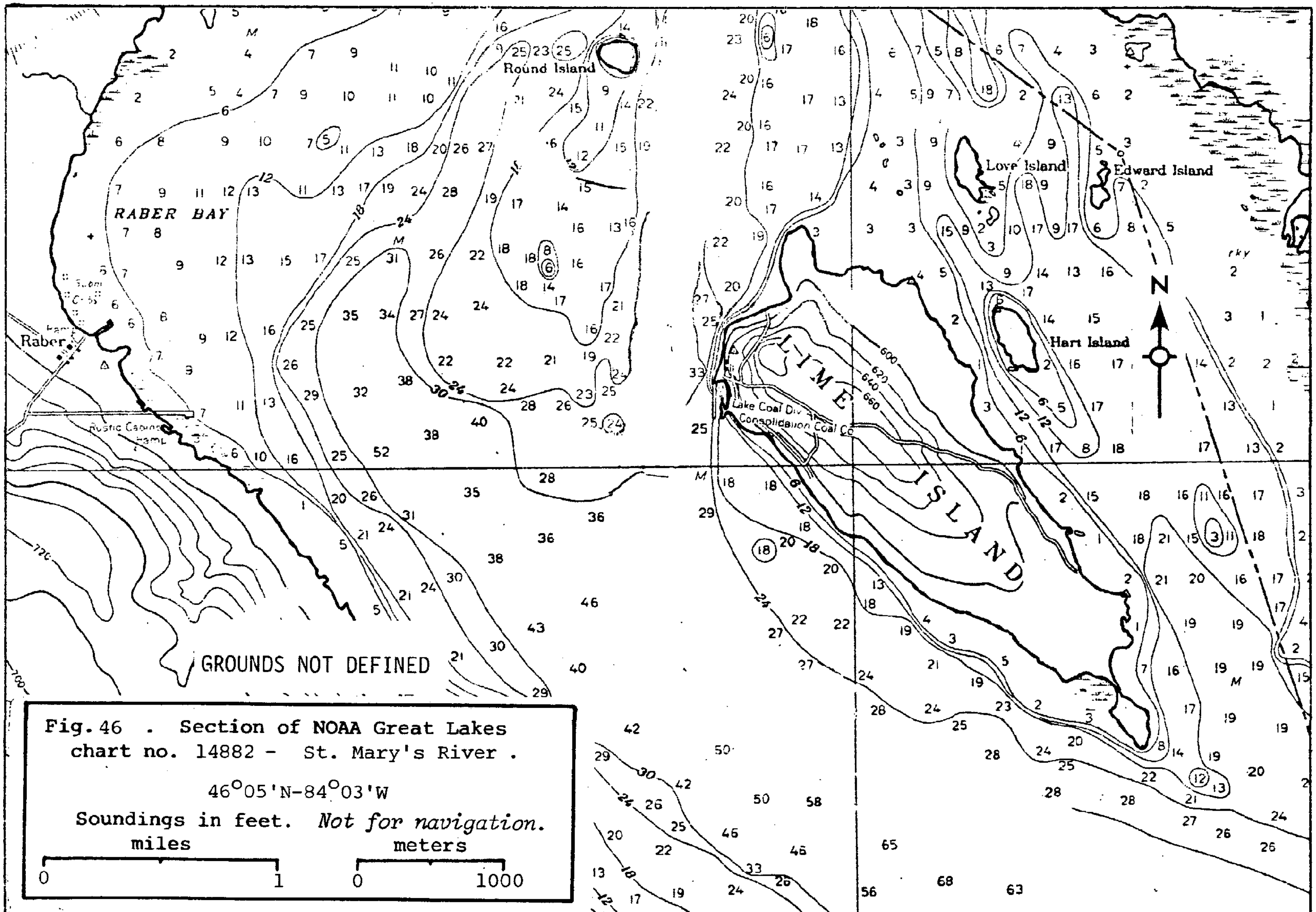



Fig. 46 . Section of NOAA Great Lakes chart no. 14882 - St. Mary's River .

46°05'N-84°03'W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

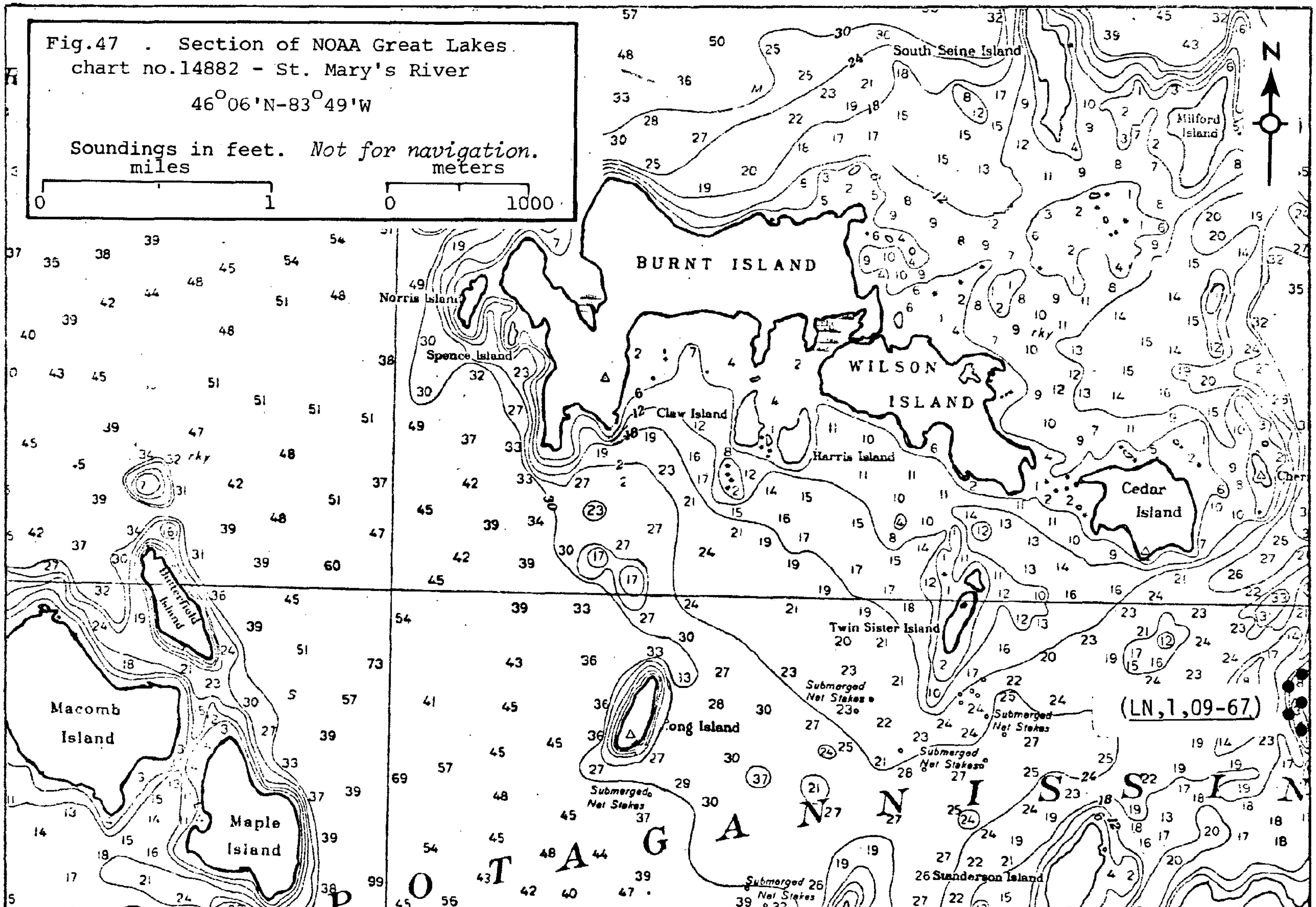



Fig.47 . Section of NOAA Great Lakes chart no.14882 - St. Mary's River
$46^{\circ}06'N-83^{\circ}49'W$

Soundings in feet. *Not for navigation.*

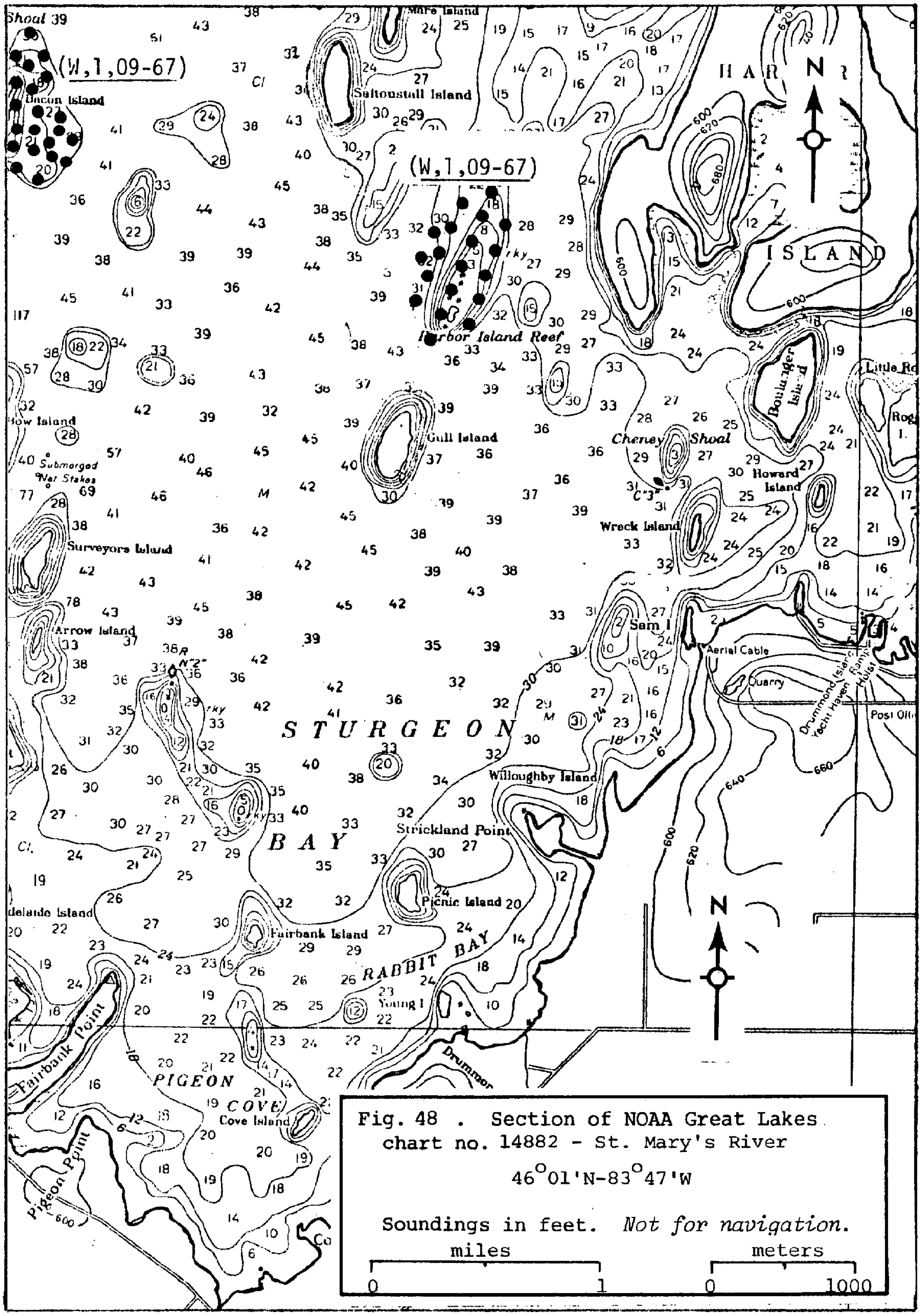



Fig. 48 . Section of NOAA Great Lakes chart no. 14882 - St. Mary's River

46°01'N-83°47'W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

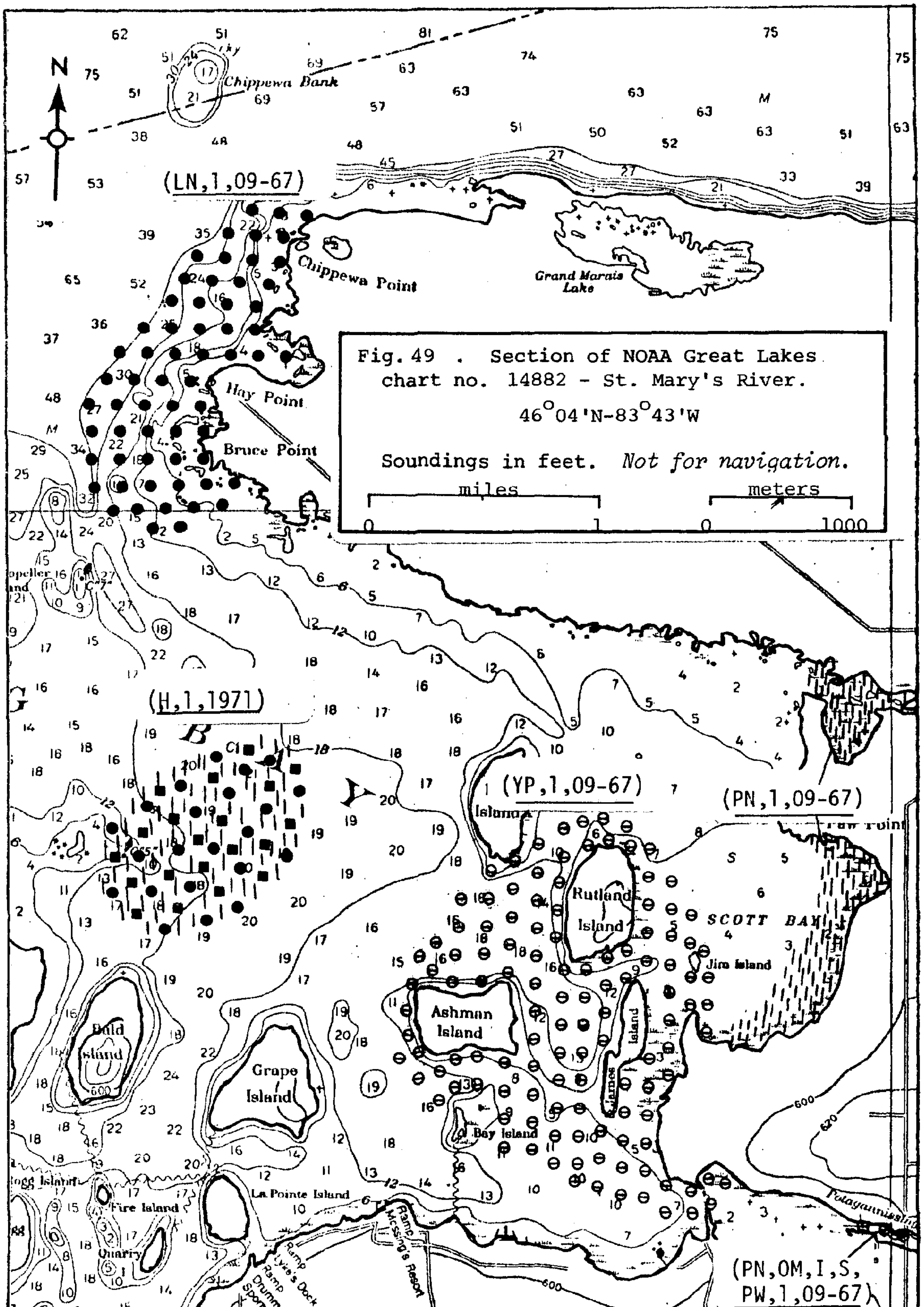



Fig. 49 . Section of NOAA Great Lakes chart no. 14882 - St. Mary's River.
46°04'N-83°43'W

Soundings in feet. *Not for navigation.*

miles 0 1    meters 0 1000

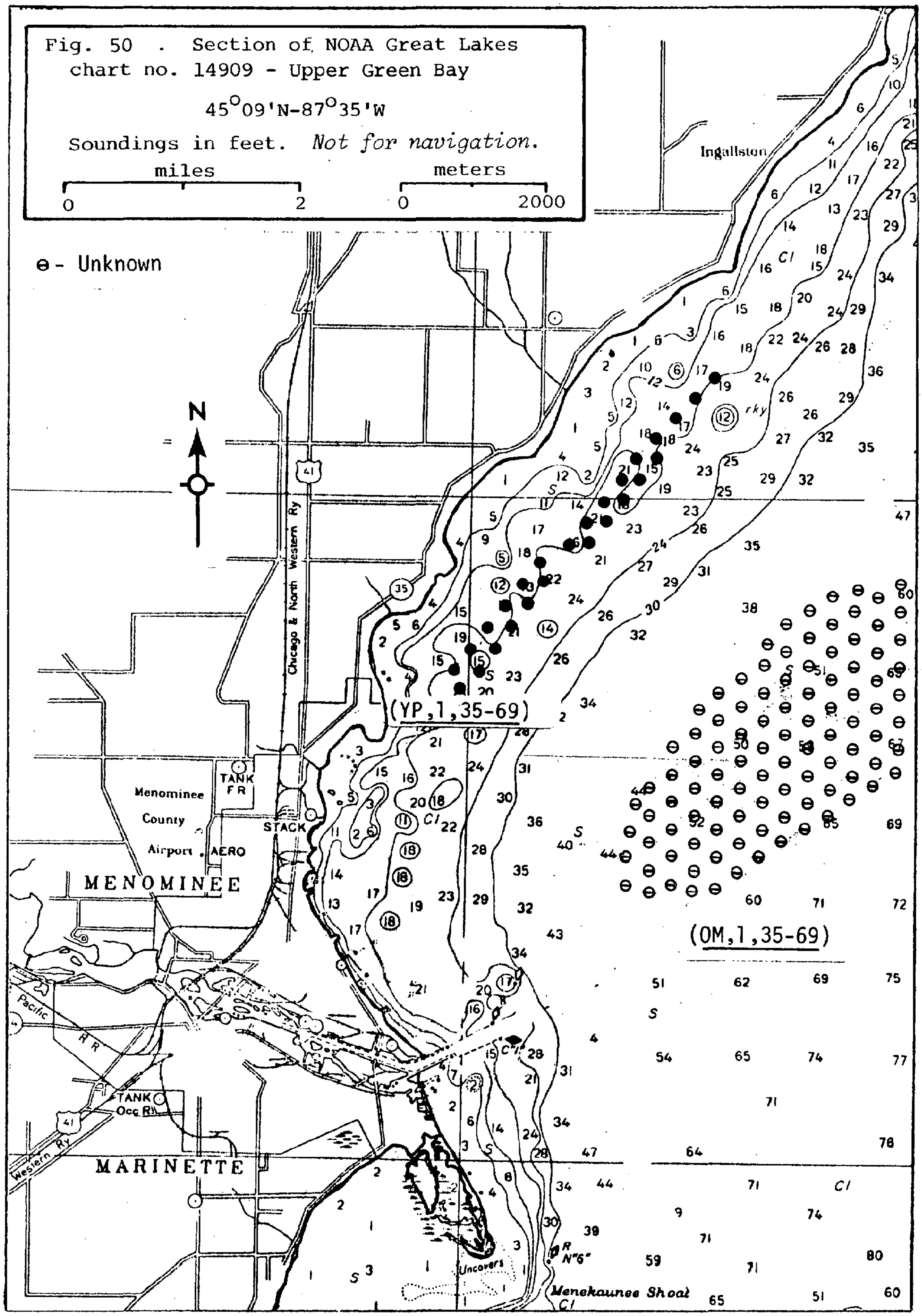


Fig. 50 . Section of NOAA Great Lakes chart no. 14909 - Upper Green Bay
45°09'N-87°35'W
Soundings in feet. Not for navigation.
miles
0
2
meters
0
2000
⊖ - Unknown
N
Ingallston
Chicago & North Western Ry
(YP,1,35-69)
(OM,1,35-69)
Menominee County Airport
AERO
TANK FR
STACK
MENOMINEE
MARINETTE
TANK Occ Ry
Pacific R R
Western Ry
Menekaunee Shoal
Uncovers

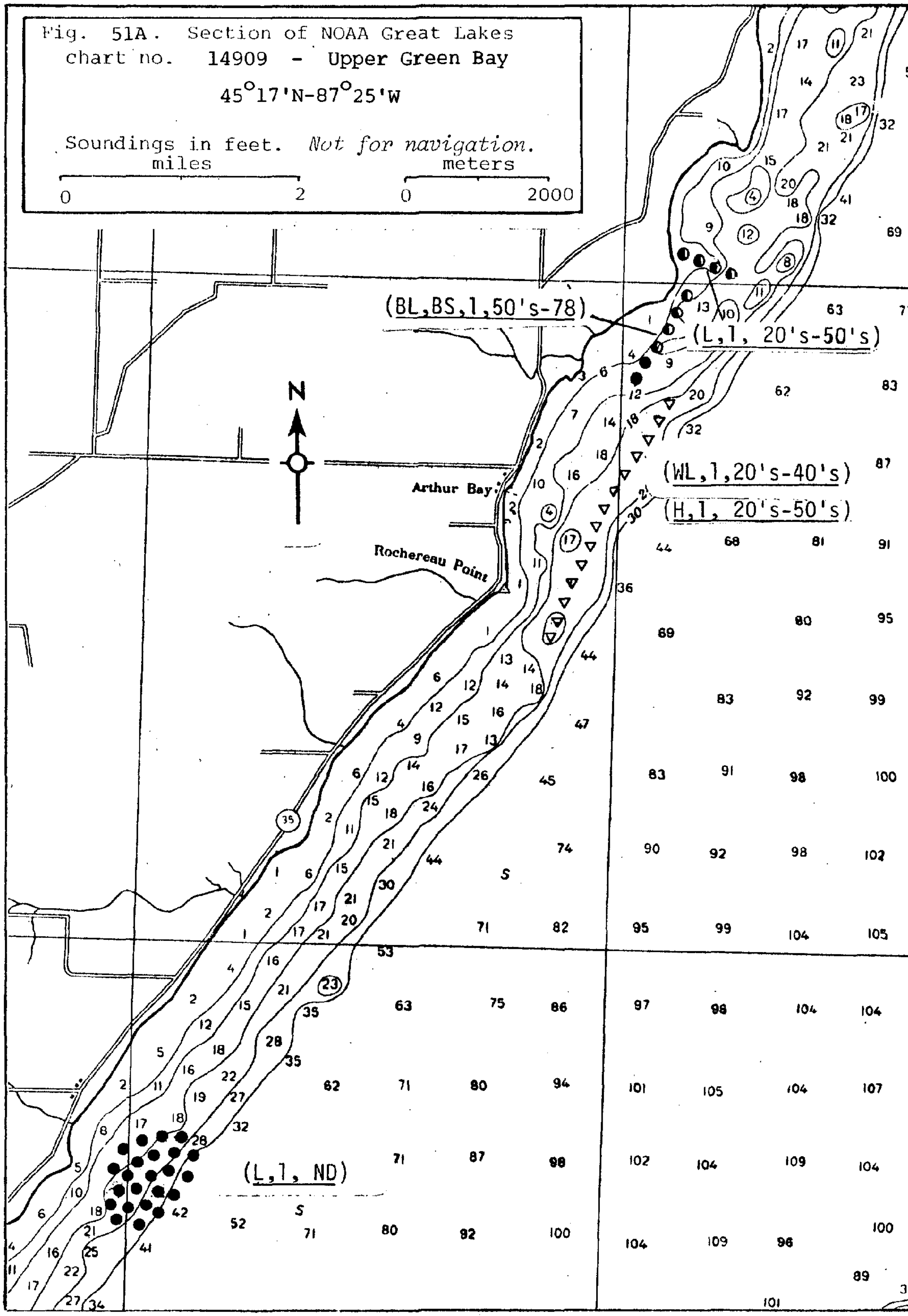



Fig. 51A. Section of NOAA Great Lakes chart no. 14909 - Upper Green Bay
45°17'N-87°25'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

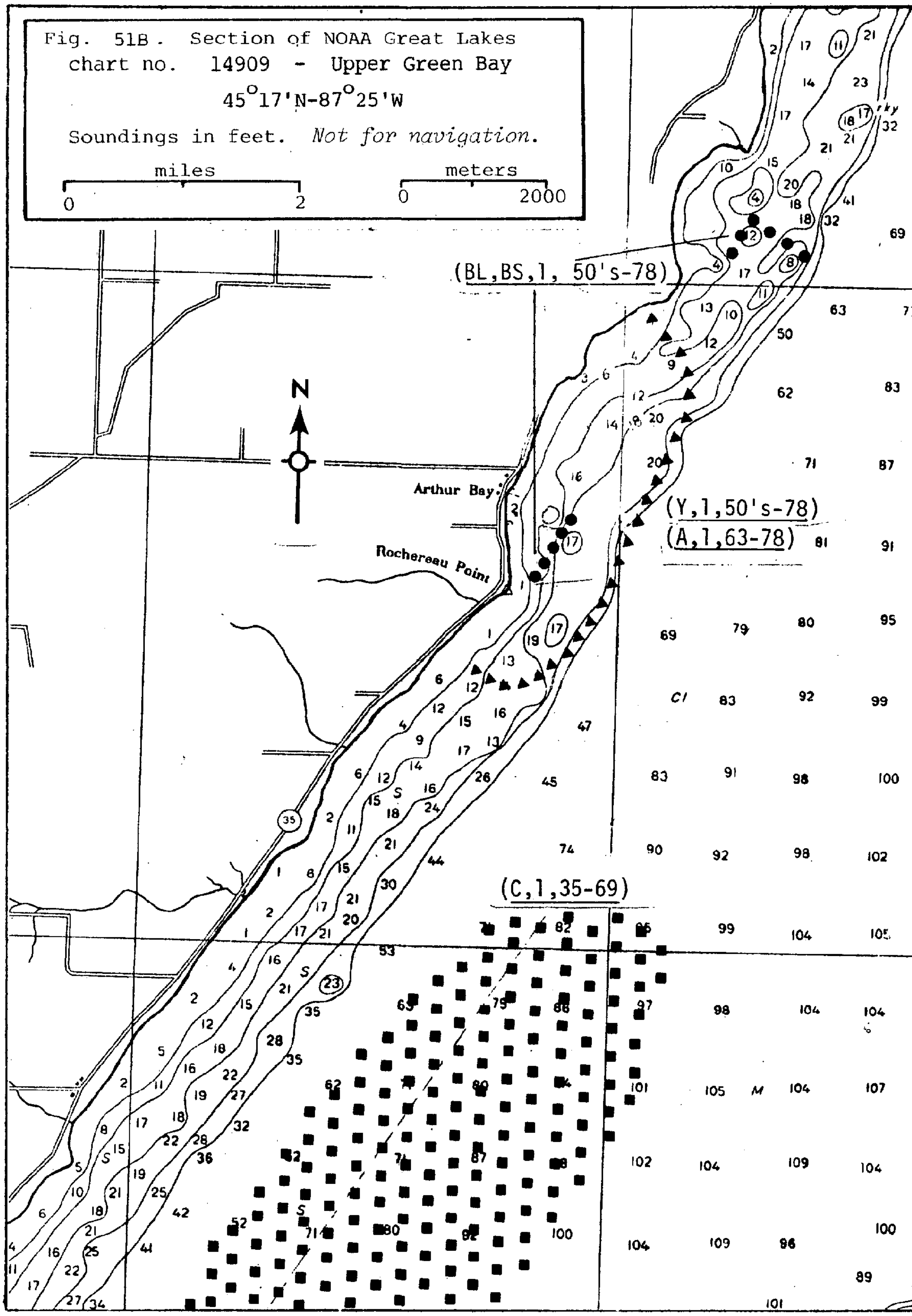



Fig. 51B. Section of NOAA Great Lakes chart no. 14909 - Upper Green Bay 45°17'N-87°25'W

Soundings in feet. *Not for navigation.*

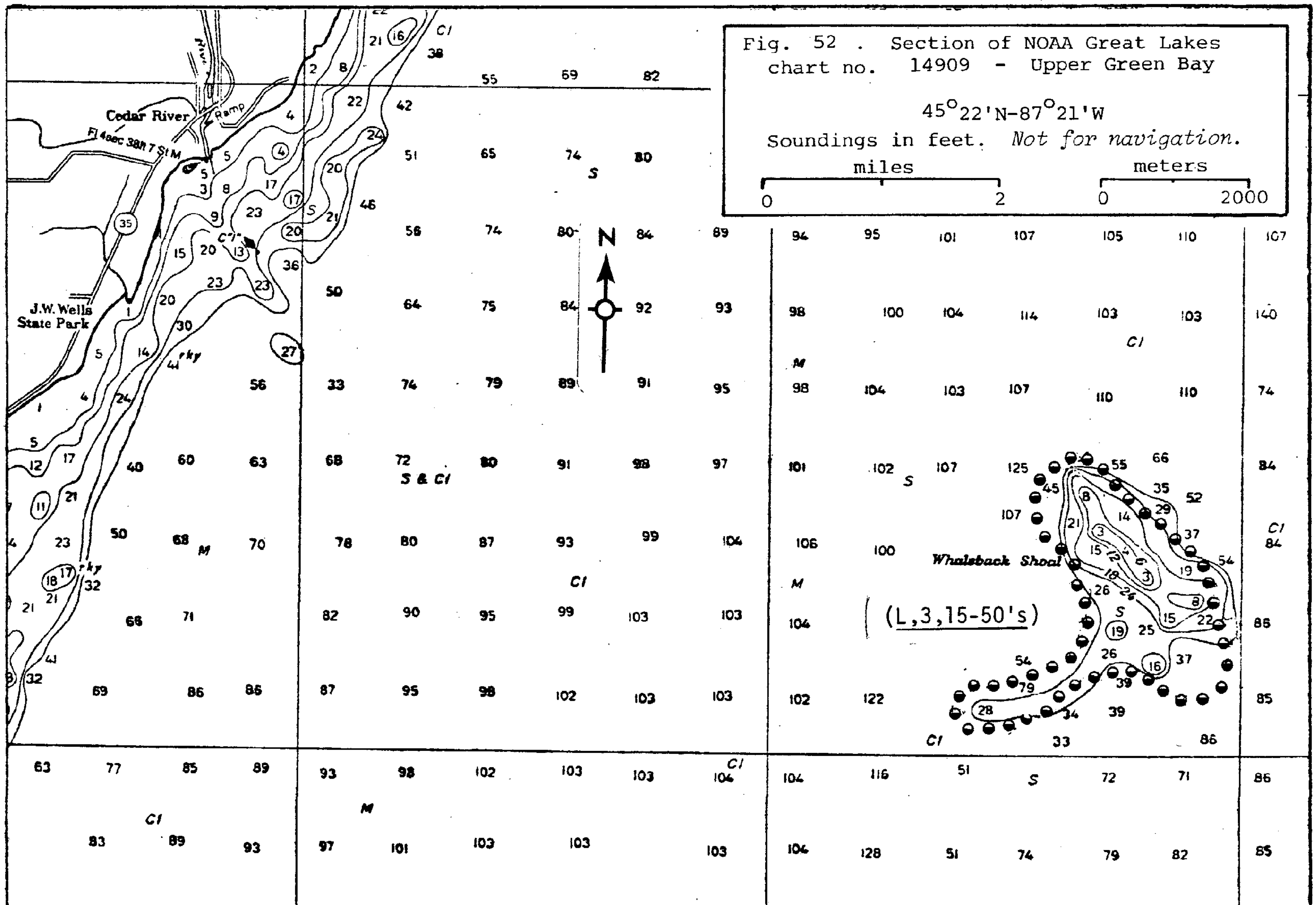



Fig. 52 . Section of NOAA Great Lakes chart no. 14909 - Upper Green Bay

$45^{\circ}22'$N-$87^{\circ}21'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

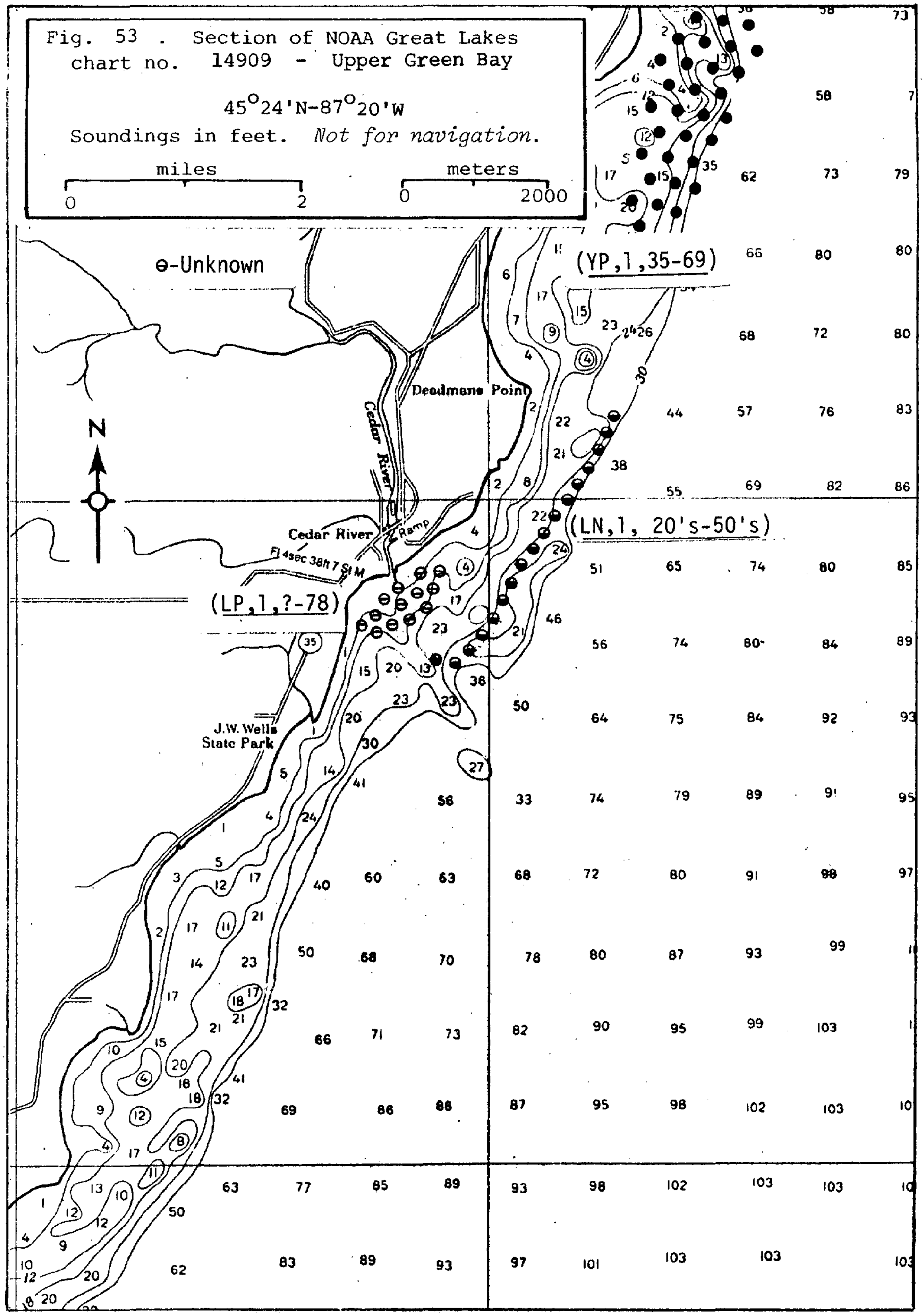



Fig. 53 . Section of NOAA Great Lakes chart no. 14909 - Upper Green Bay

45°24'N-87°20'W

Soundings in feet. *Not for navigation.*

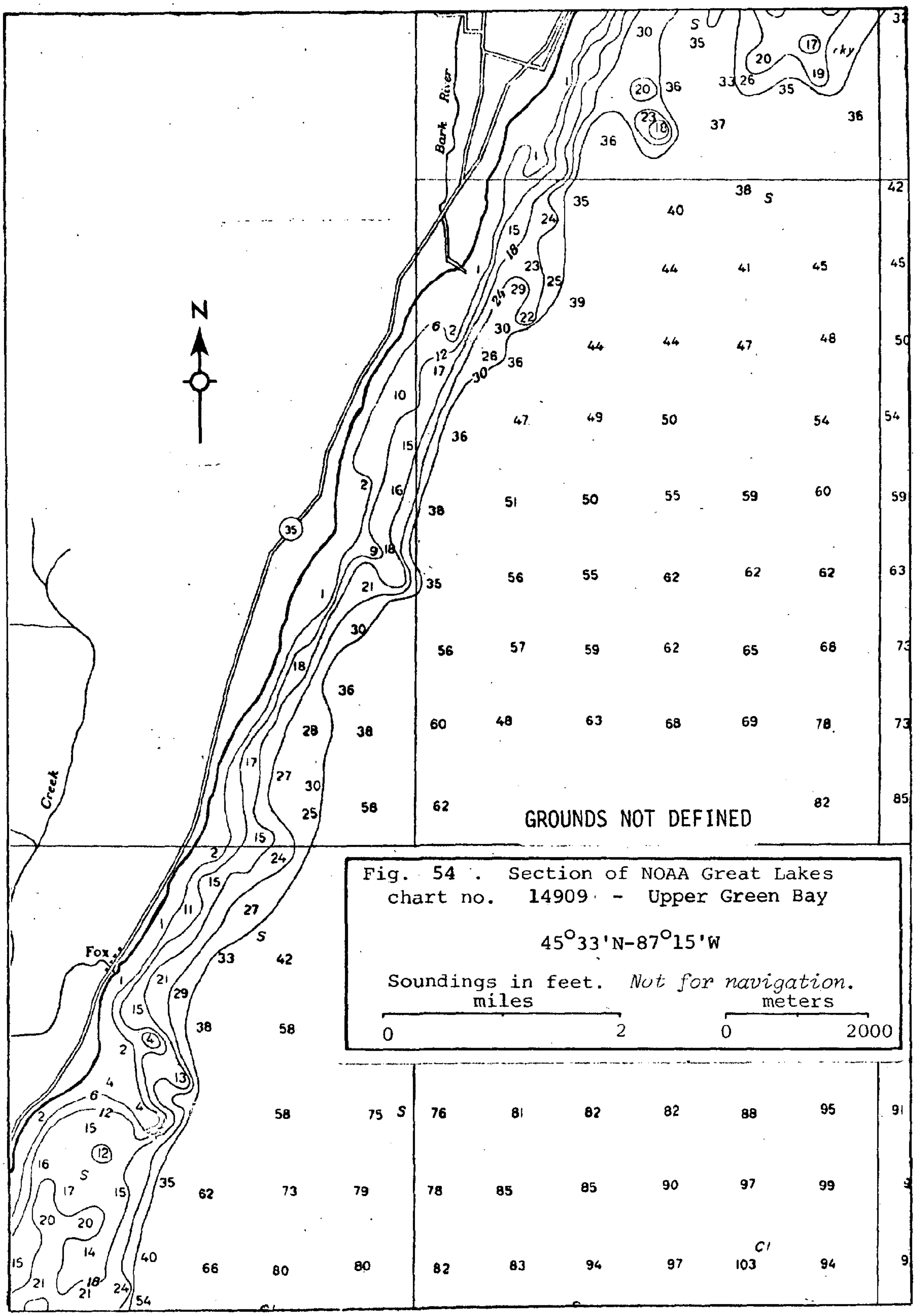



Fig. 54 . Section of NOAA Great Lakes chart no. 14909 - Upper Green Bay

$45^{\circ}33'$N-$87^{\circ}15'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

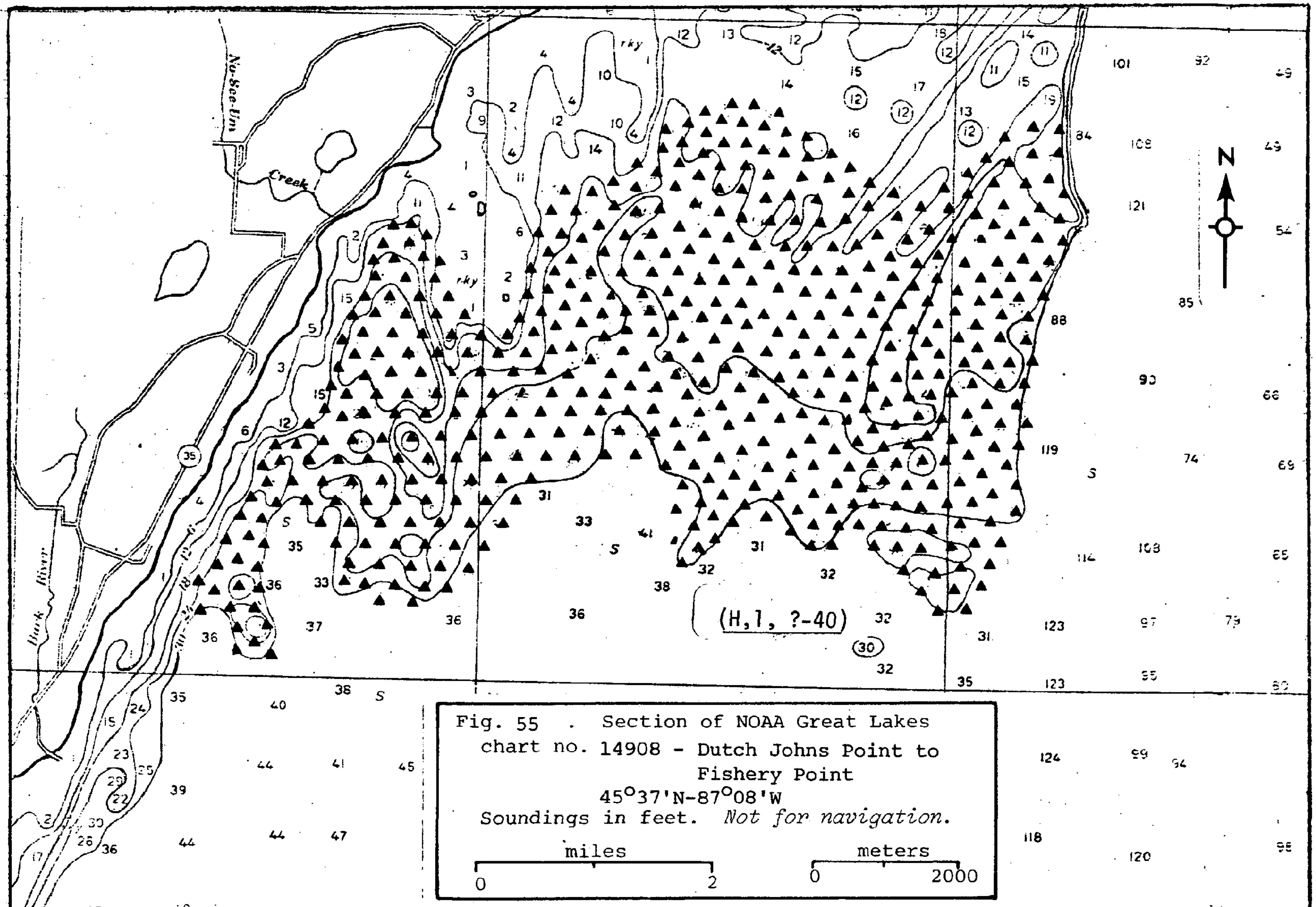



Fig. 55 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
$45^{o}37'N-87^{o}08'W$
Soundings in feet. *Not for navigation.*

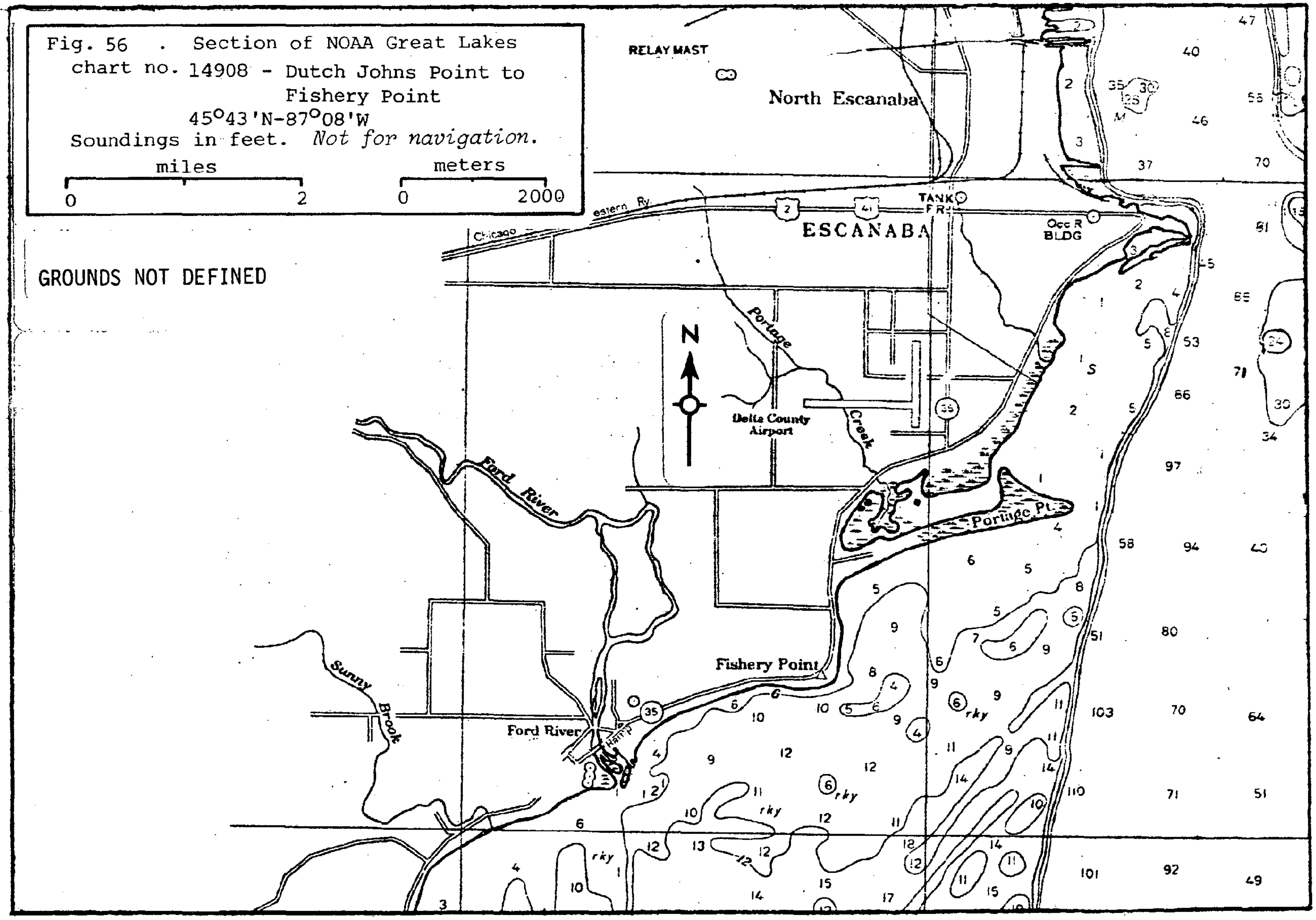



Fig. 56 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
45°43'N-87°08'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

GROUNDS NOT DEFINED

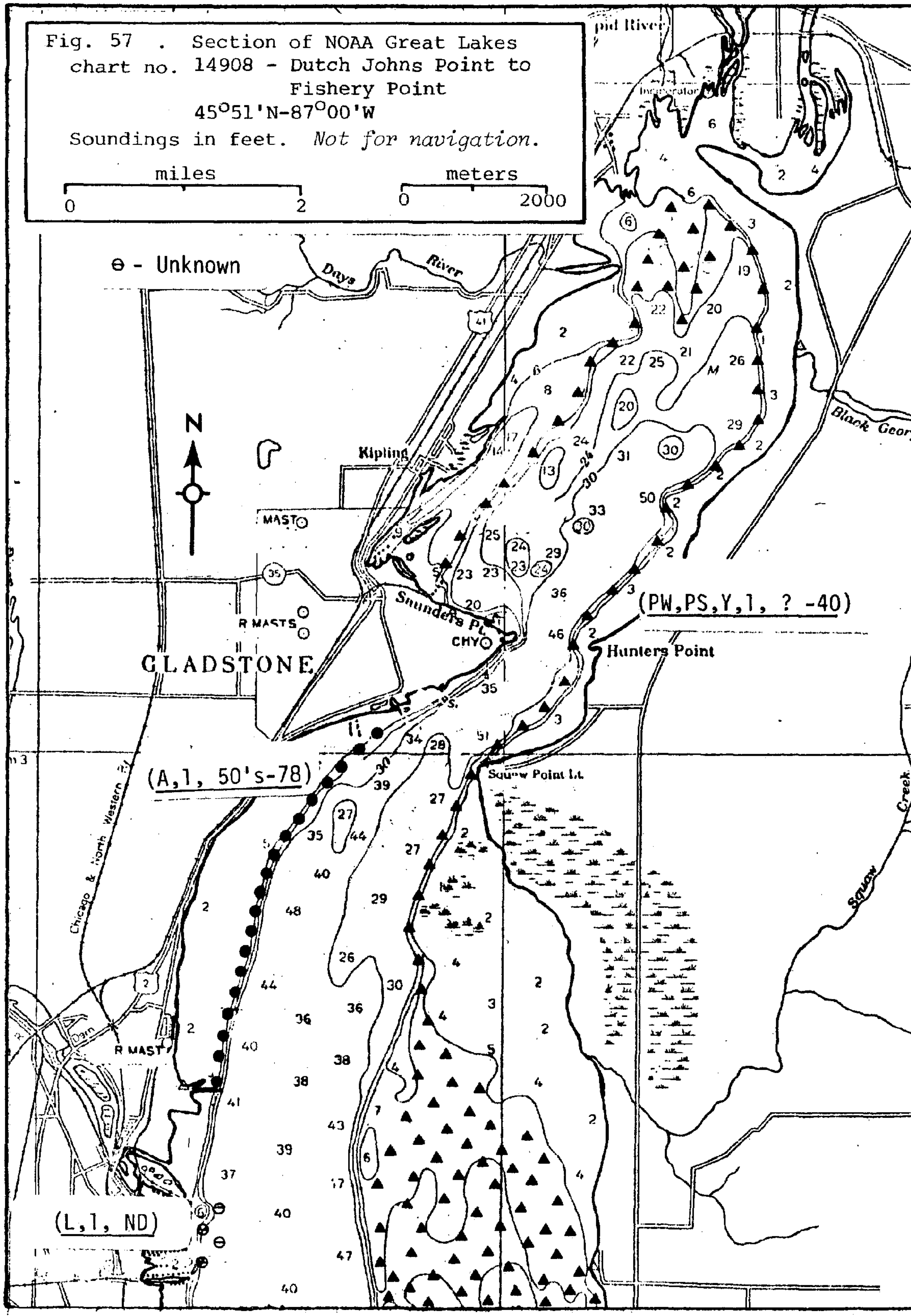



Fig. 57 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
45°51'N-87°00'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

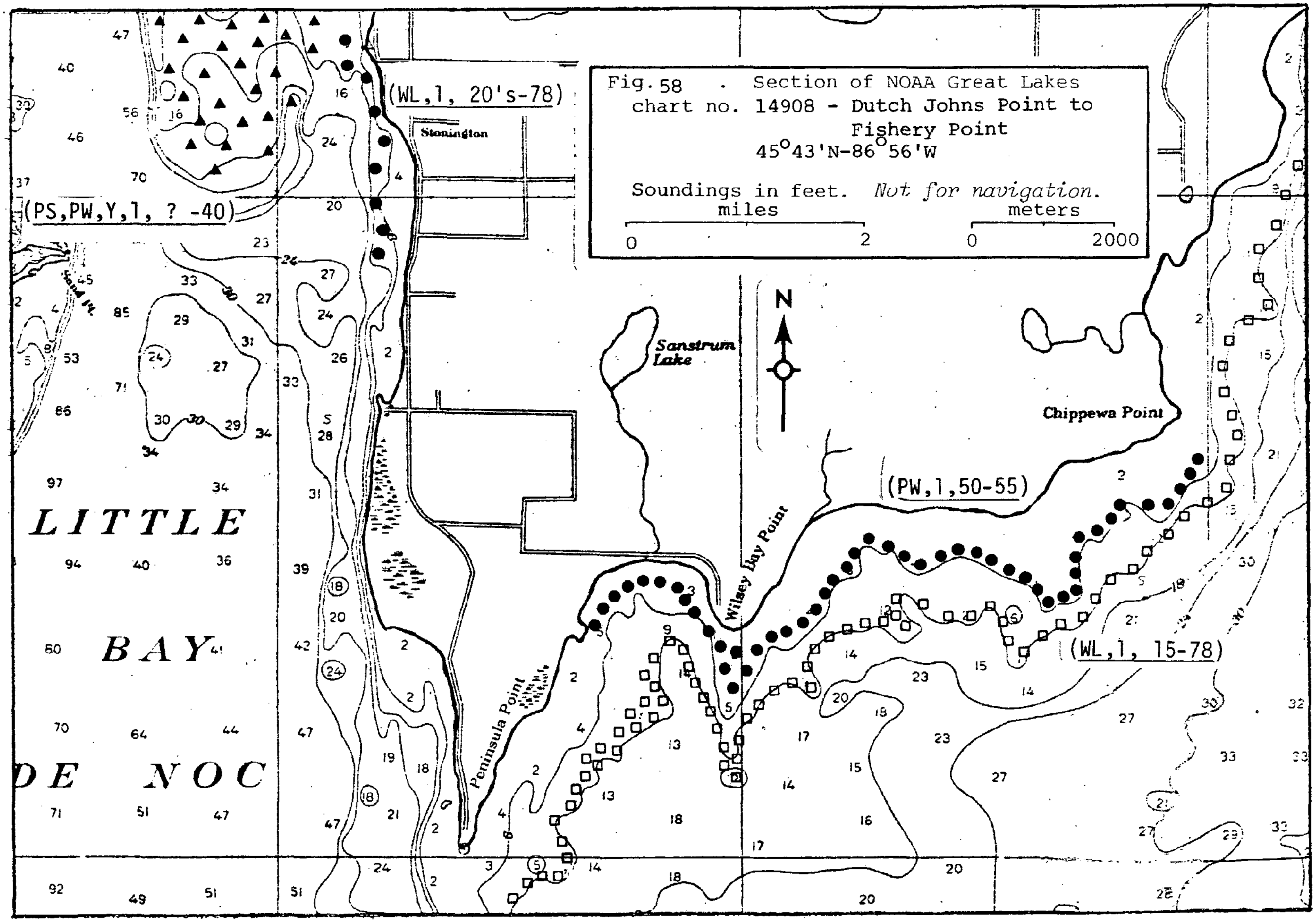



Fig. 58 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point 45°43'N-86°56'W

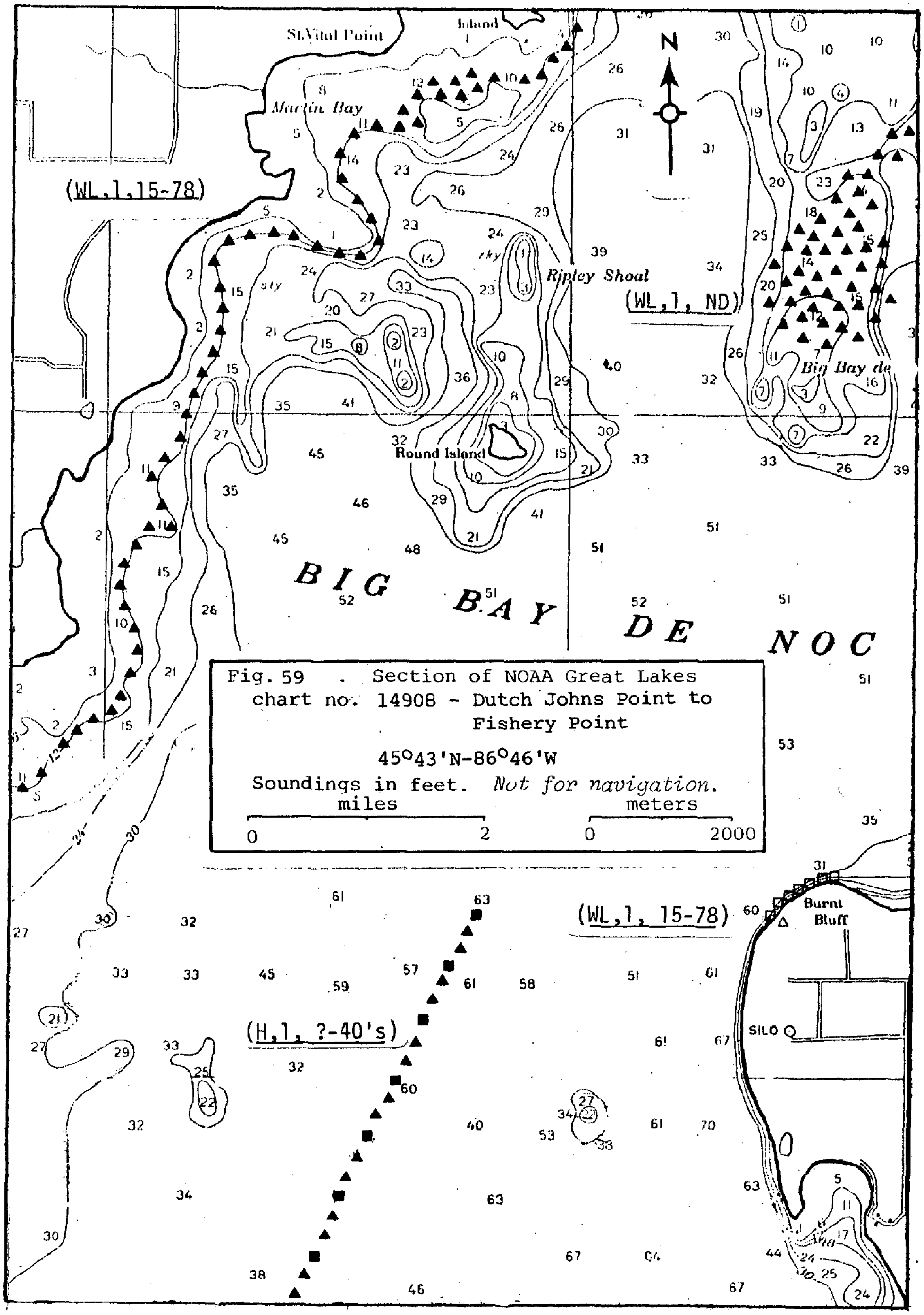



Fig. 59 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point

45°43'N-86°46'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

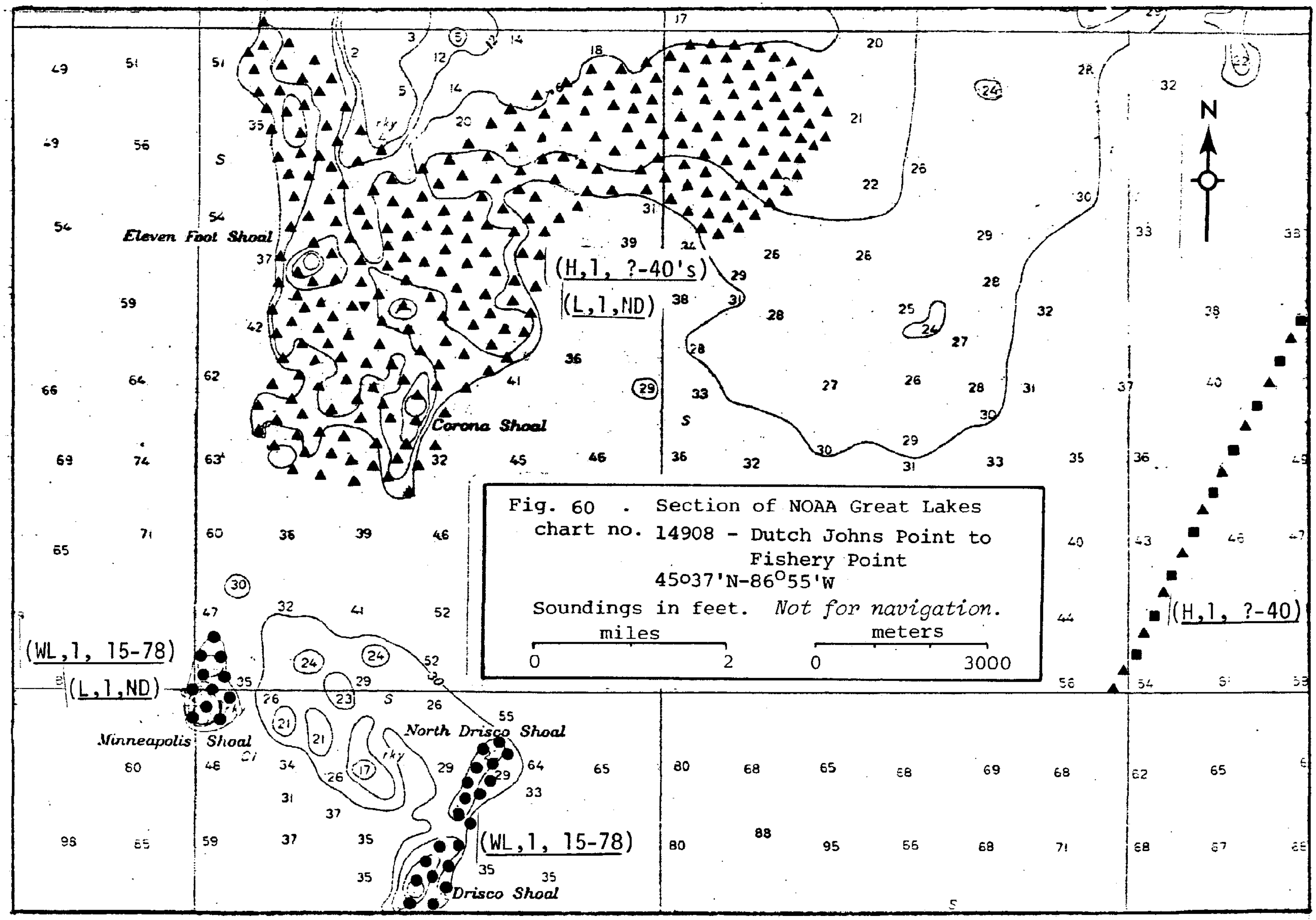



Fig. 60 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
45°37'N-86°55'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 3000

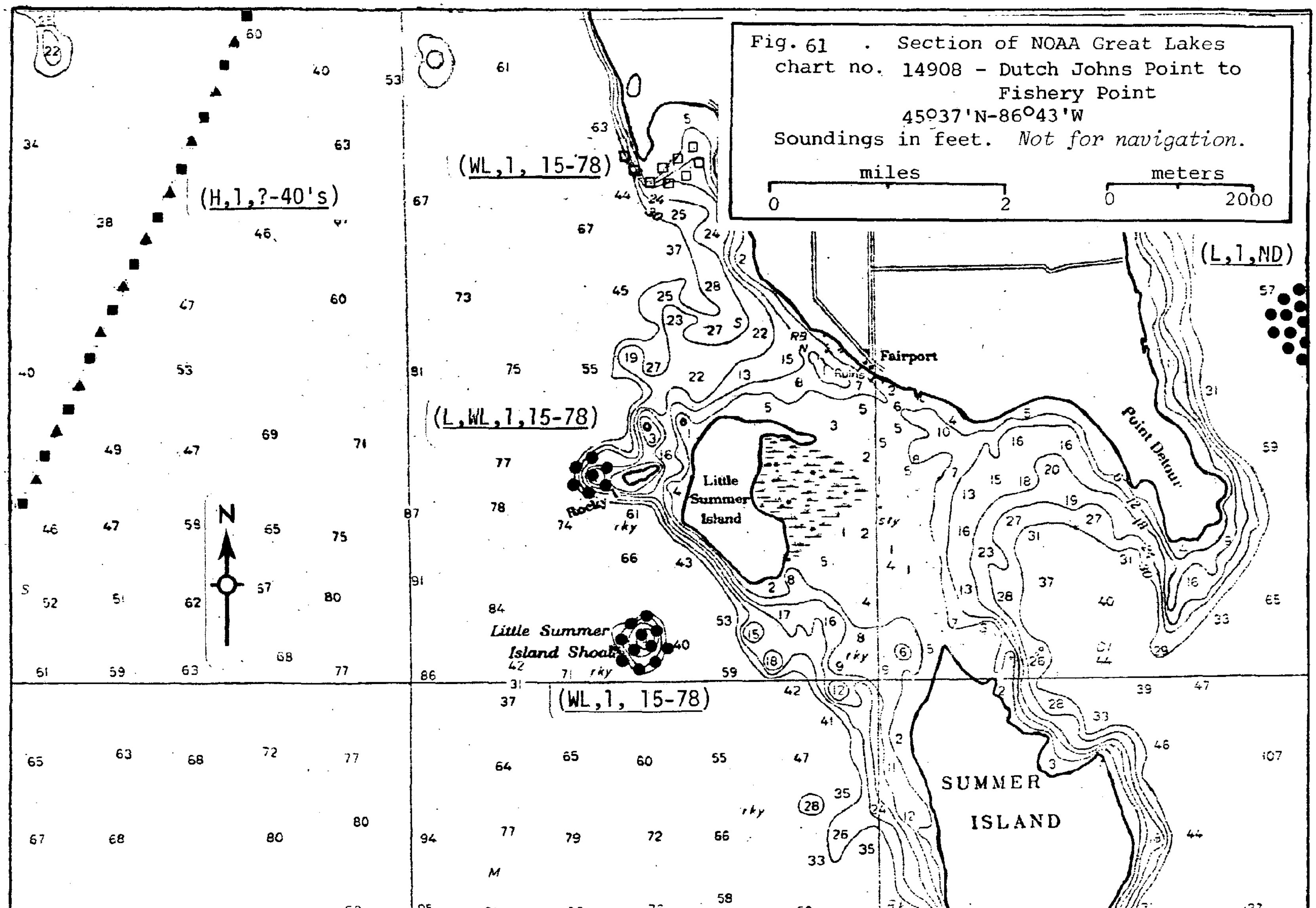



Fig. 61 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point 45°37'N-86°43'W Soundings in feet. *Not for navigation.*

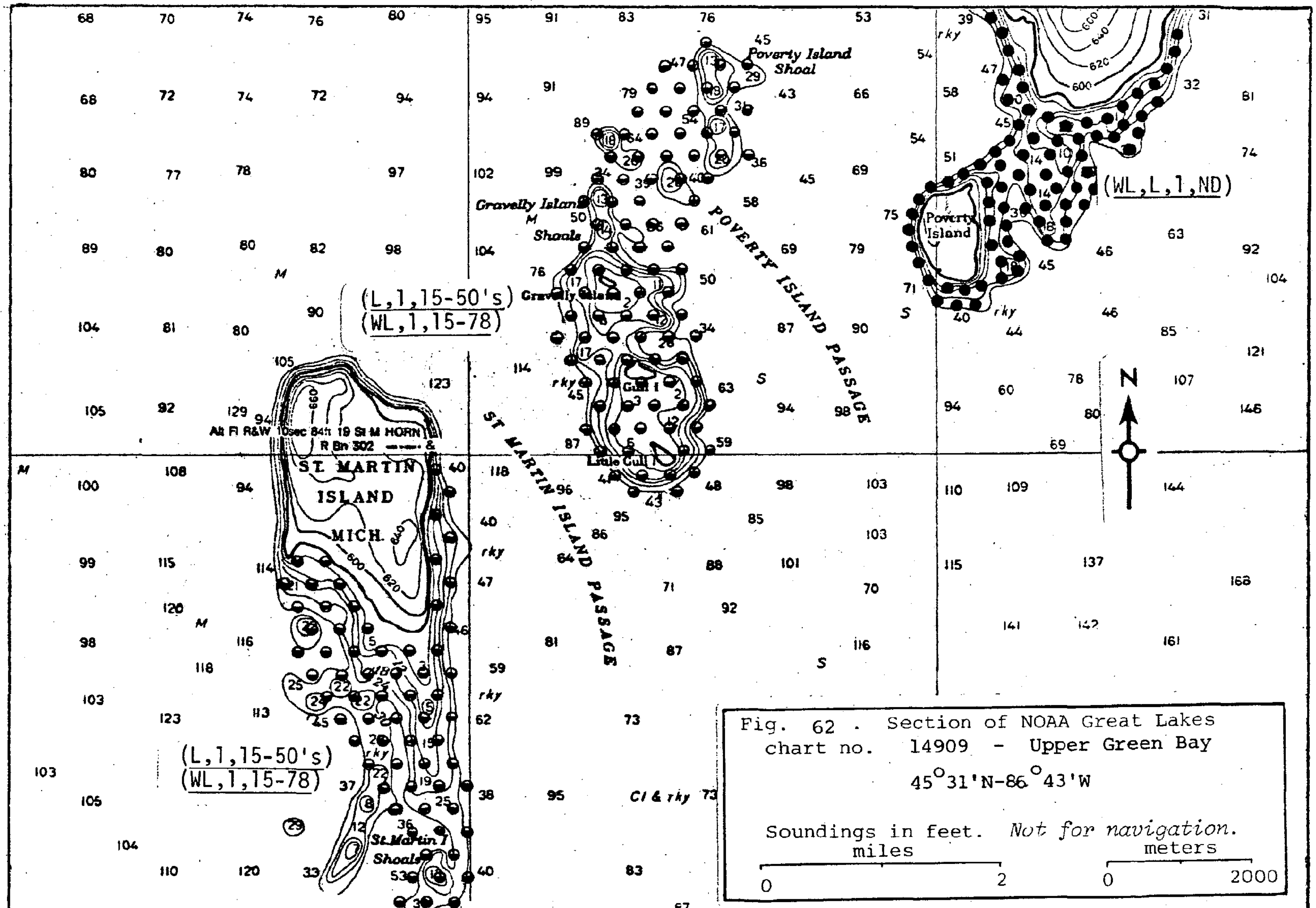



Fig. 62. Section of NOAA Great Lakes chart no. 14909 - Upper Green Bay
$45^{\circ}31'$N-$86^{\circ}43'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

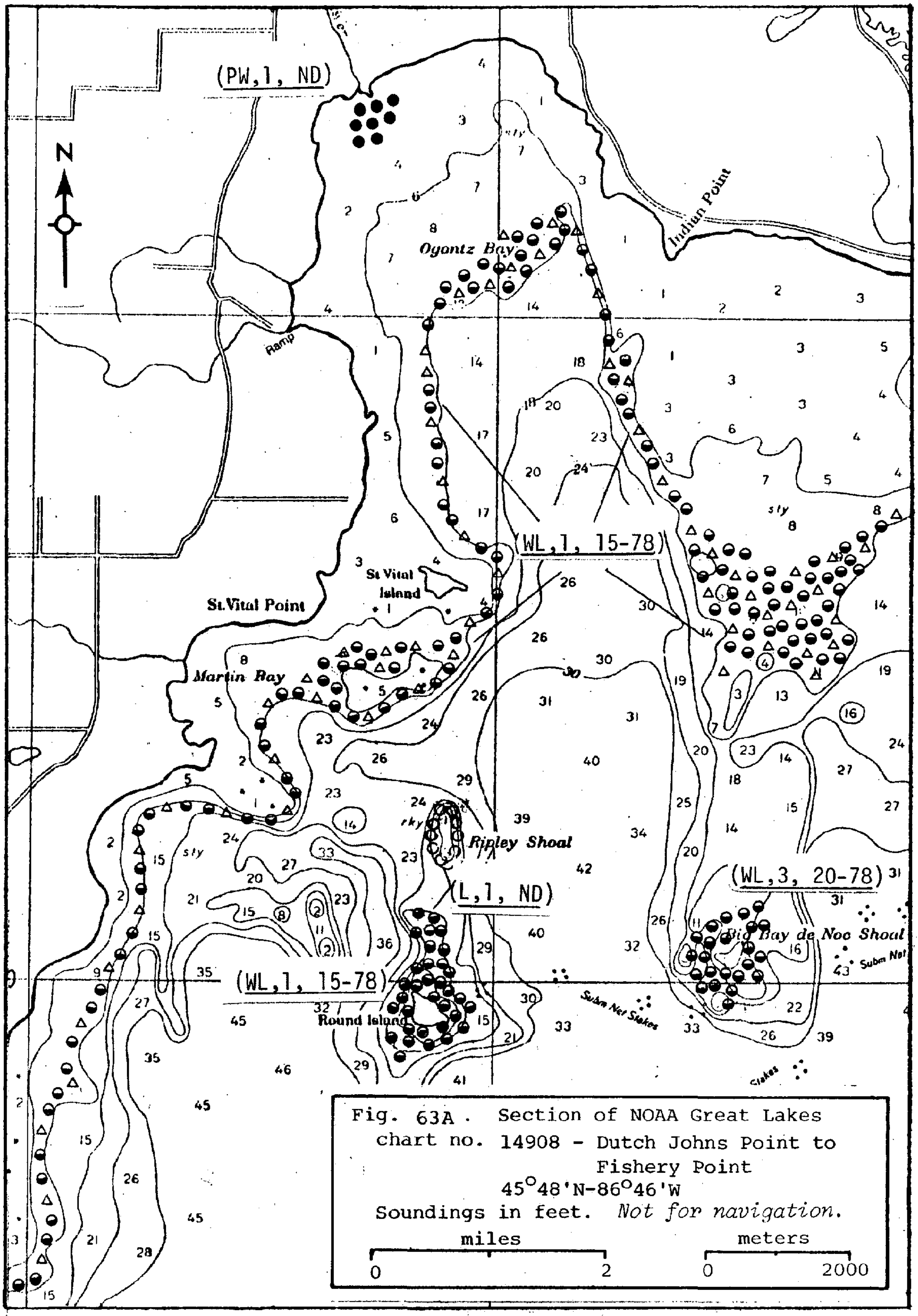



Fig. 63A . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
45°48'N-86°46'W
Soundings in feet. *Not for navigation.*

miles 0 2   meters 0 2000

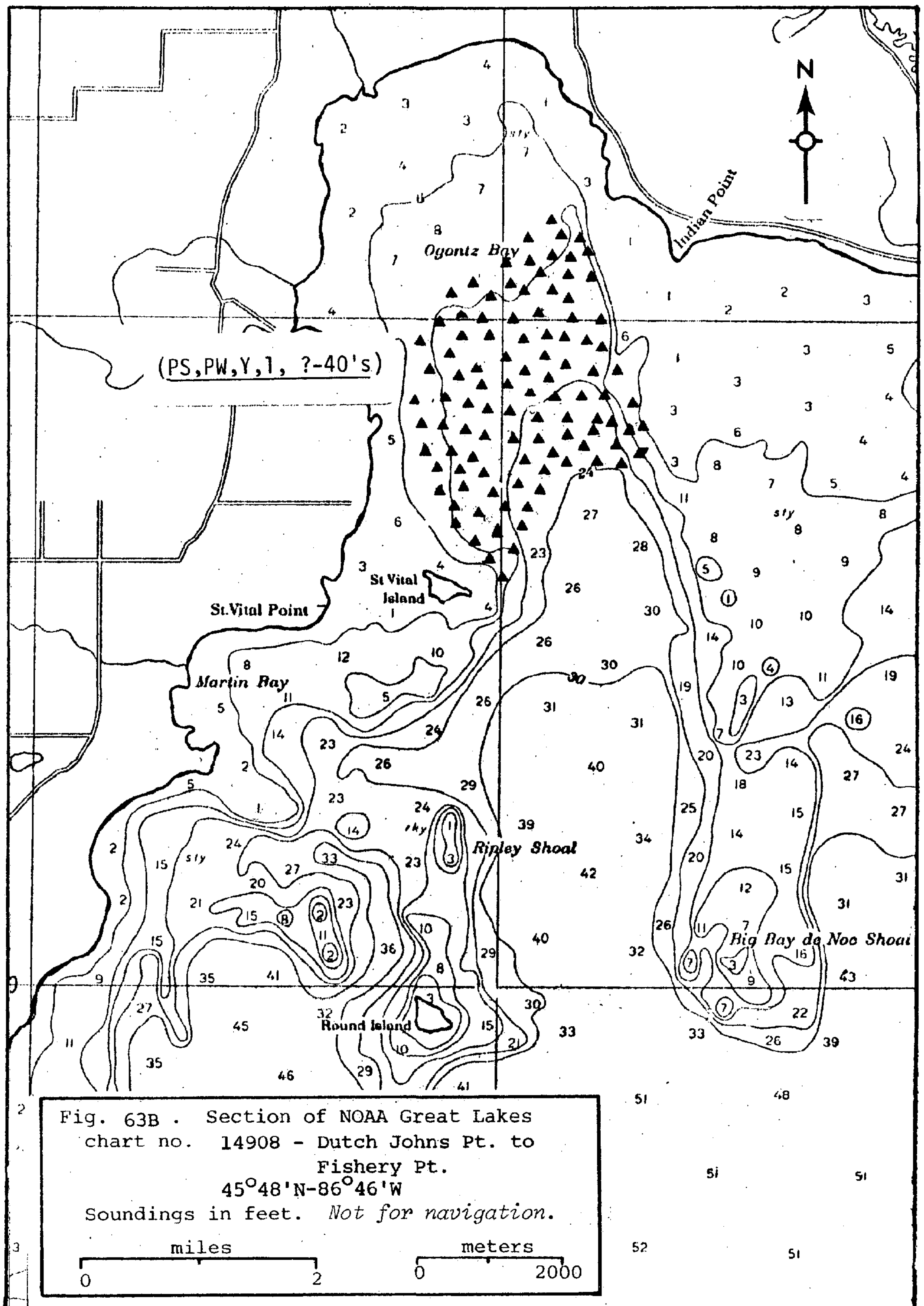



Fig. 63B . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Pt. to Fishery Pt.
45°48'N-86°46'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

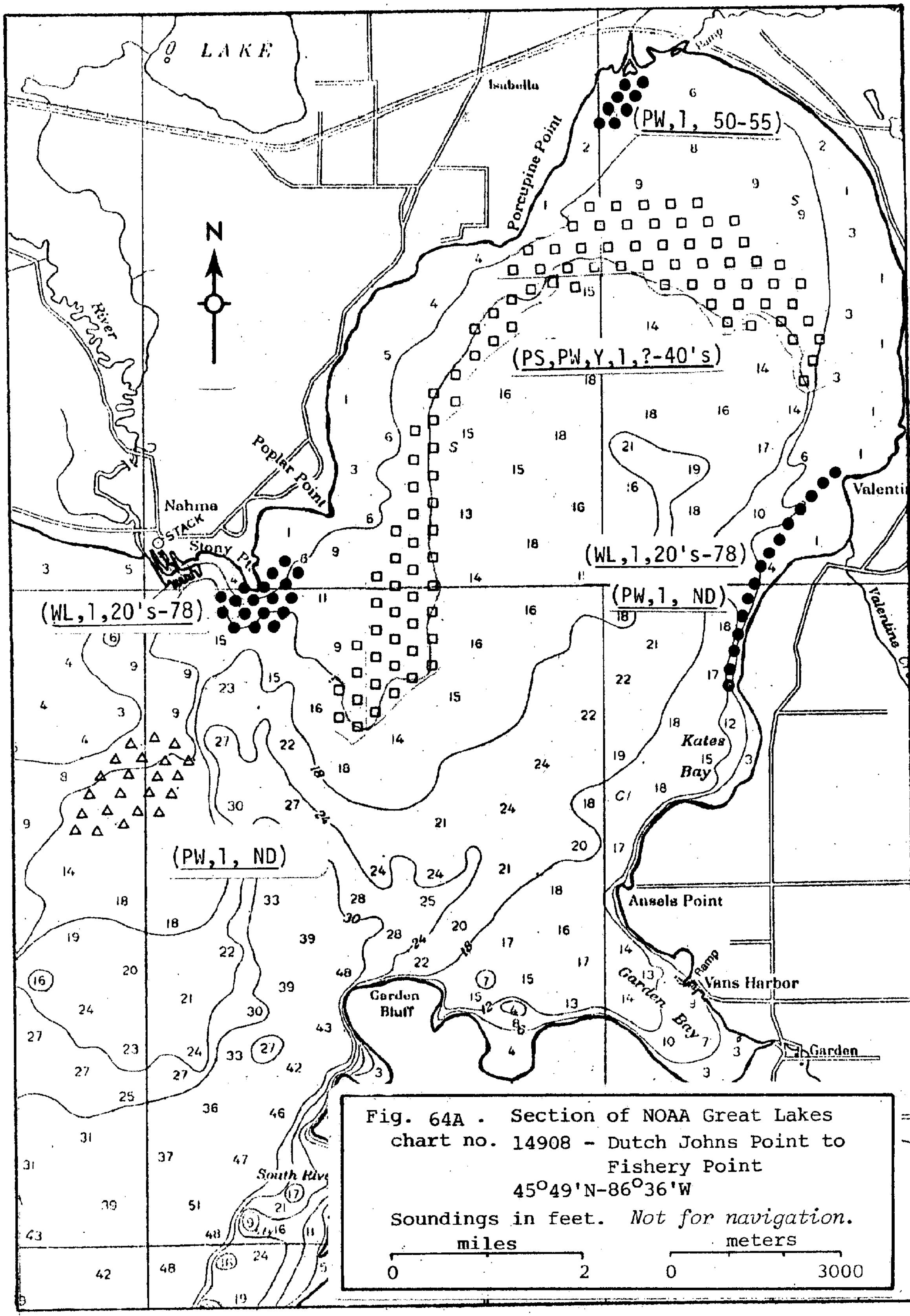



Fig. 64A · Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
$45^{o}49'N-86^{o}36'W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

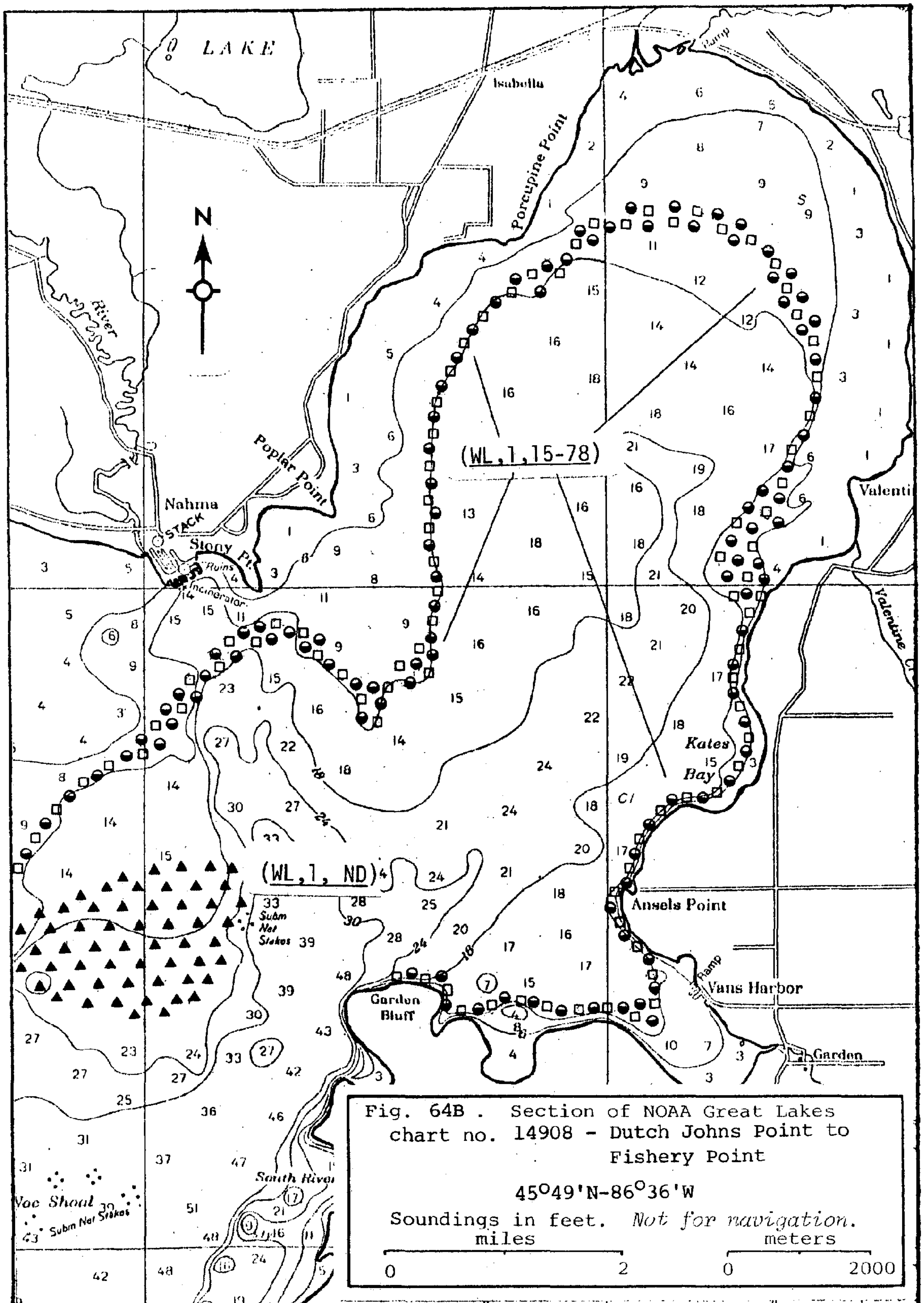



Fig. 64B . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point

45°49'N-86°36'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

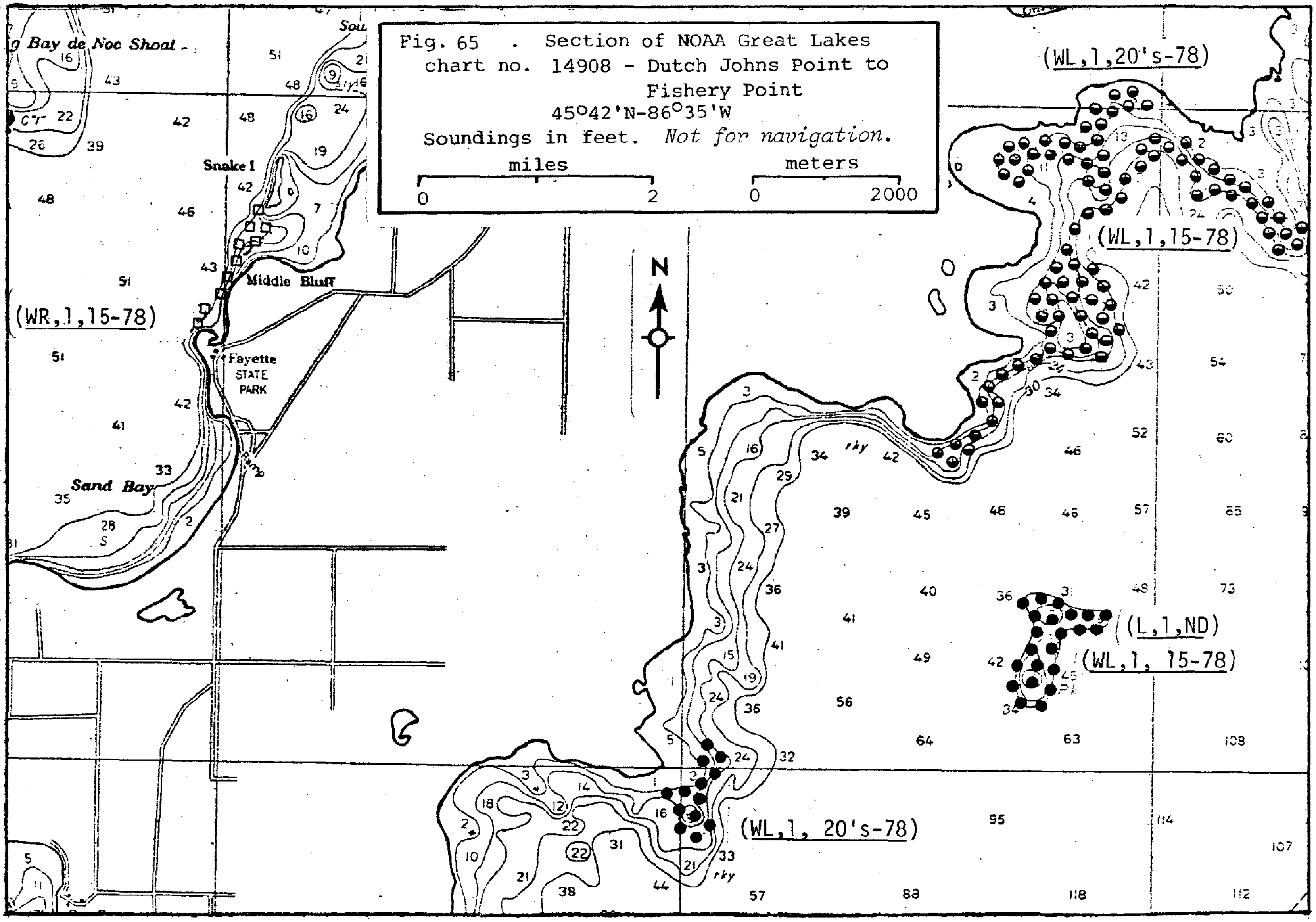



Fig. 65 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
45°42'N-86°35'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

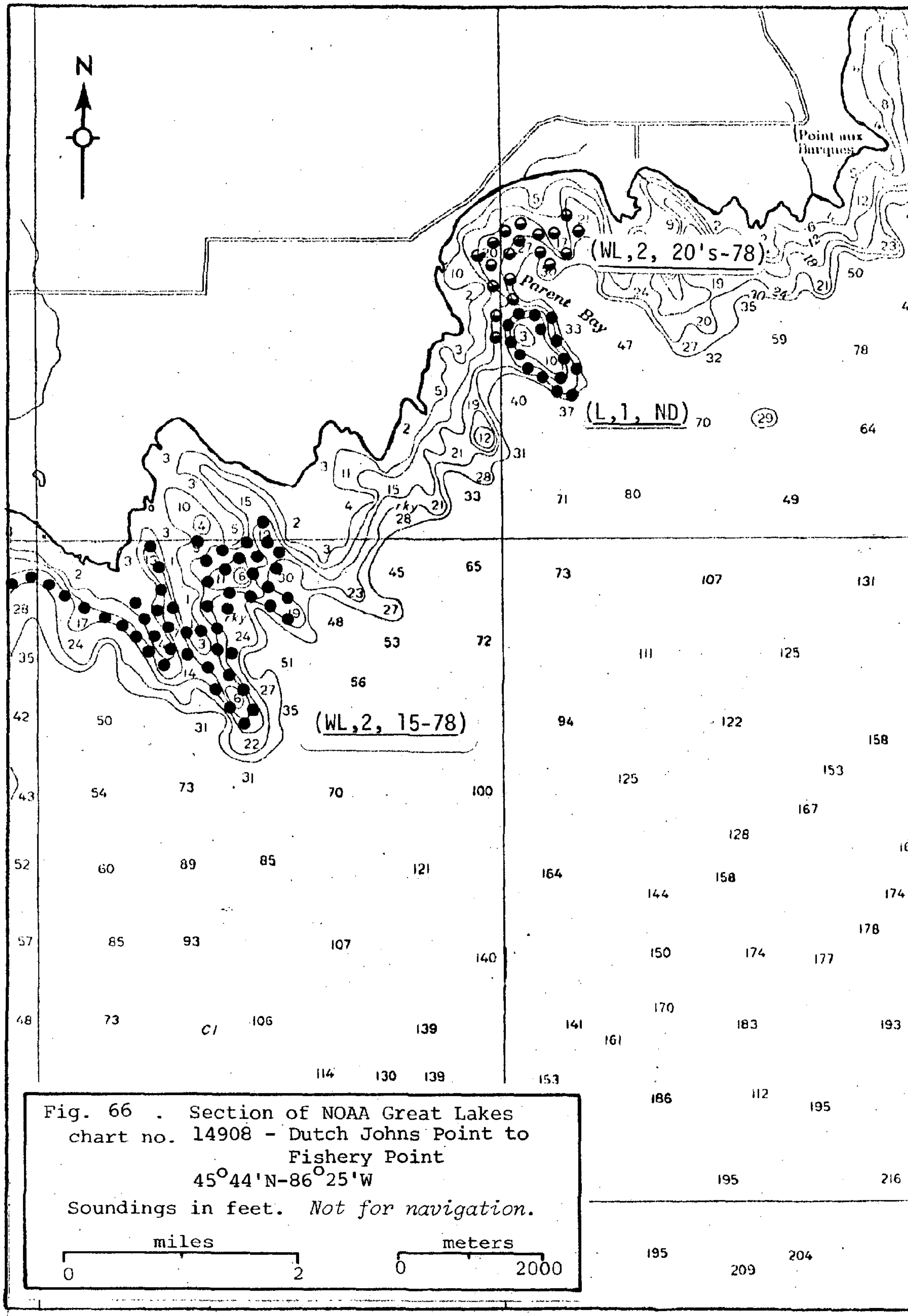



Fig. 66 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
$45^{\circ}44'$N-$86^{\circ}25'$W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

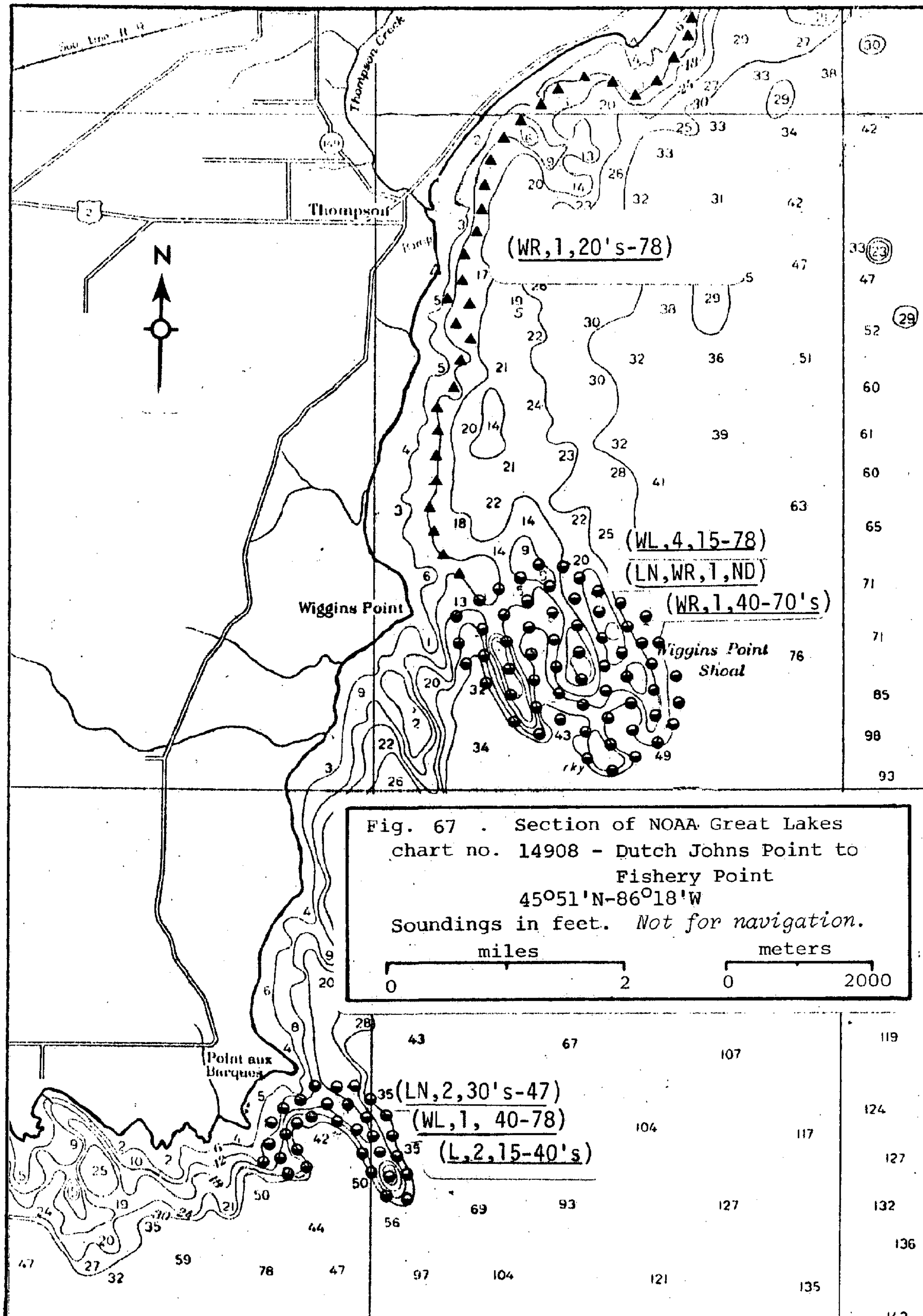



Fig. 67 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point
45°51'N-86°18'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

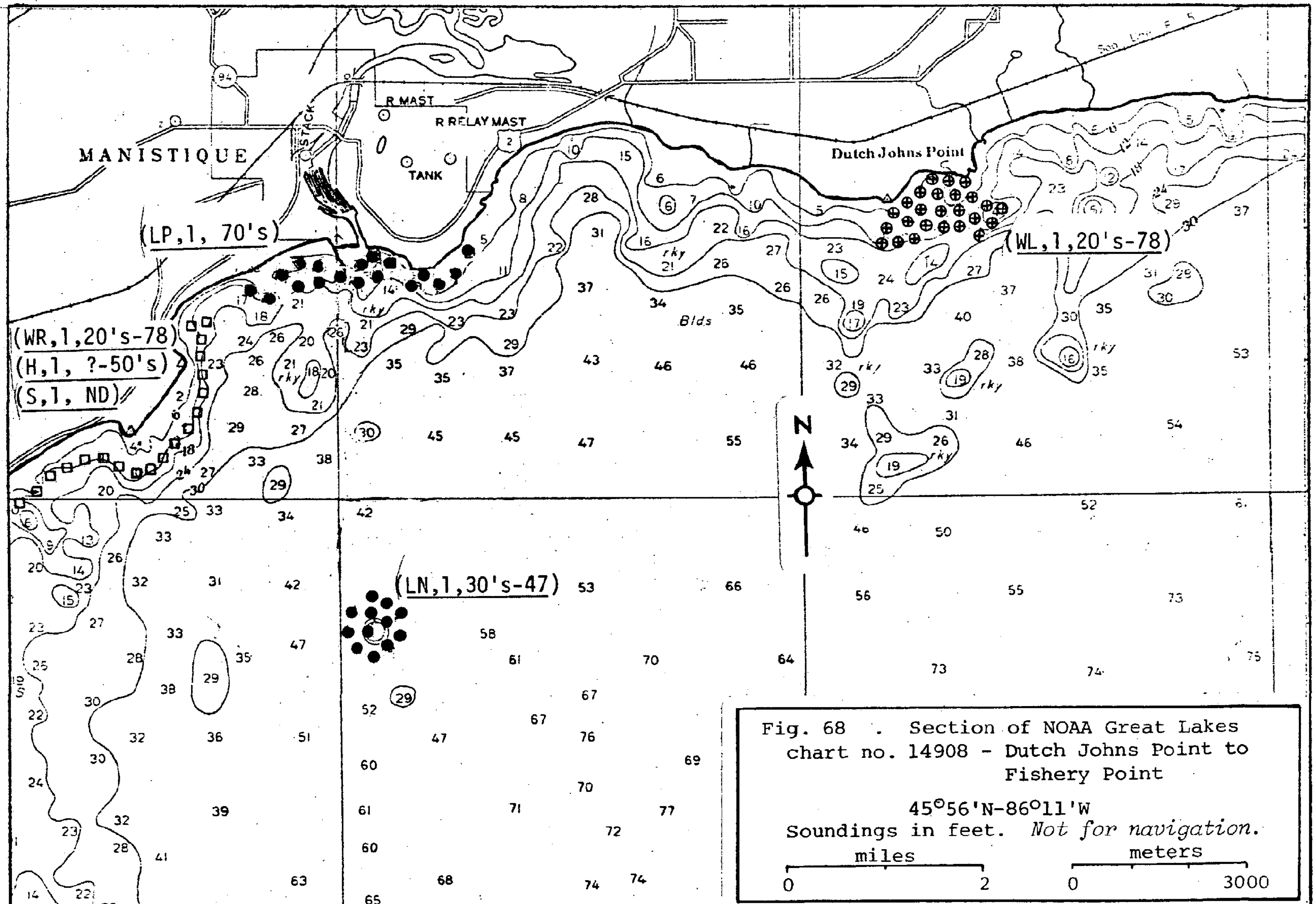



Fig. 68 . Section of NOAA Great Lakes chart no. 14908 - Dutch Johns Point to Fishery Point

45°56'N-86°11'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

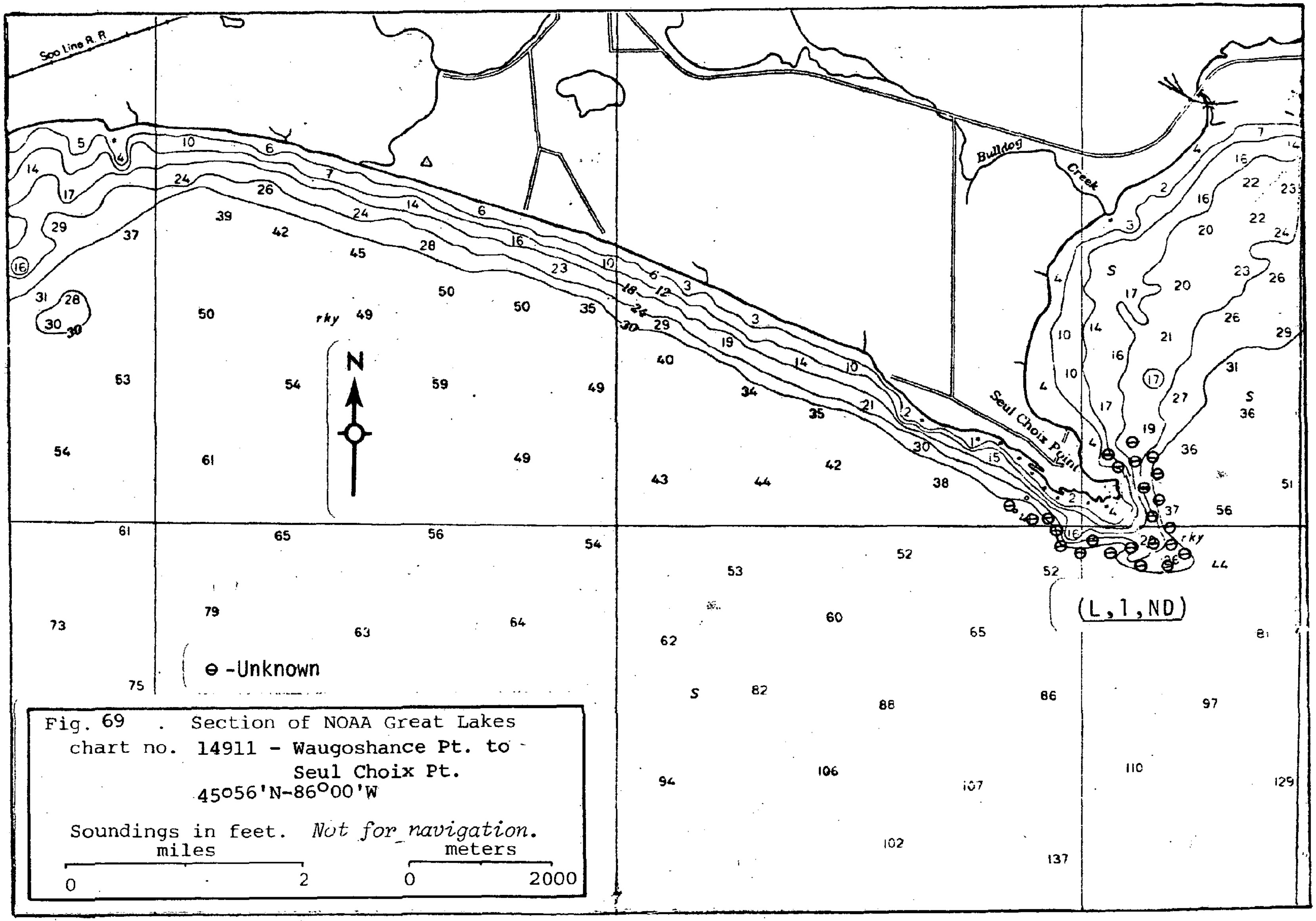



Fig. 69 . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt.
45°56'N-86°00'W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

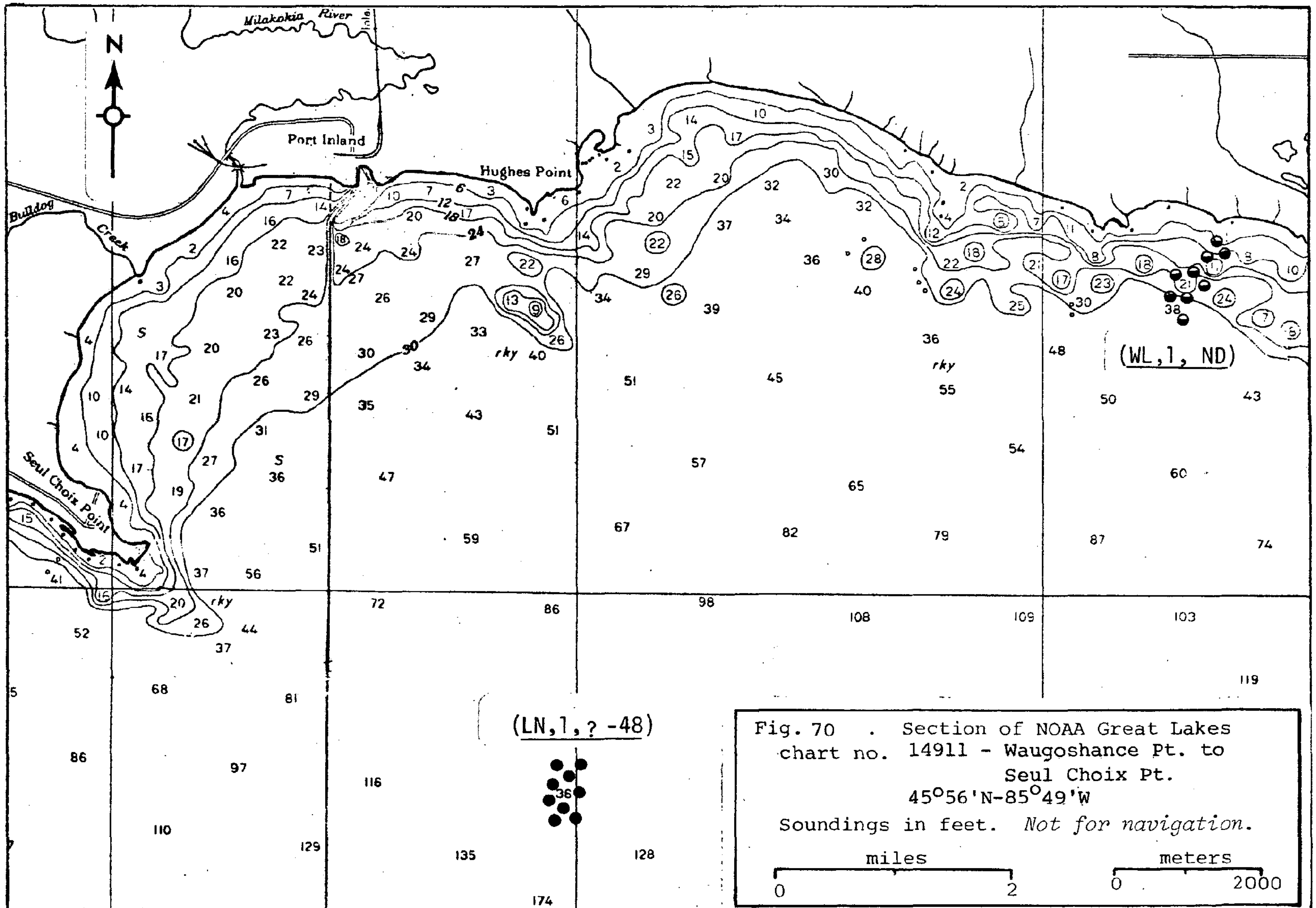



Fig. 70 . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt.
45°56'N-85°49'W
Soundings in feet. *Not for navigation.*

miles 0 2    meters 0 2000

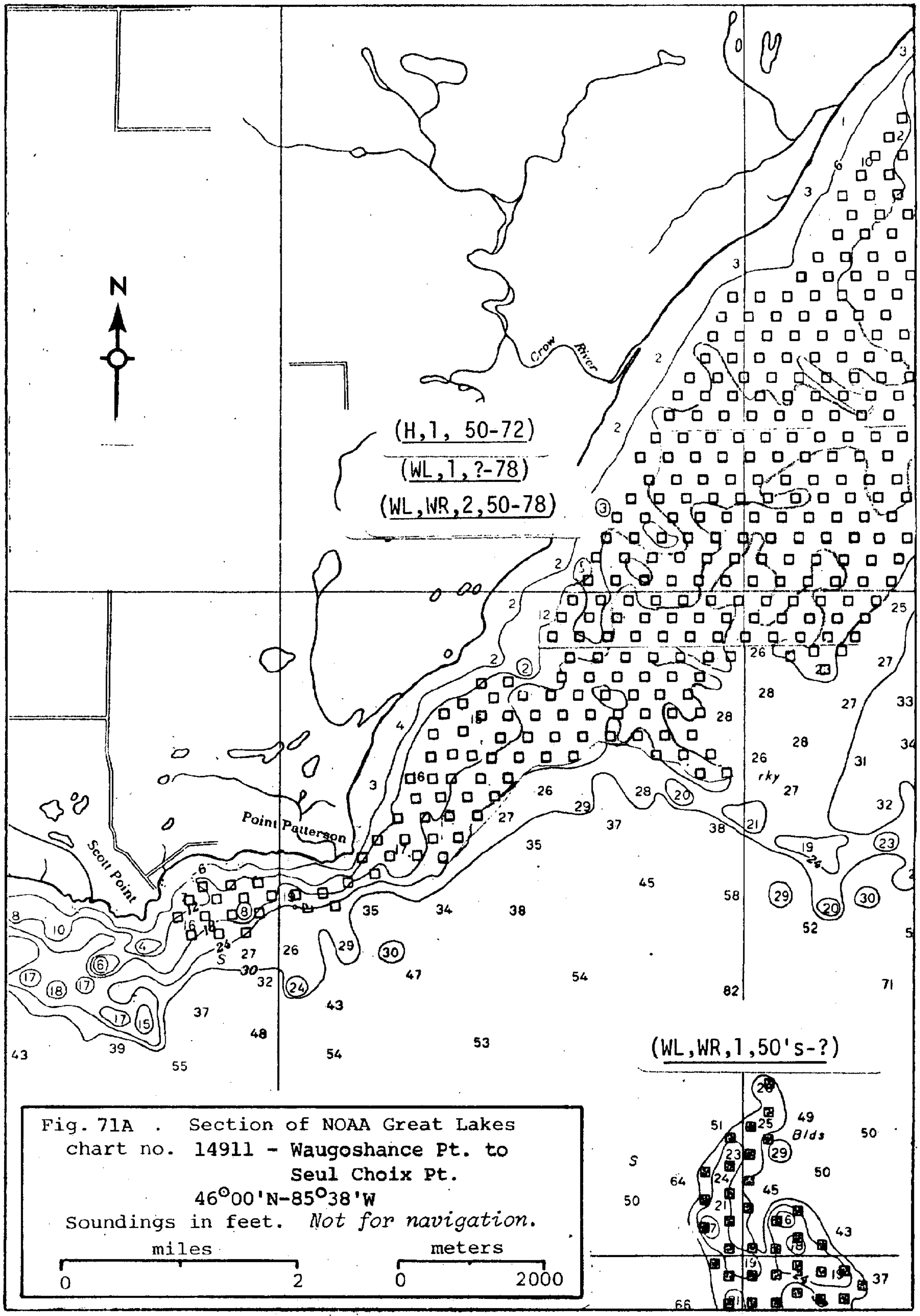



Fig. 71A . Section of NOAA Great Lakes chart no. **14911 - Waugoshance Pt. to Seul Choix Pt.**
46°00'N-85°38'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

Fig. 71B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt. 46°00'N-85°38'W

Soundings in feet. *Not for navigation.*

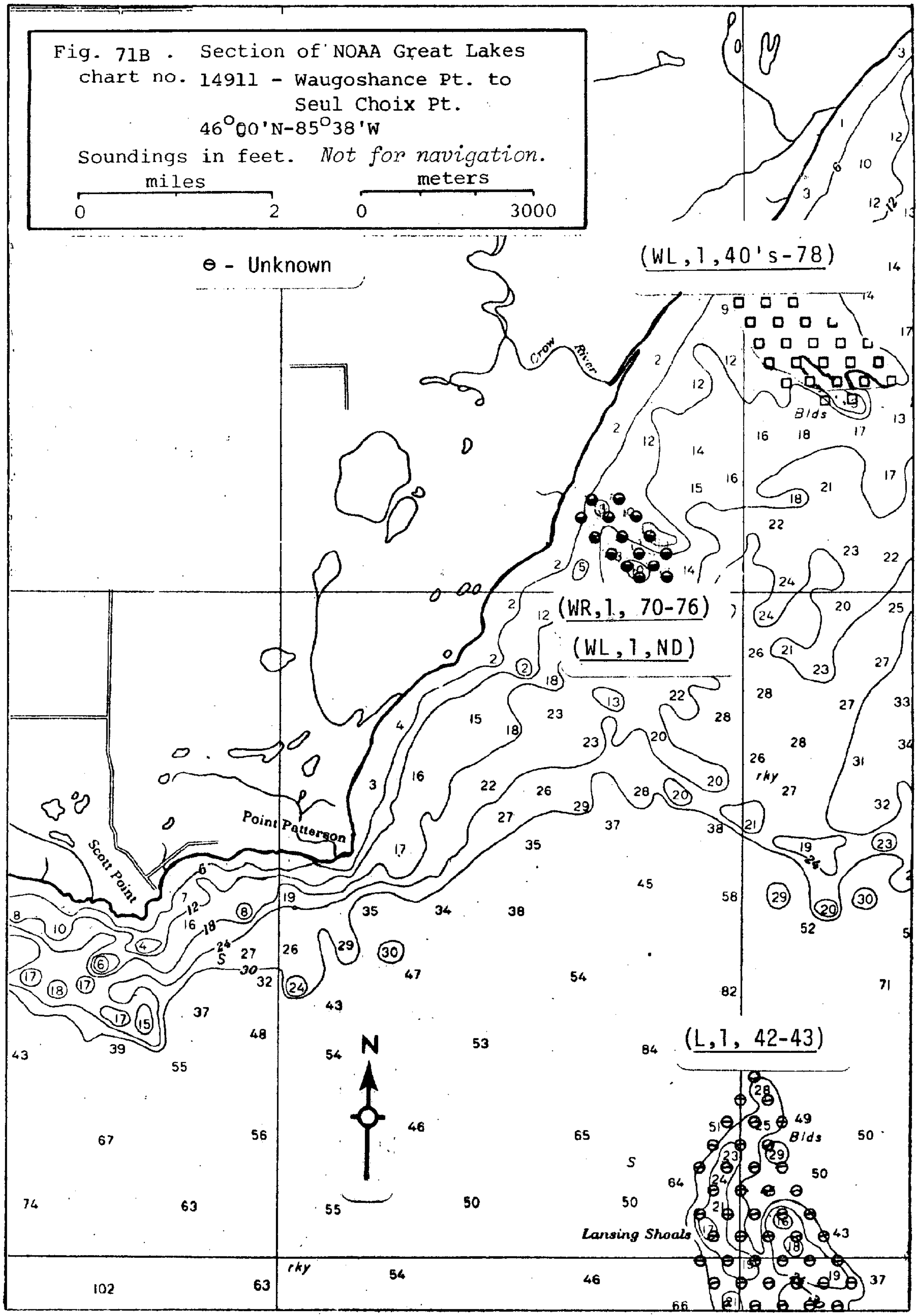
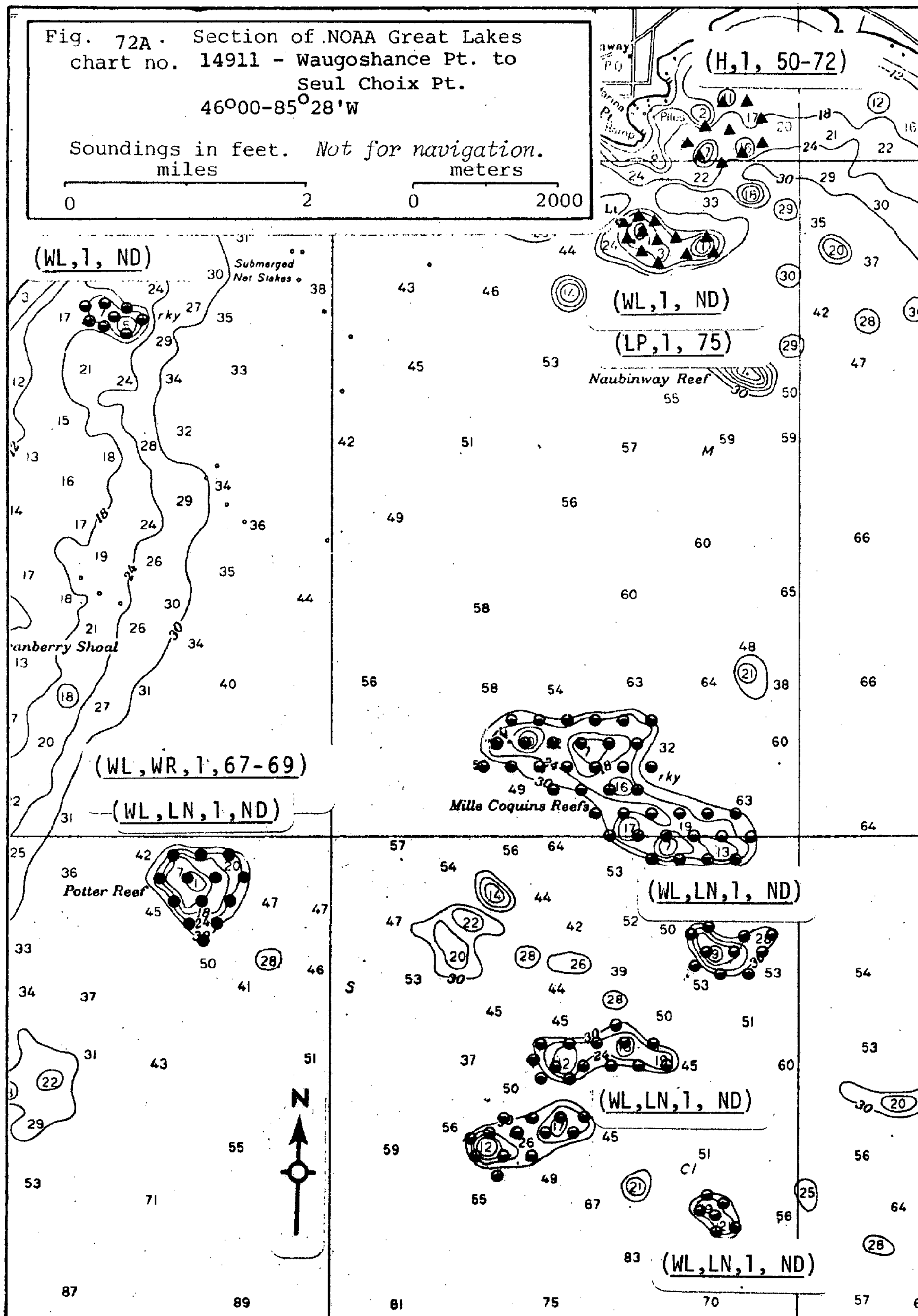


Fig. 72A. Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt. 46°00-85°28'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000



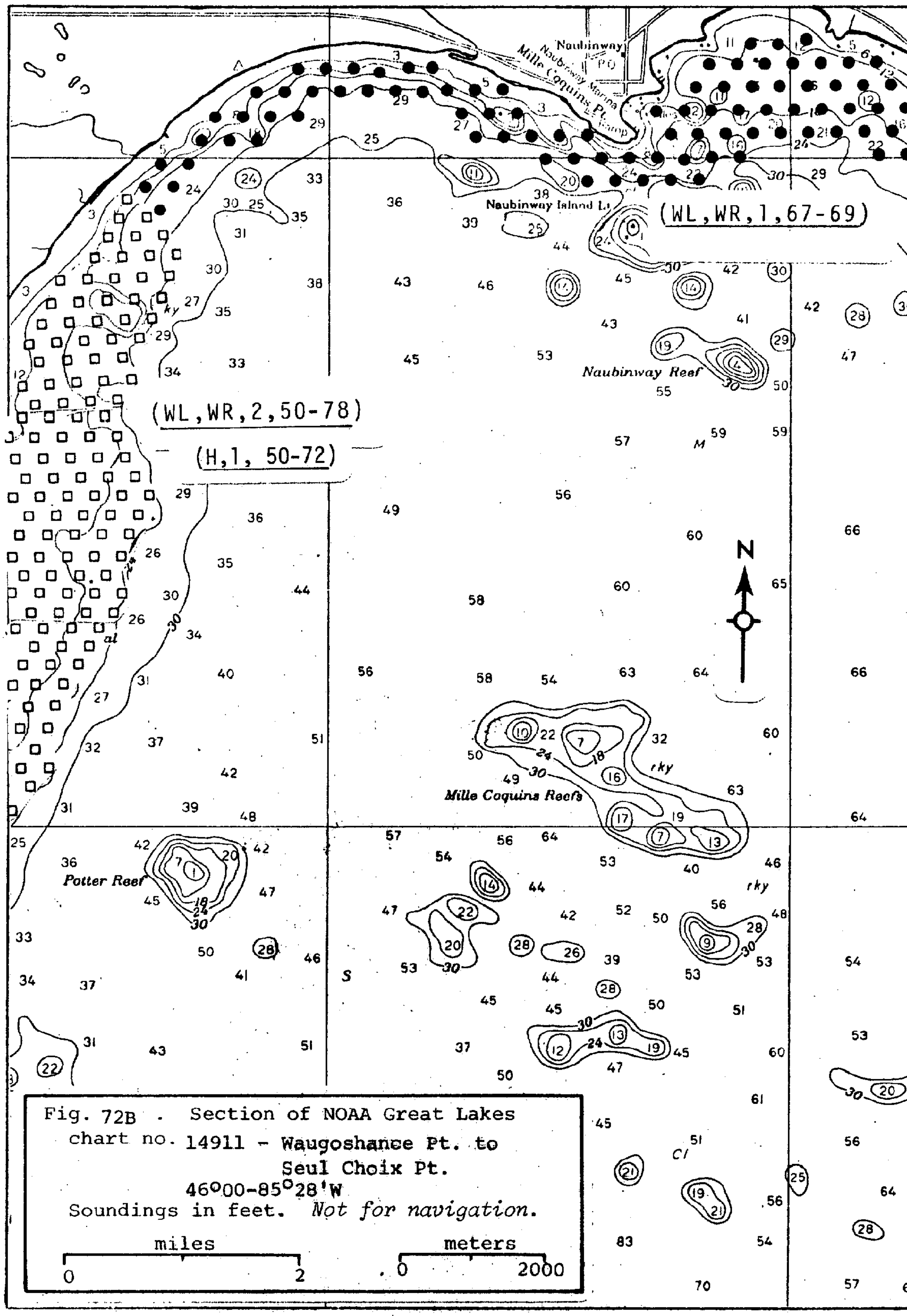



Fig. 72B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt.
46°00-85°28'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

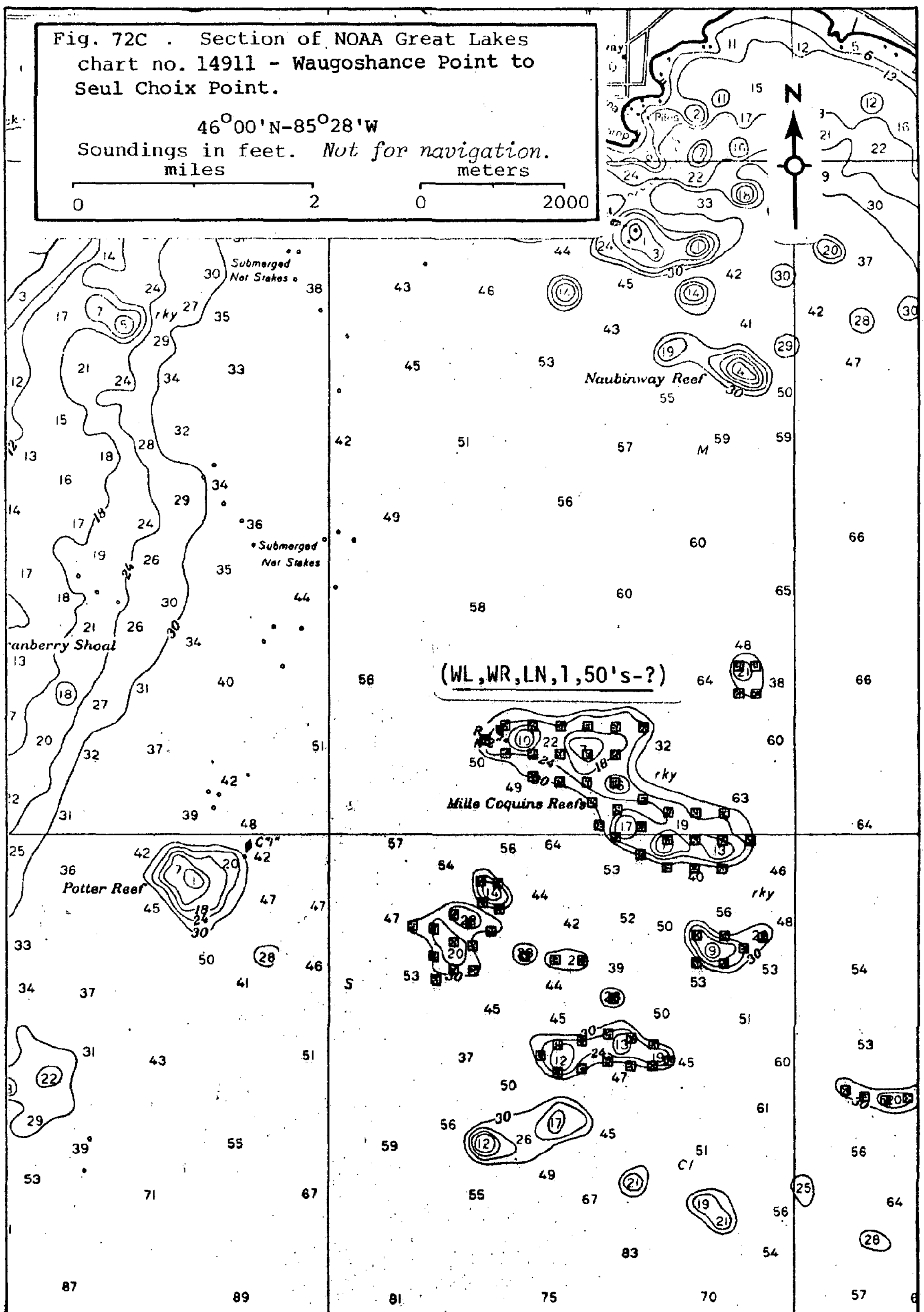



Fig. 72C . Section of NOAA Great Lakes chart no. 14911 - **Waugoshance Point to Seul Choix Point.**

46°00'N-85°28'W

Soundings in feet. *Not for navigation.*

miles 0 2 — meters 0 2000

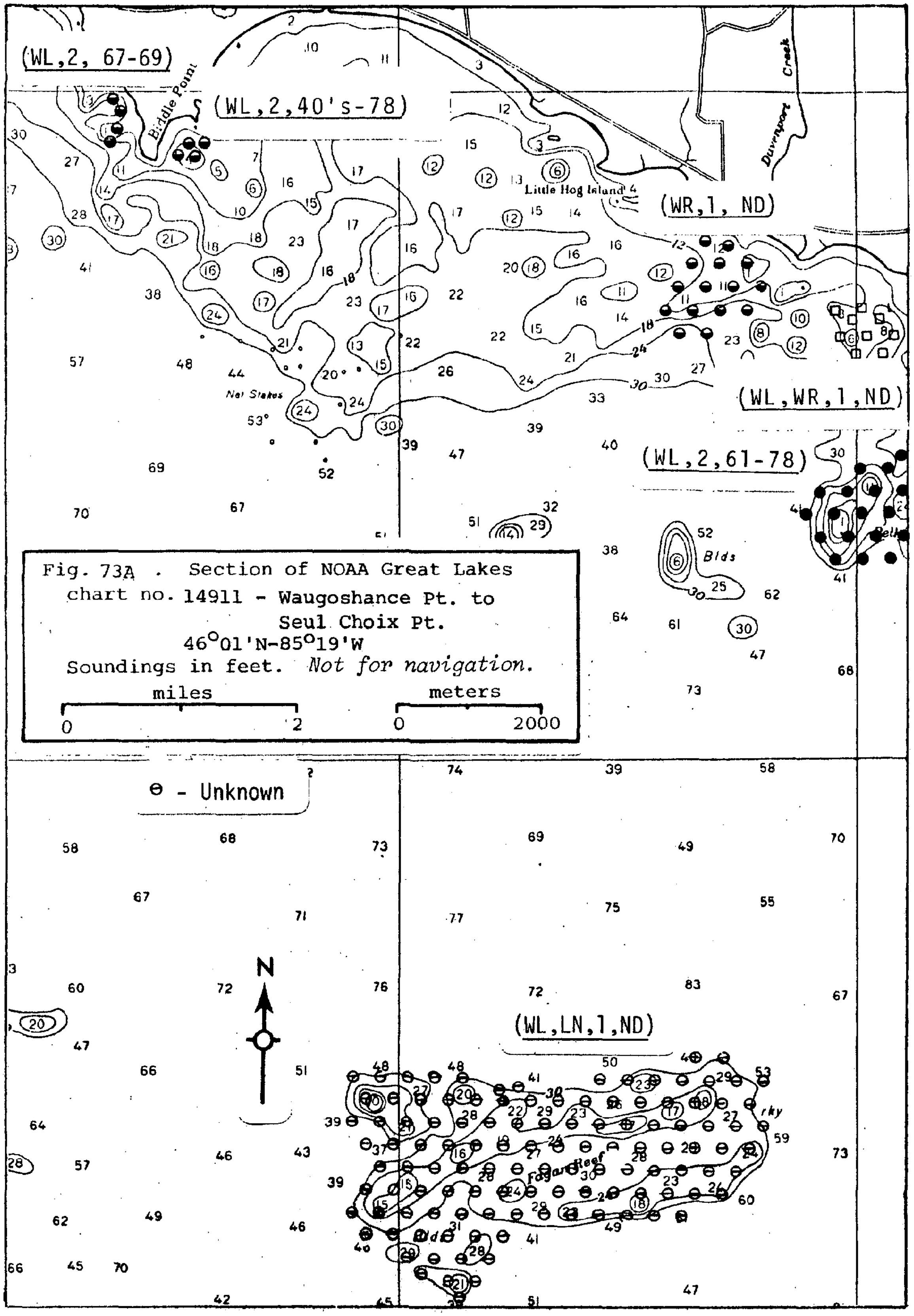



Fig. 73A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt. 46°01'N-85°19'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

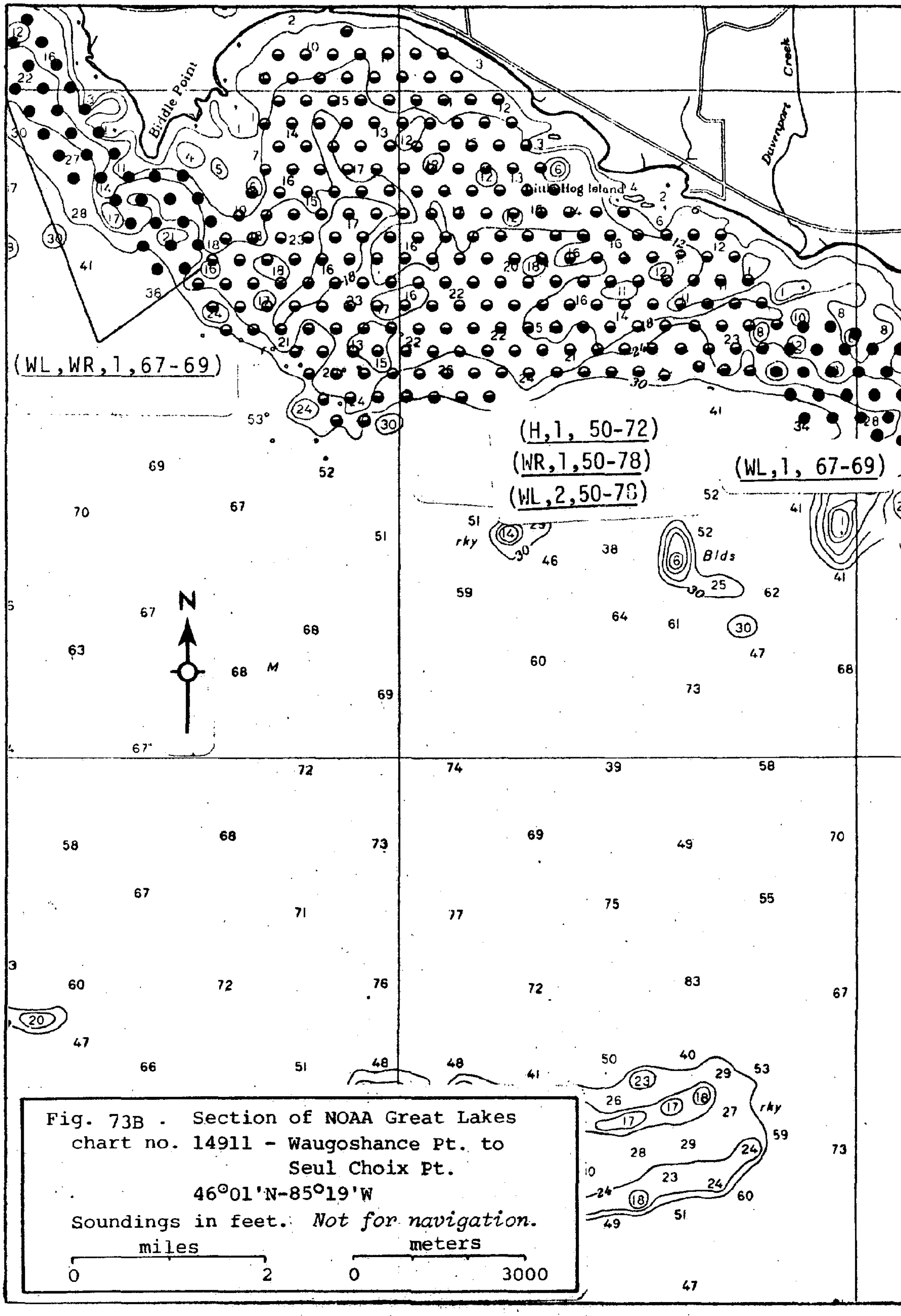



Fig. 73B - Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt.
46°01'N-85°19'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 3000

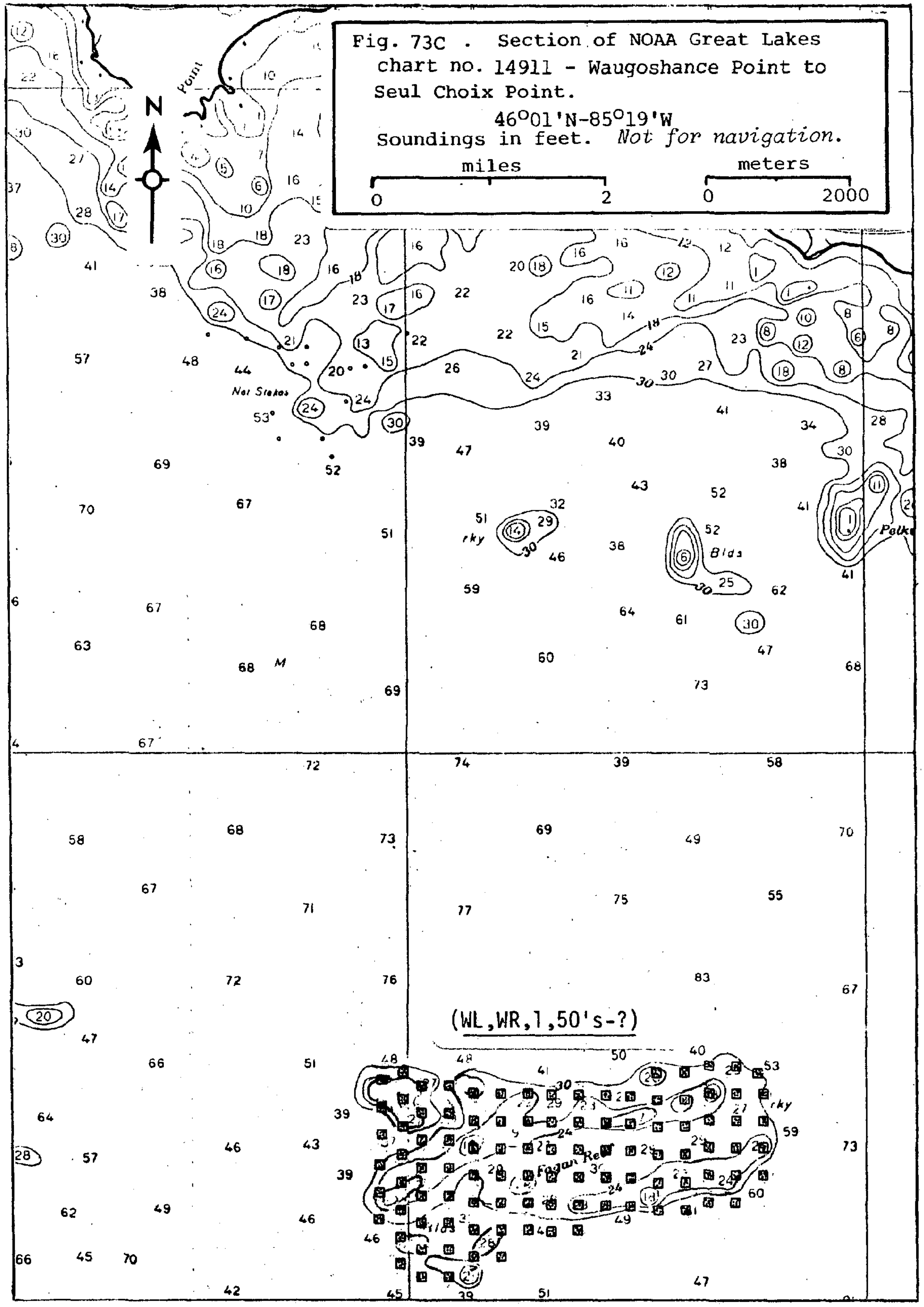



Fig. 73C . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
46°01'N-85°19'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

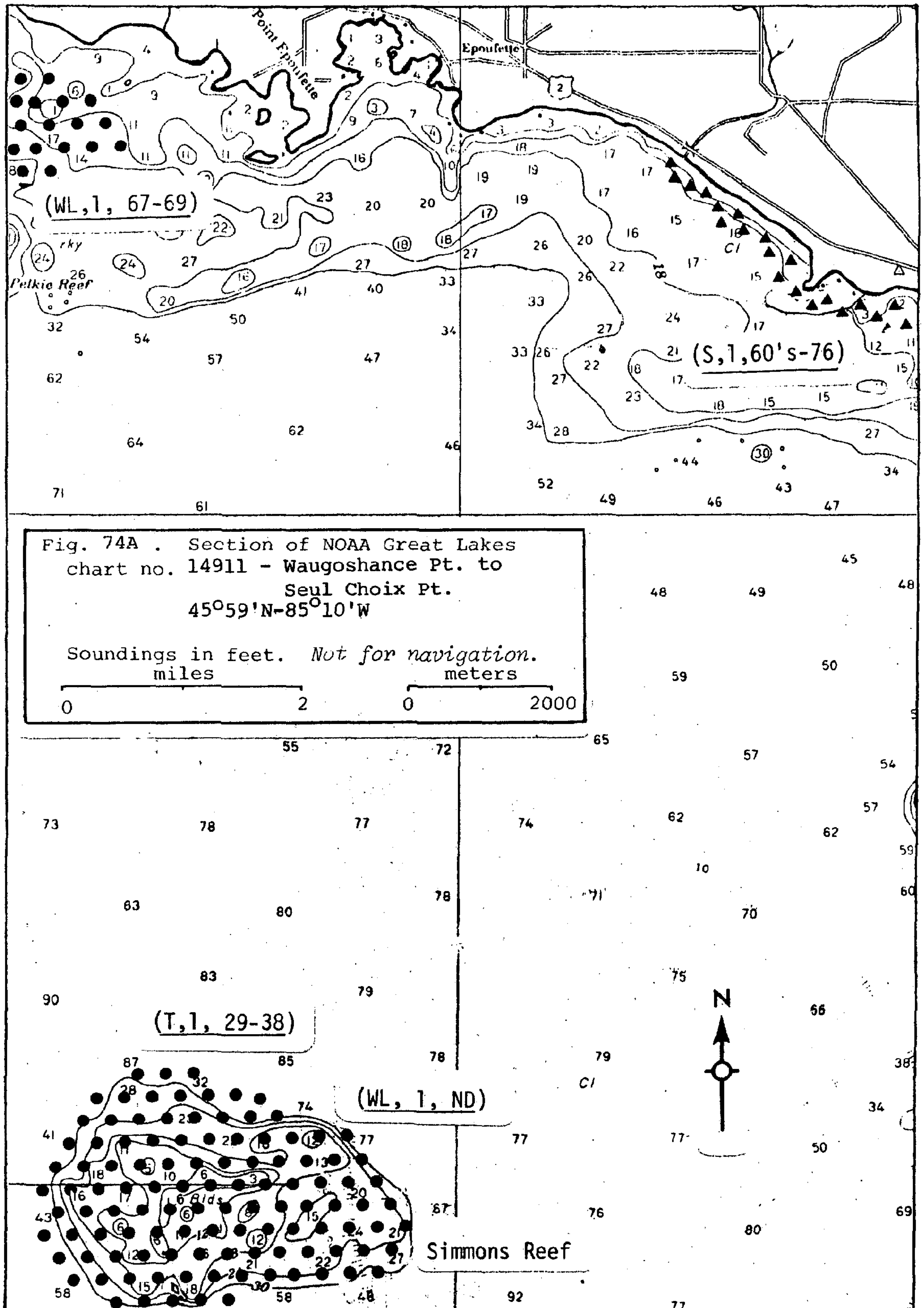



Fig. 74A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt.
45°59'N-85°10'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

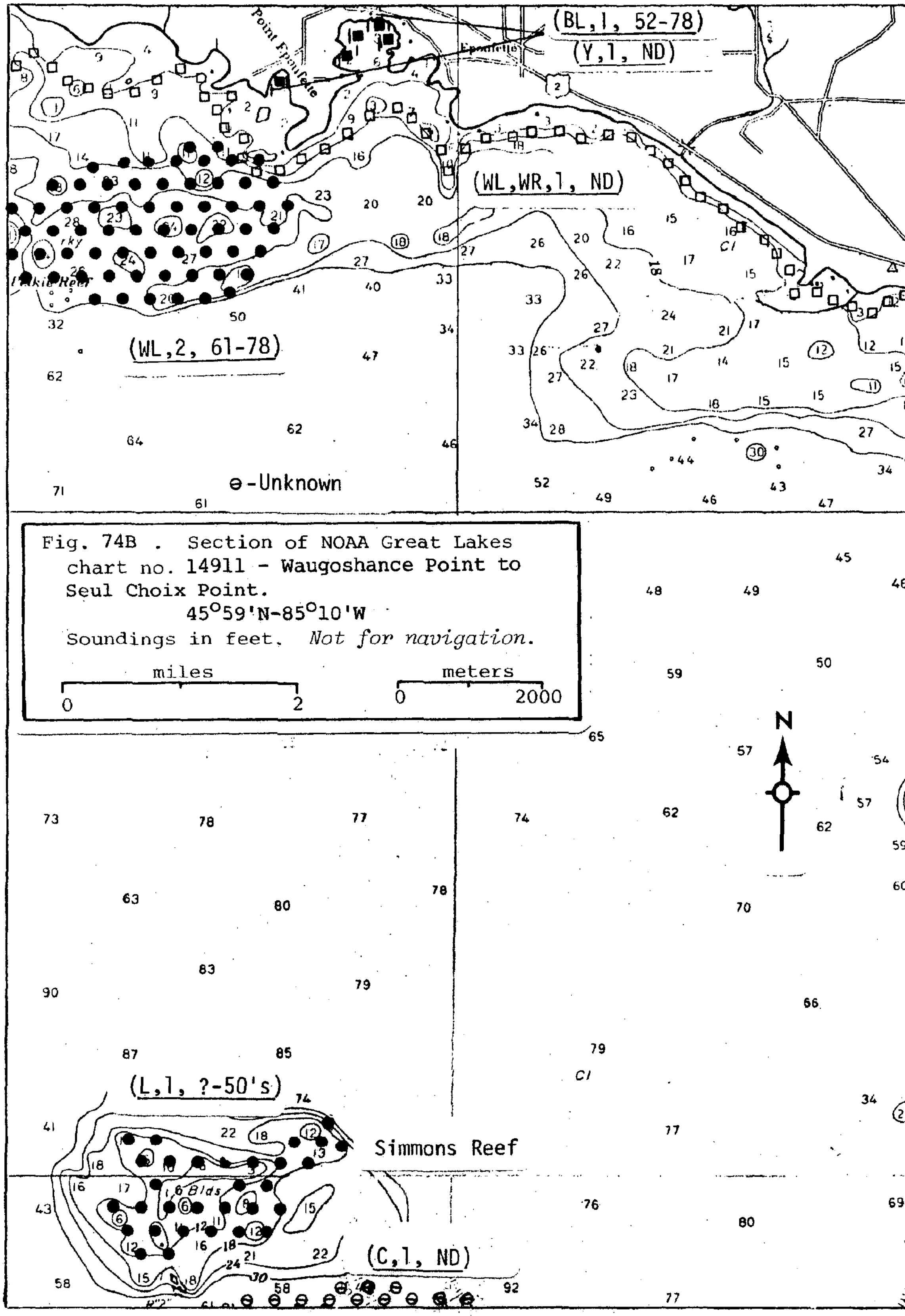



Fig. 74B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°59'N-85°10'W
Soundings in feet. *Not for navigation.*

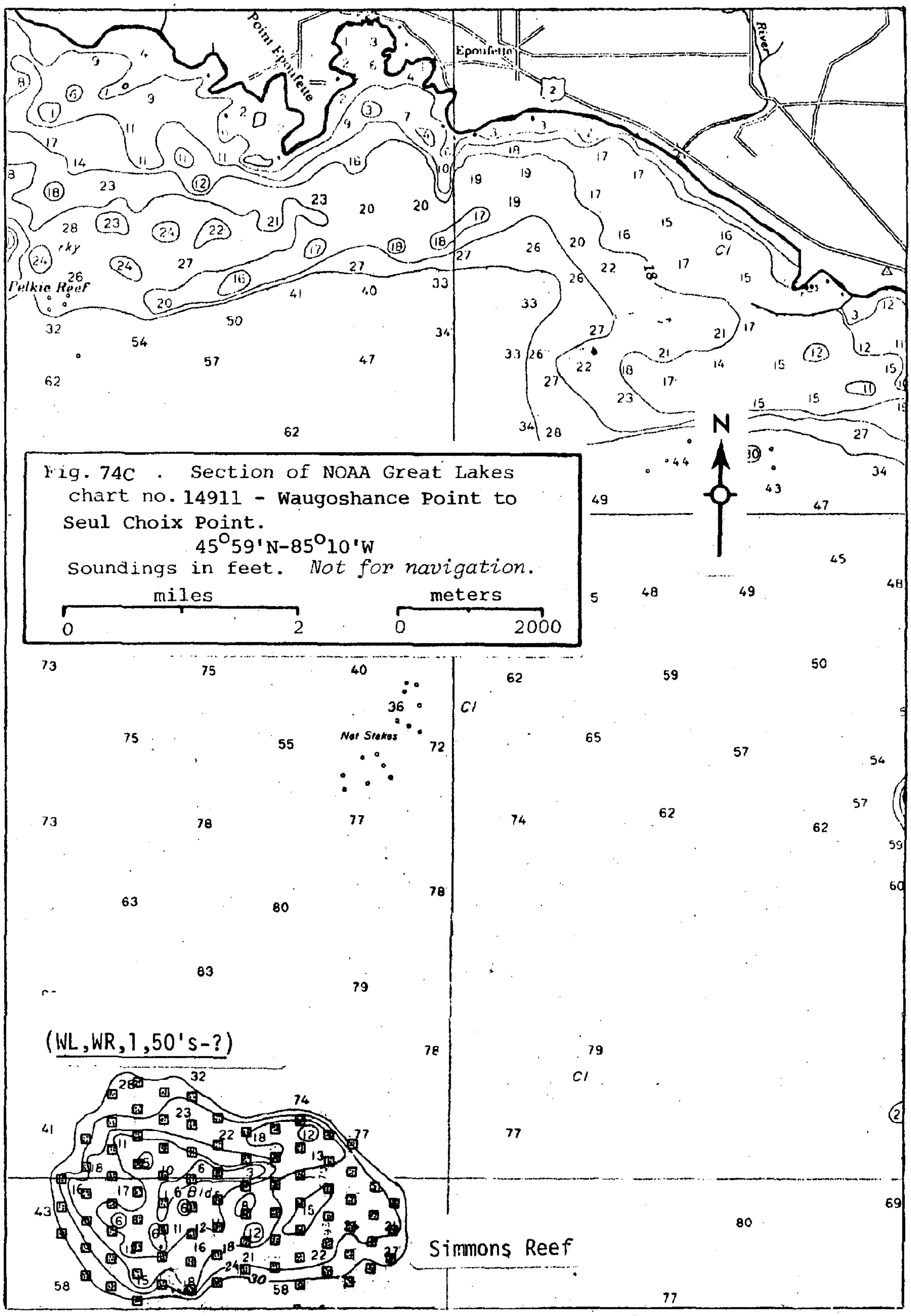



Fig. 74C . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°59'N-85°10'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

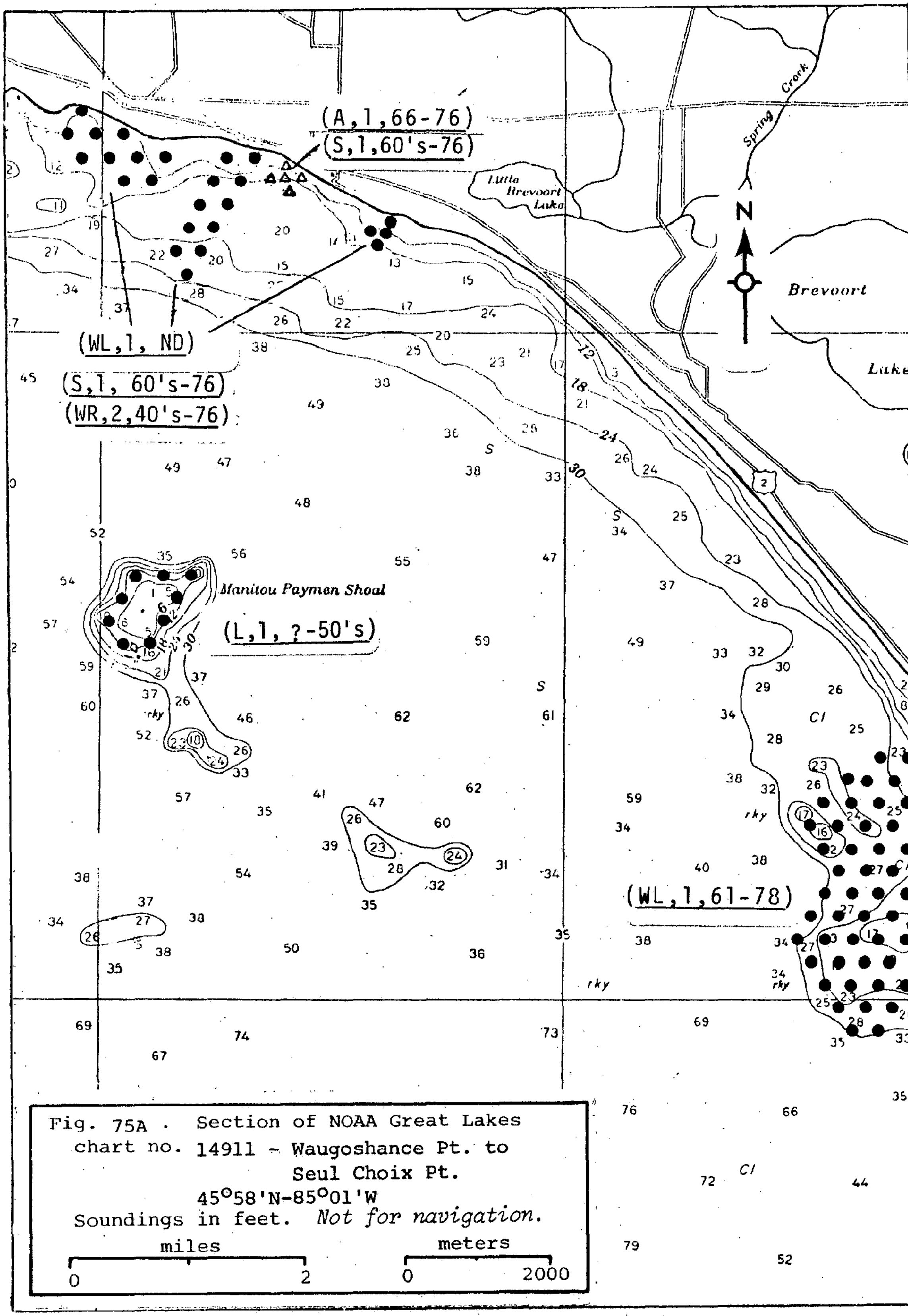



Fig. 75A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt.
45°58'N-85°01'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

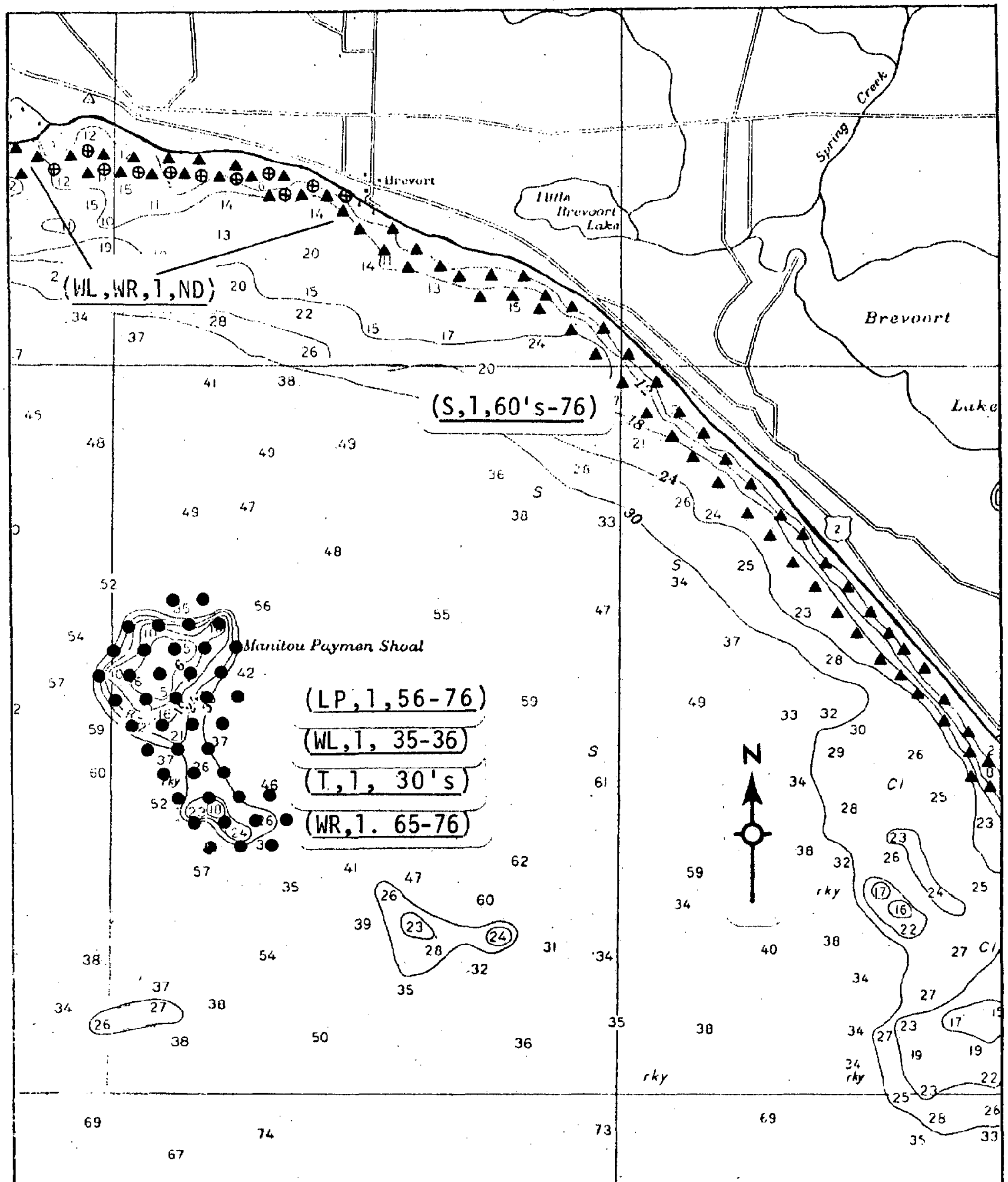



Fig. 75B. Section of NOAA Great Lakes chart no. 14911 - Waugoshance Pt. to Seul Choix Pt.
45°58'N-85°01'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

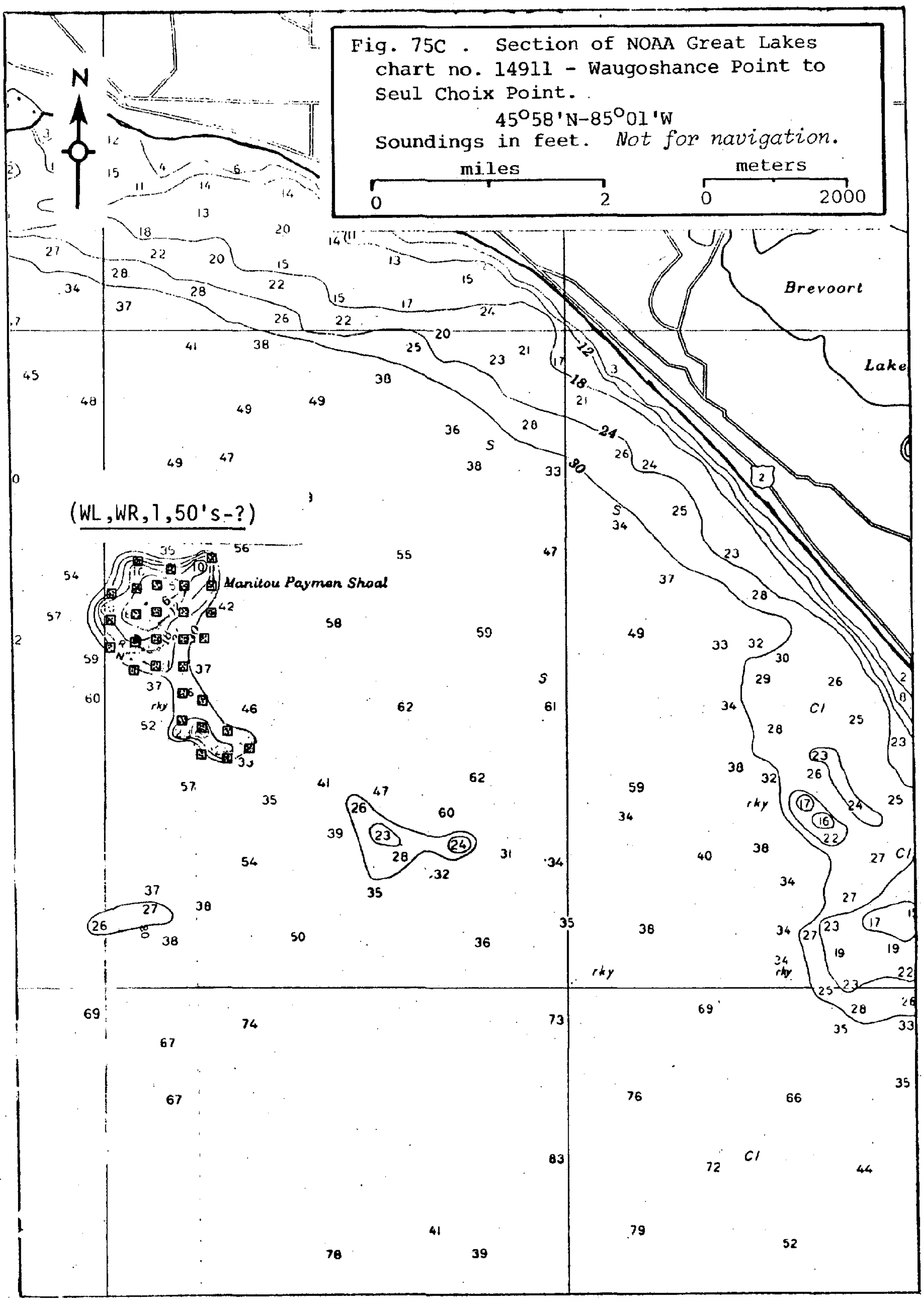



Fig. 75C . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°58'N-85°01'W
Soundings in feet. *Not for navigation.*

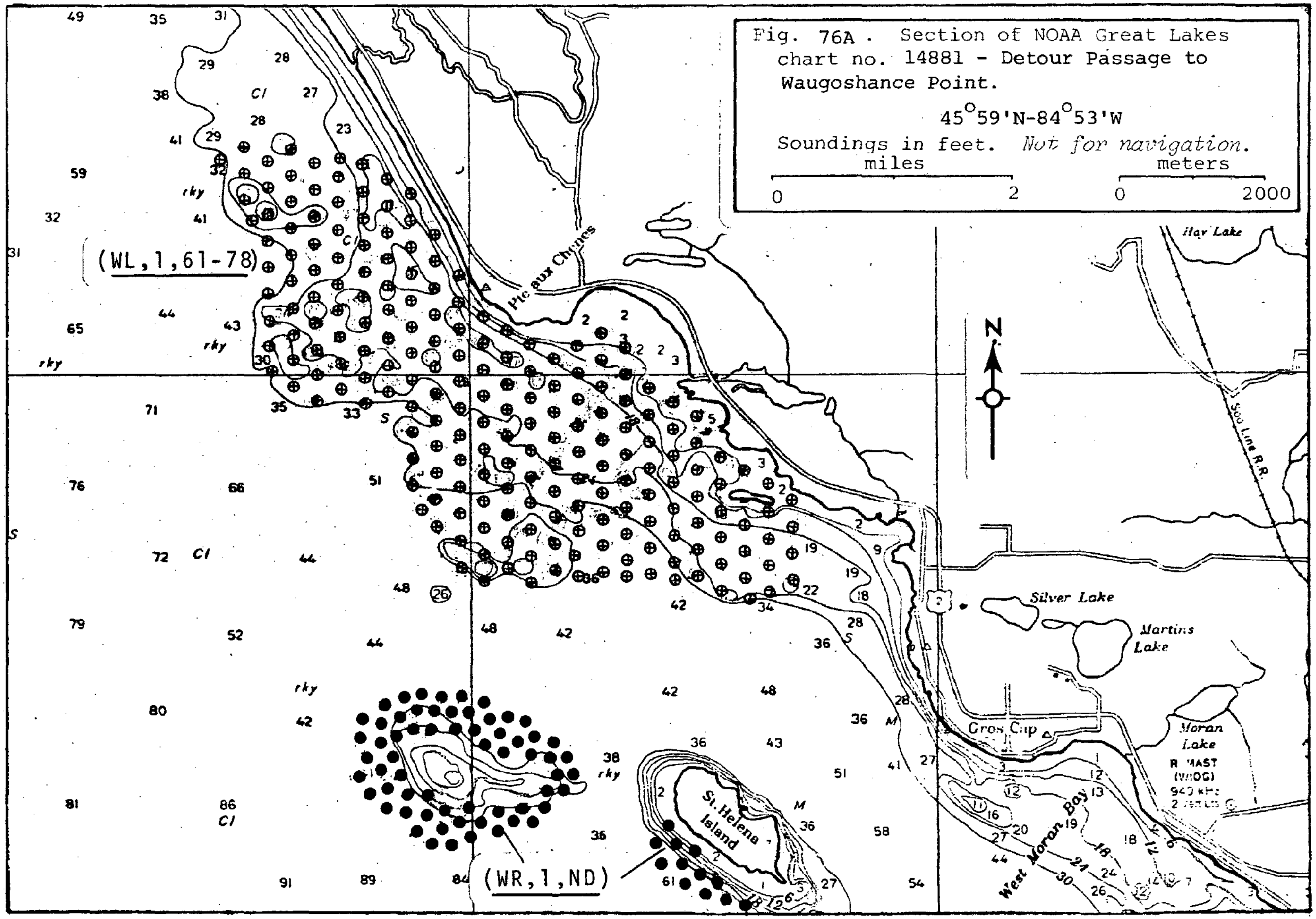



Fig. 76A. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.

45°59'N-84°53'W

Soundings in feet. *Not for navigation.*

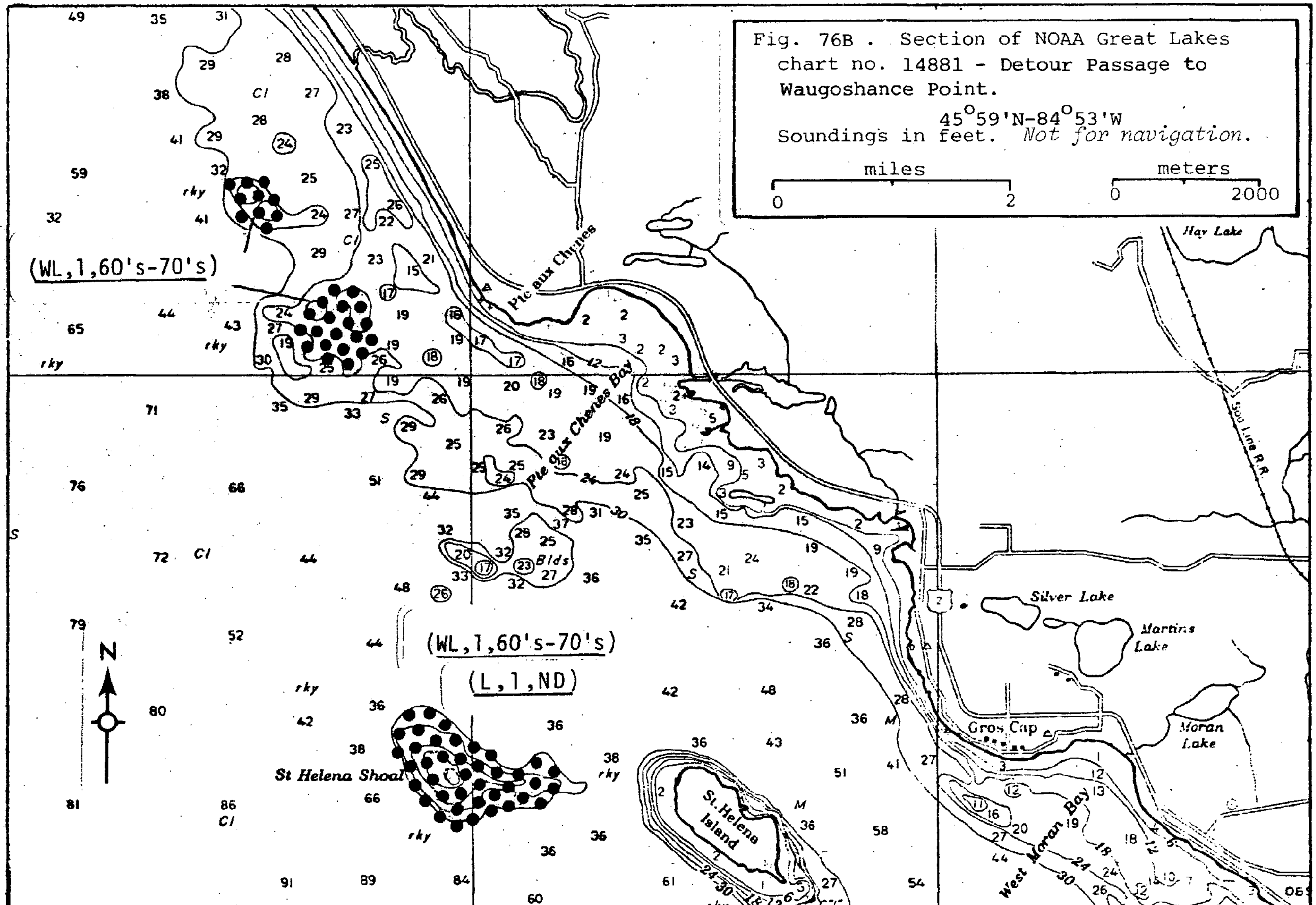



Fig. 76B . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°59'N-84°53'W
Soundings in feet. *Not for navigation.*

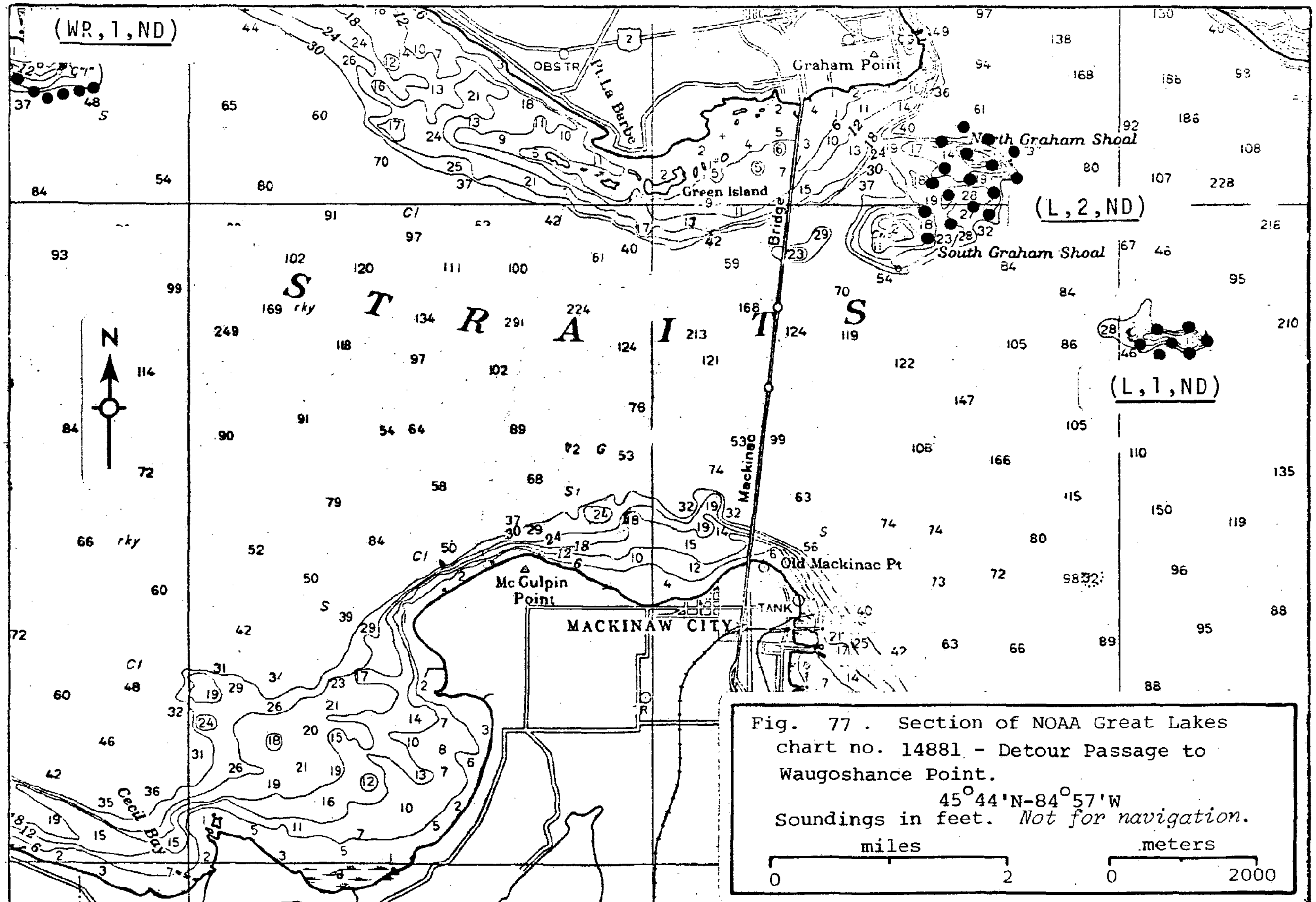



Fig. 77 . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°44'N-84°57'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

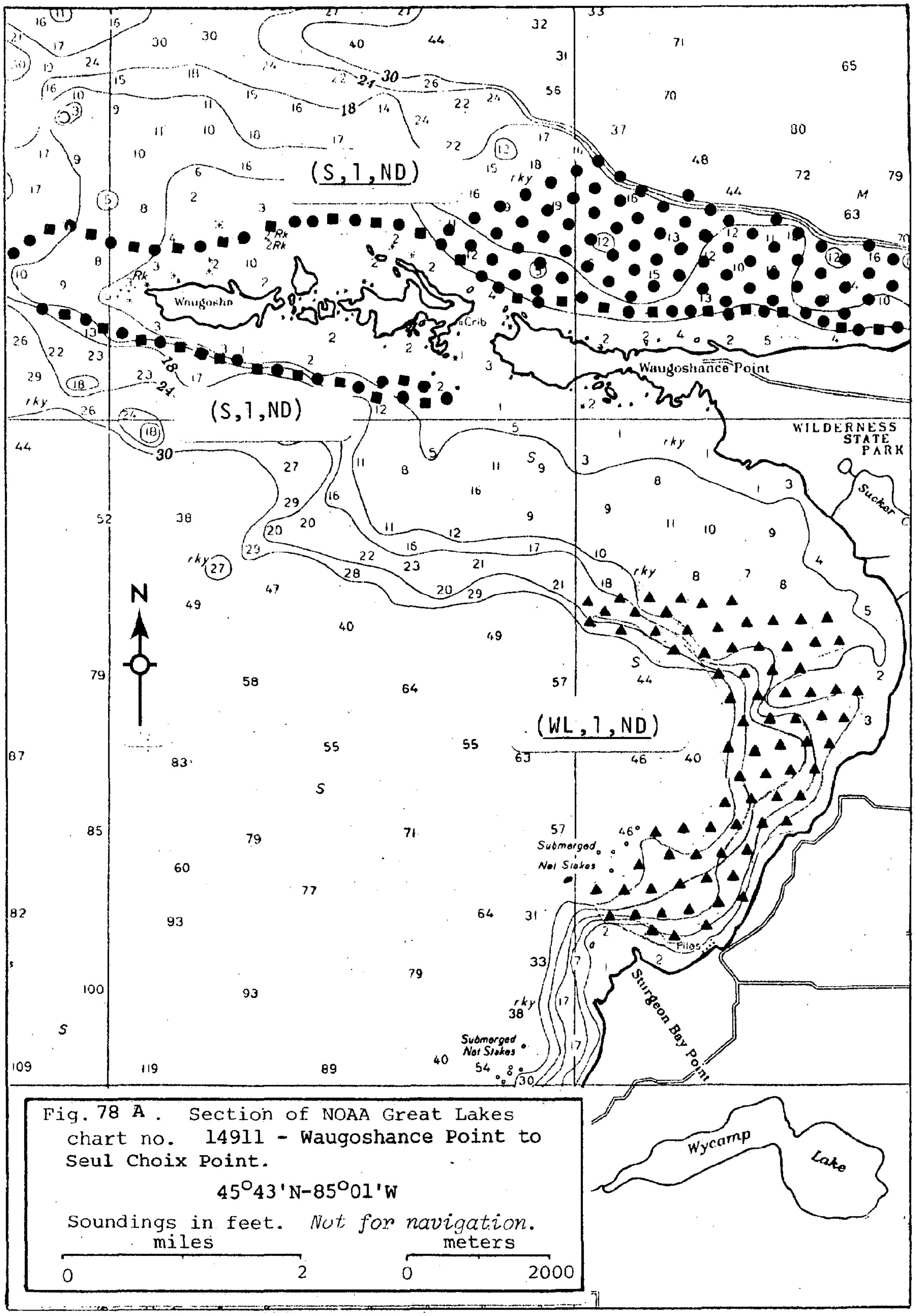



Fig. 78 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

$45^{o}43'$N-$85^{o}01'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

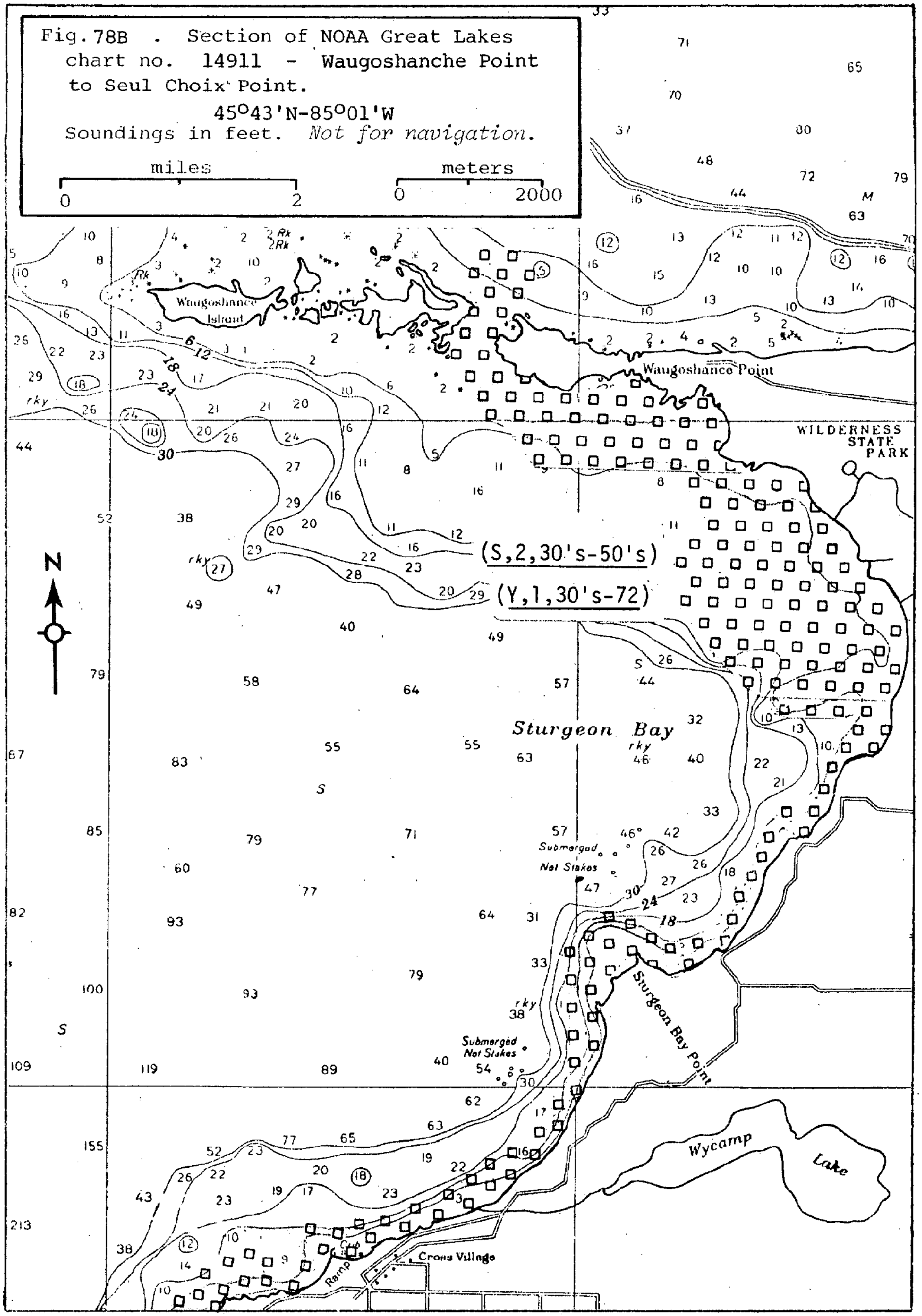



Fig. 78B . Section of NOAA Great Lakes chart no. 14911 - Waugoshanche Point to Seul Choix Point.
45°43'N-85°01'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

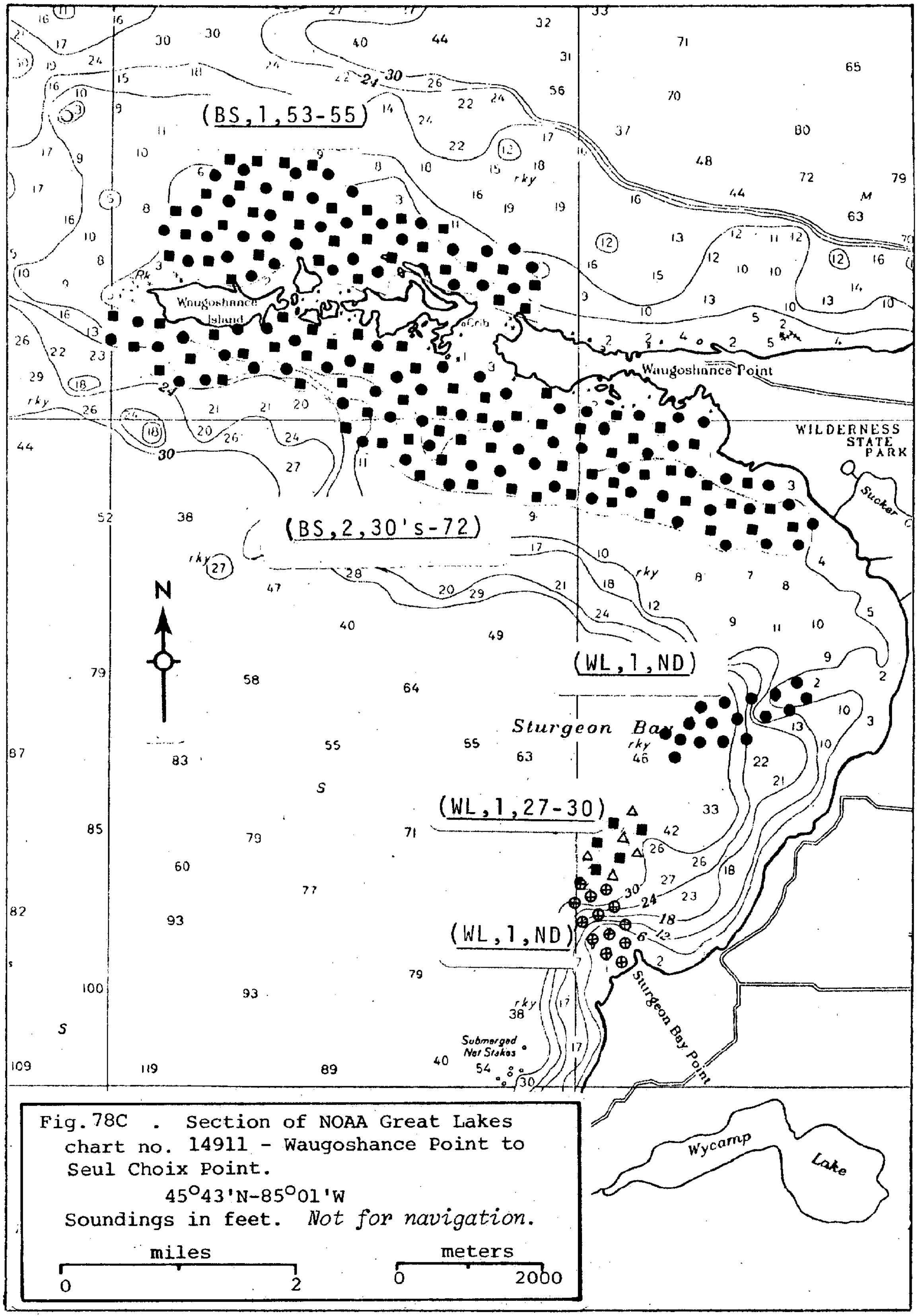



Fig. 78C . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°43'N-85°01'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

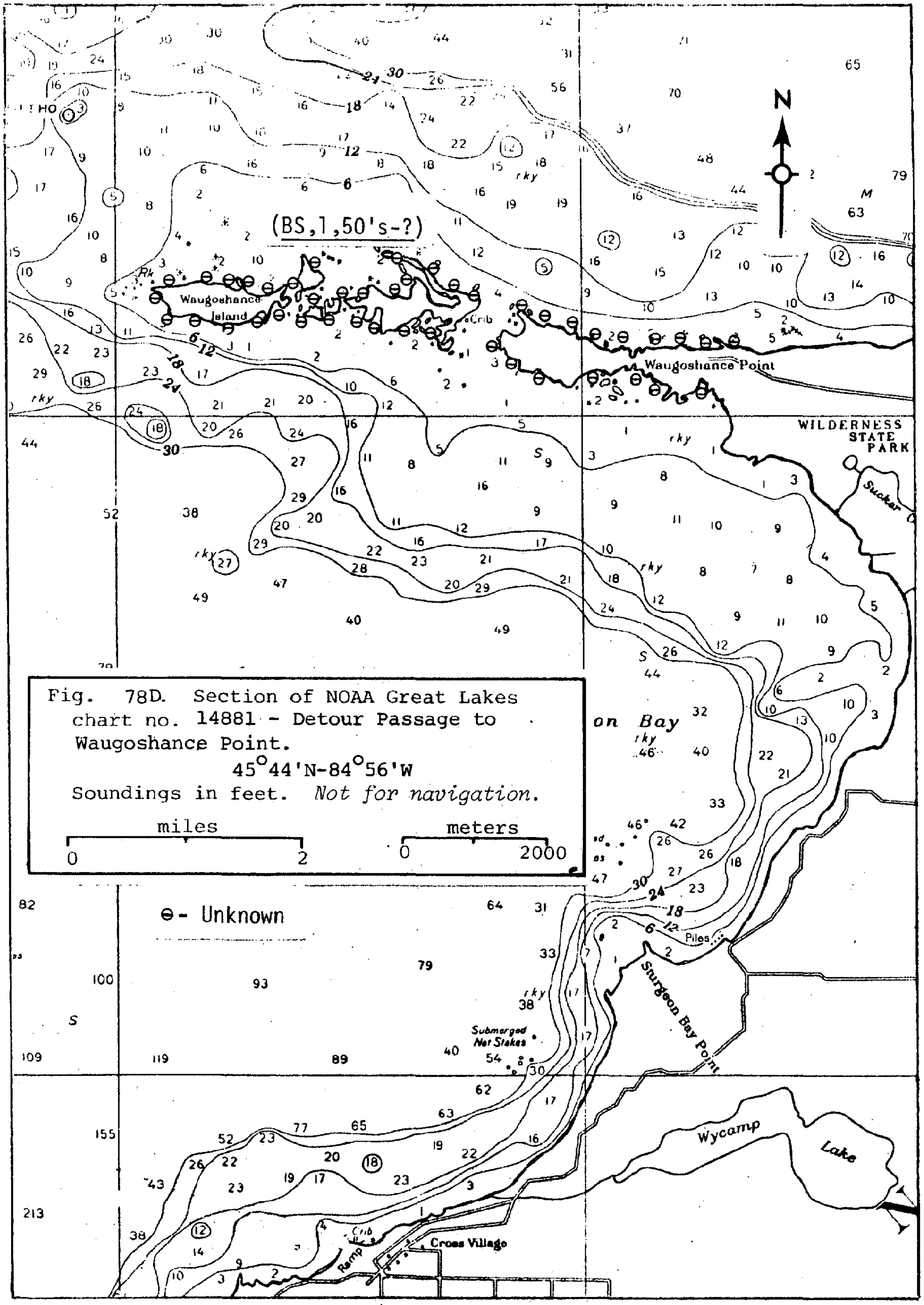



Fig. 78D. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°44'N-84°56'W
Soundings in feet. *Not for navigation.*
miles 0 2   meters 0 2000

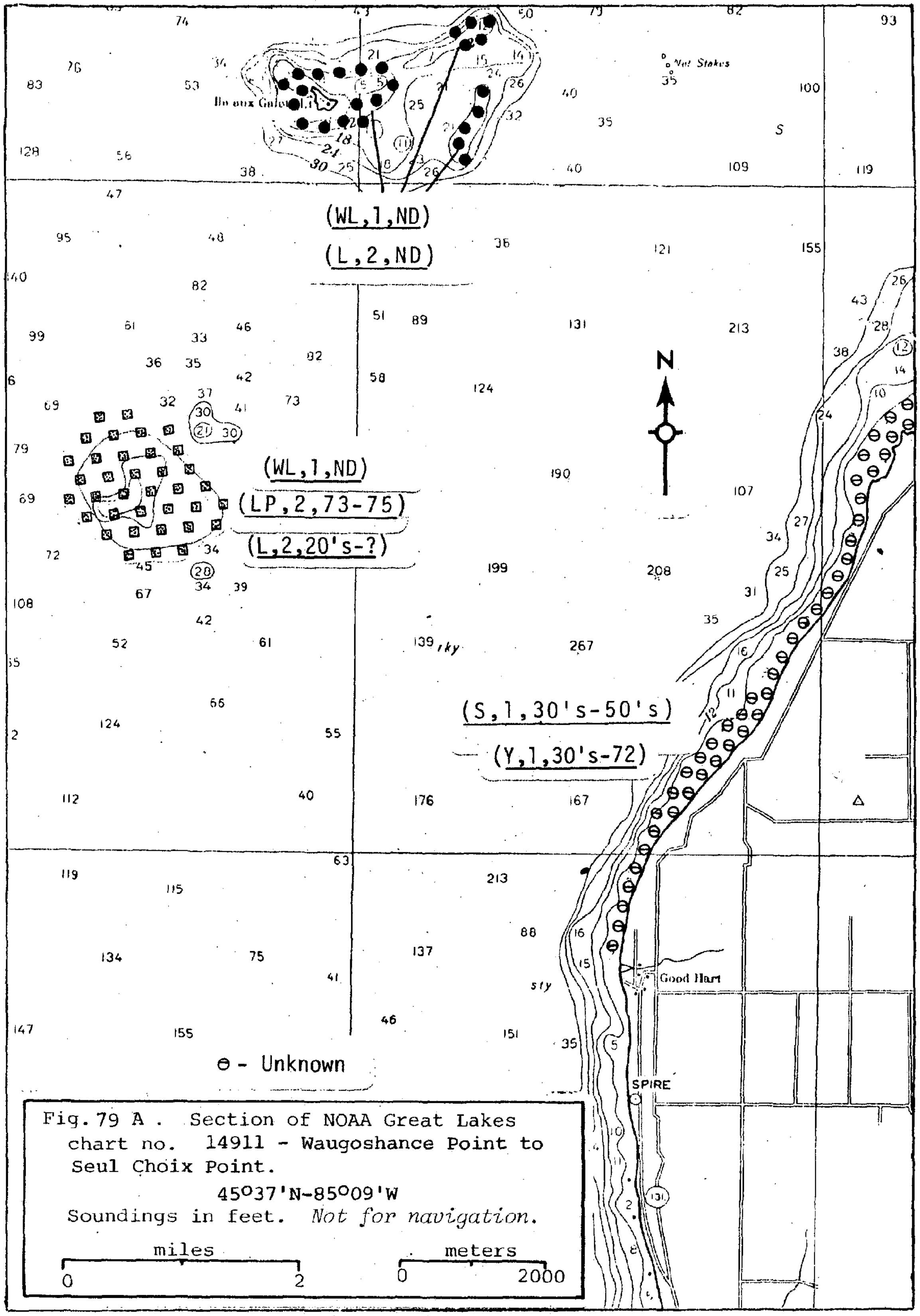



Fig. 79 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°37'N-85°09'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

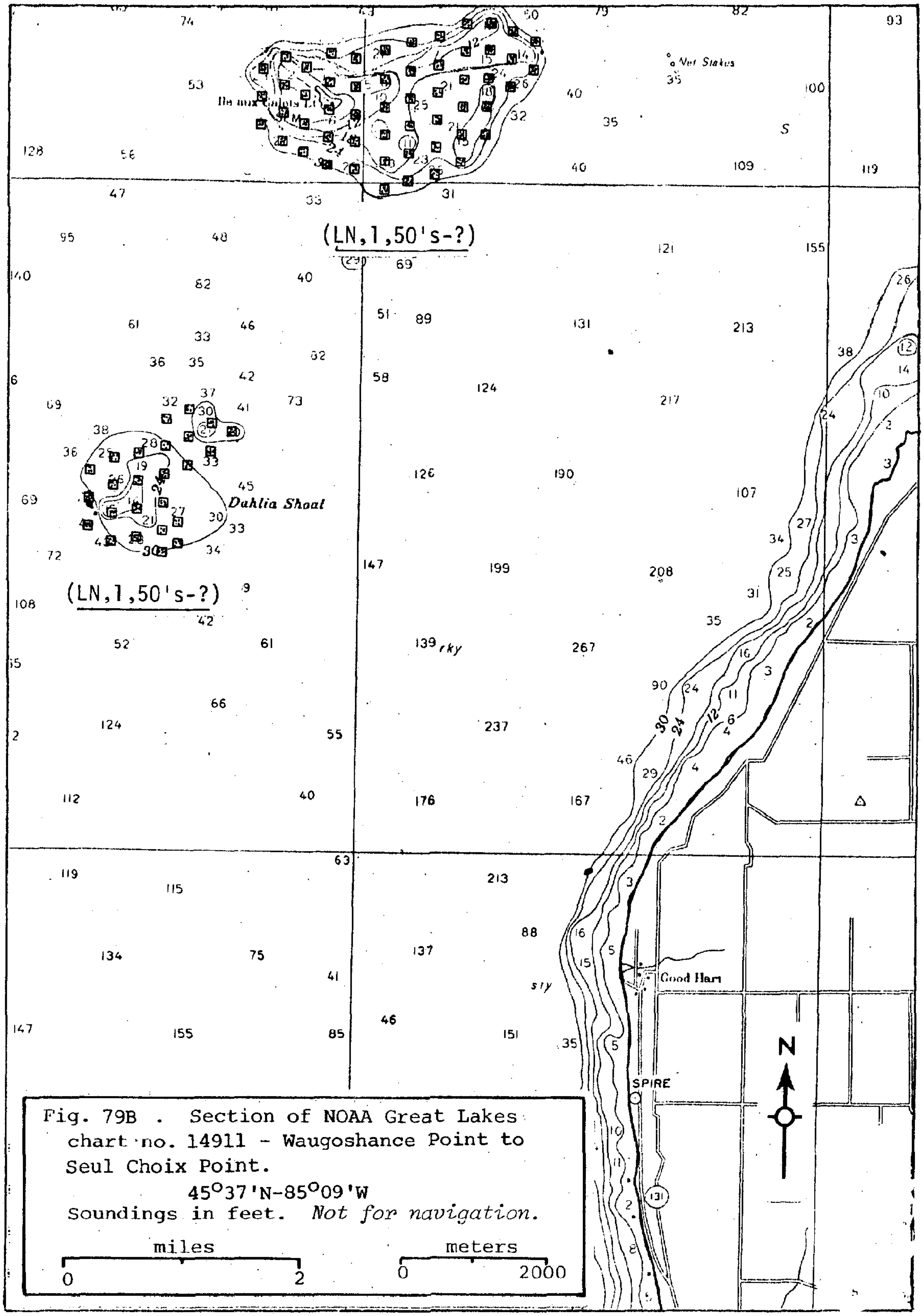



Fig. 79B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°37'N-85°09'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

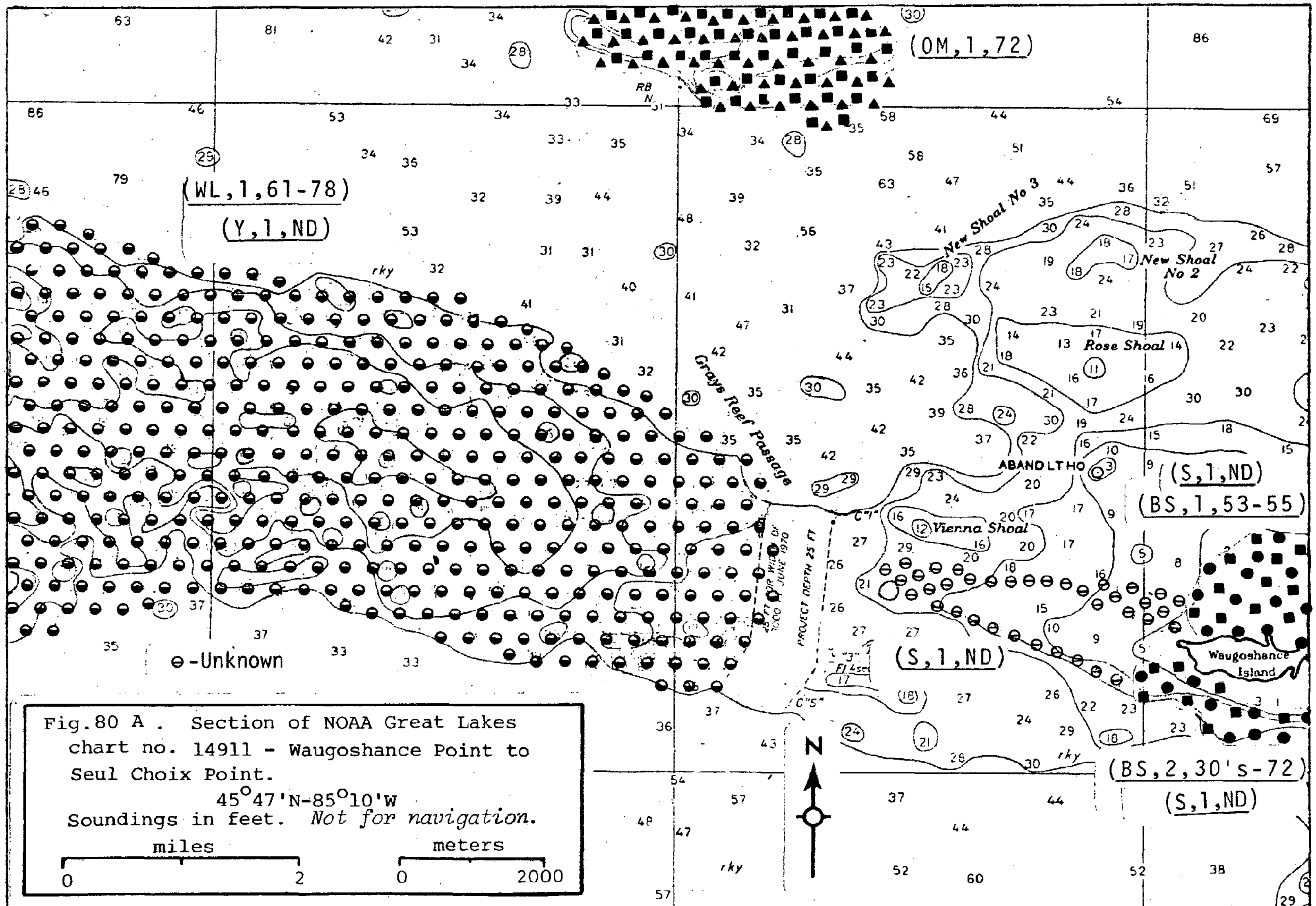



Fig.80 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
$45^{\circ}47'$N-$85^{\circ}10'$W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

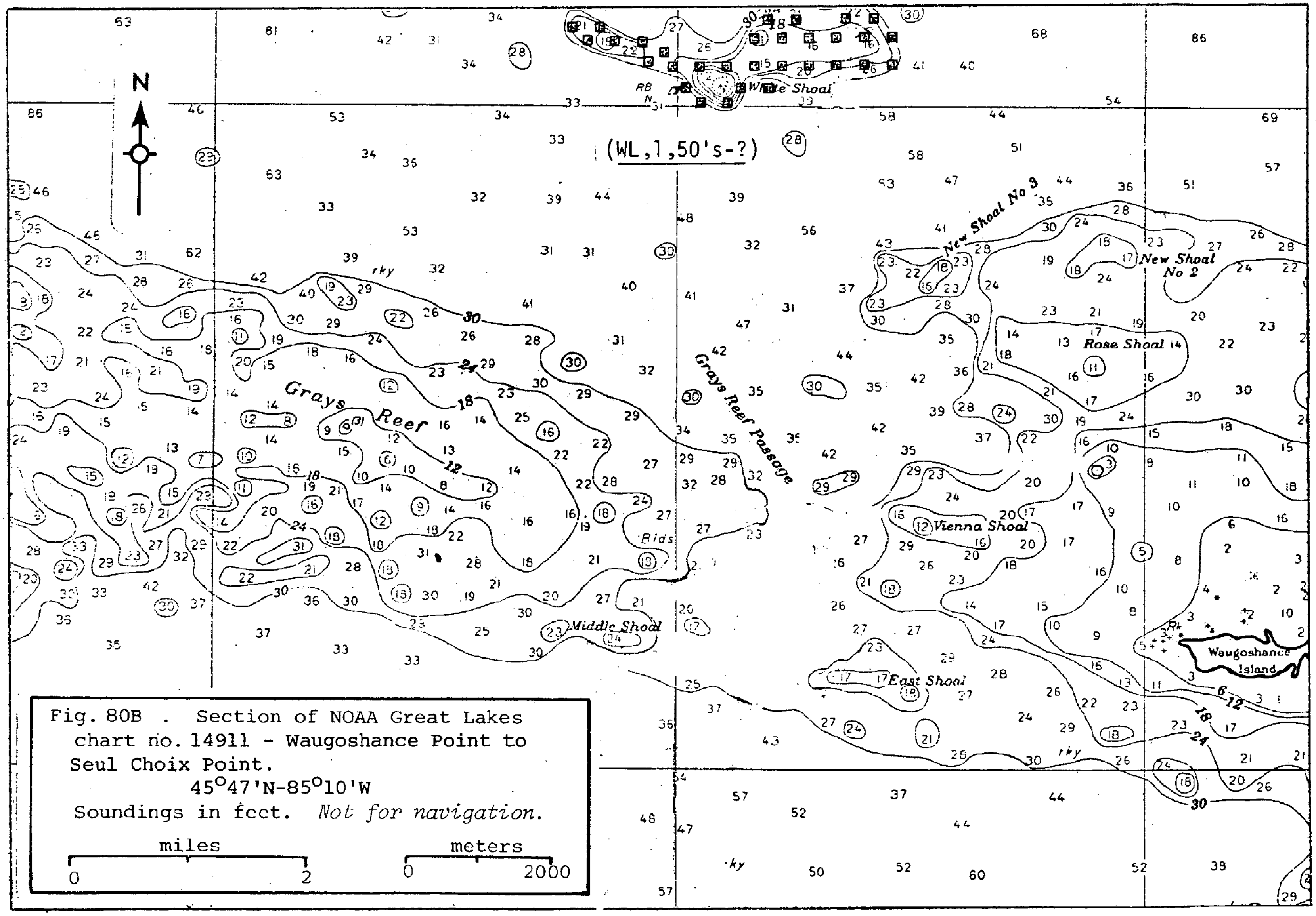



Fig. 80B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°47'N-85°10'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

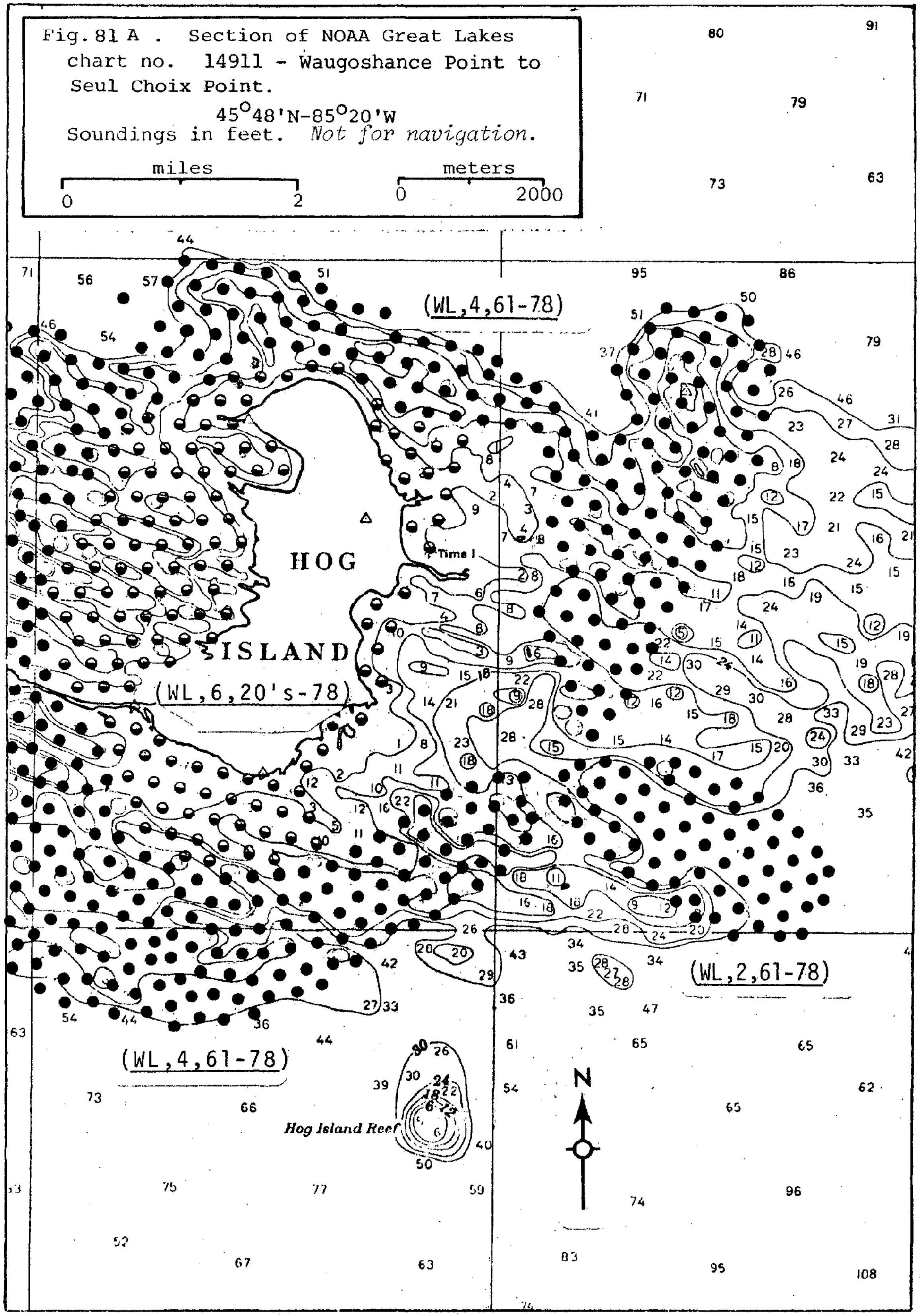



Fig. 81 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°48'N-85°20'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

Fig. 81B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°37'N-85°33'W

Soundings in feet. *Not for navigation.*

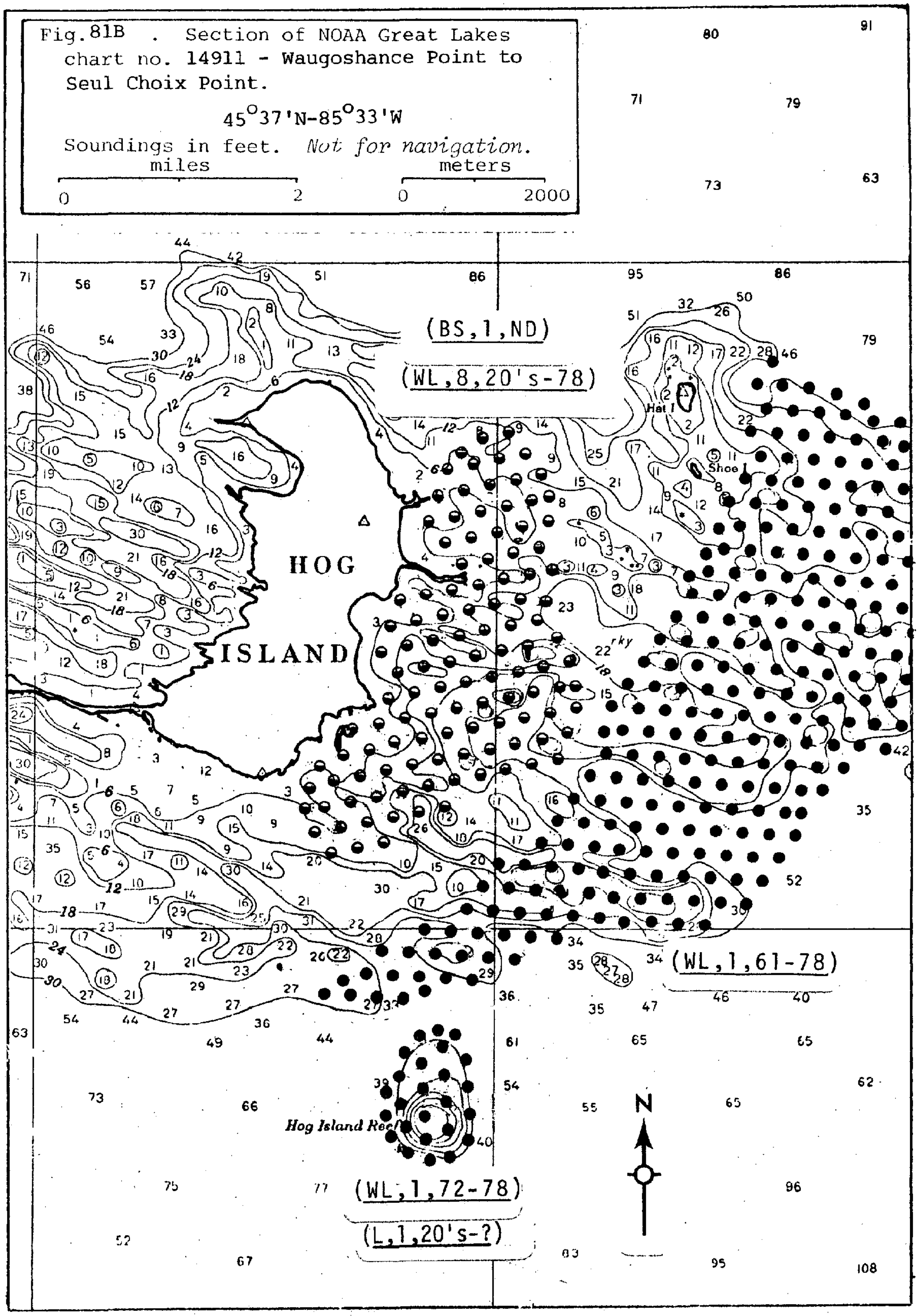
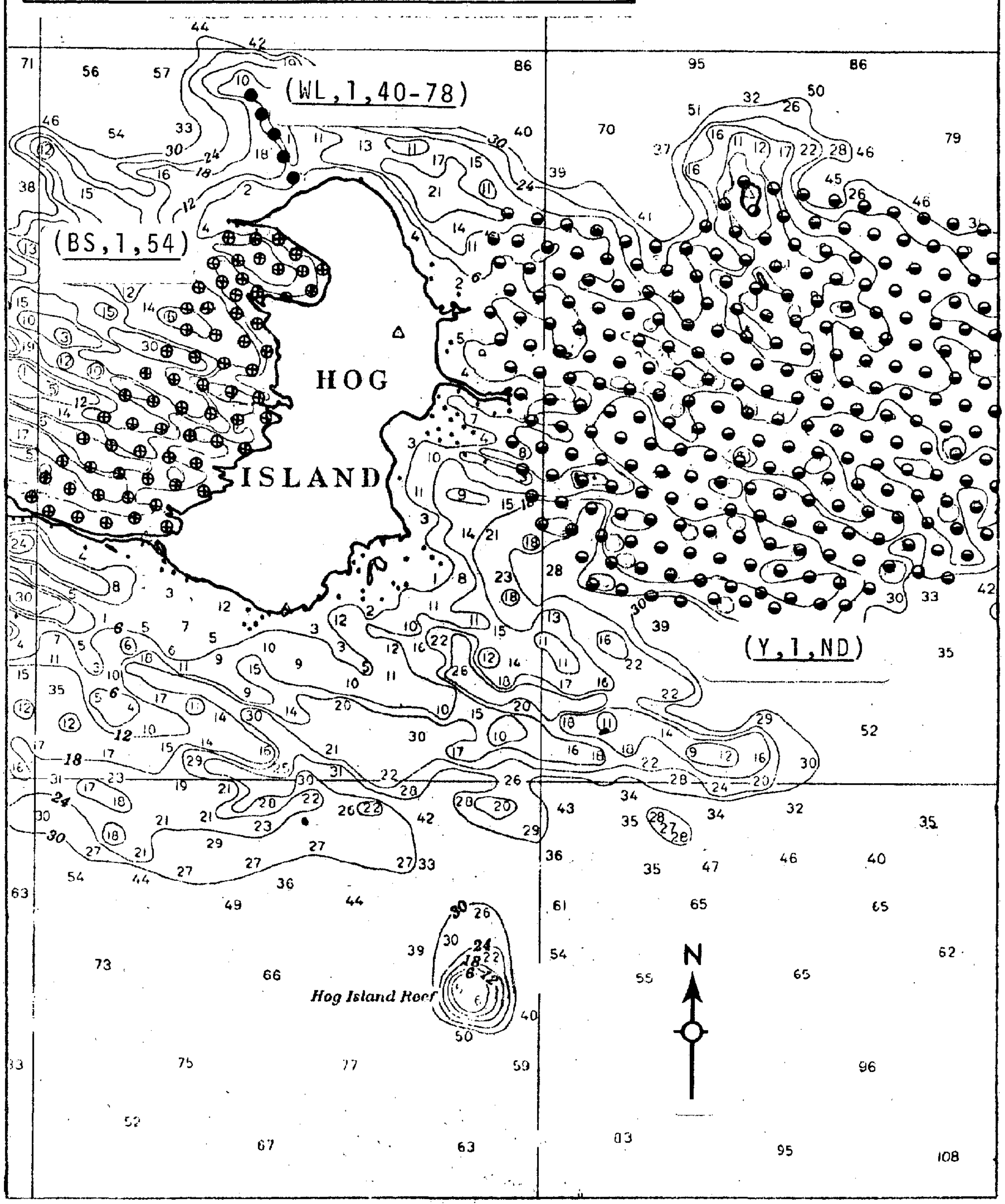


Fig.81C . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Chiox Point.

45°37'N-85°33'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000



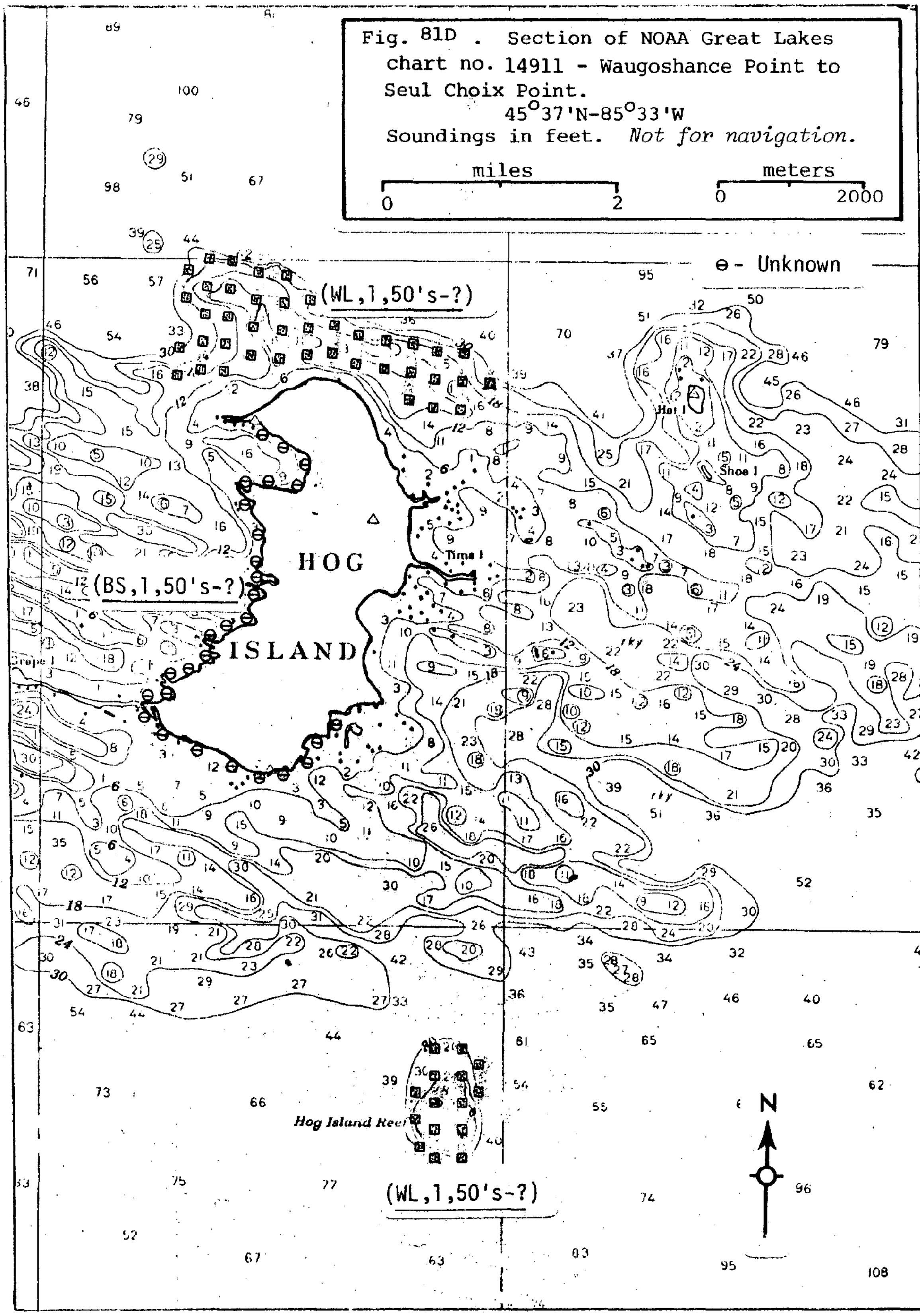



Fig. 81D . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°37'N-85°33'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

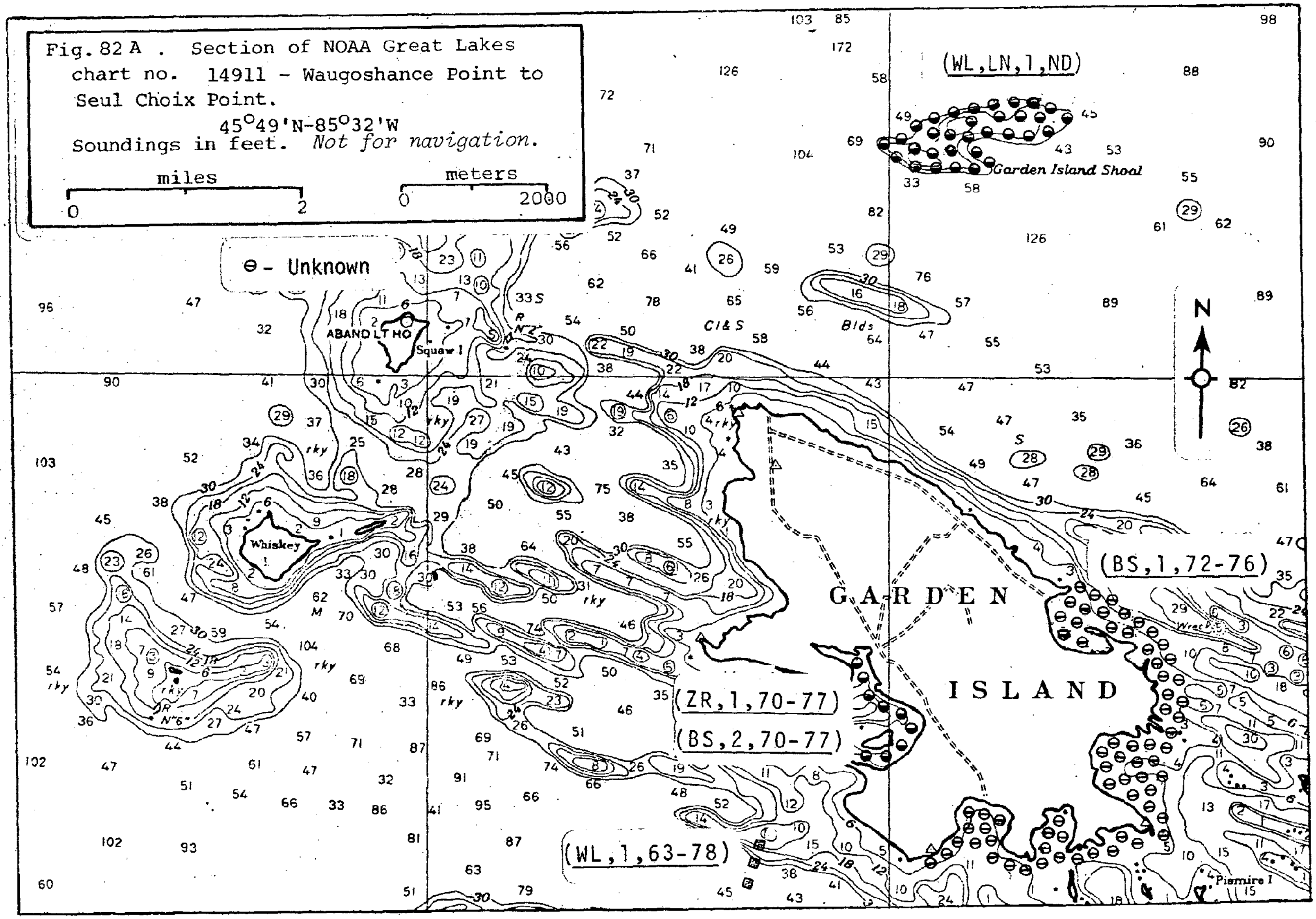



Fig. 82 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°49'N-85°32'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

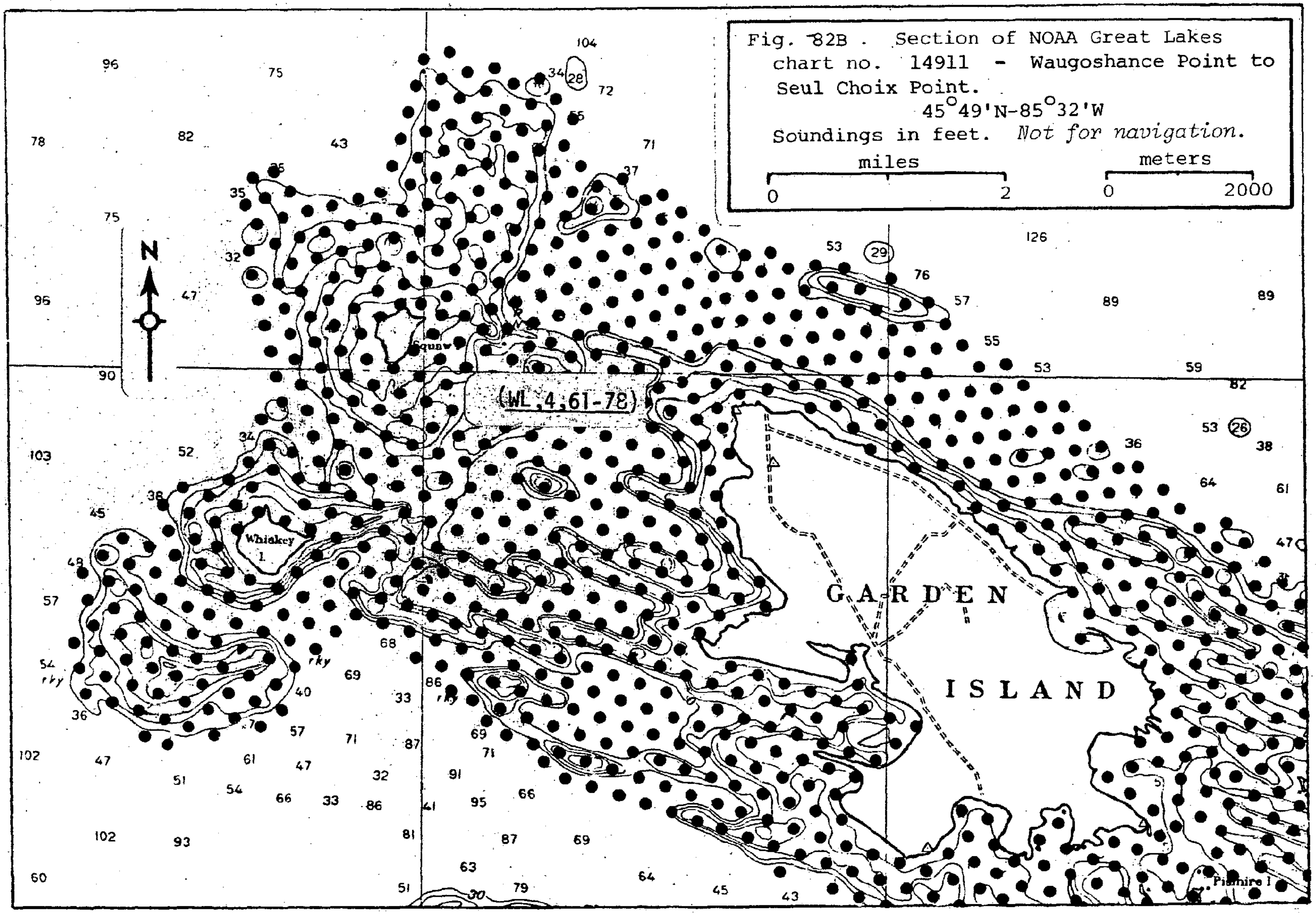
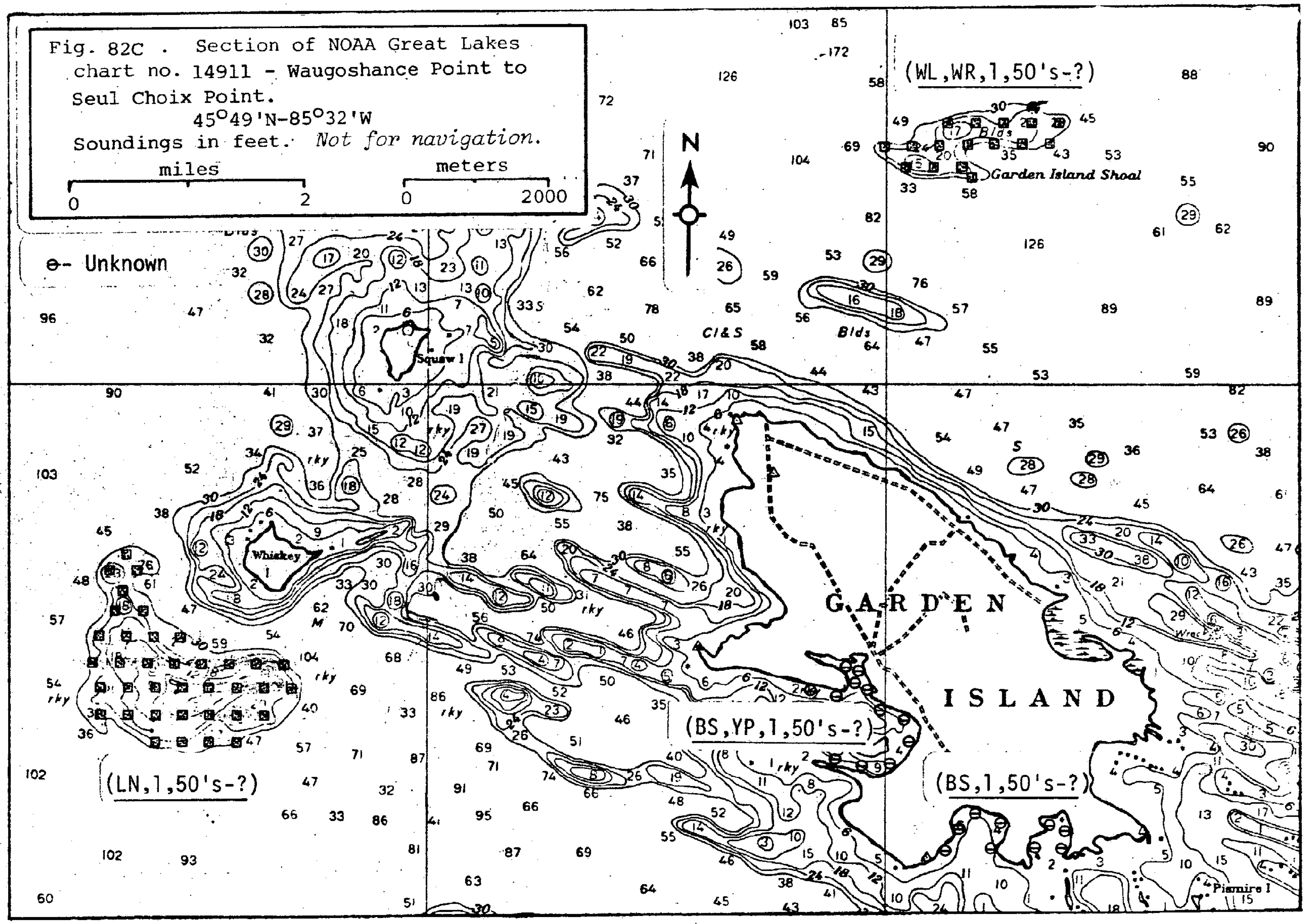



Fig. 82B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°49'N-85°32'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

Fig. 82C . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°49'N-85°32'W
Soundings in feet. *Not for navigation.*



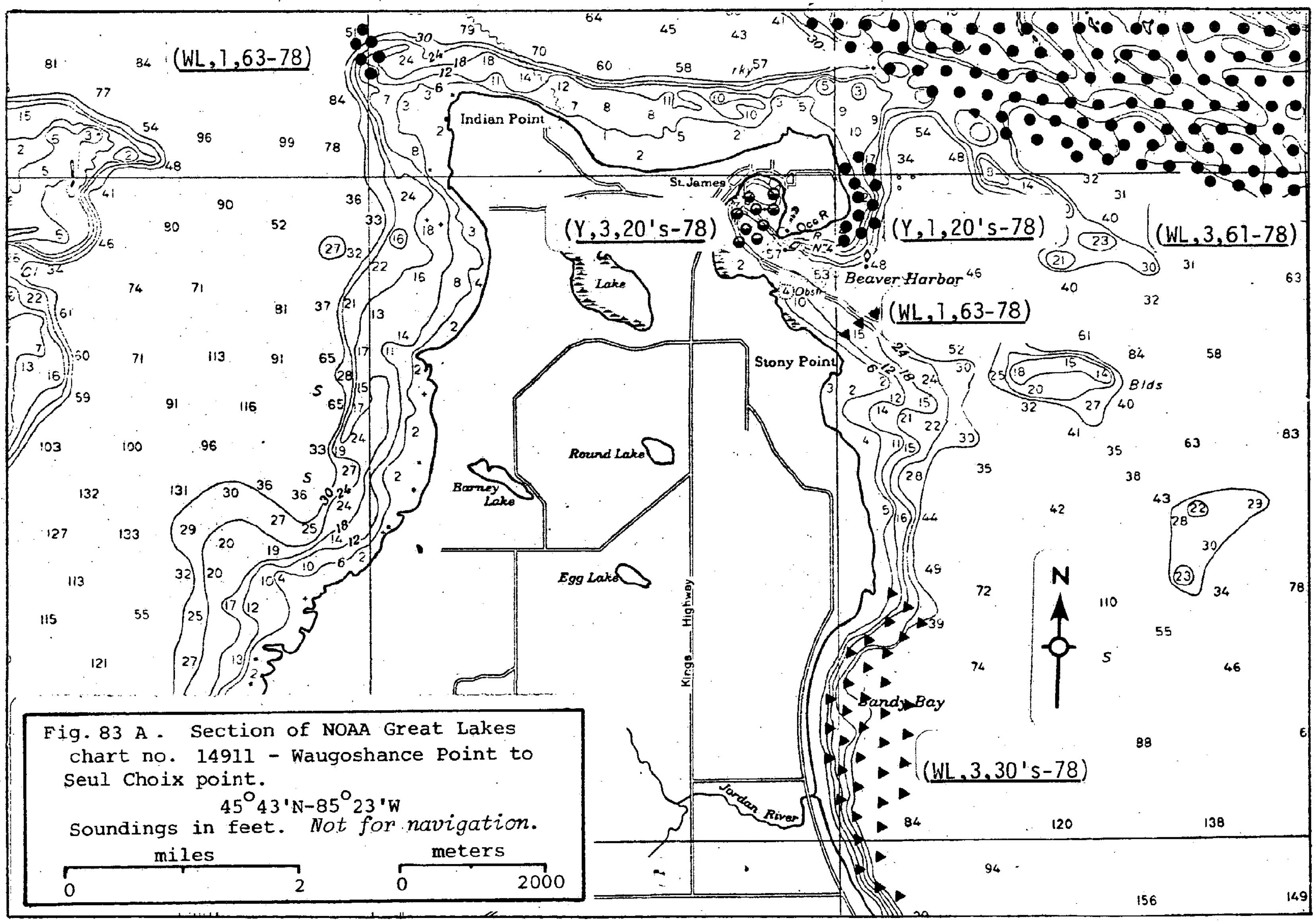



Fig. 83 A. Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix point.
45°43'N-85°23'W
Soundings in feet. *Not for navigation.*

miles 0 — 2 meters 0 — 2000

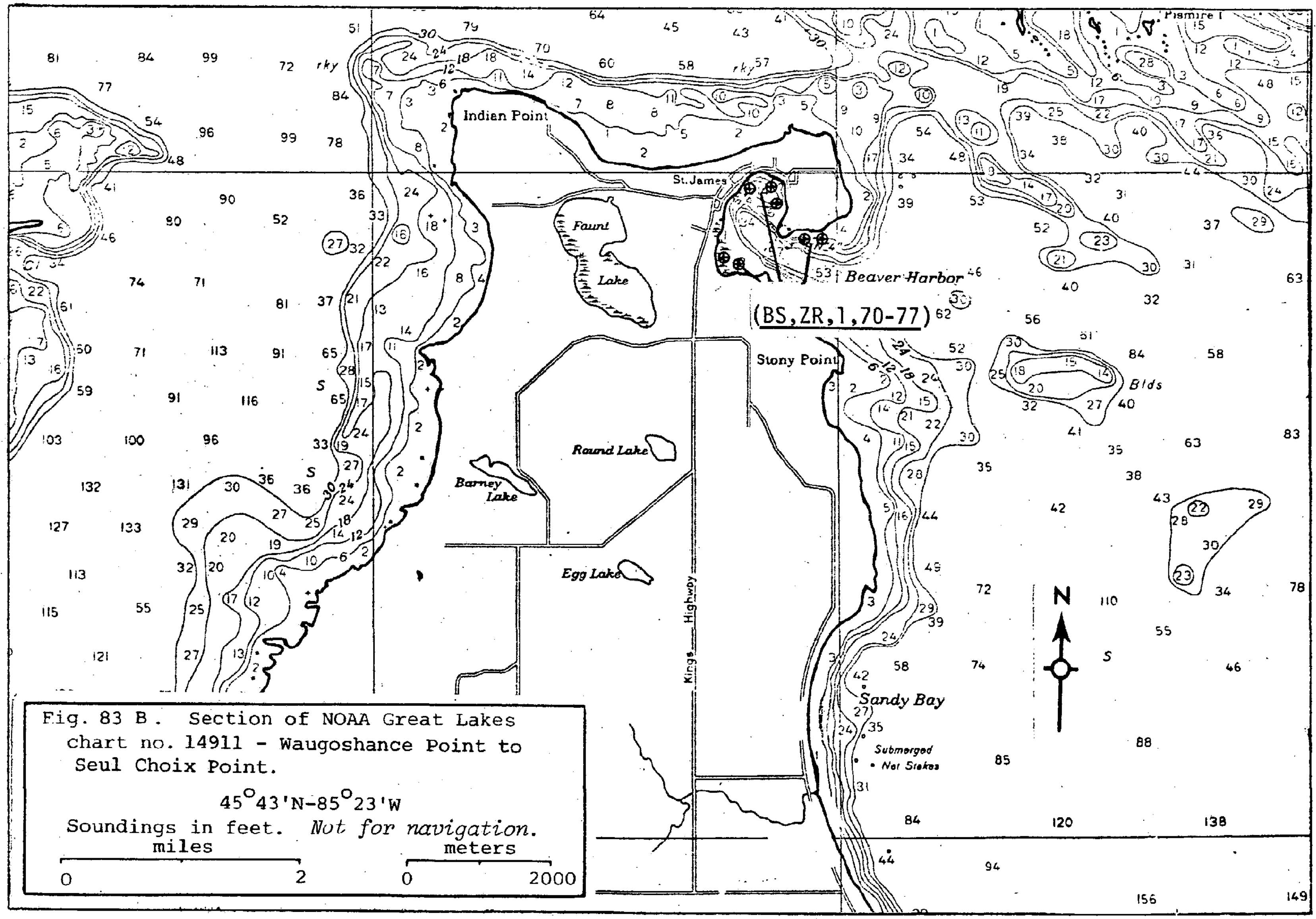



Fig. 83 B. Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°43'N-85°23'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

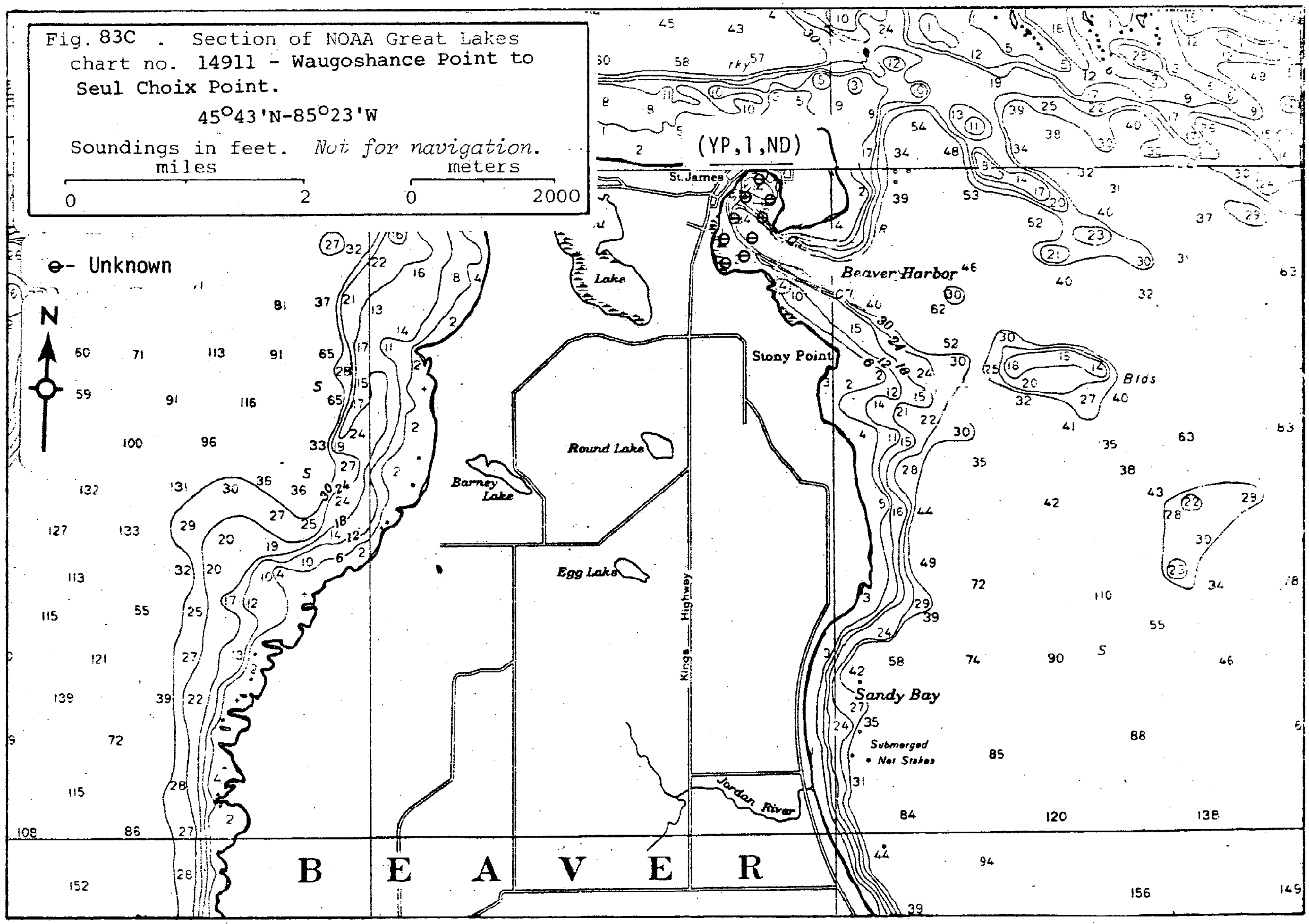



Fig. 83C . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°43'N-85°23'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

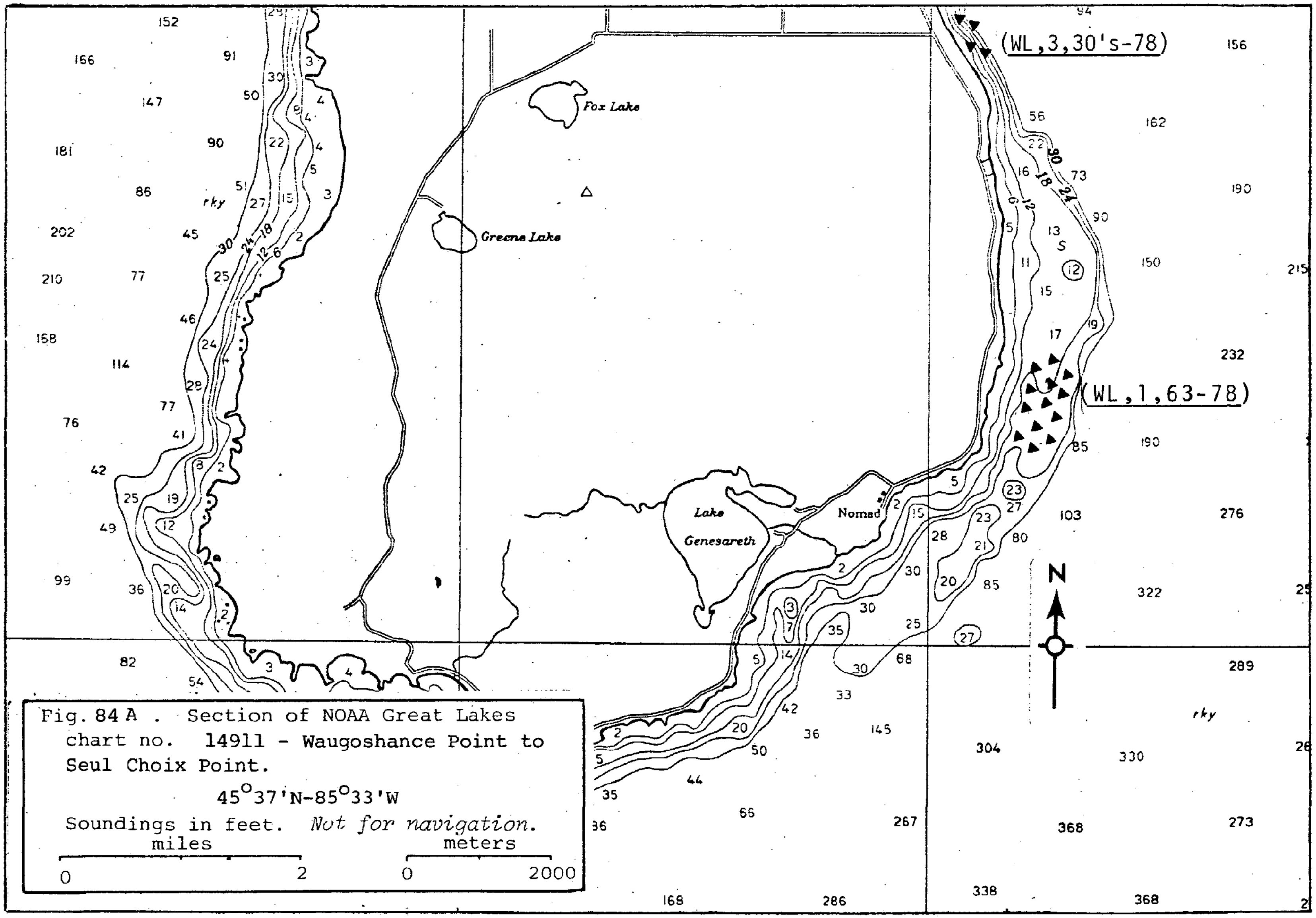



Fig. 84 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°37'N-85°33'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

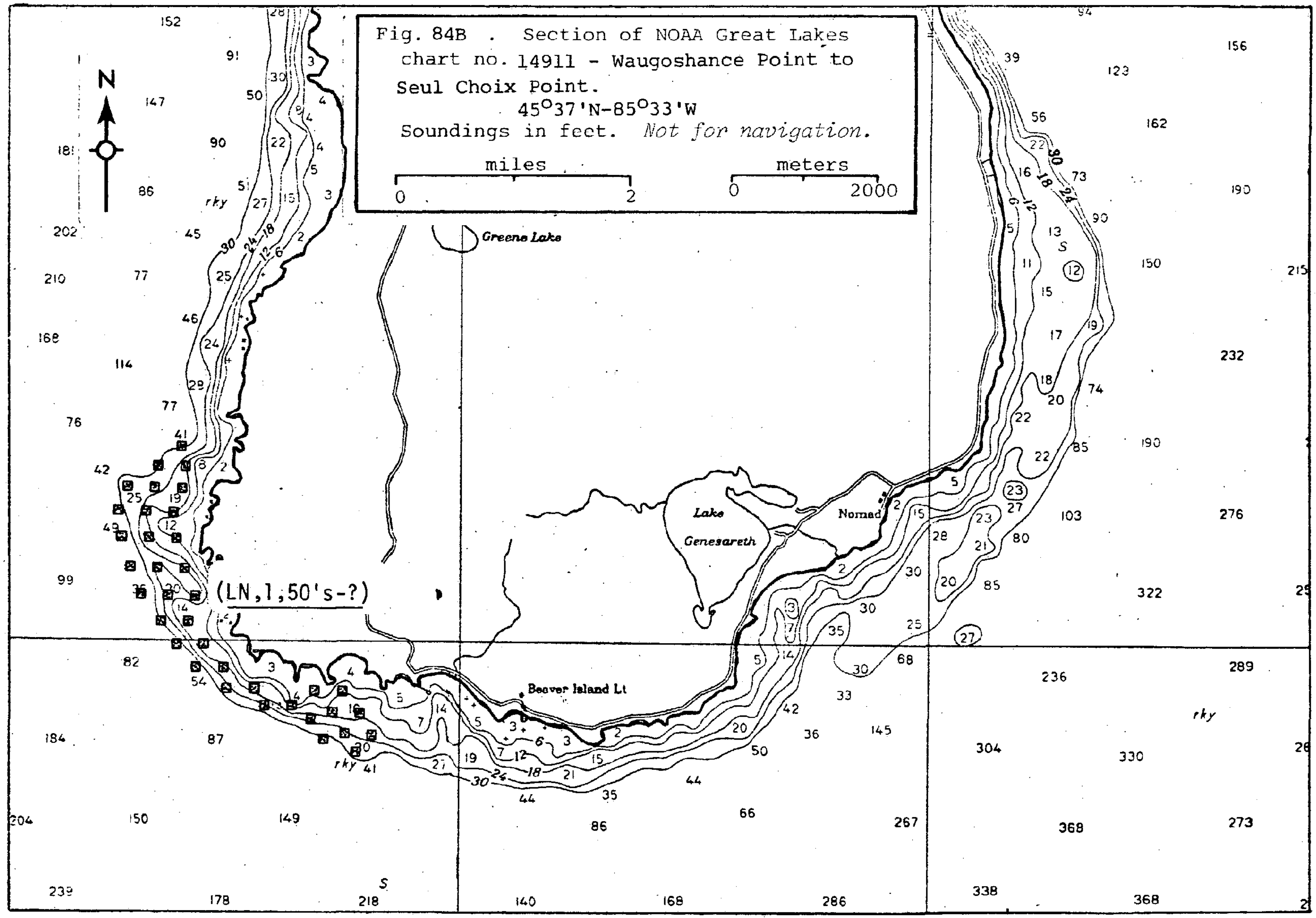



Fig. 84B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
45°37'N-85°33'W
Soundings in feet. *Not for navigation.*

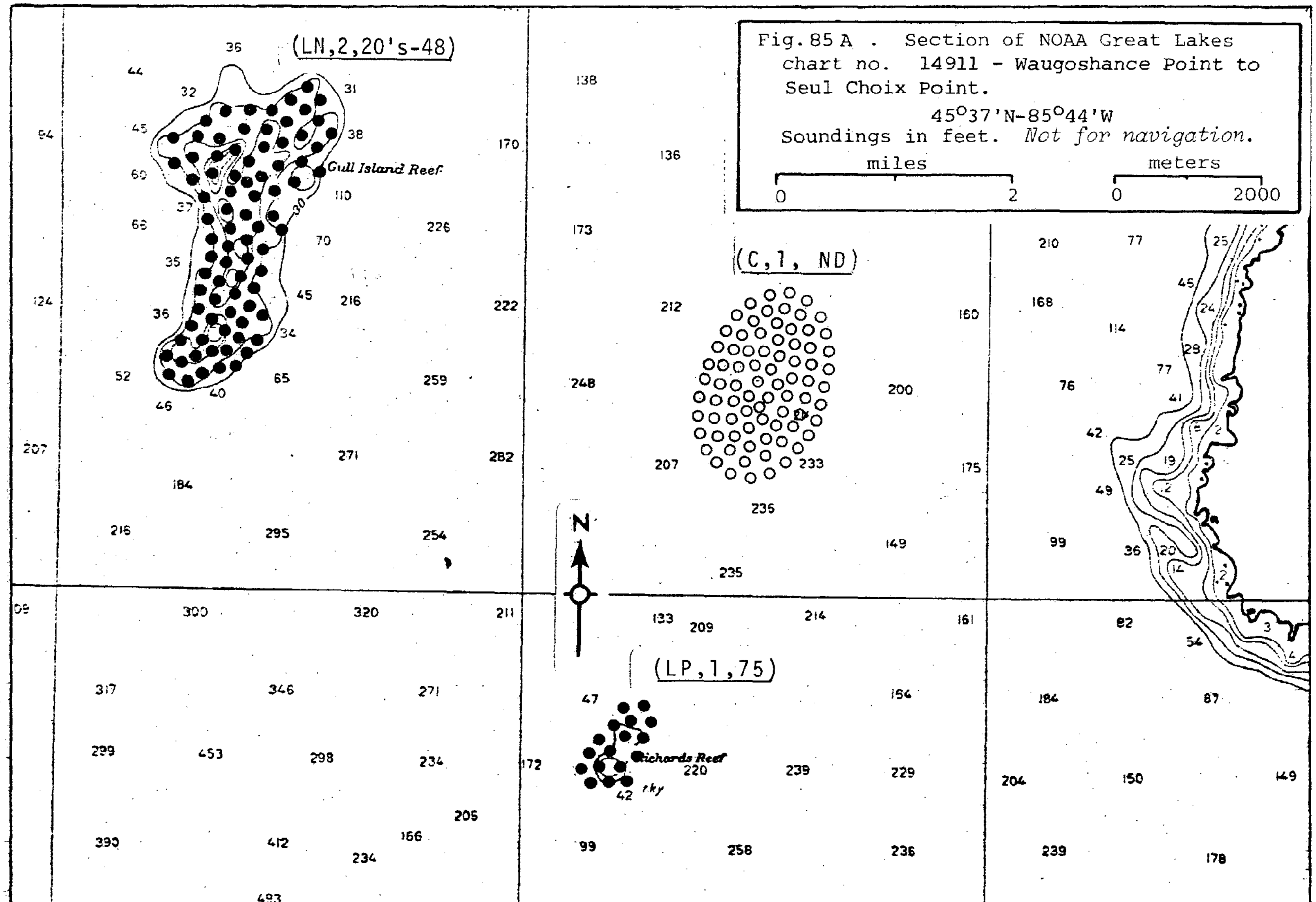



Fig. 85 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
$45^{o}37'N-85^{o}44'W$
Soundings in feet. *Not for navigation.*

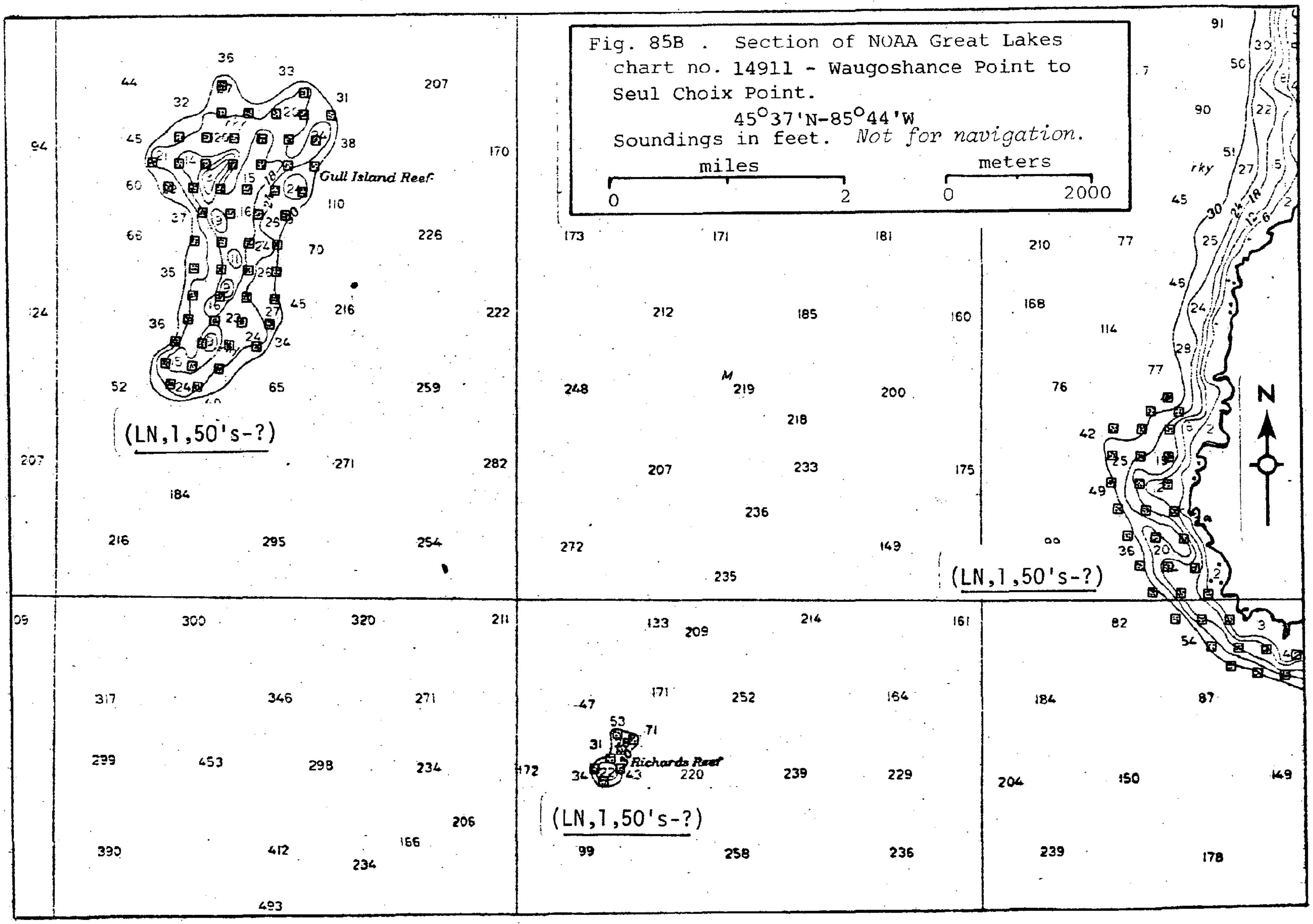



Fig. 85B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
$45^{\circ}37'$N-$85^{\circ}44'$W
Soundings in feet. *Not for navigation.*

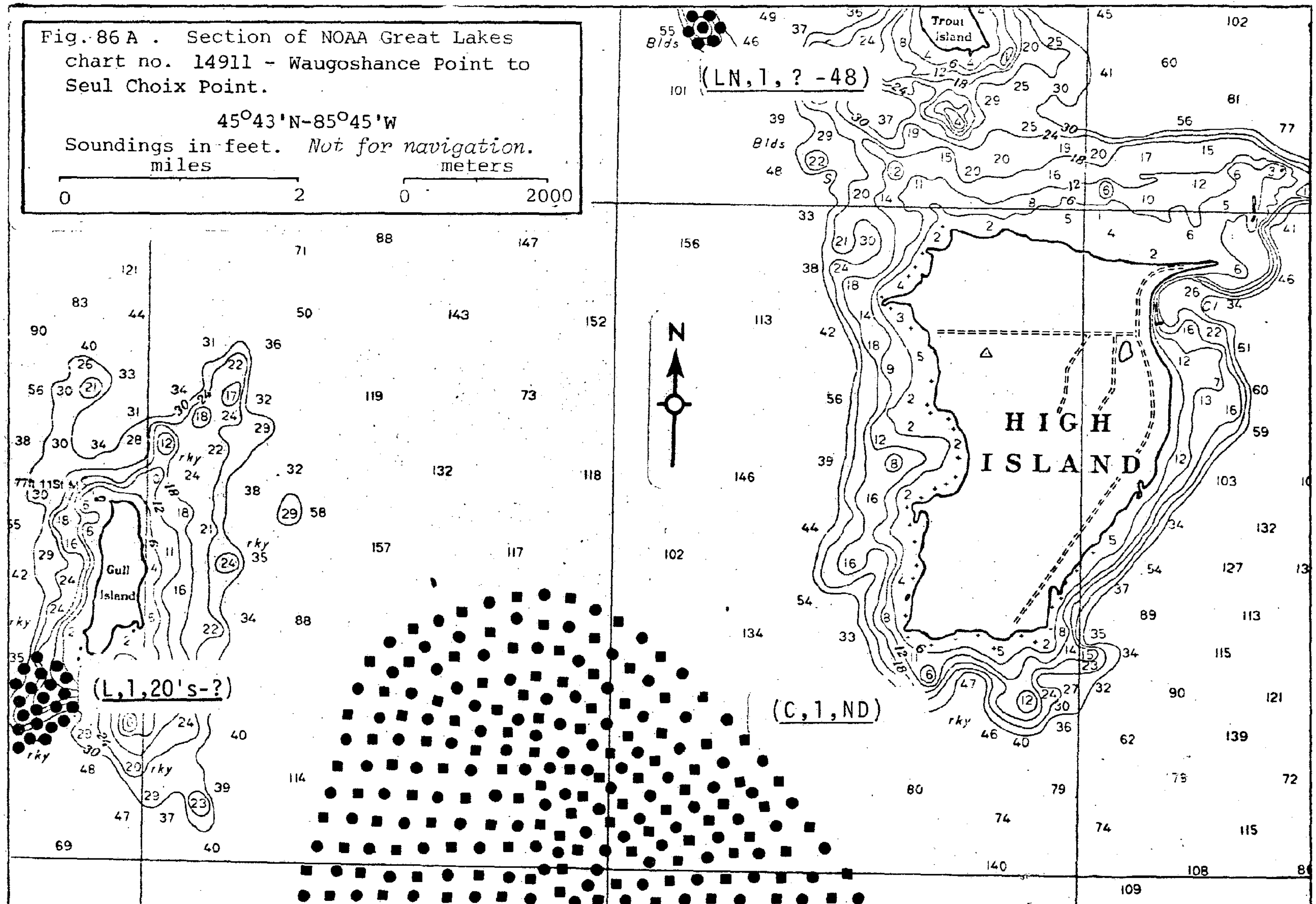



Fig. 86 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°43'N-85°45'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

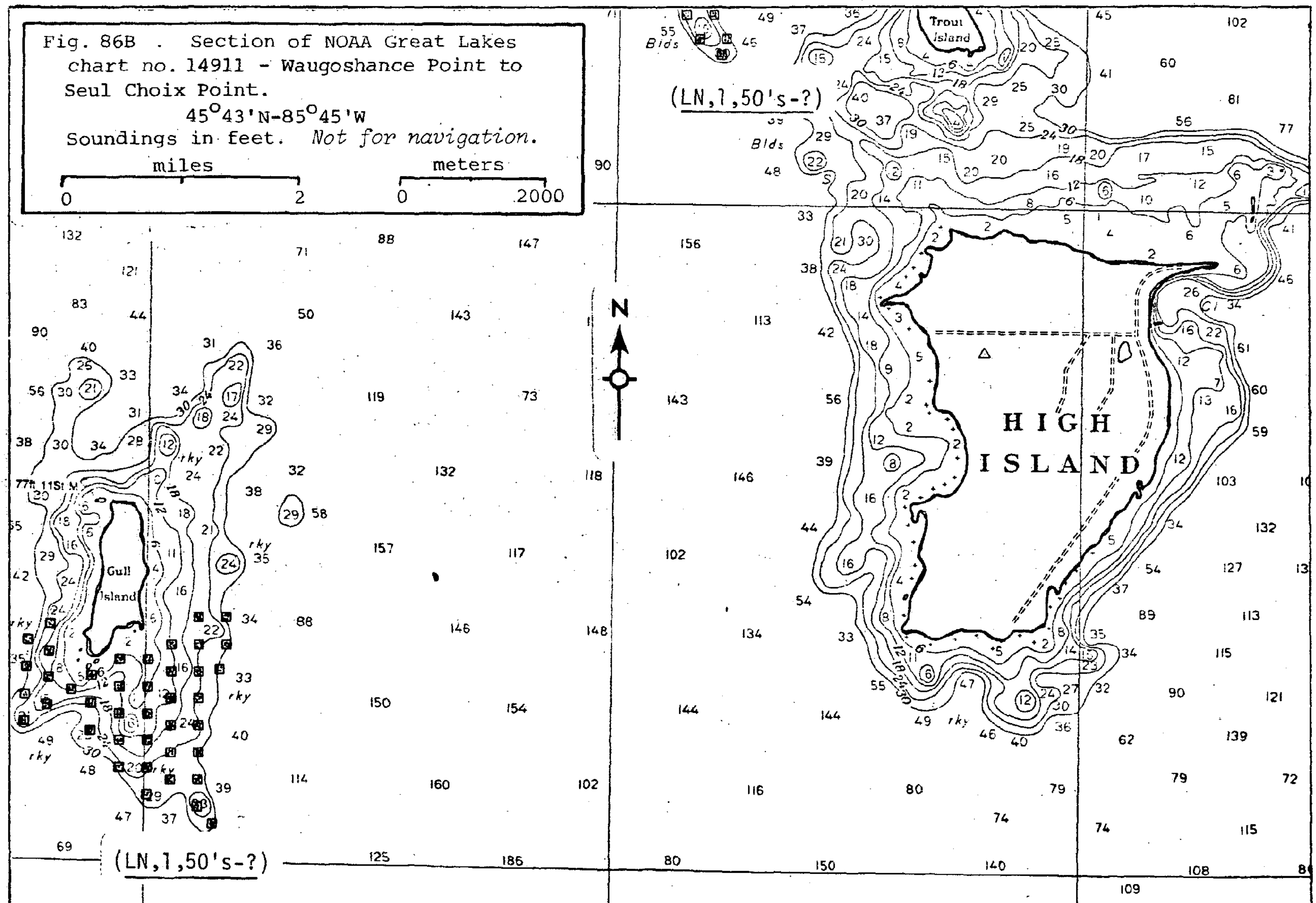
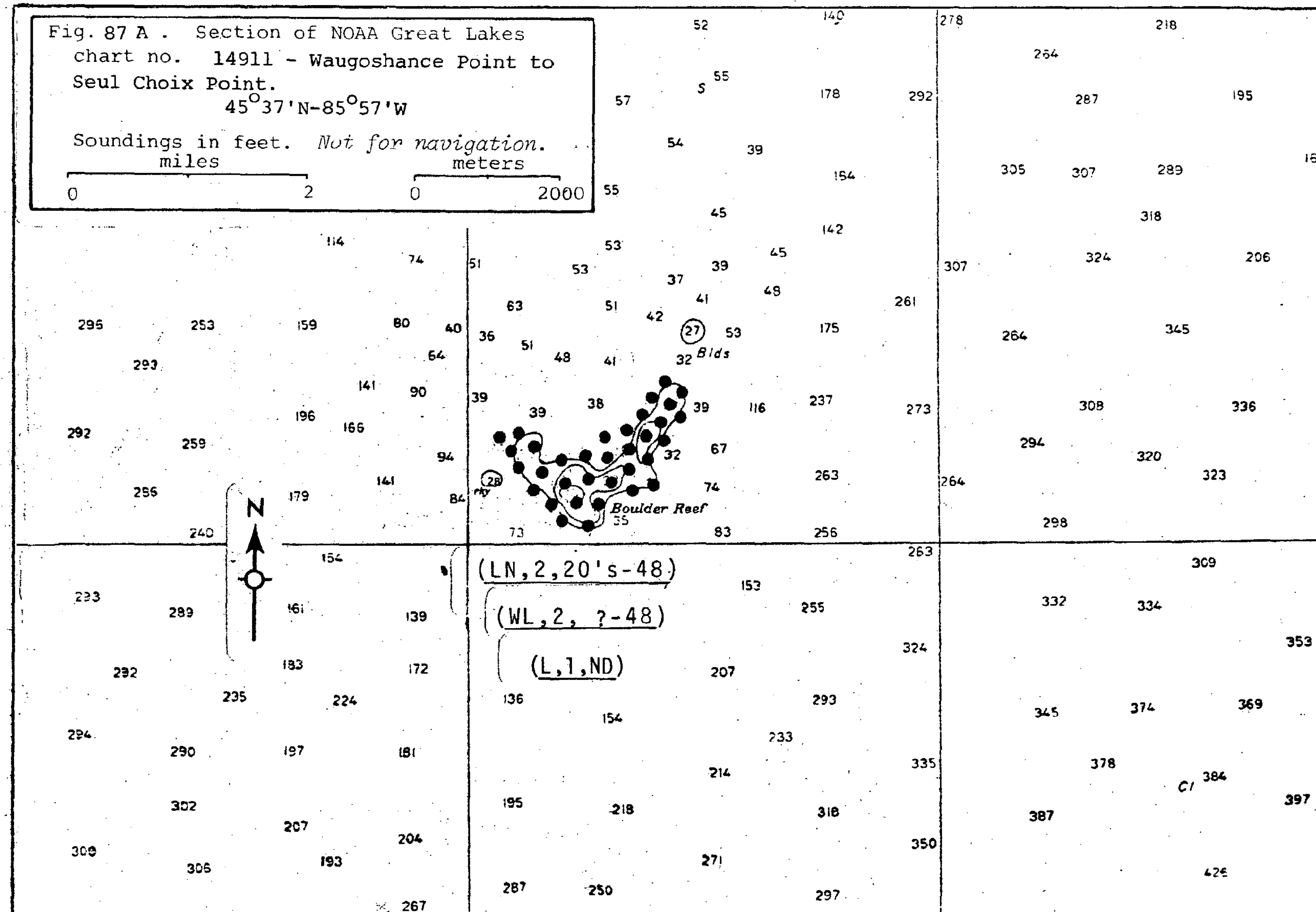



Fig. 86B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
$45^{o}43'N-85^{o}45'W$
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

Fig. 87 A . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.
$45^{o}37'N-85^{o}57'W$

Soundings in feet. *Not for navigation.*



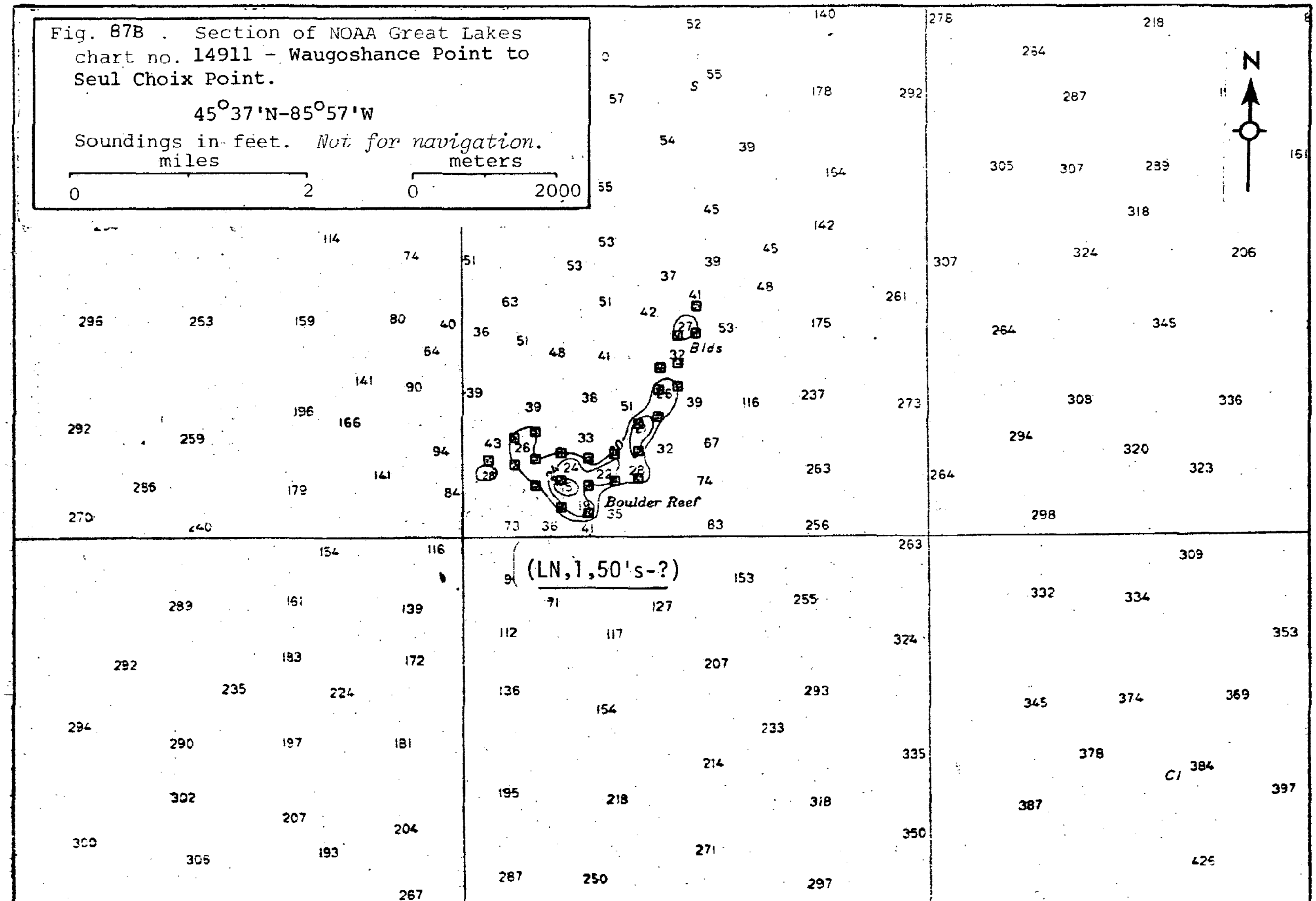



Fig. 87B . Section of NOAA Great Lakes chart no. 14911 - Waugoshance Point to Seul Choix Point.

45°37'N-85°57'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

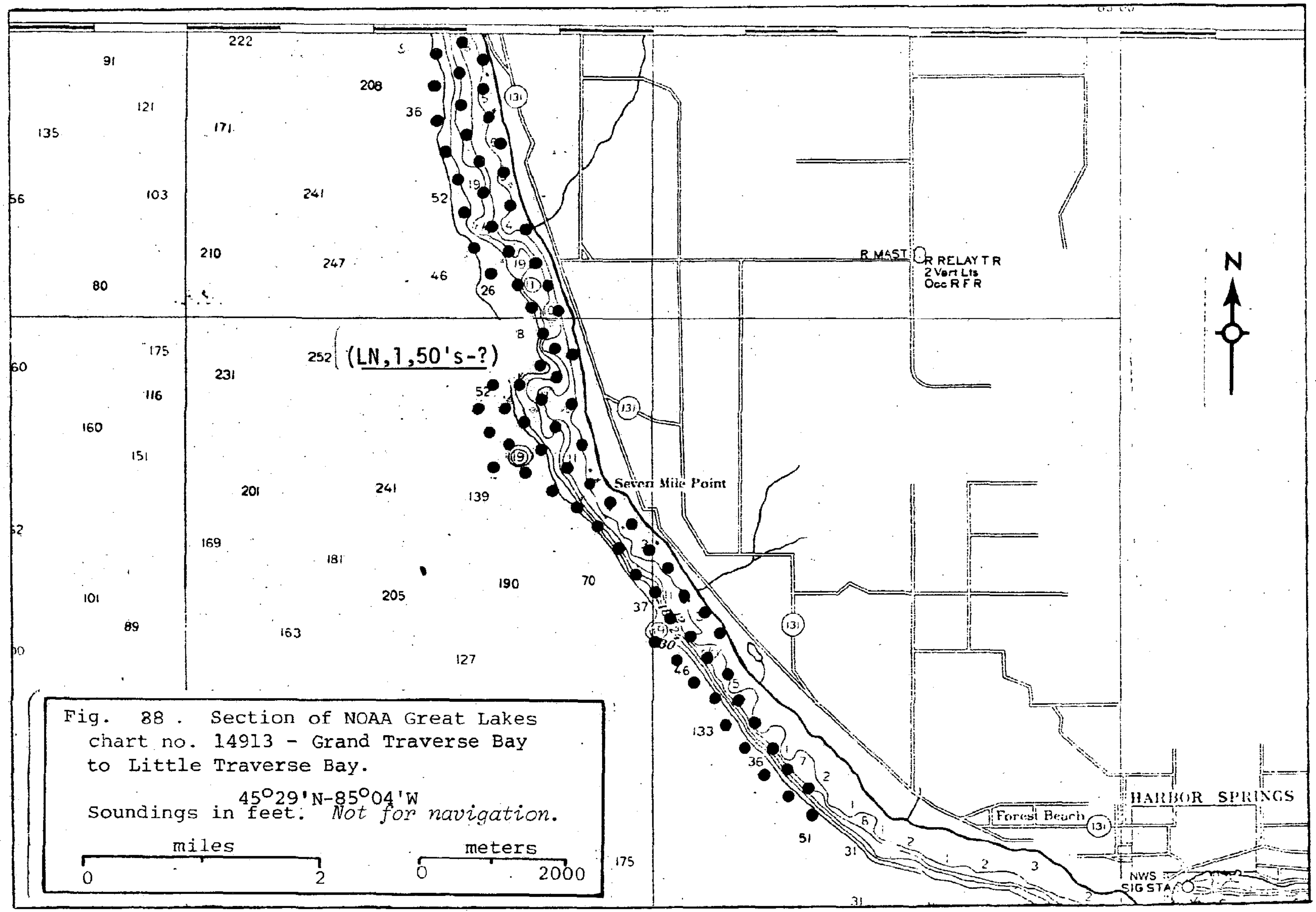



Fig. 88 . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.

45°29'N-85°04'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

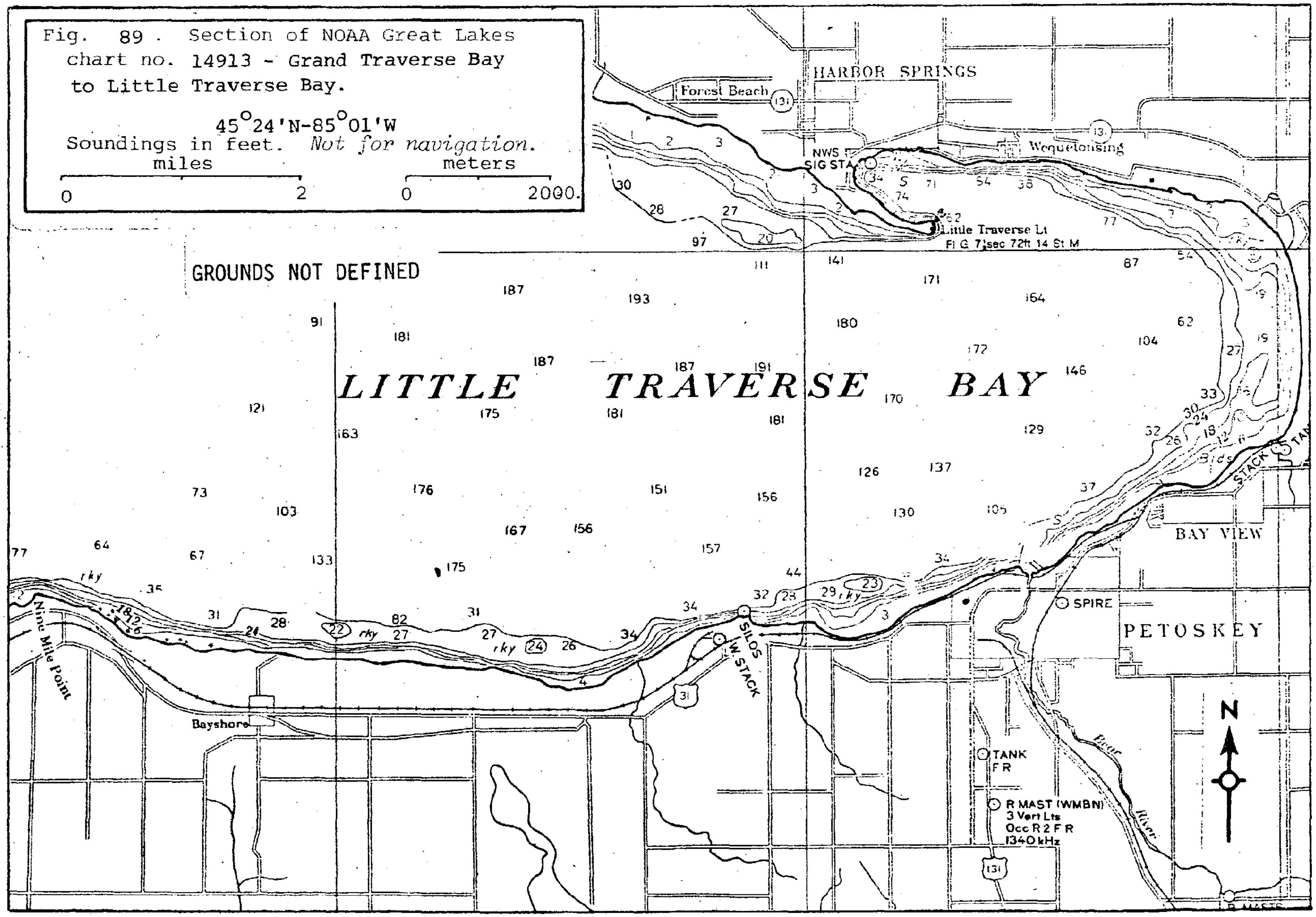



Fig. 89. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.

$45^{\circ}24'$N-$85^{\circ}01'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000.

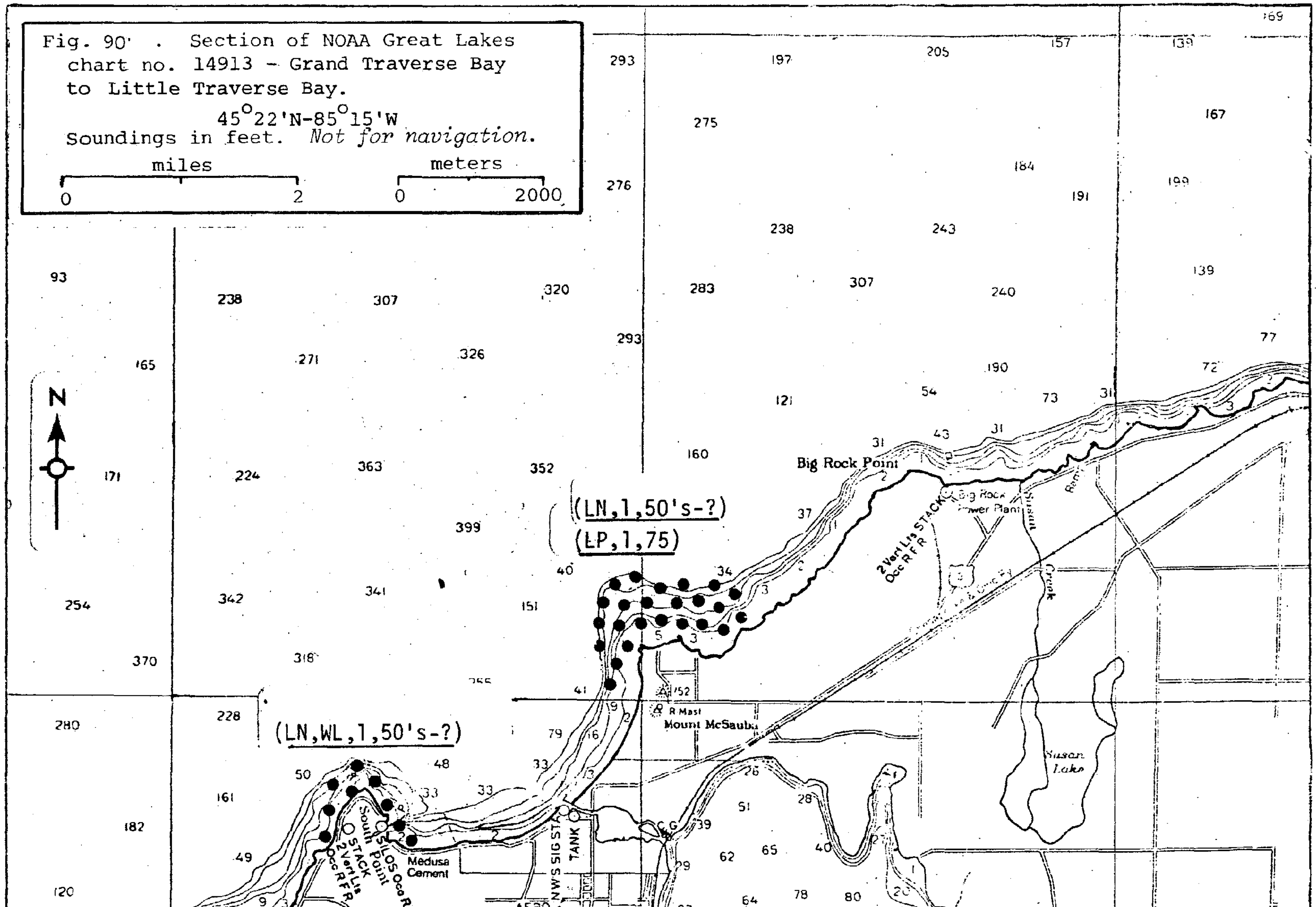



Fig. 90 . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
$45^{\circ}22'N-85^{\circ}15'W$
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

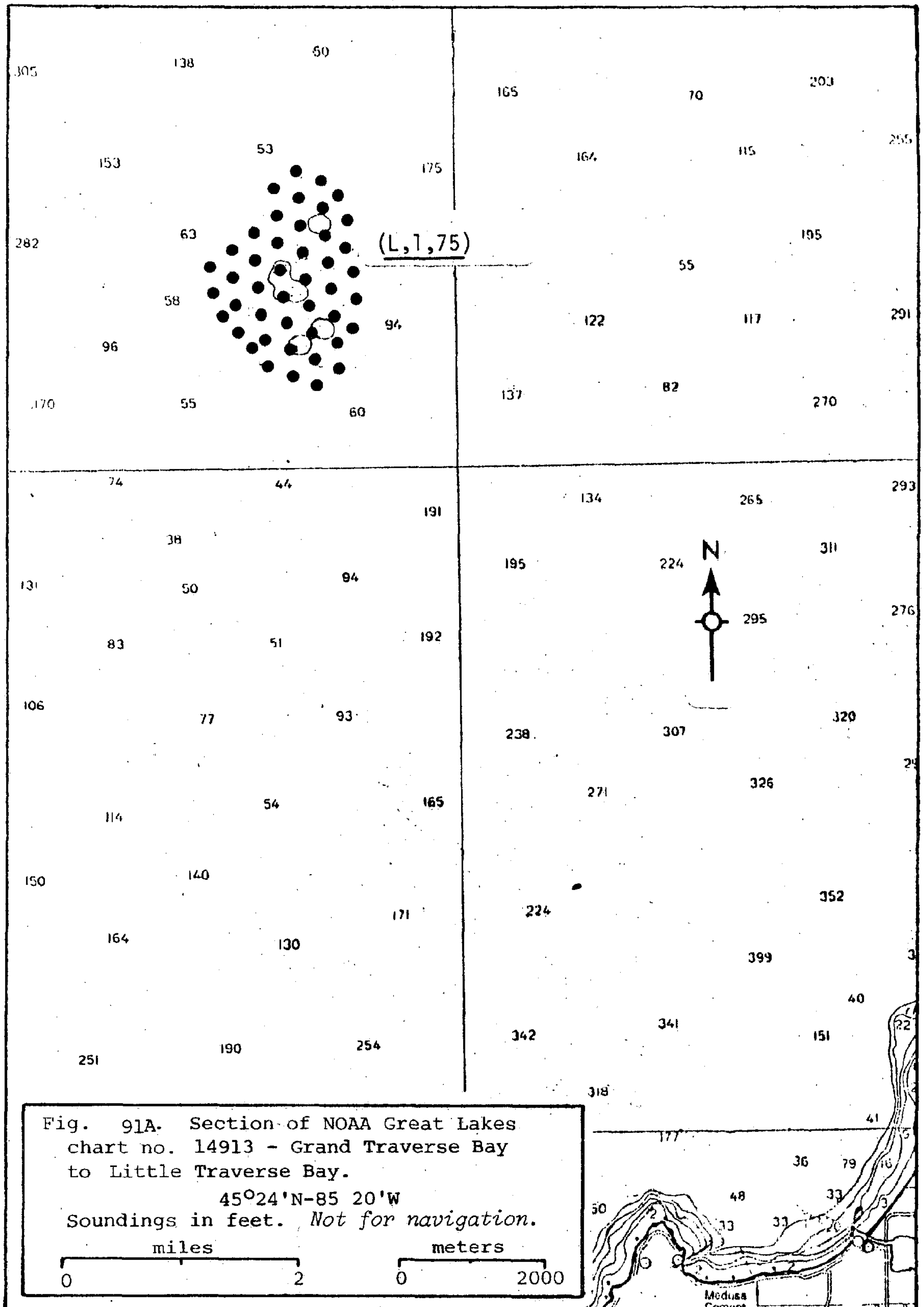



Fig. 91A. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
$45^{o}24'N$-85 20'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

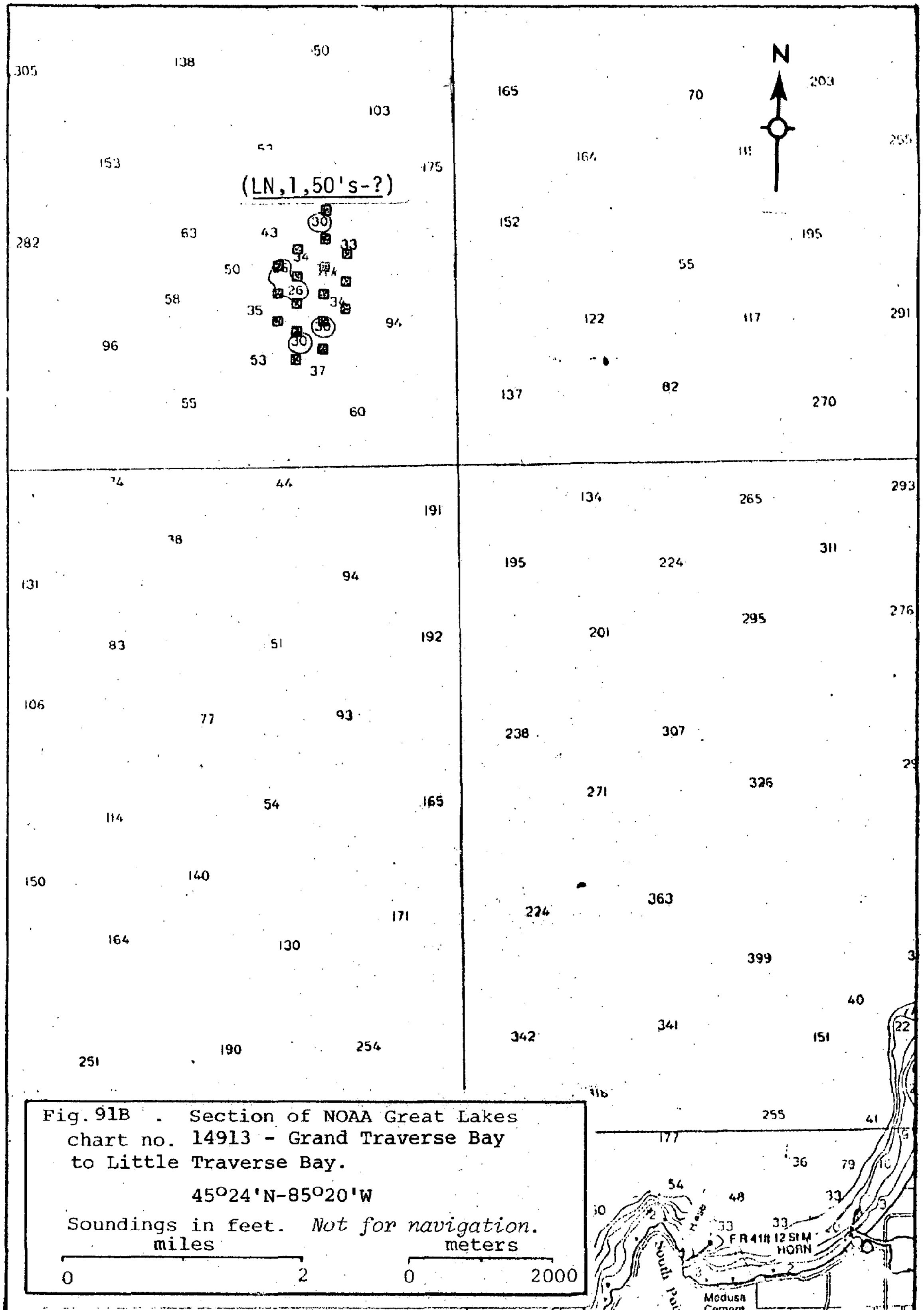


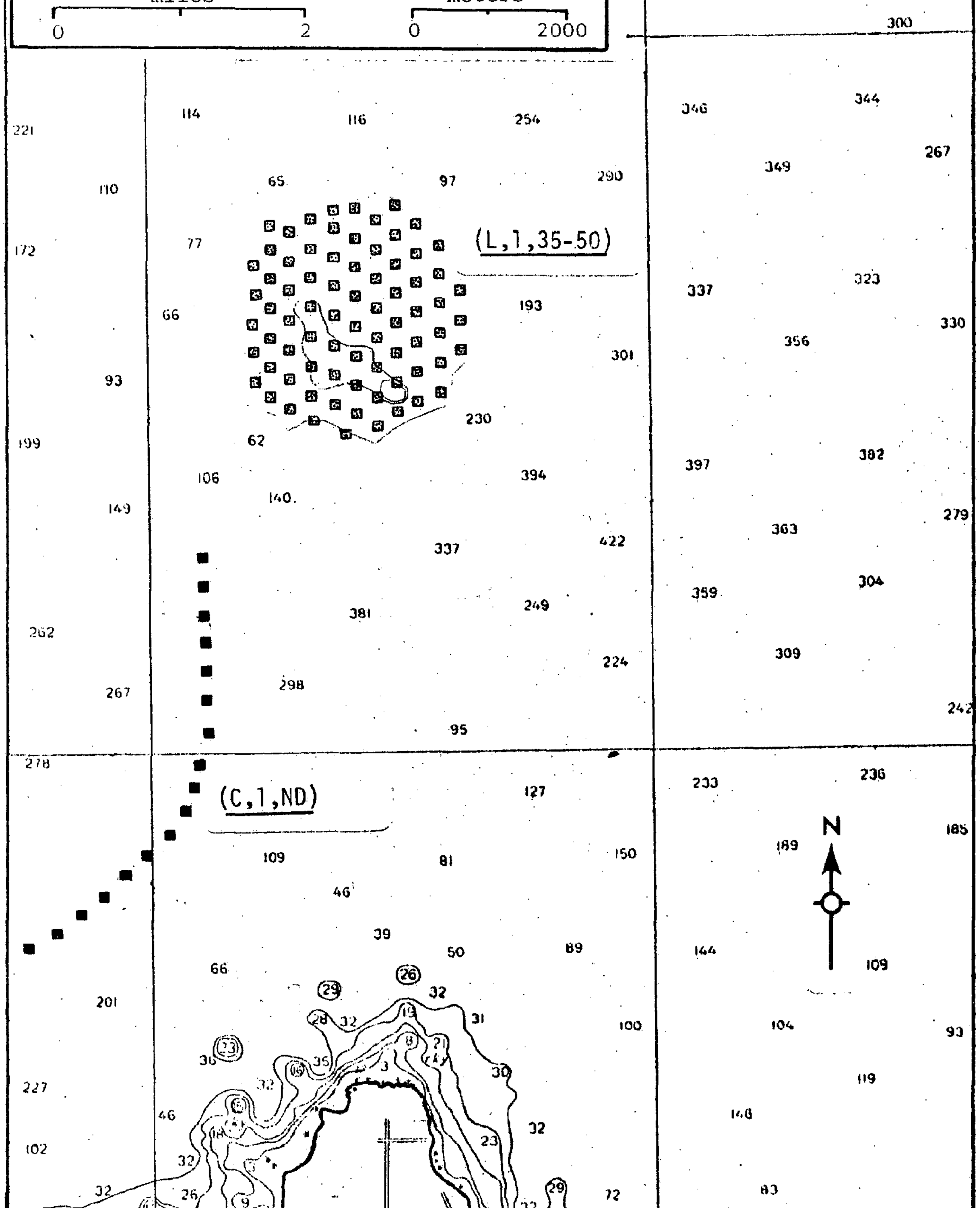

Fig. 91B . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.

45°24'N-85°20'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

Fig. 92 . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
45°17'N-85°33'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000



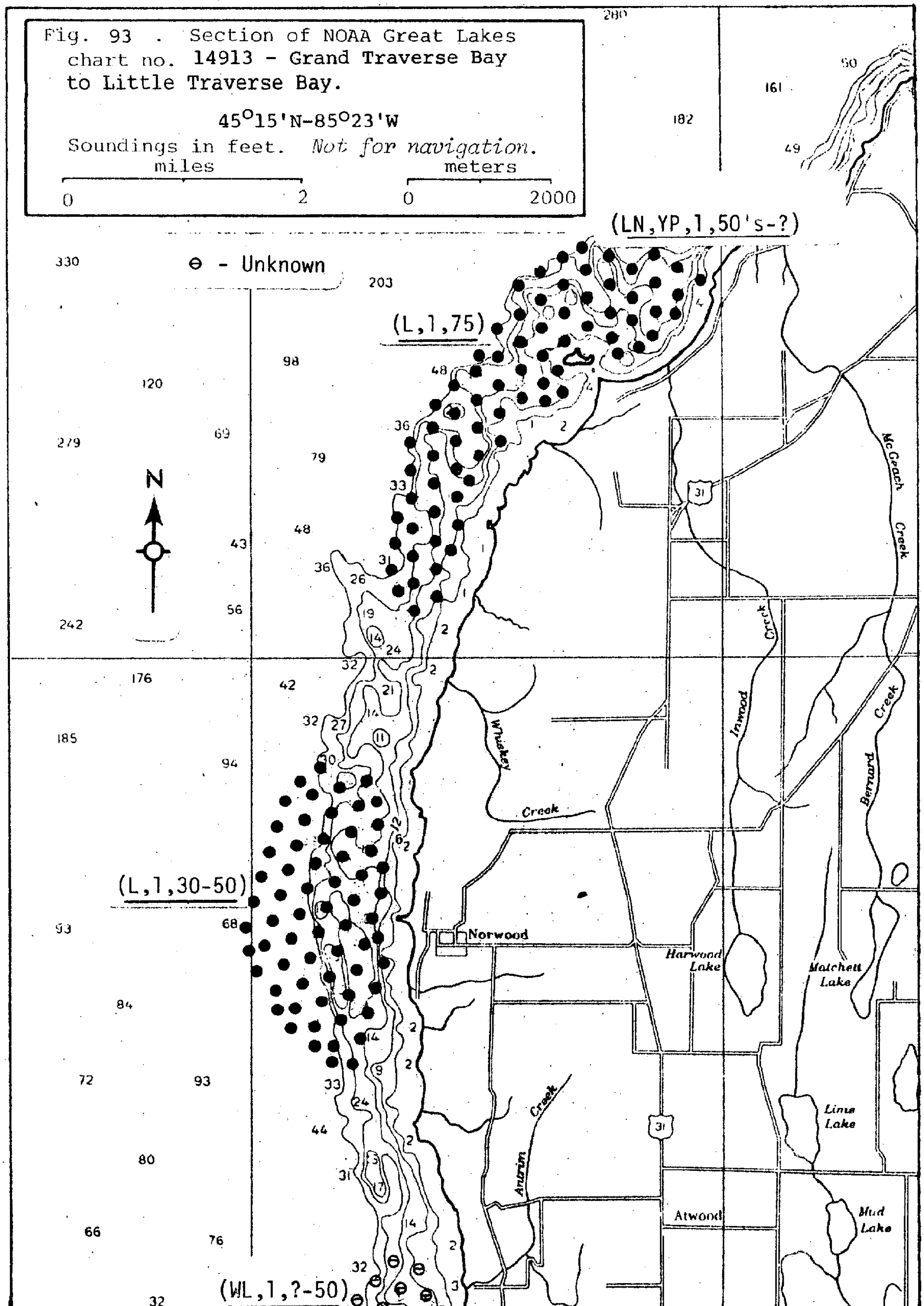



Fig. 93 . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.

45°15'N-85°23'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

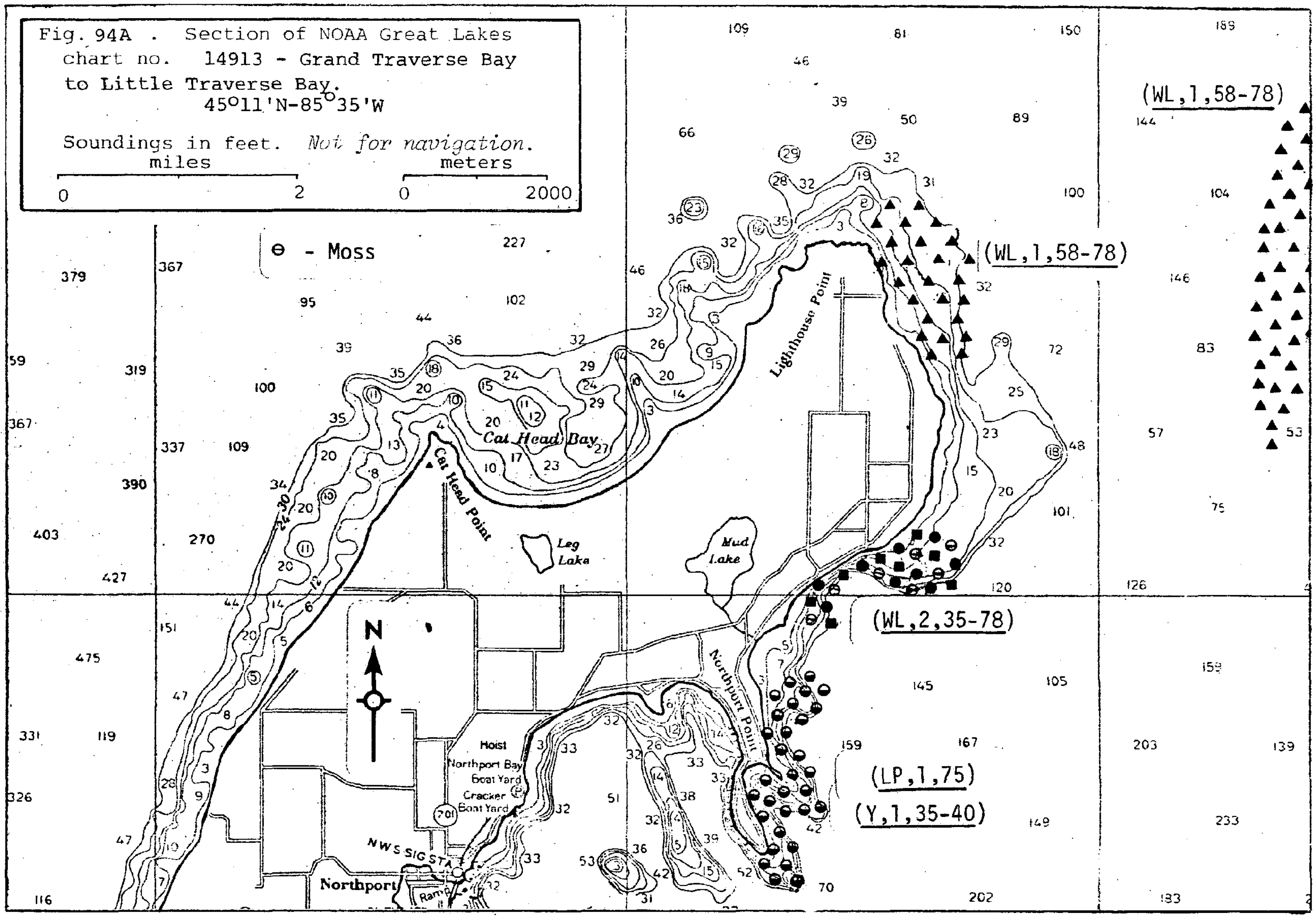



Fig. 94A . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay. 45°11'N-85°35'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

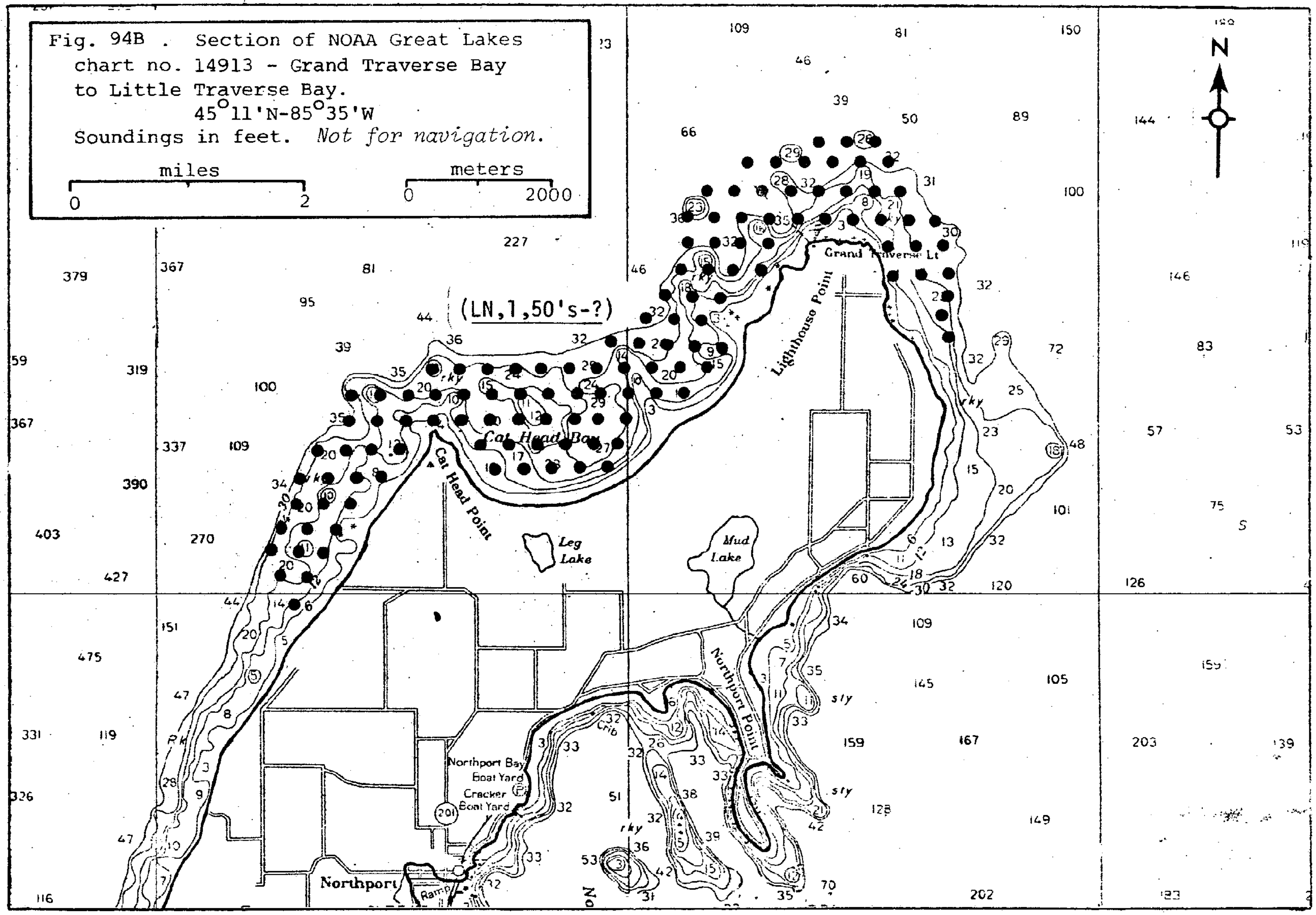



Fig. 94B . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
$45^{\circ}11'N-85^{\circ}35'W$
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

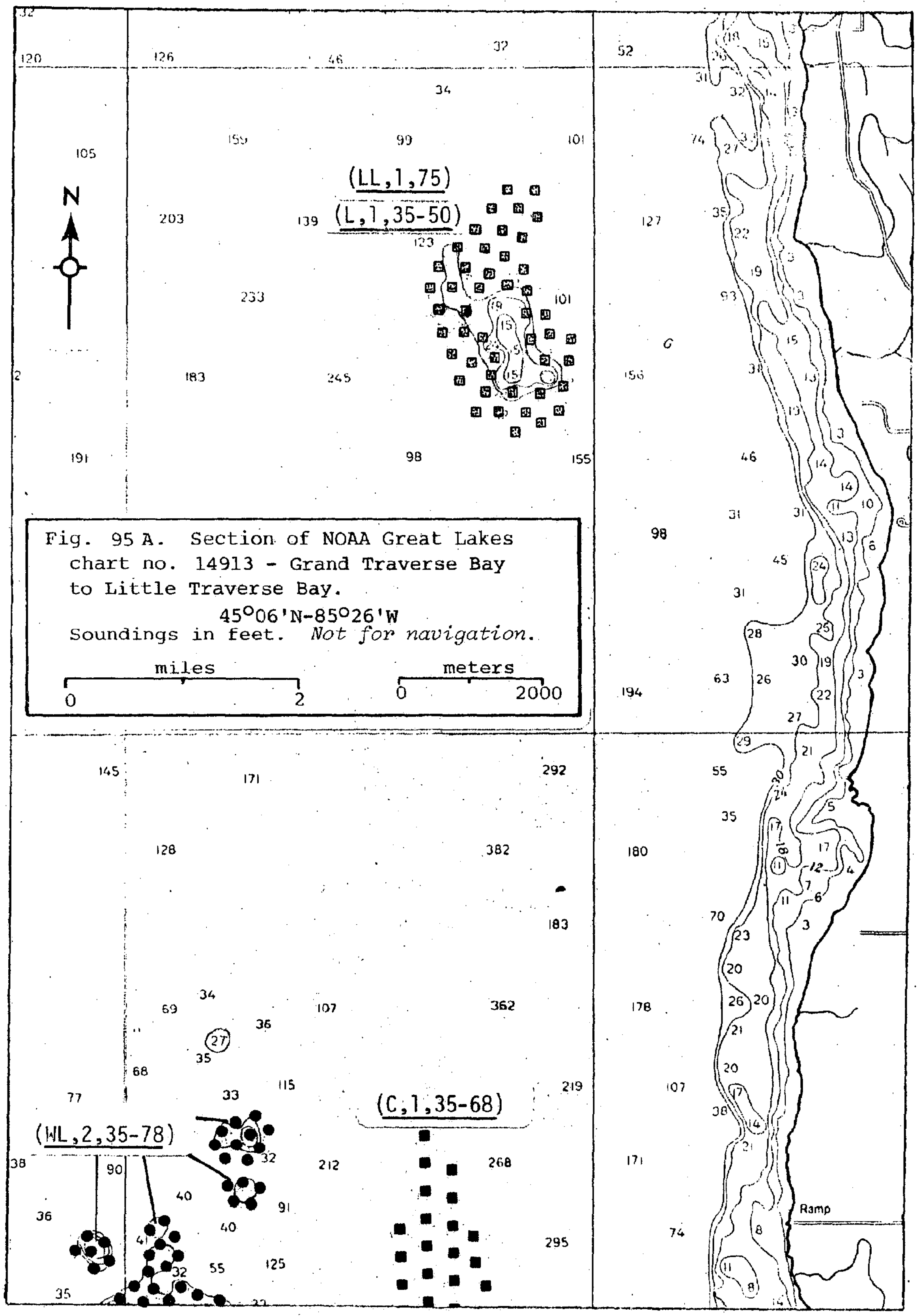



Fig. 95 A. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
45°06'N-85°26'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

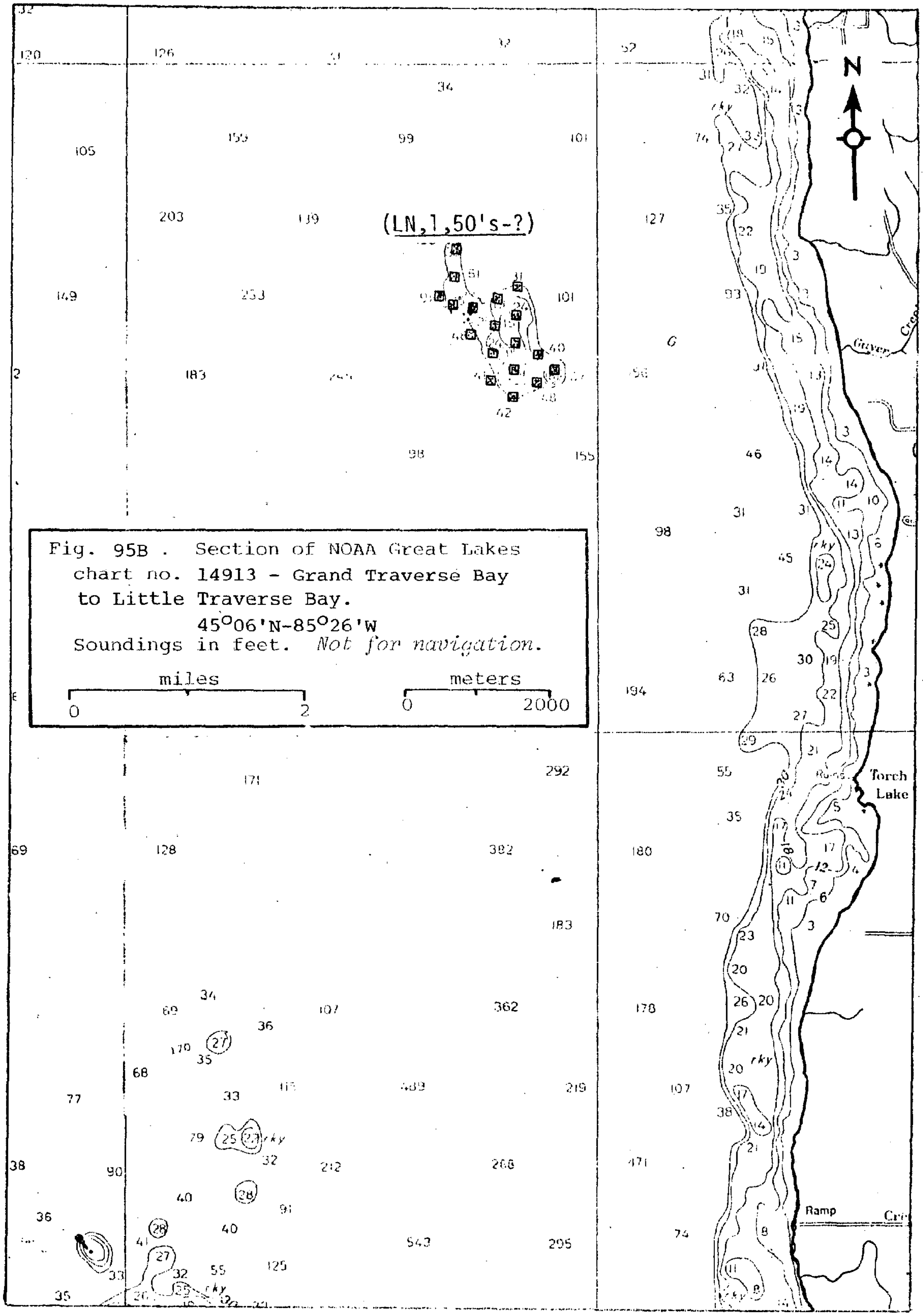



Fig. 95B . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
45°06'N-85°26'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

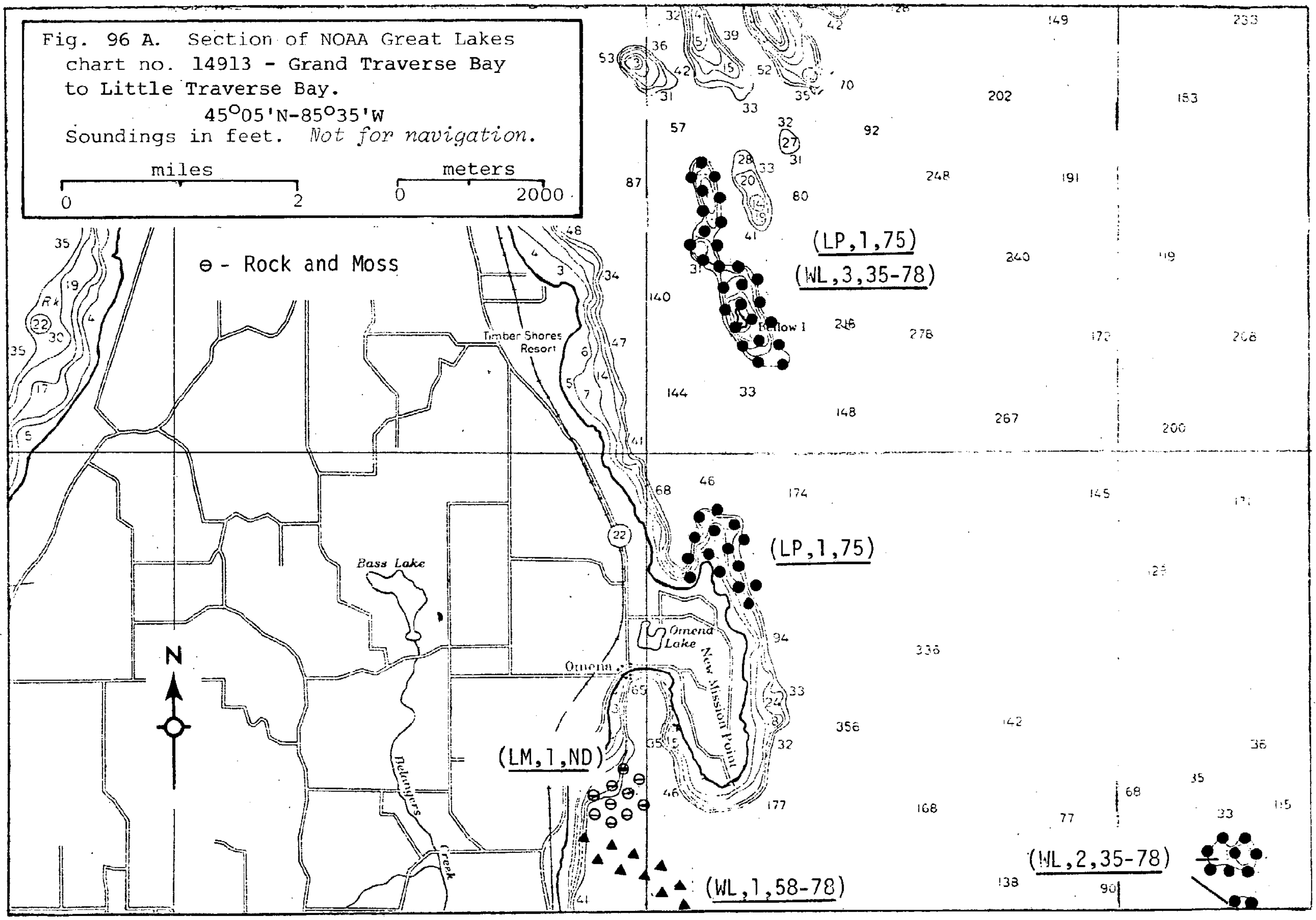



Fig. 96 A. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
45°05'N-85°35'W
Soundings in feet. *Not for navigation.*

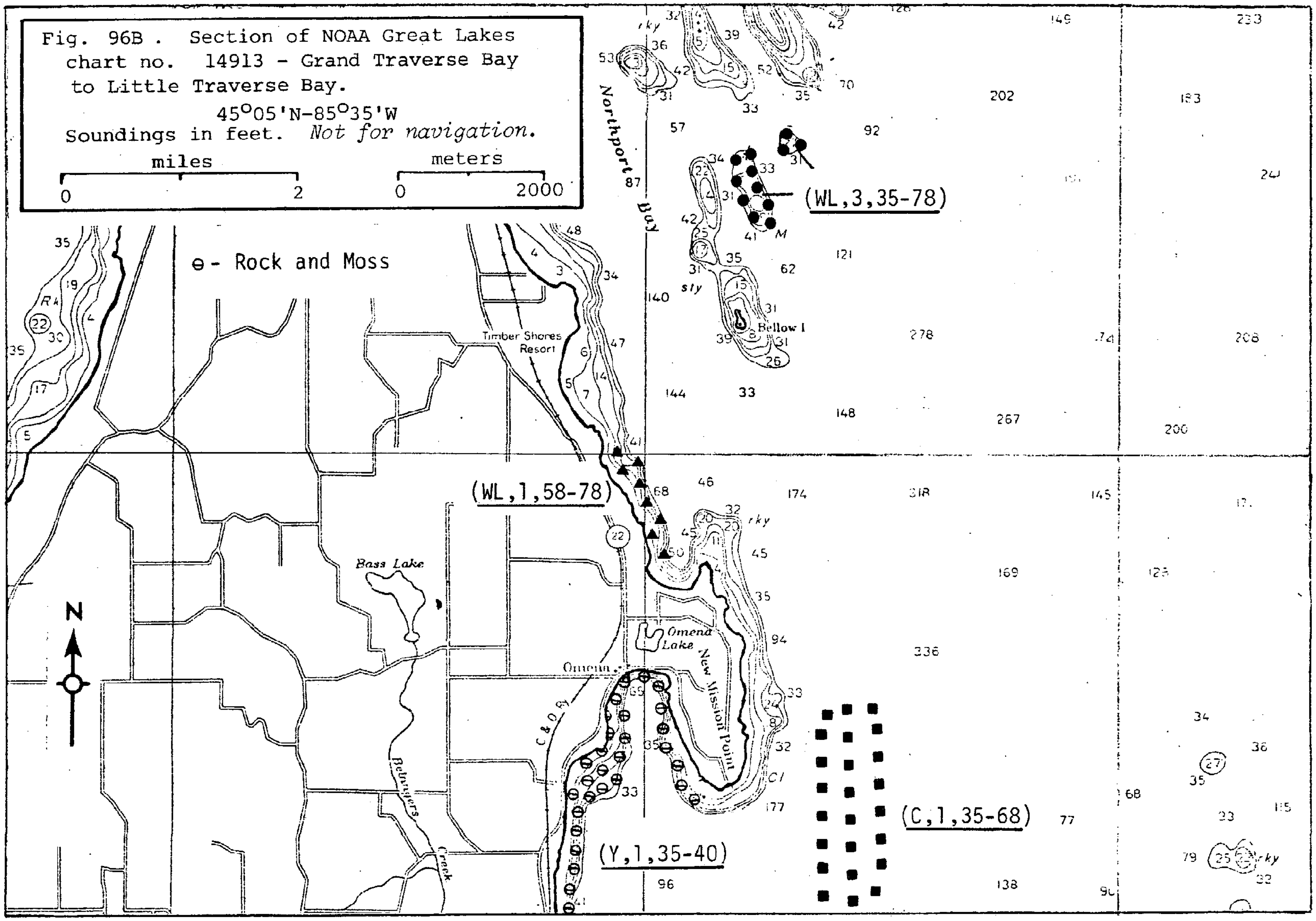



Fig. 96B . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
$45^{o}05'N-85^{o}35'W$
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

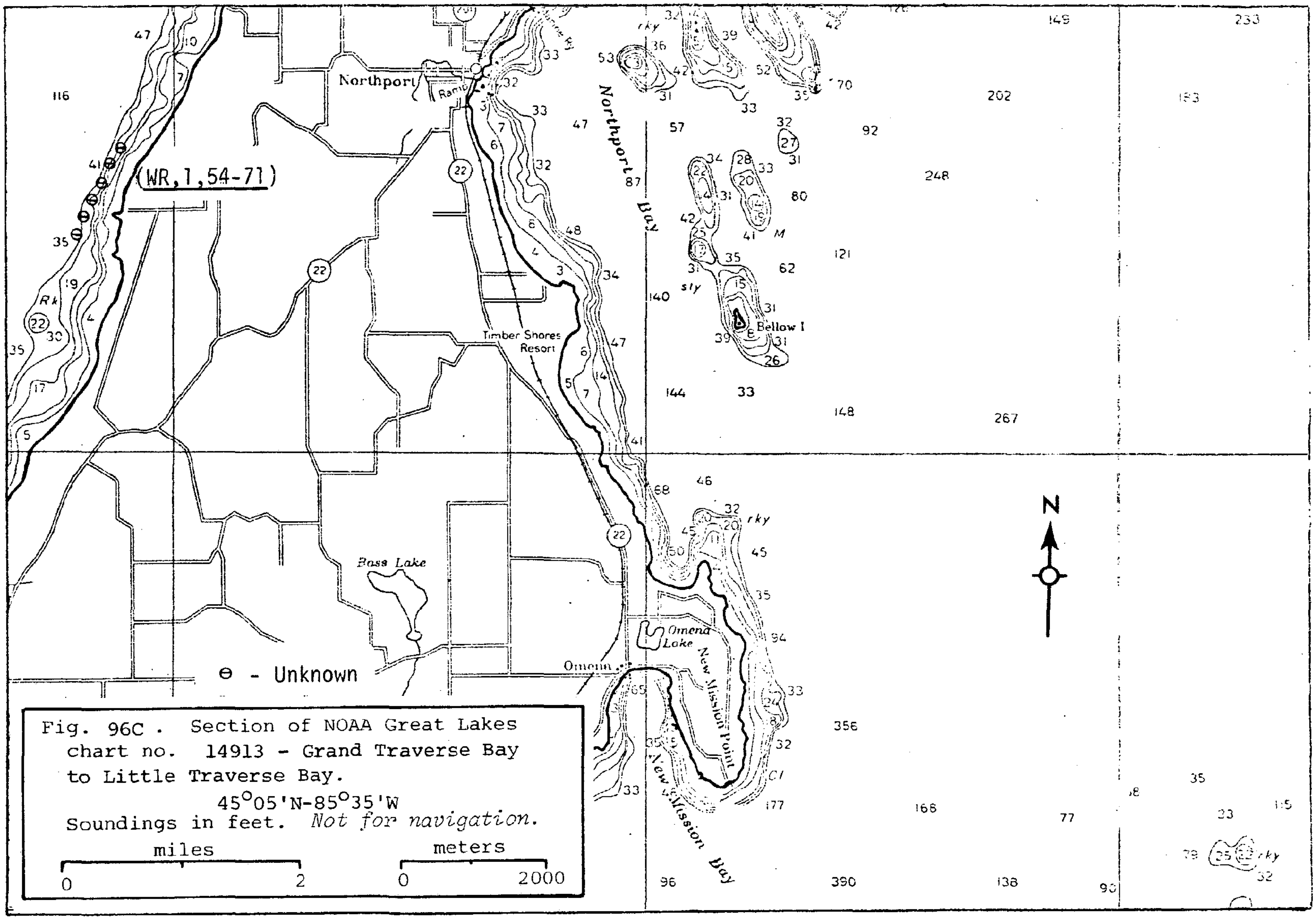



Fig. 96C . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
45°05'N-85°35'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

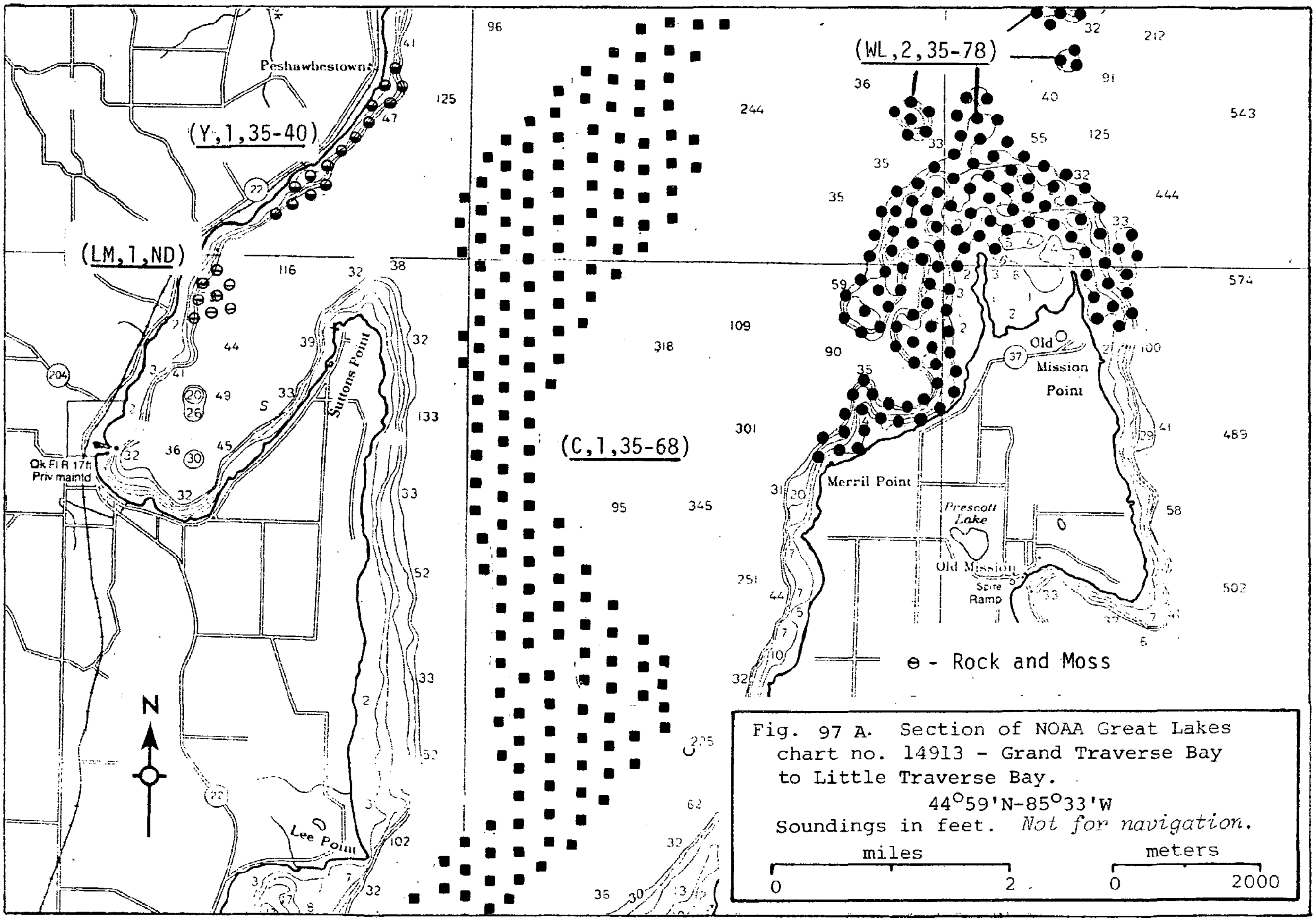



Fig. 97 A. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
$44^{\circ}59'N-85^{\circ}33'W$
Soundings in feet. *Not for navigation.*

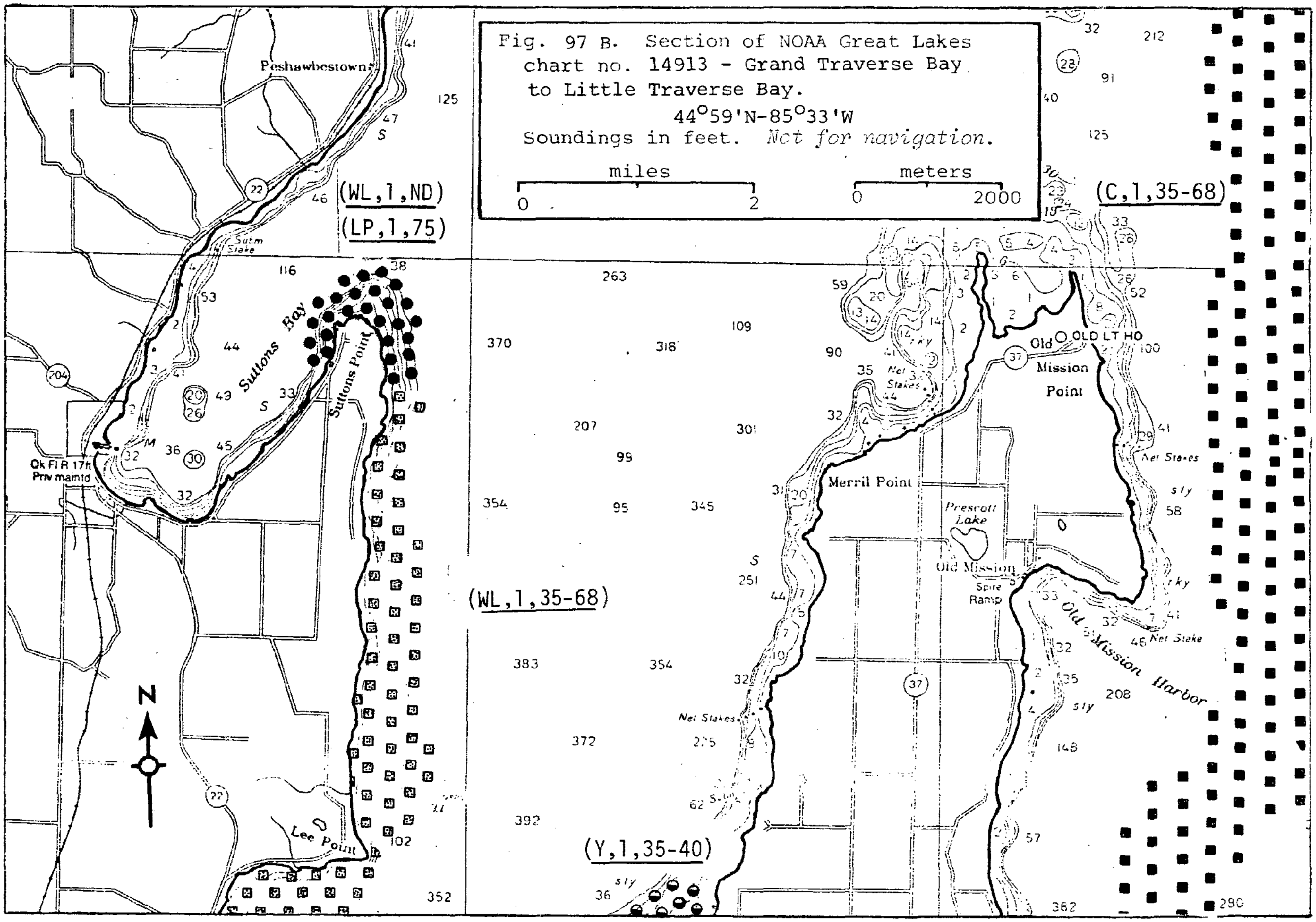



Fig. 97 B. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
44°59'N-85°33'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

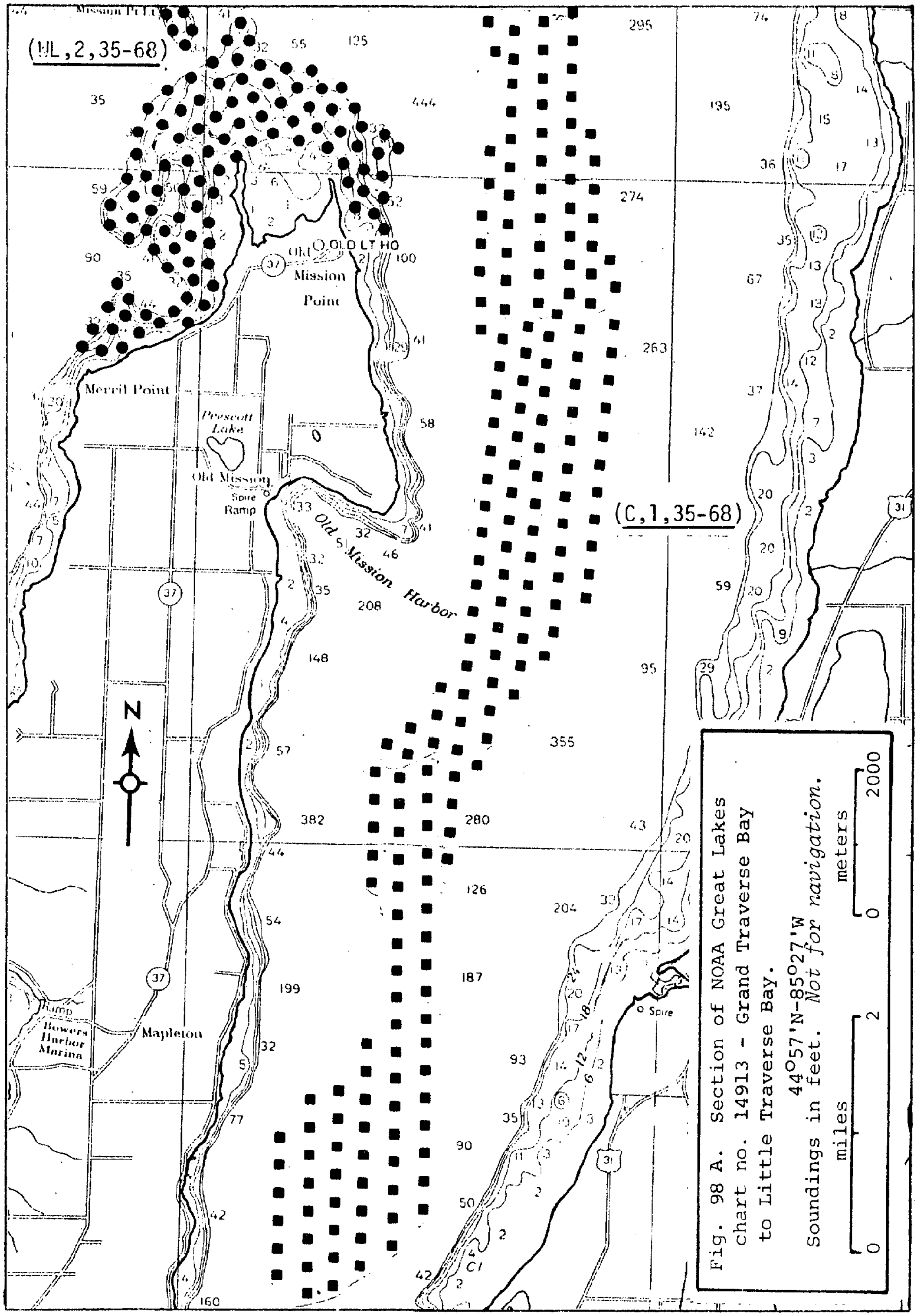



Fig. 98 A. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
44°57'N-85°27'W
Soundings in feet. *Not for navigation.*

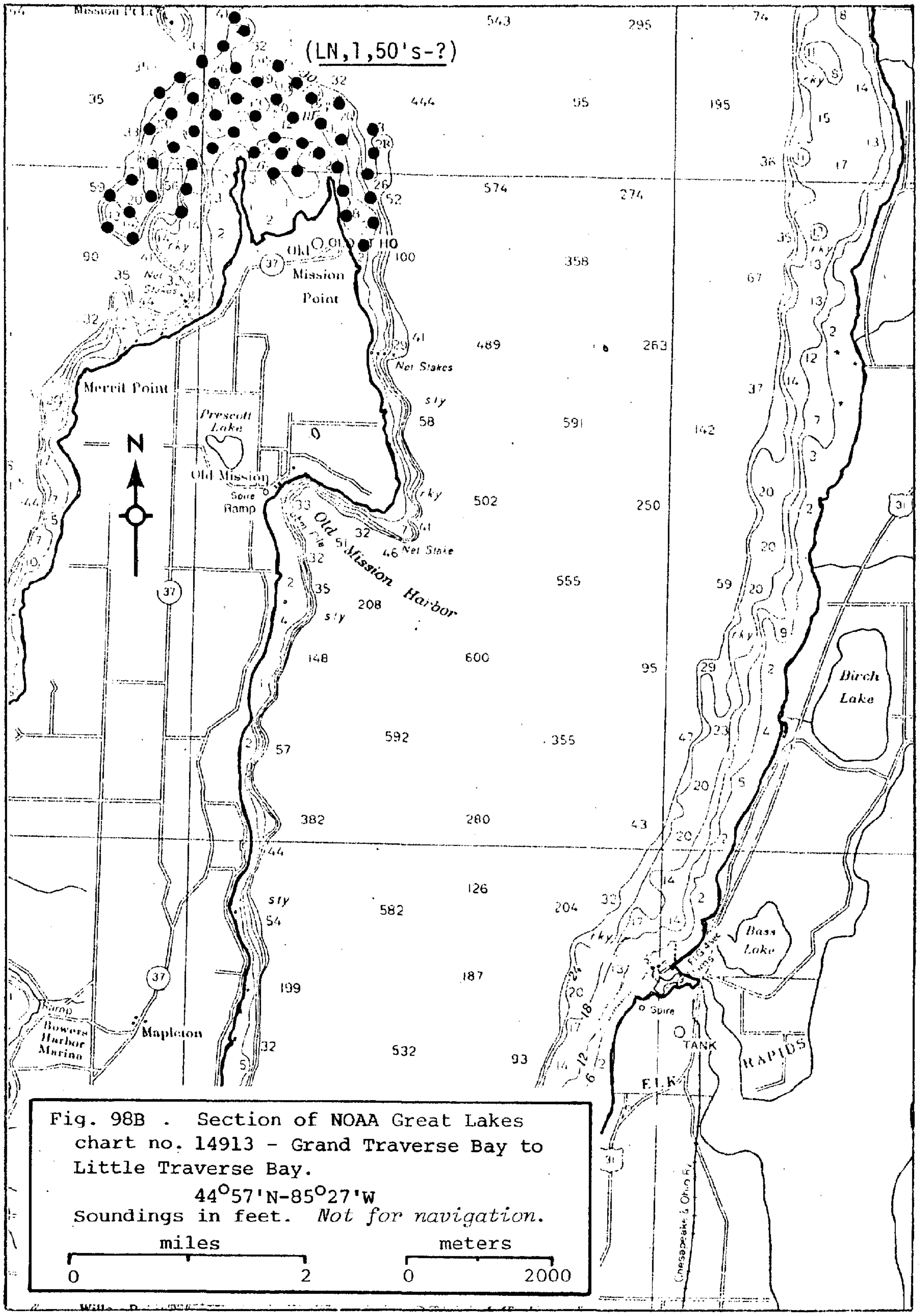



Fig. 98B . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
$44^{\circ}57'$N-$85^{\circ}27'$W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

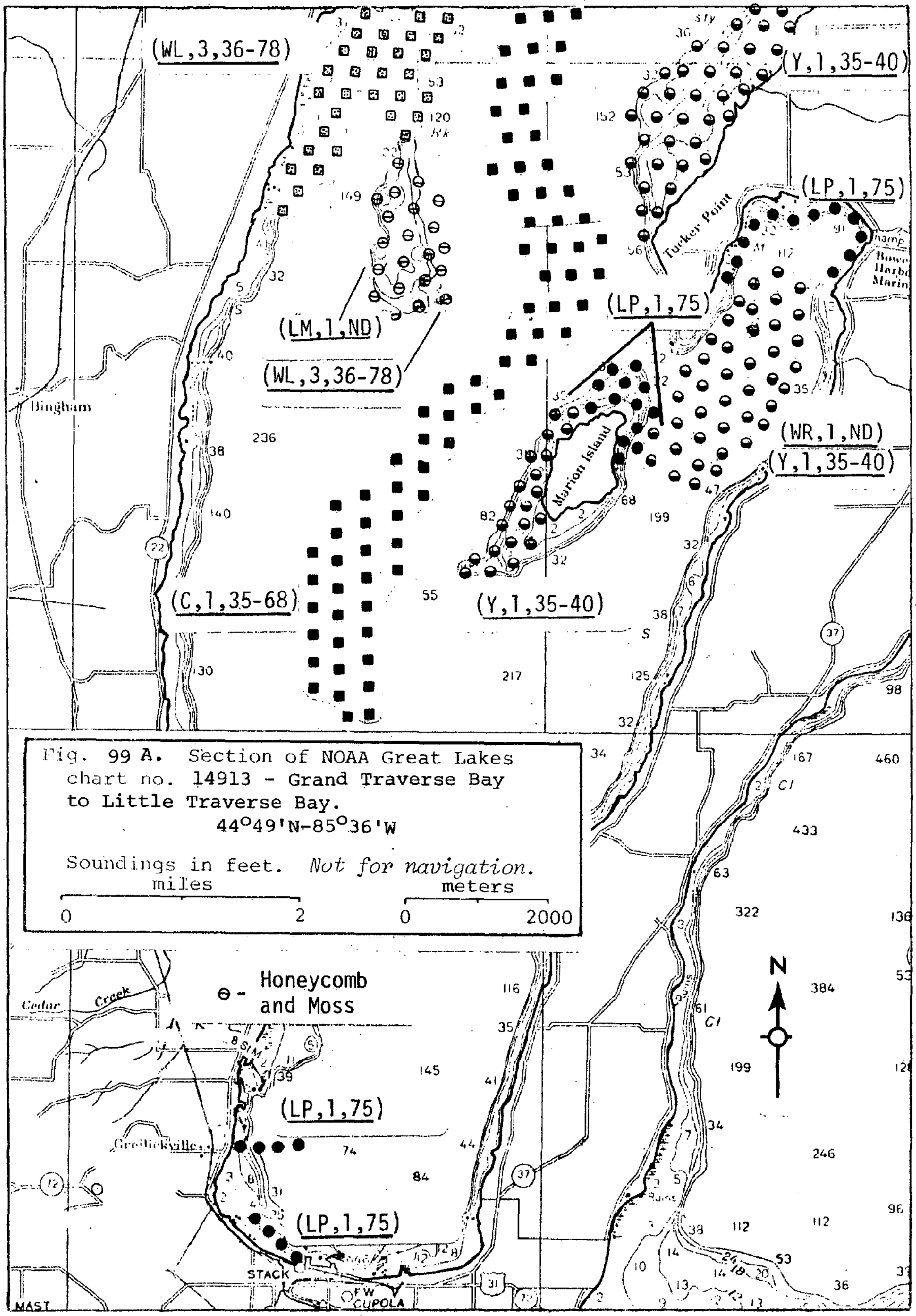



Fig. 99 A. Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.
44°49'N-85°36'W

Soundings in feet. *Not for navigation.*

miles: 0 – 2; meters: 0 – 2000

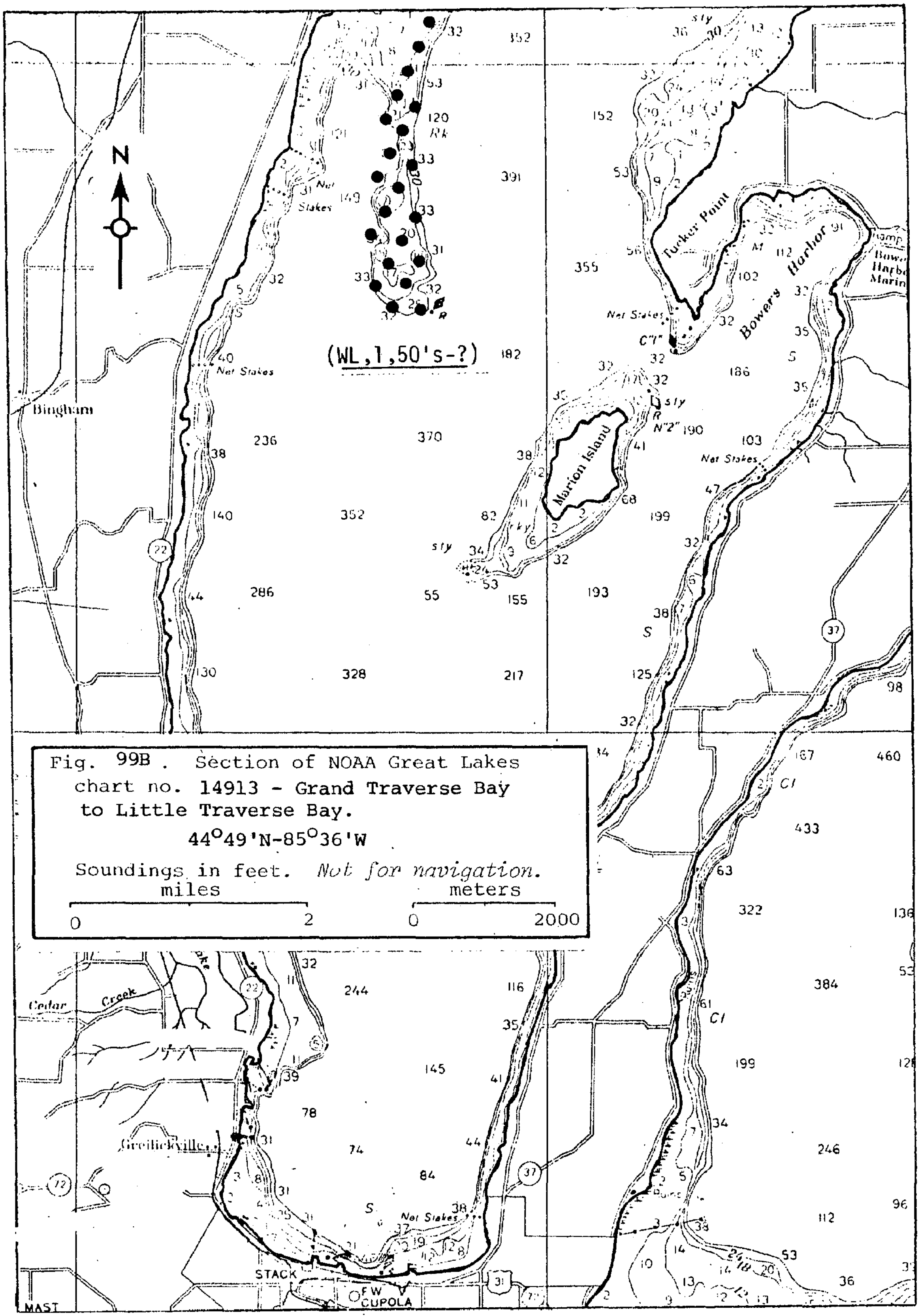



Fig. 99B . Section of NOAA Great Lakes chart no. 14913 - Grand Traverse Bay to Little Traverse Bay.

44°49'N-85°36'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

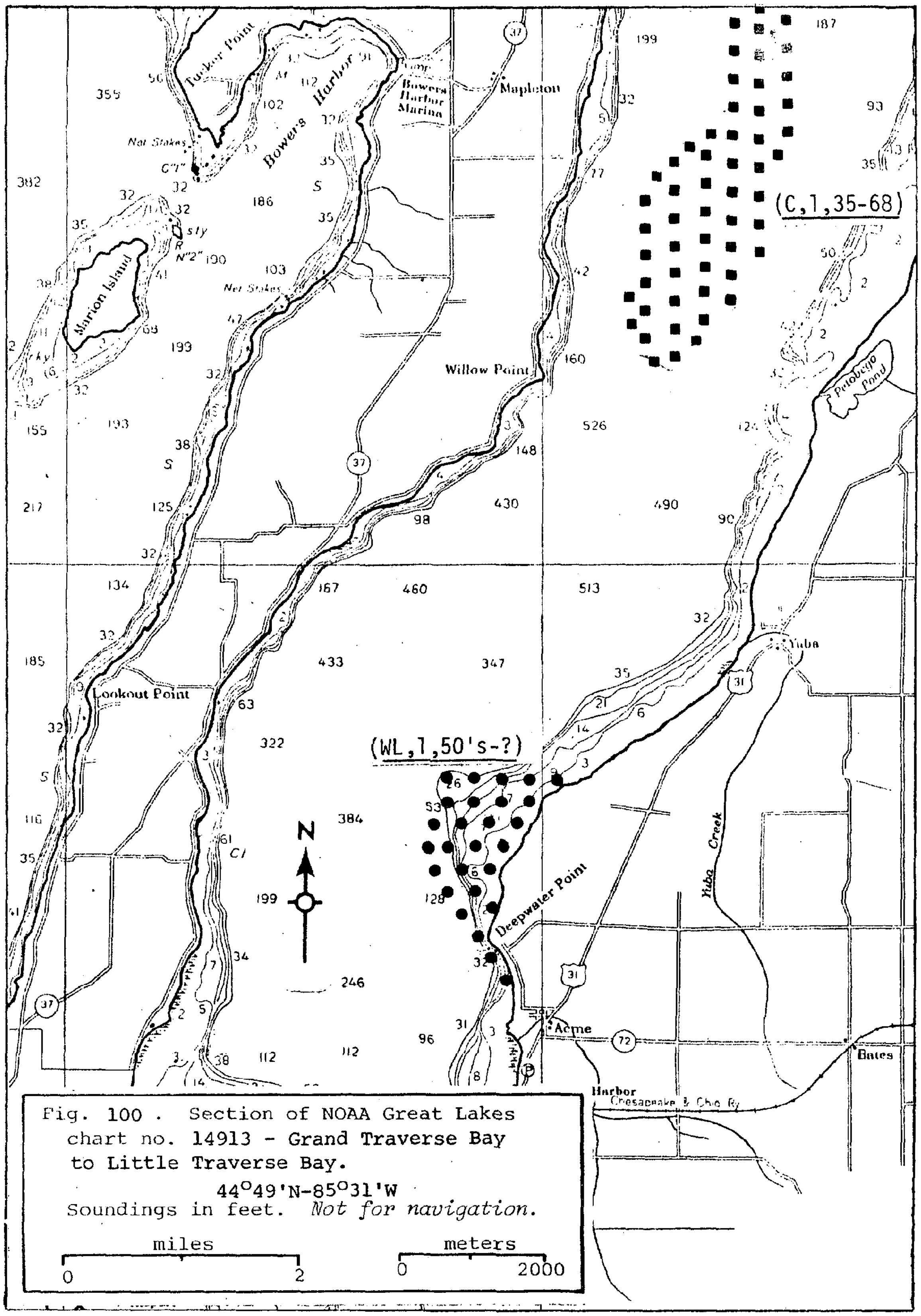



Fig. 100 . Section of NOAA Great Lakes chart no. 14913 - **Grand Traverse Bay to Little Traverse Bay.**

$44^{\circ}49'$N-$85^{\circ}31'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

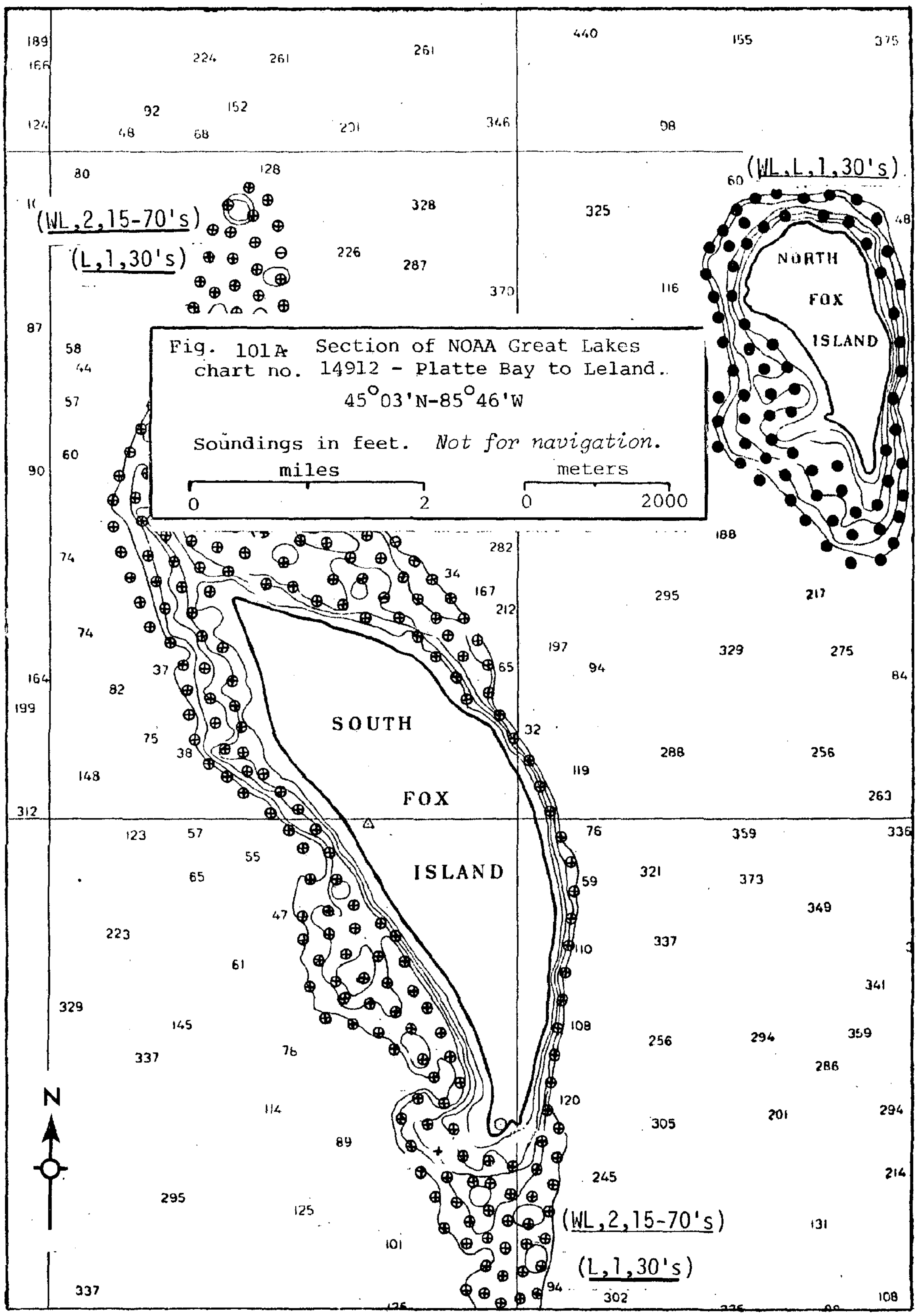


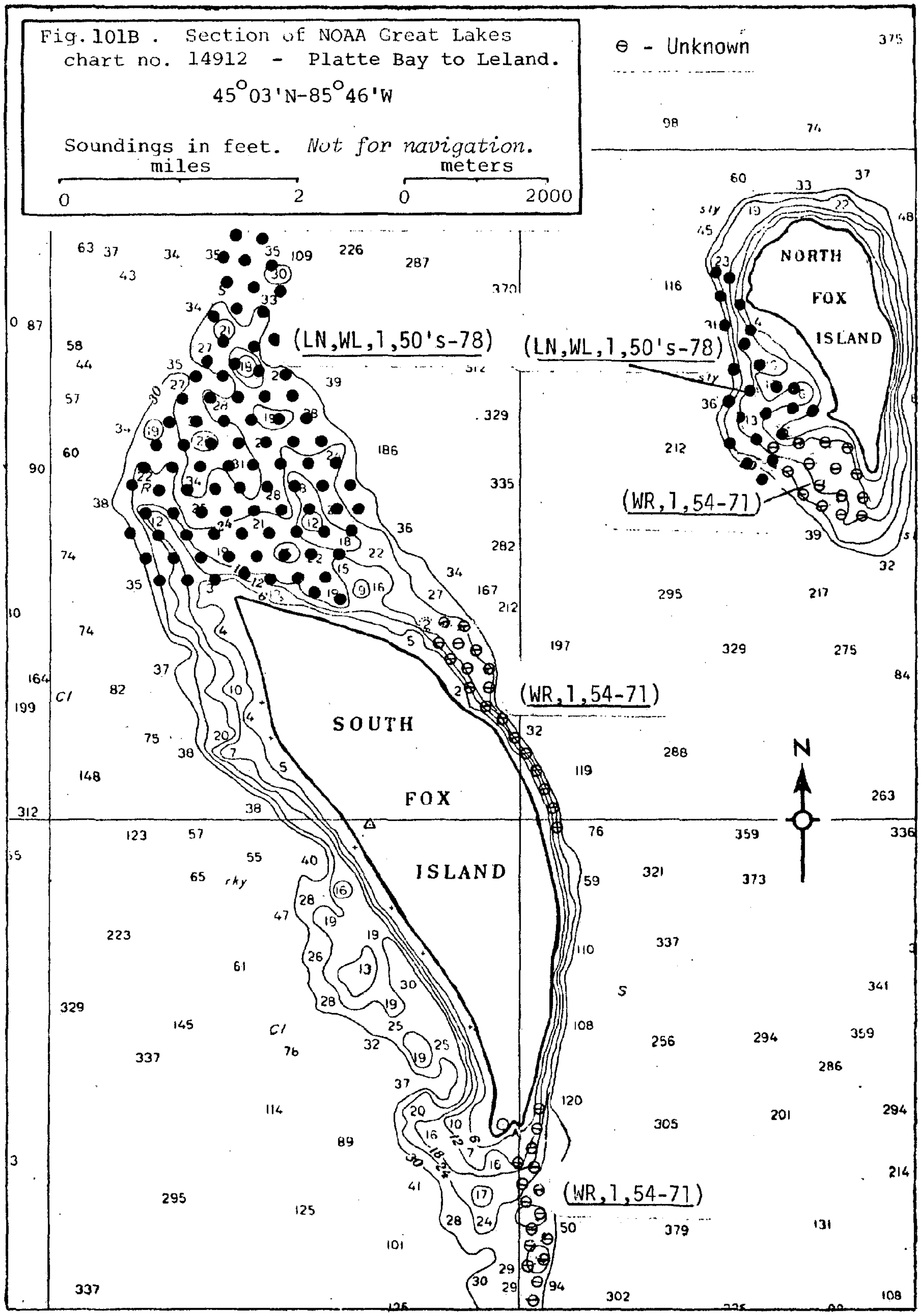

Fig. 101A Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
$45^{\circ}03'N-85^{\circ}46'W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

Fig. 101B . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
45°03'N-85°46'W

Soundings in feet. *Not for navigation.*



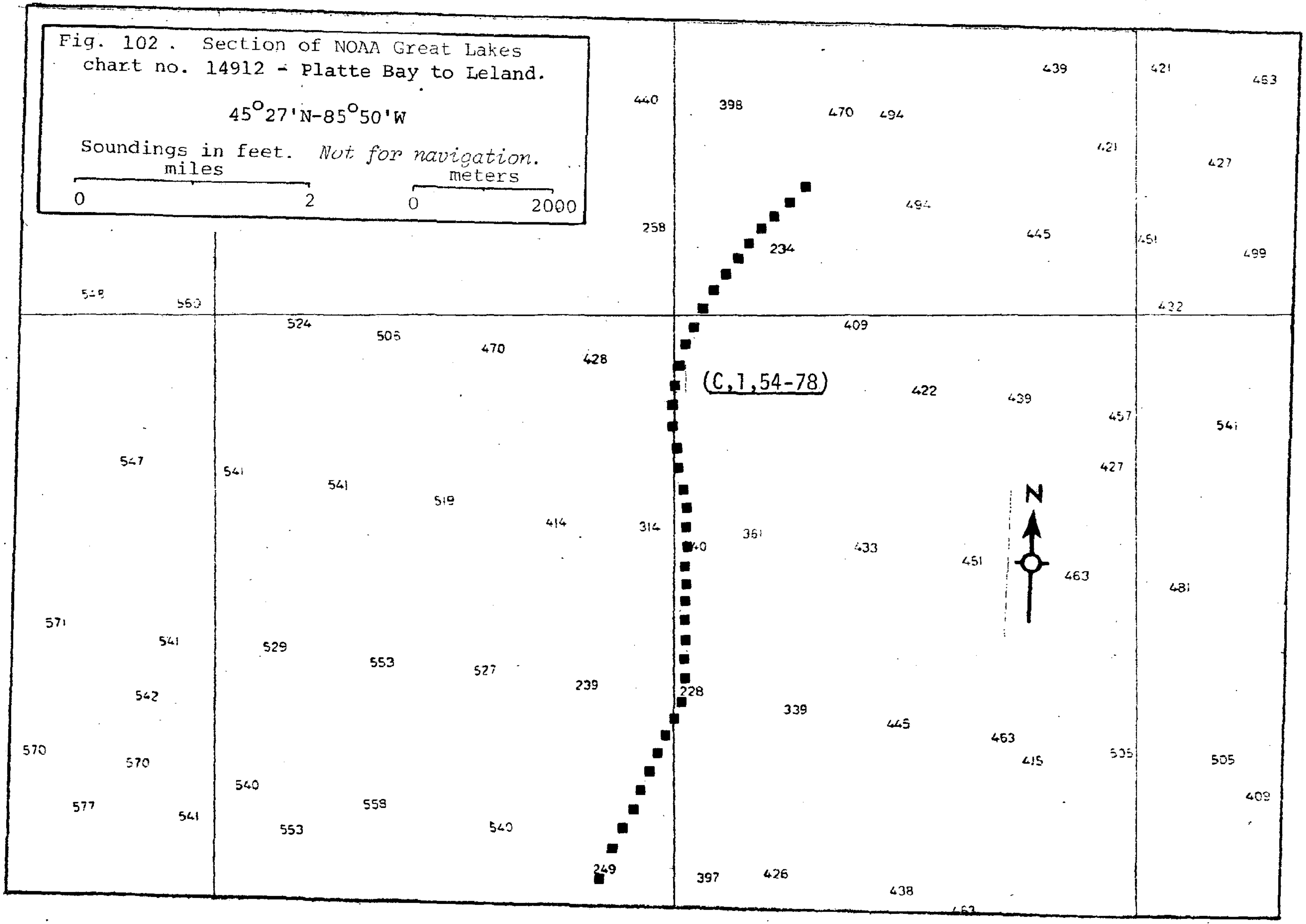



Fig. 102. Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

45°27'N-85°50'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

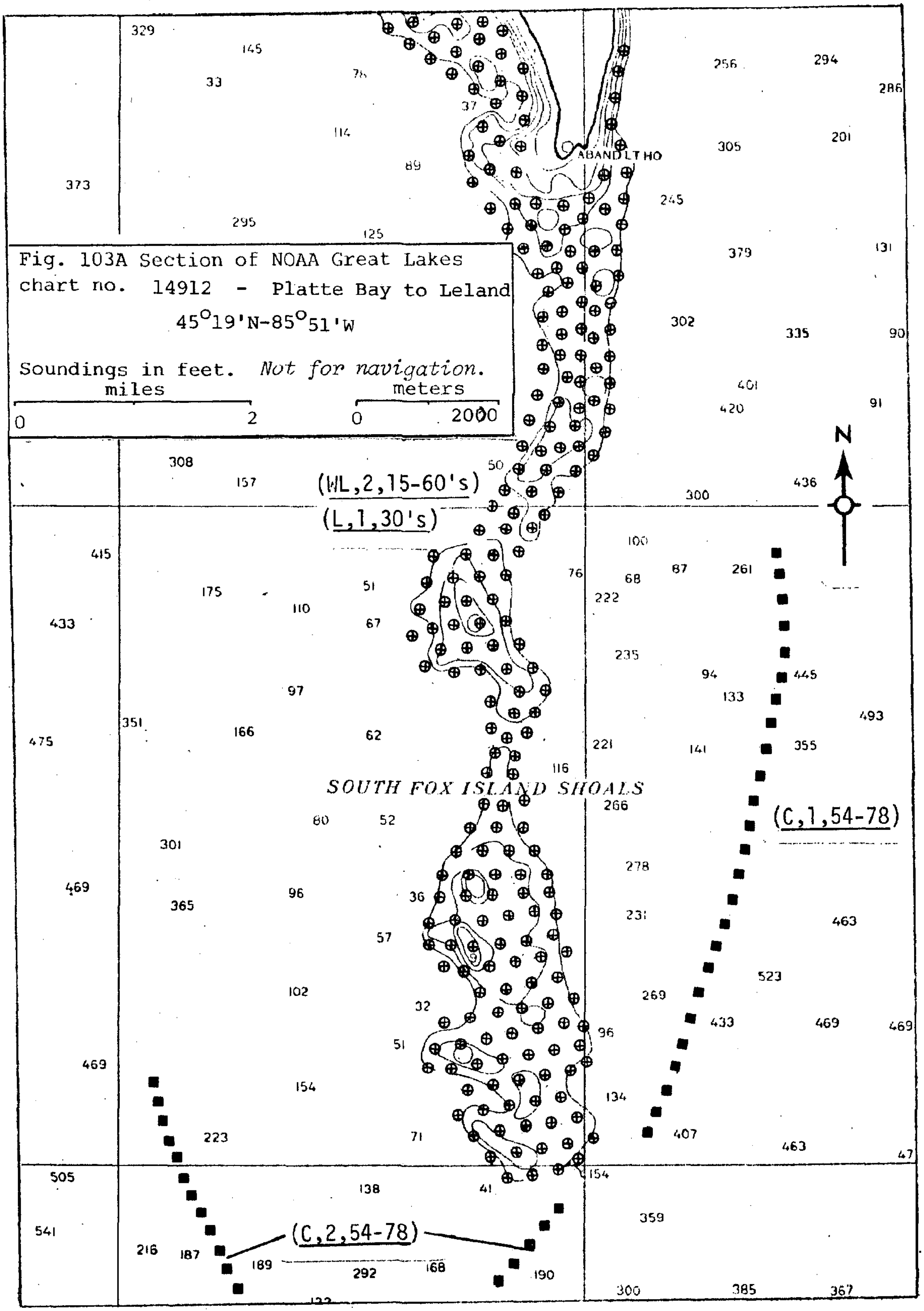



Fig. 103A Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland
$45^{\circ}19'N-85^{\circ}51'W$

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

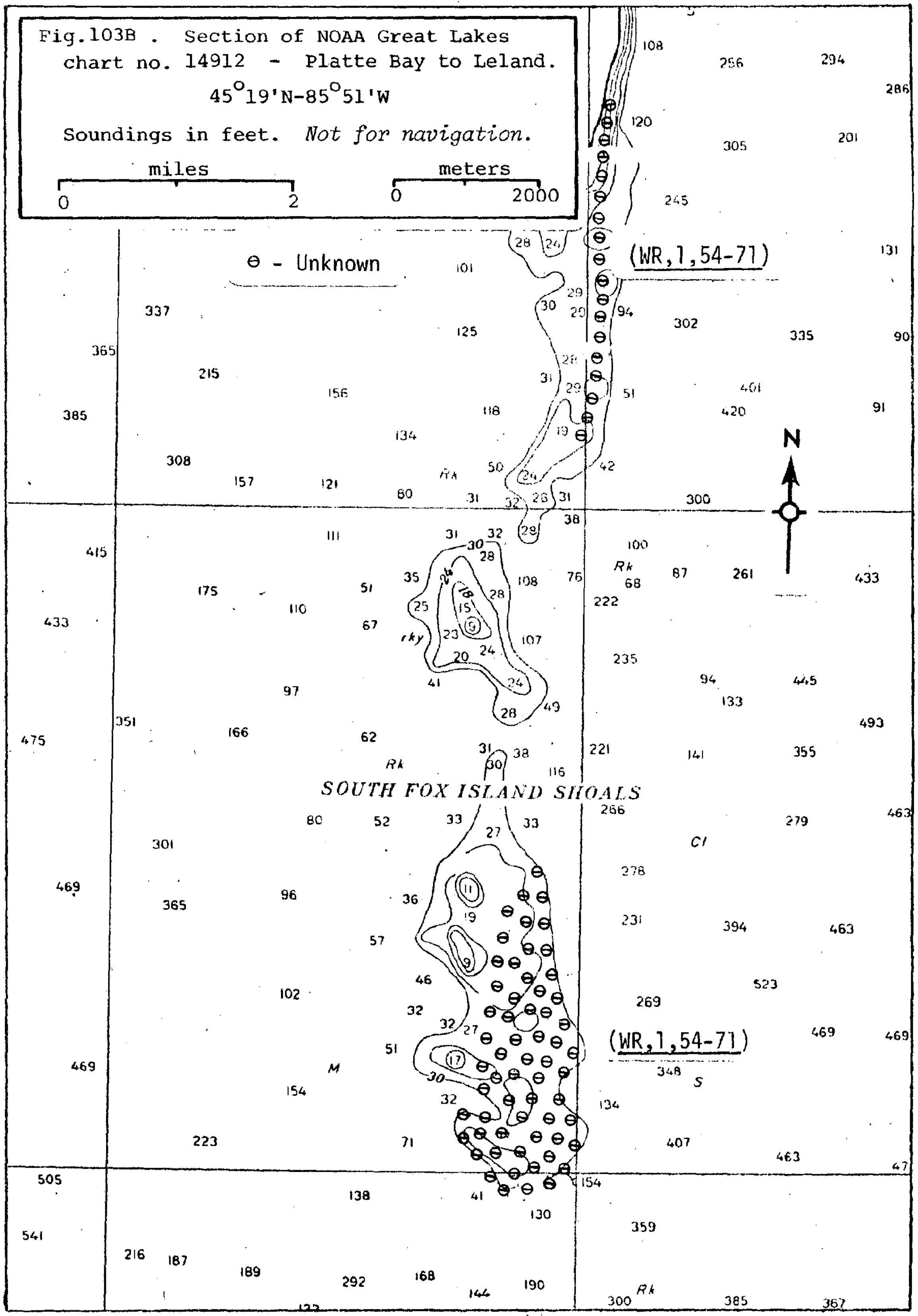



Fig.103B . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
$45^{o}19'N-85^{o}51'W$
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

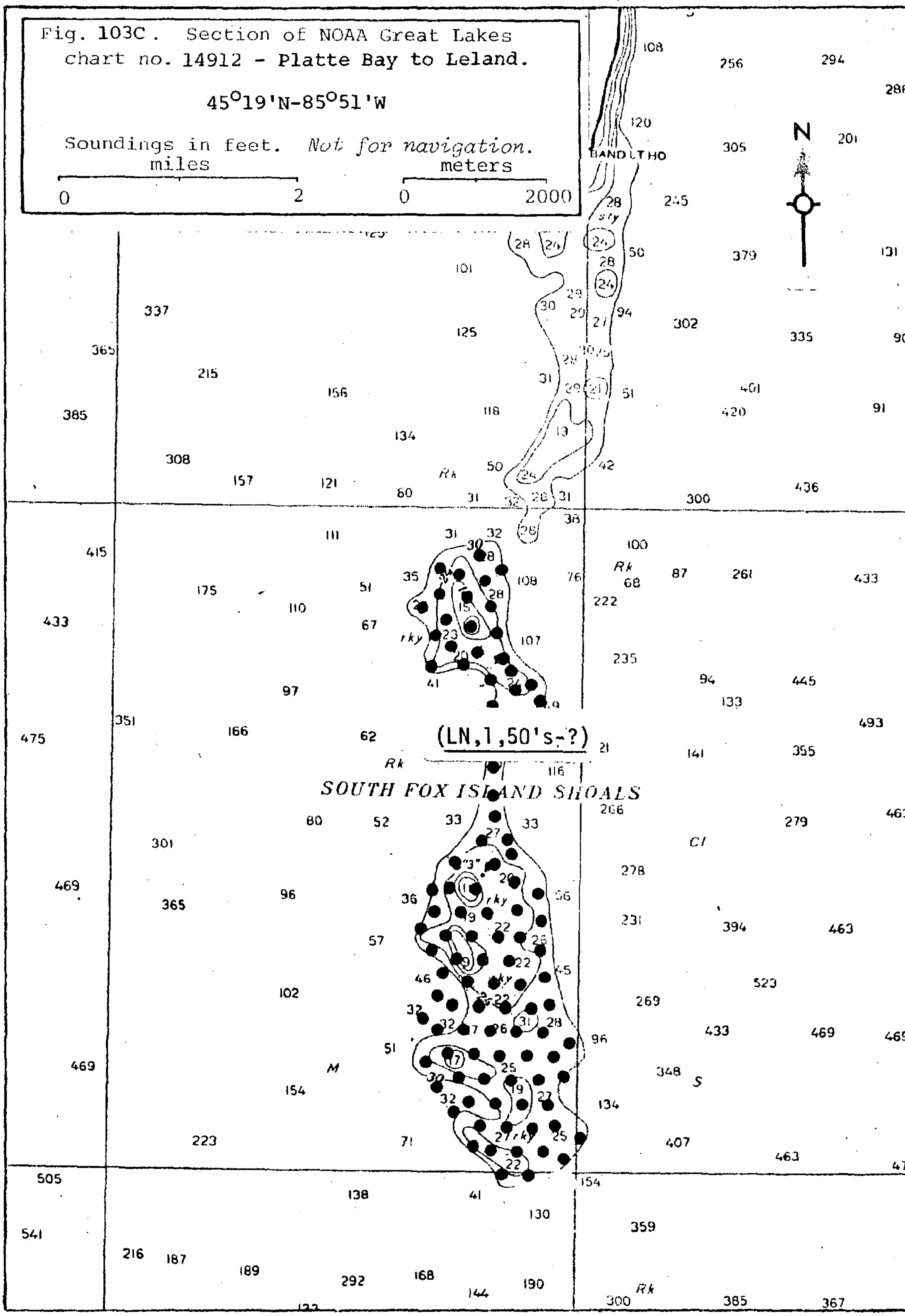



Fig. 103C. Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

45°19'N-85°51'W

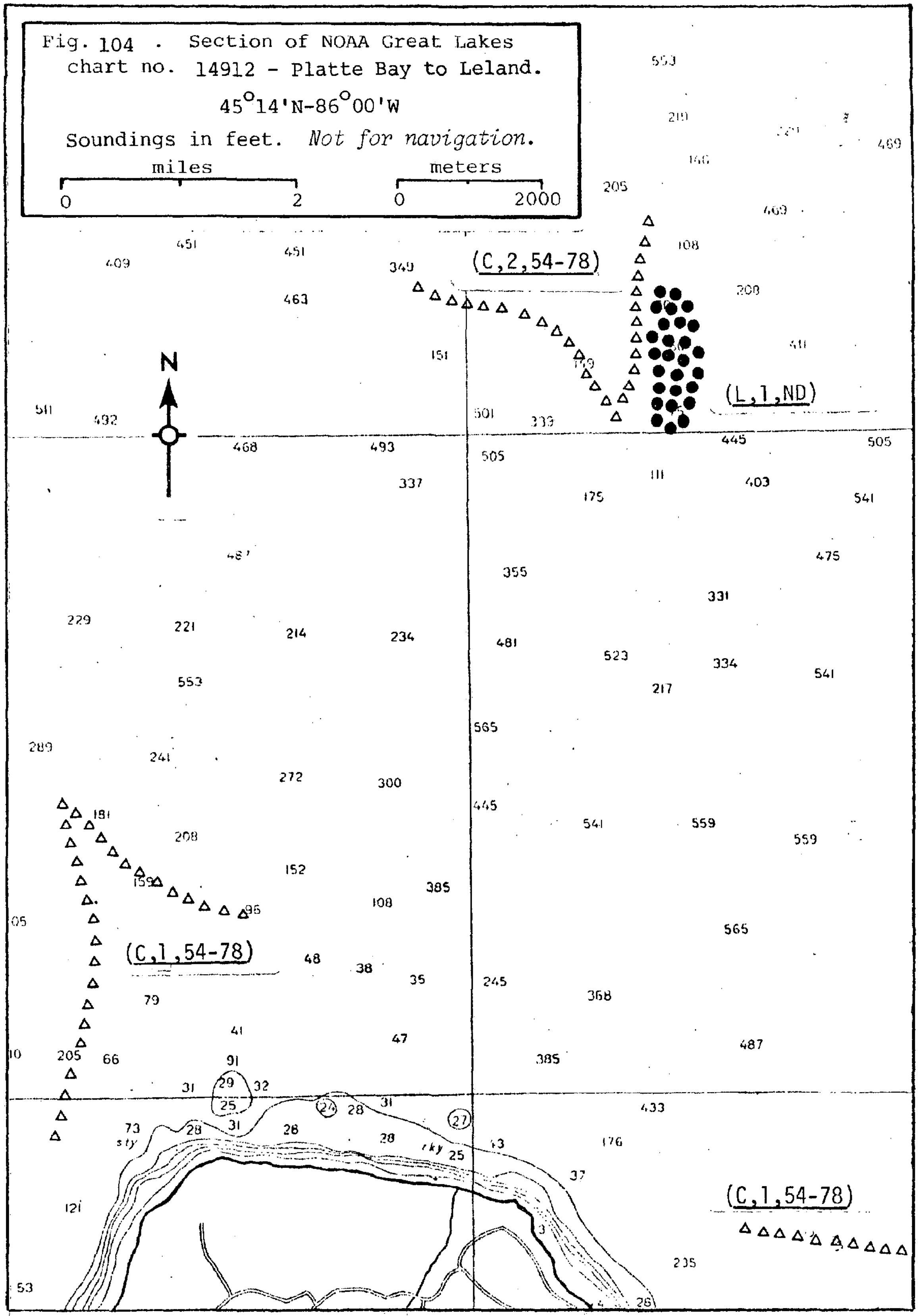



Fig. 104 . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
$45^{\circ}14'$N-$86^{\circ}00'$W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

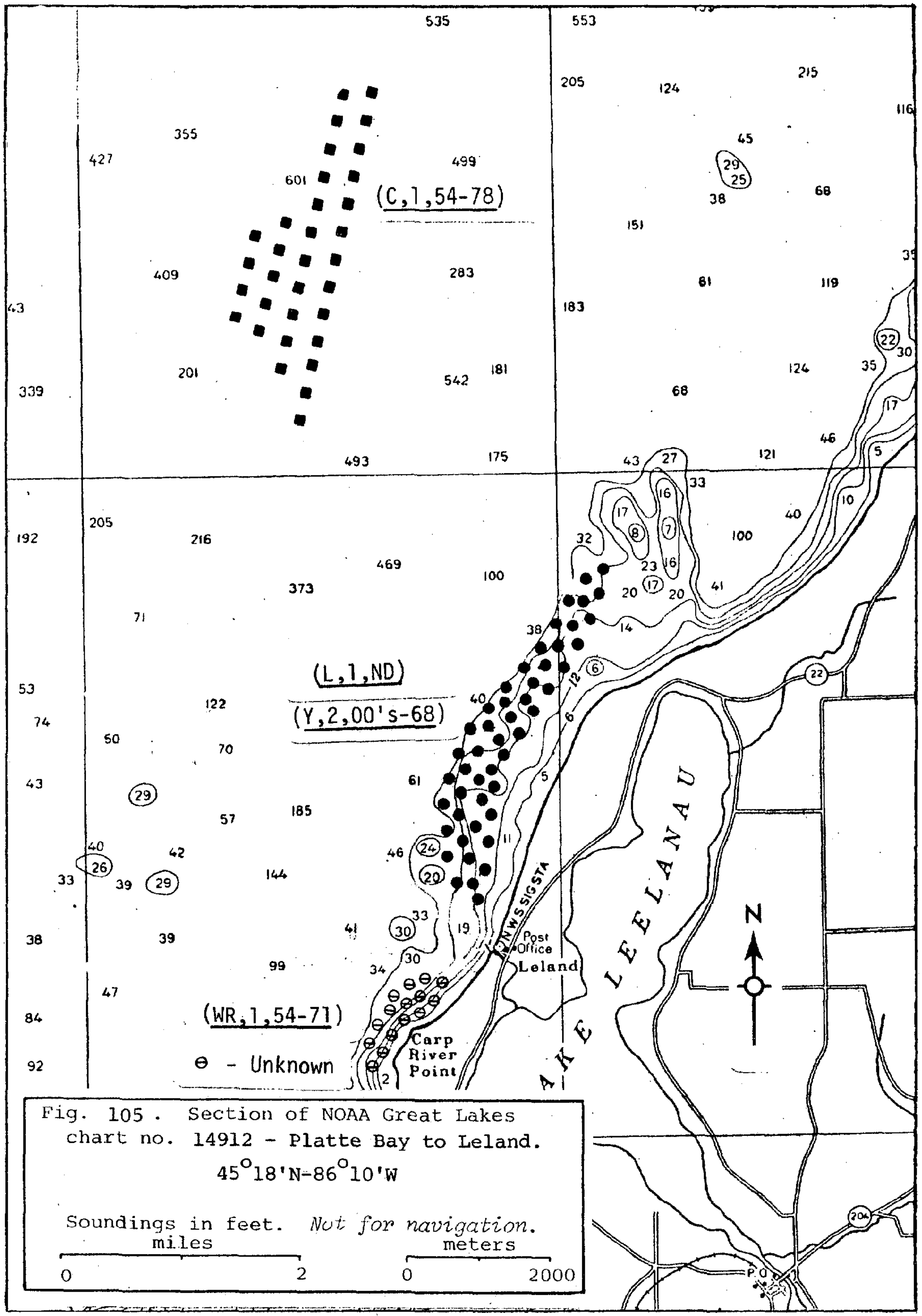



Fig. 105 . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland. 45°18'N-86°10'W

Soundings in feet. *Not for navigation.*

miles 0 — 2 meters 0 — 2000

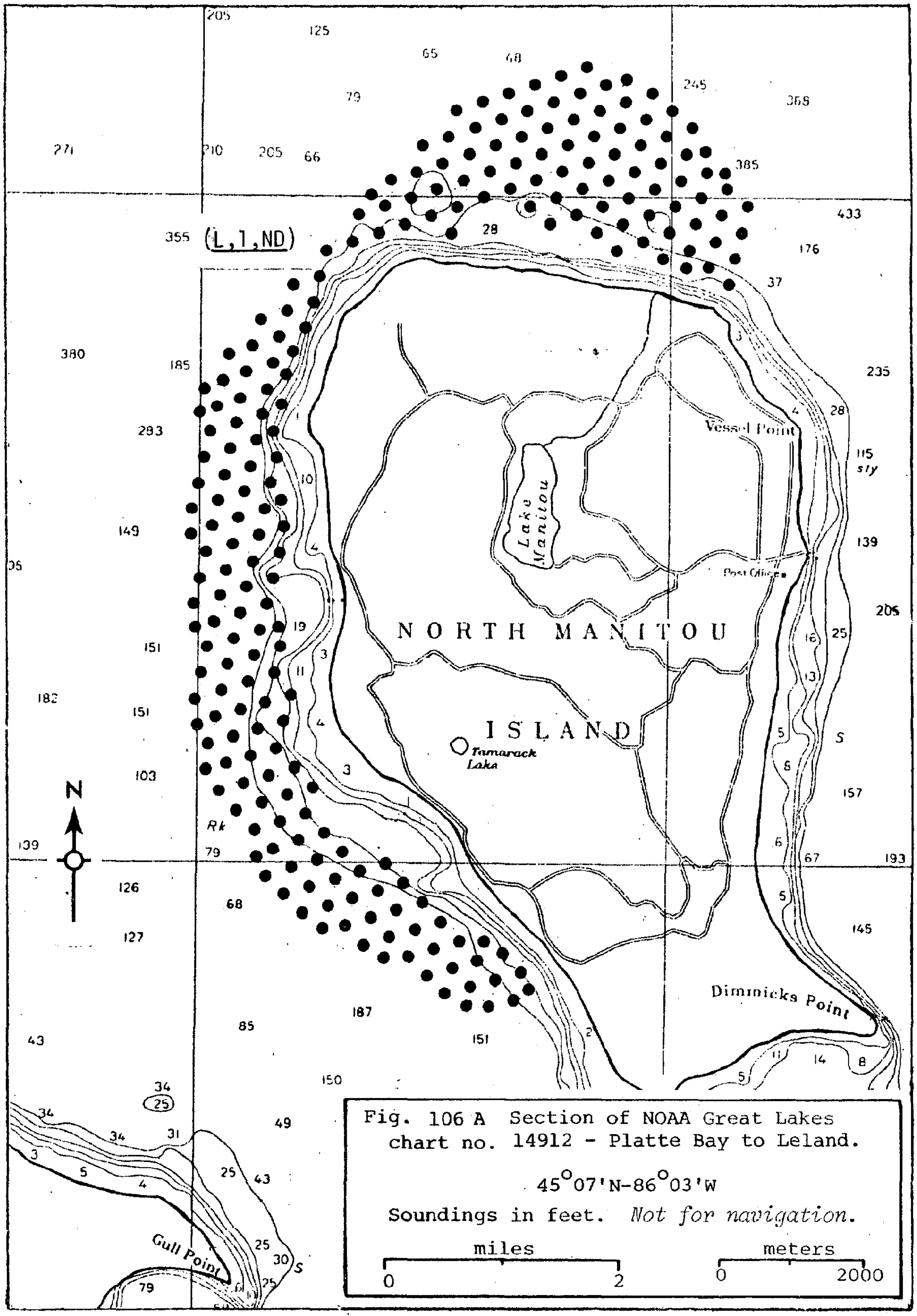



Fig. 106 A Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

45°07'N-86°03'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

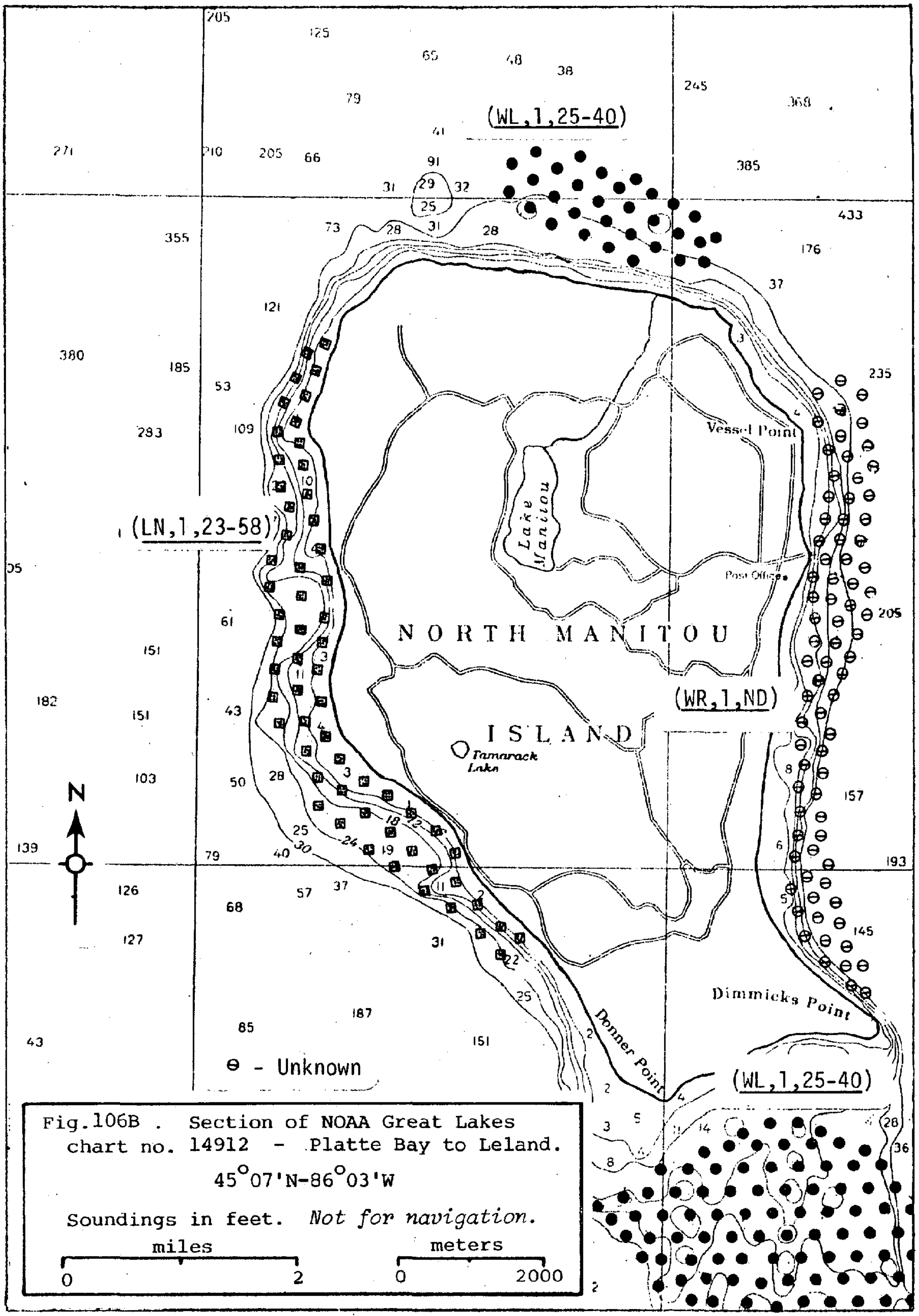



Fig.106B . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
45°07'N-86°03'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

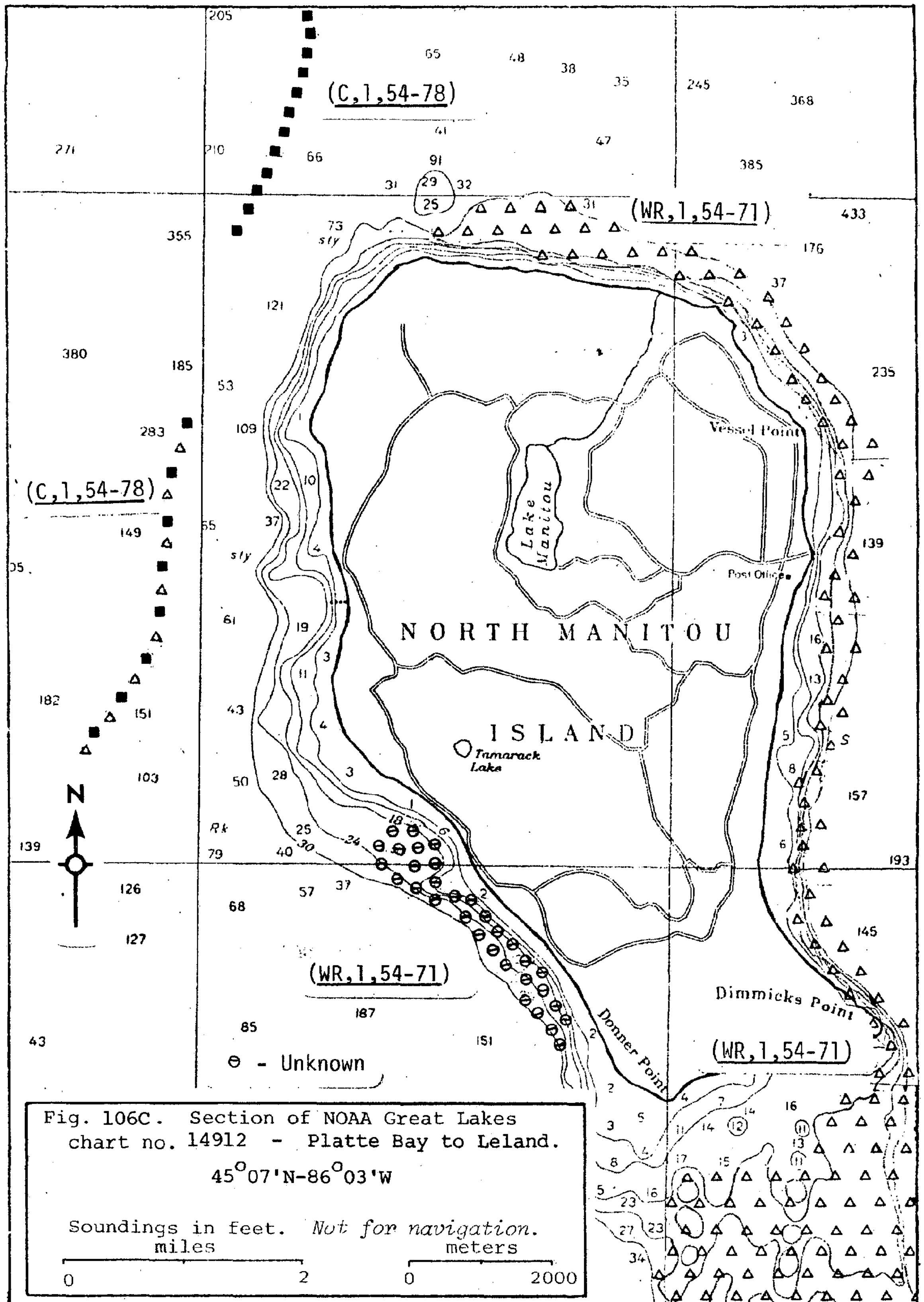



Fig. 106C. Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
$45^{o}07'N-86^{o}03'W$

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

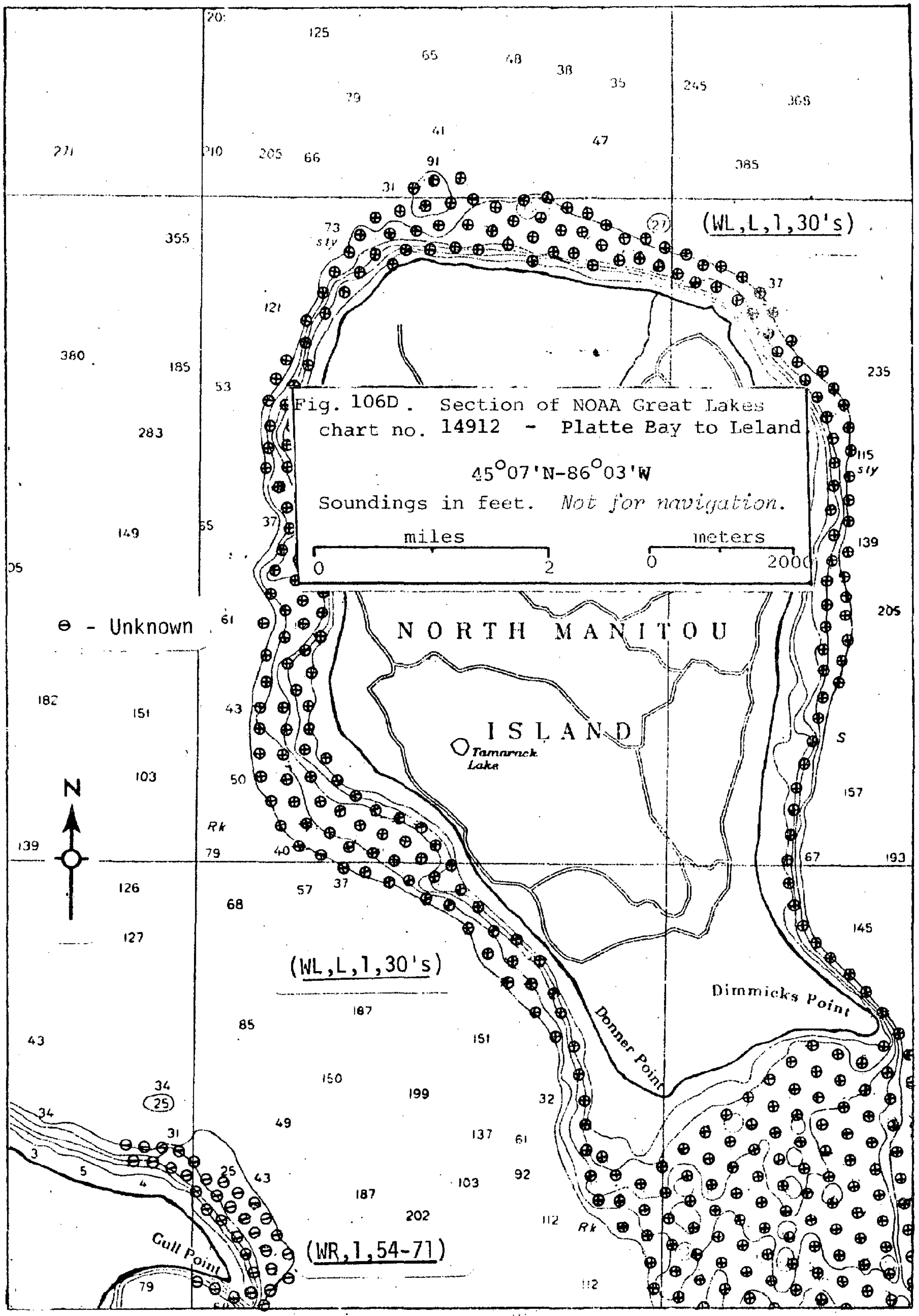


Fig. 106D. Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland
45°07'N-86°03'W
Soundings in feet. *Not for navigation.*

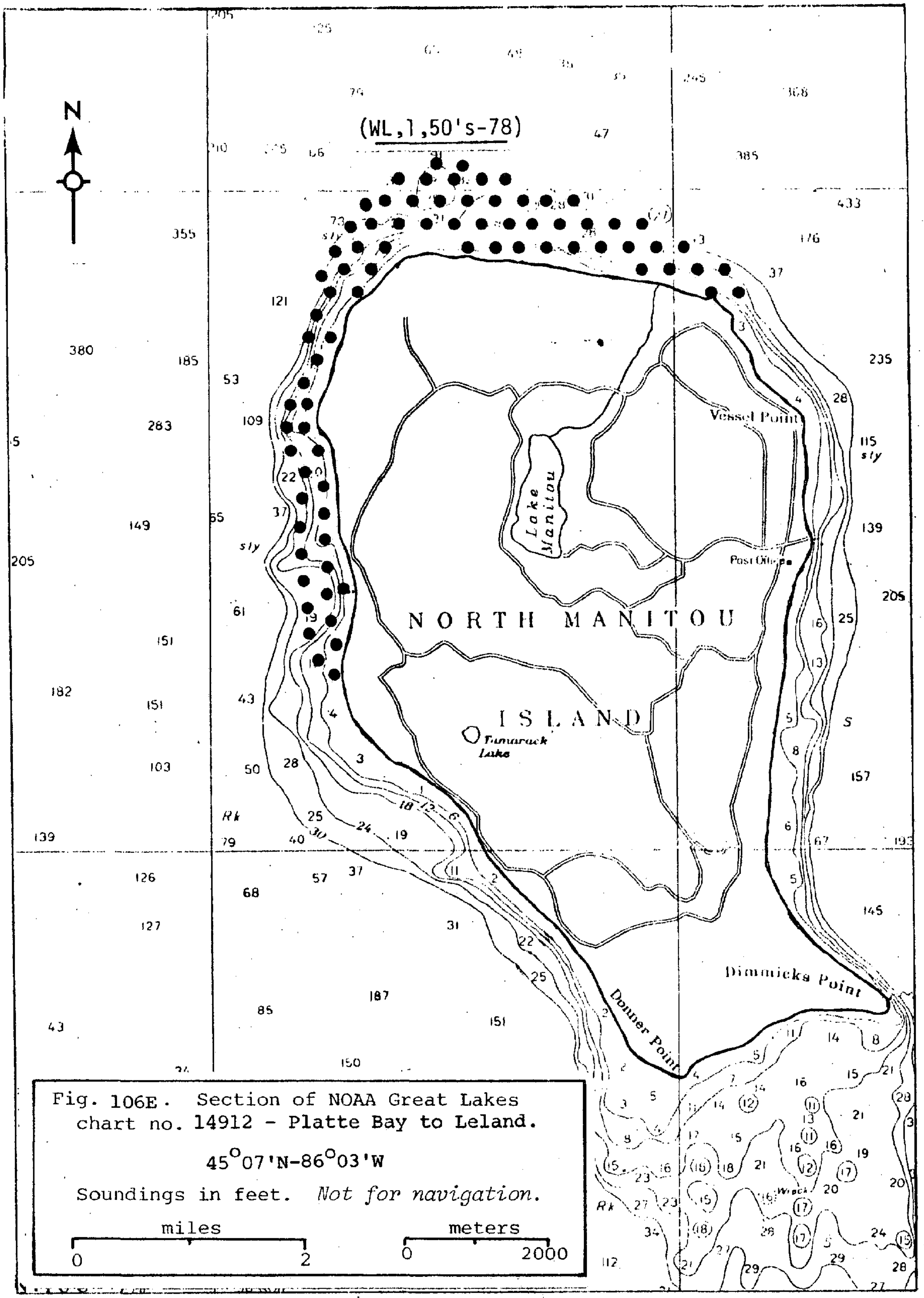



Fig. 106E. Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

45°07'N-86°03'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

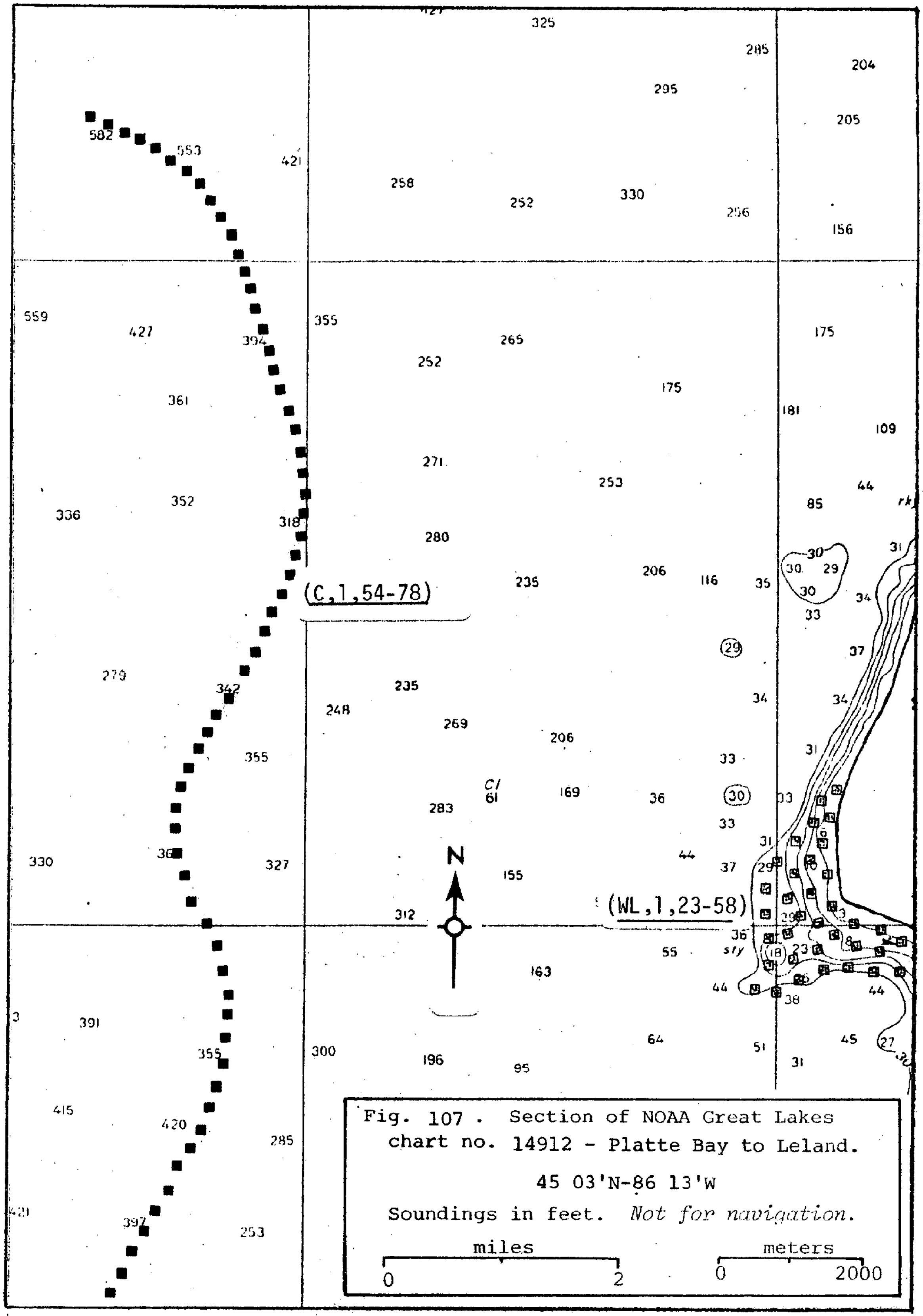



Fig. 107 . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

45 03'N-86 13'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

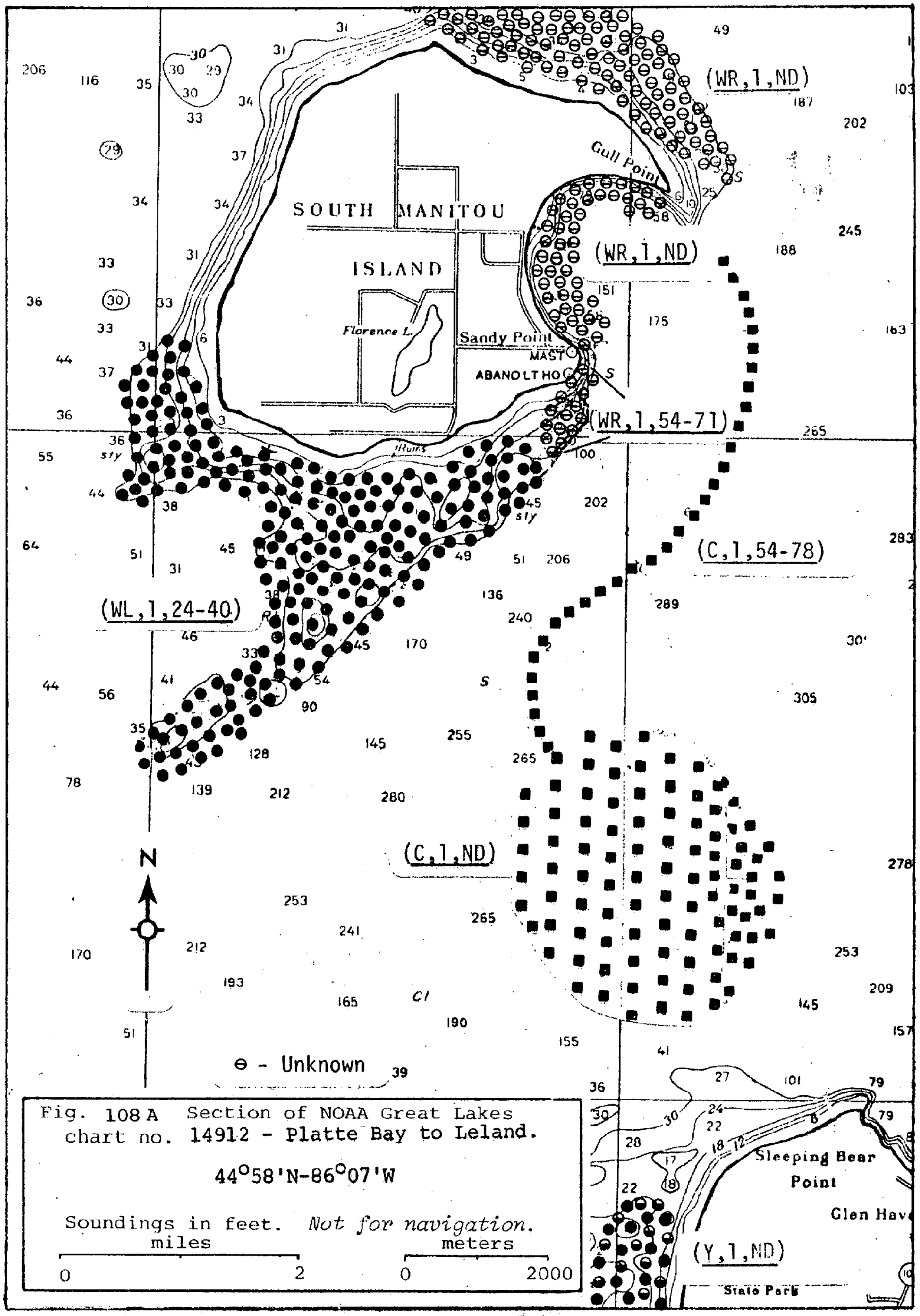



Fig. 108 A Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

44°58'N-86°07'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

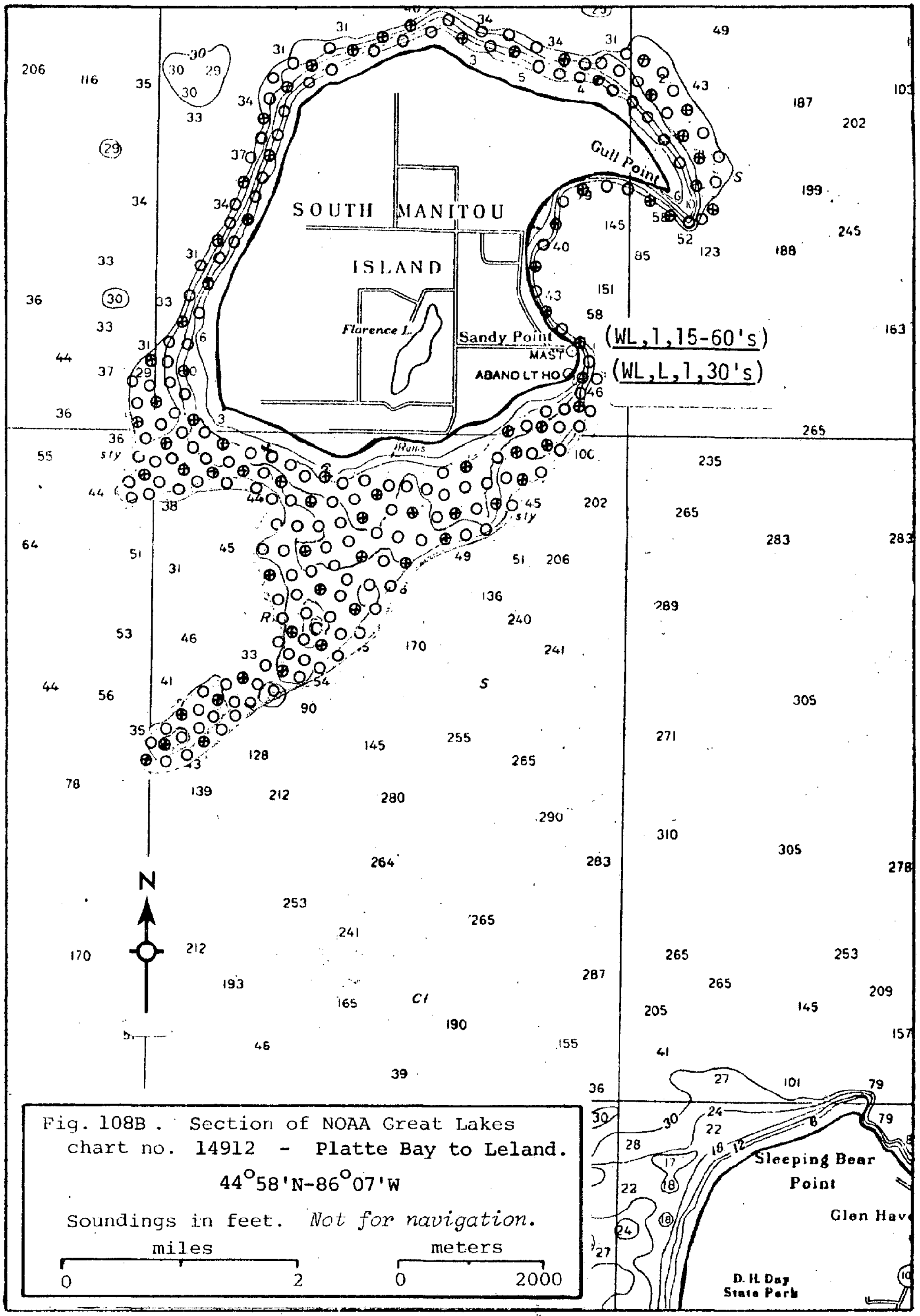



Fig. 108B . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
44°58'N-86°07'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

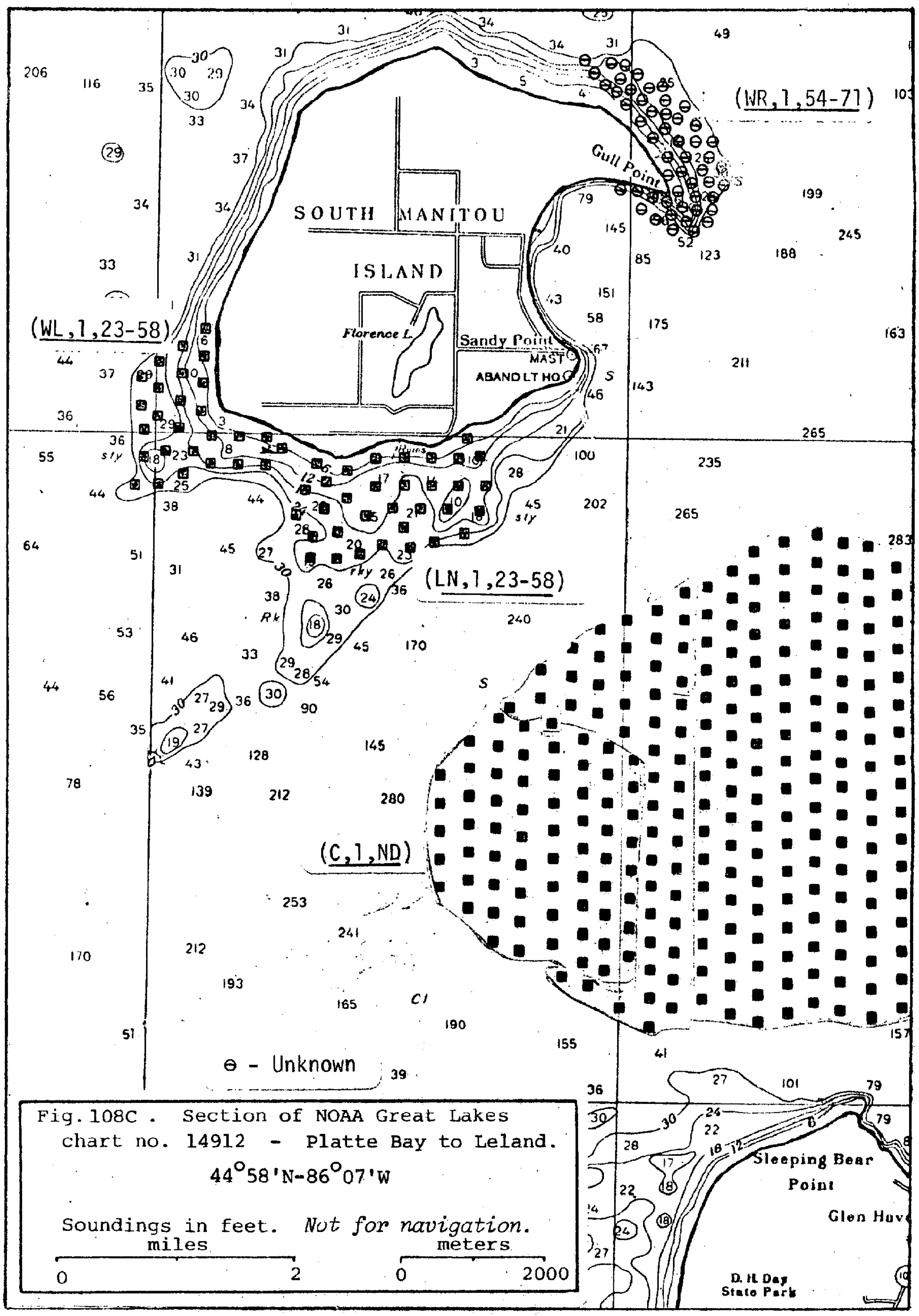



Fig. 108C . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.
44°58'N-86°07'W

Soundings in feet. *Not for navigation.*

miles: 0 – 2 meters: 0 – 2000

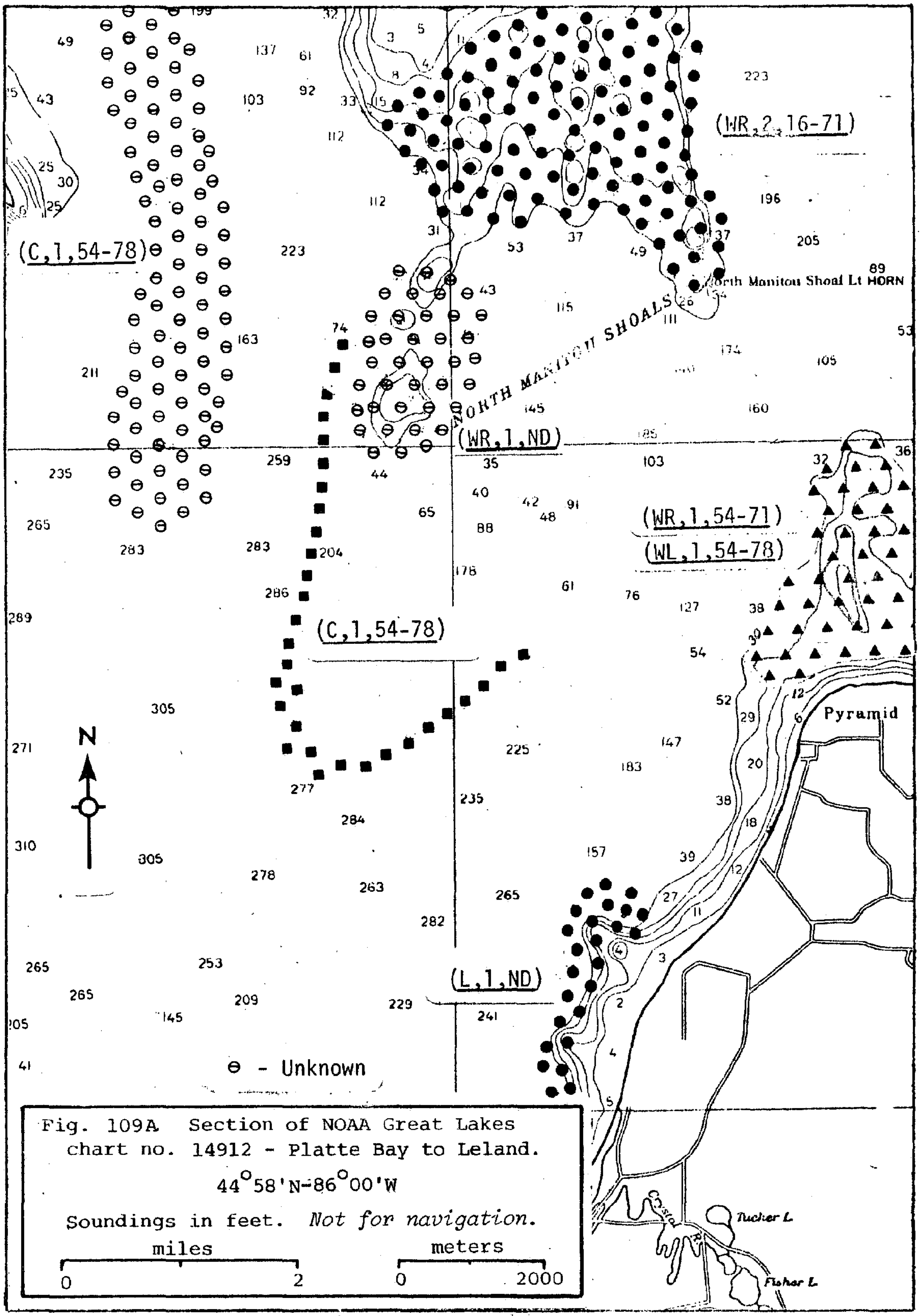



Fig. 109A Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

44°58'N-86°00'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

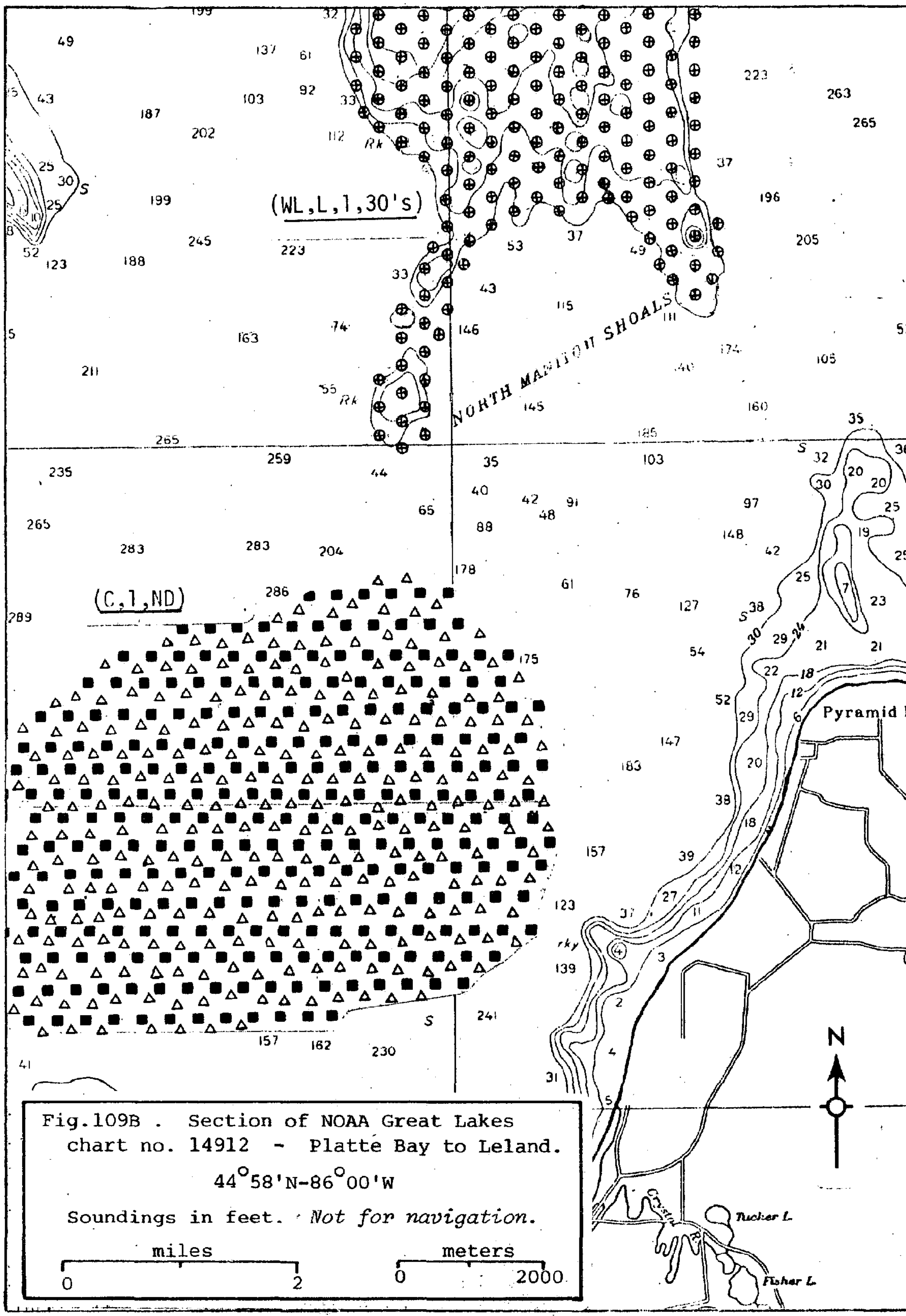



Fig.109B . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

44°58'N-86°00'W

Soundings in feet. *Not for navigation.*

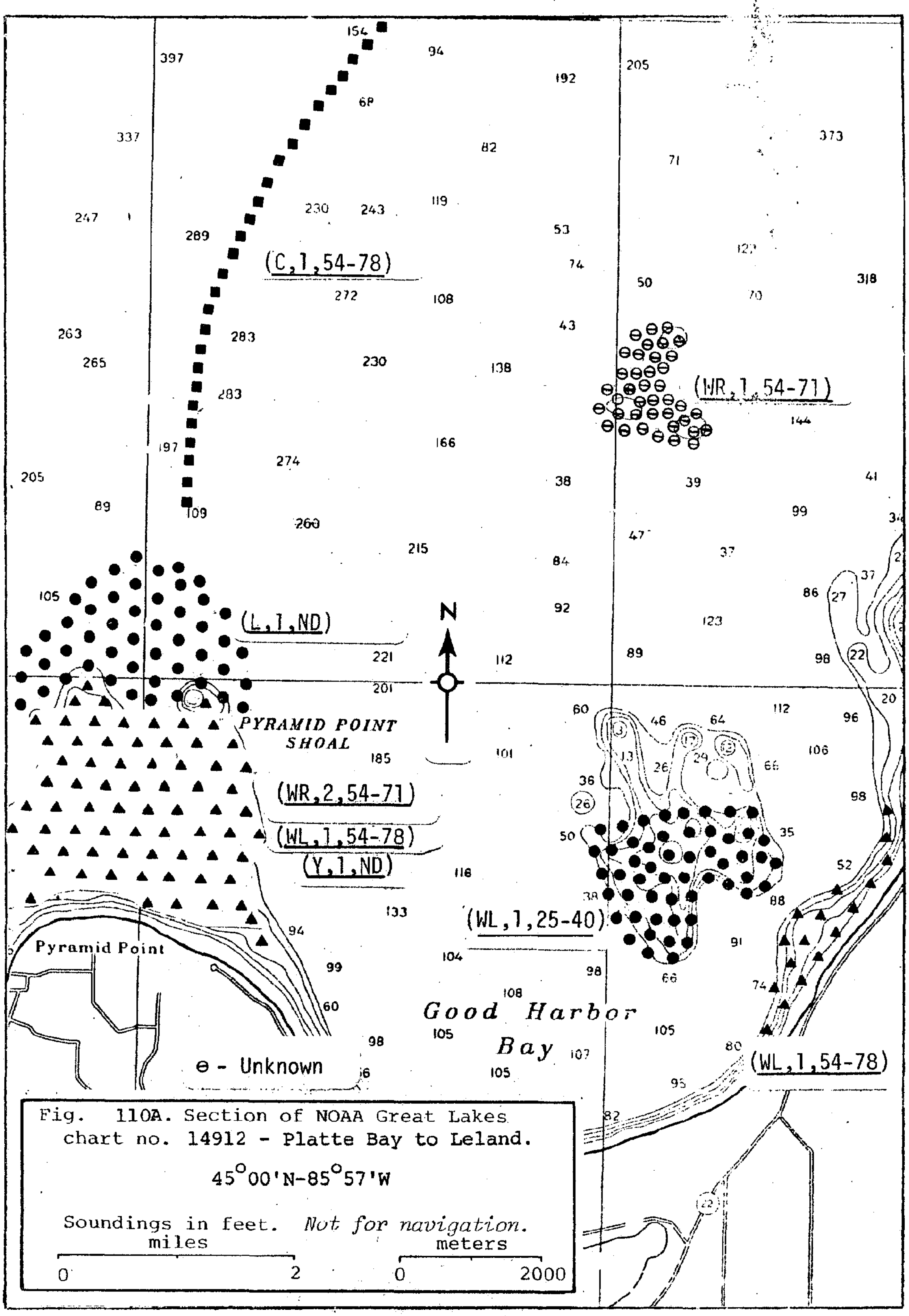



Fig. 110A. Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

45°00'N-85°57'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

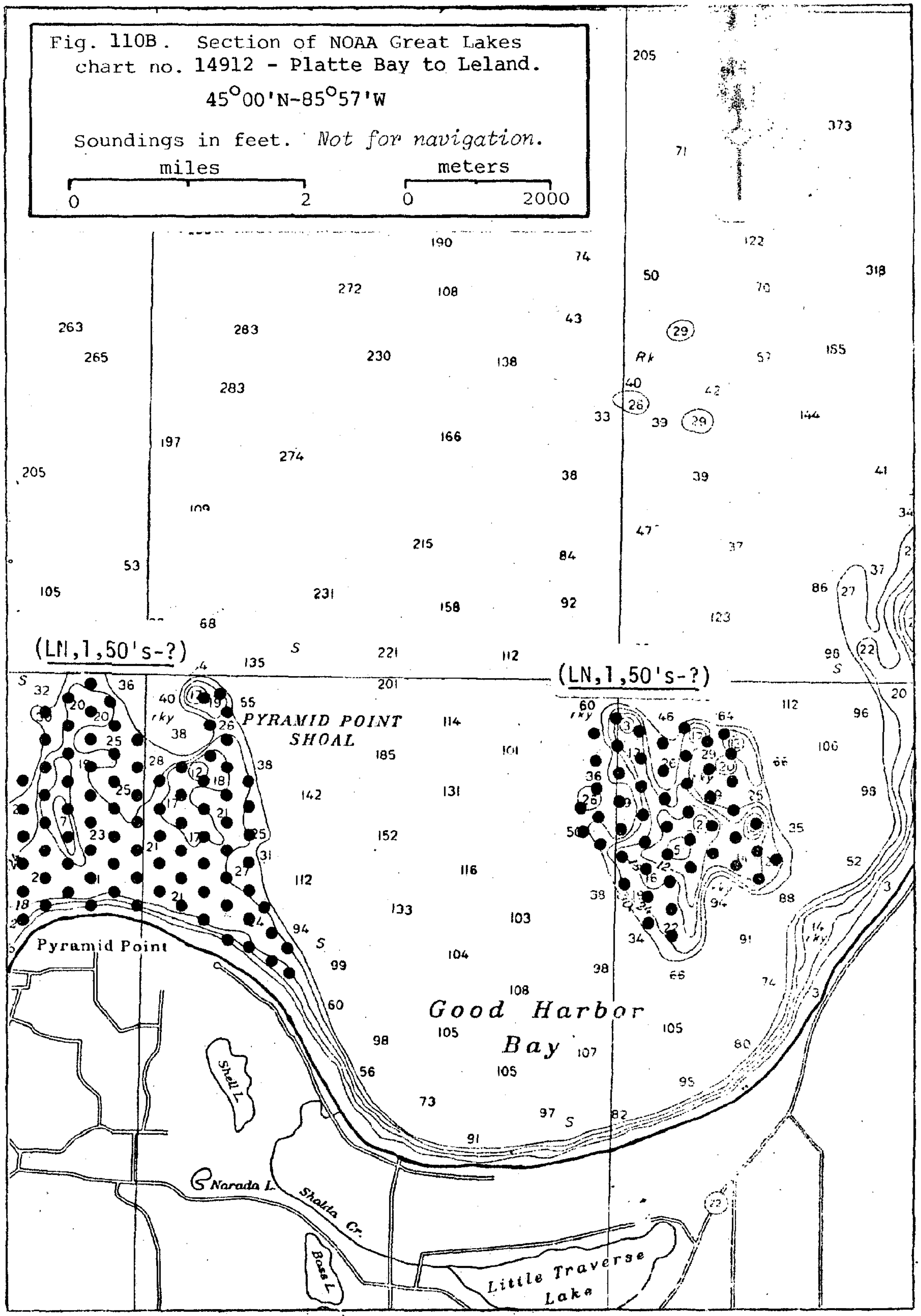



Fig. 110B. Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

45°00'N-85°57'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

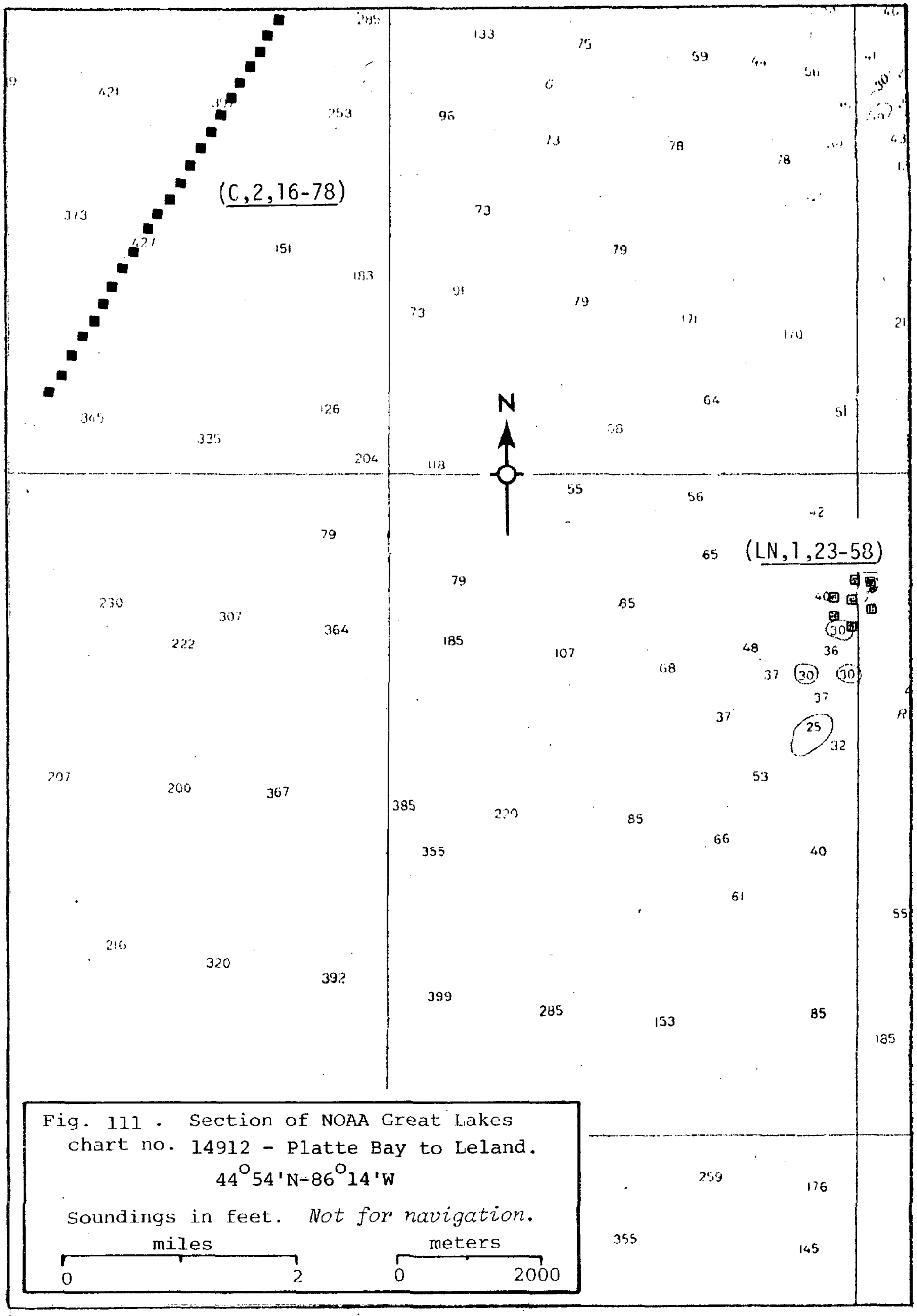



Fig. 111 . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland. 44°54'N-86°14'W

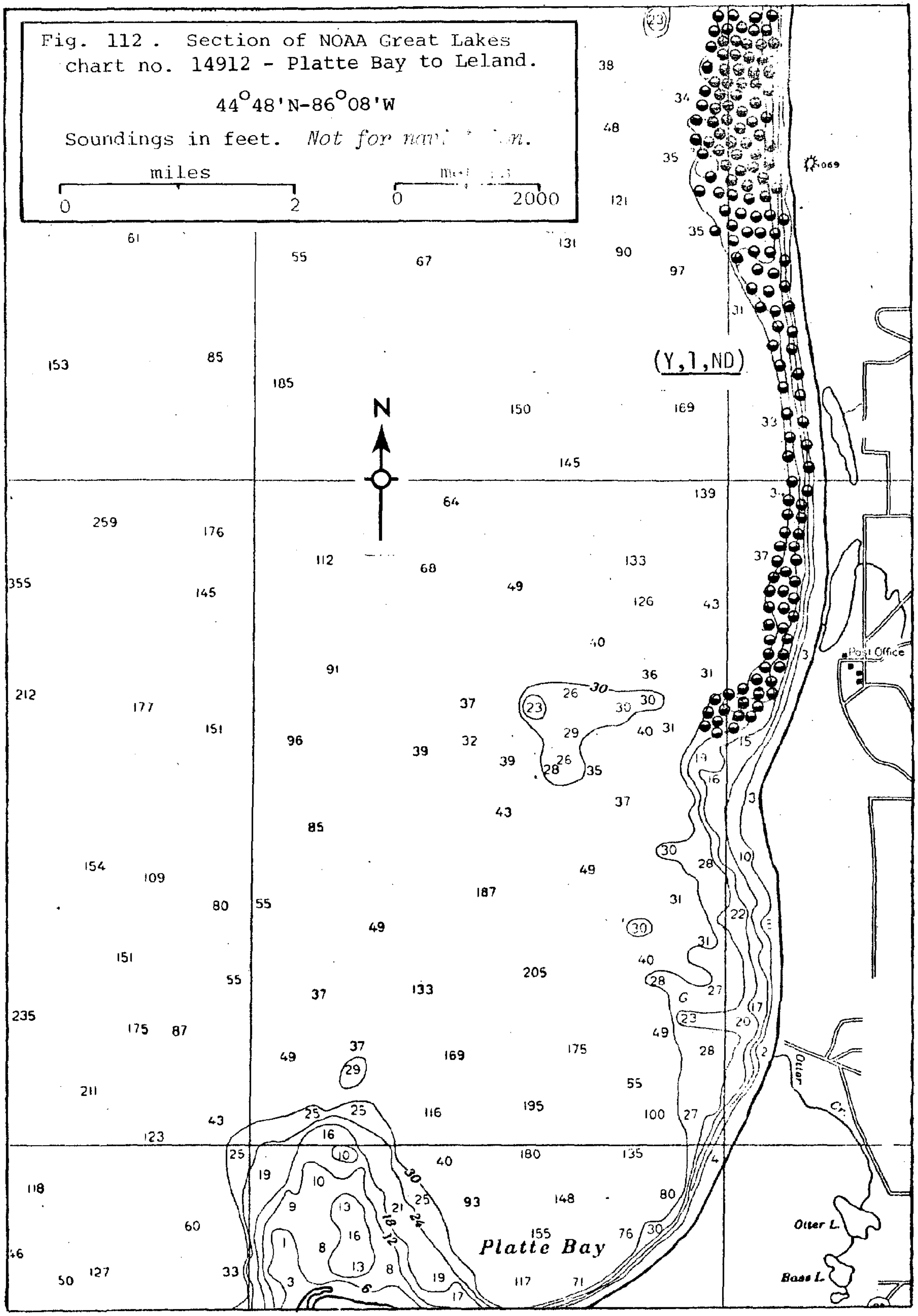
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

Fig. 112 . Section of NOAA Great Lakes chart no. 14912 - Platte Bay to Leland.

44°48'N-86°08'W

Soundings in feet. *Not for* [illegible]



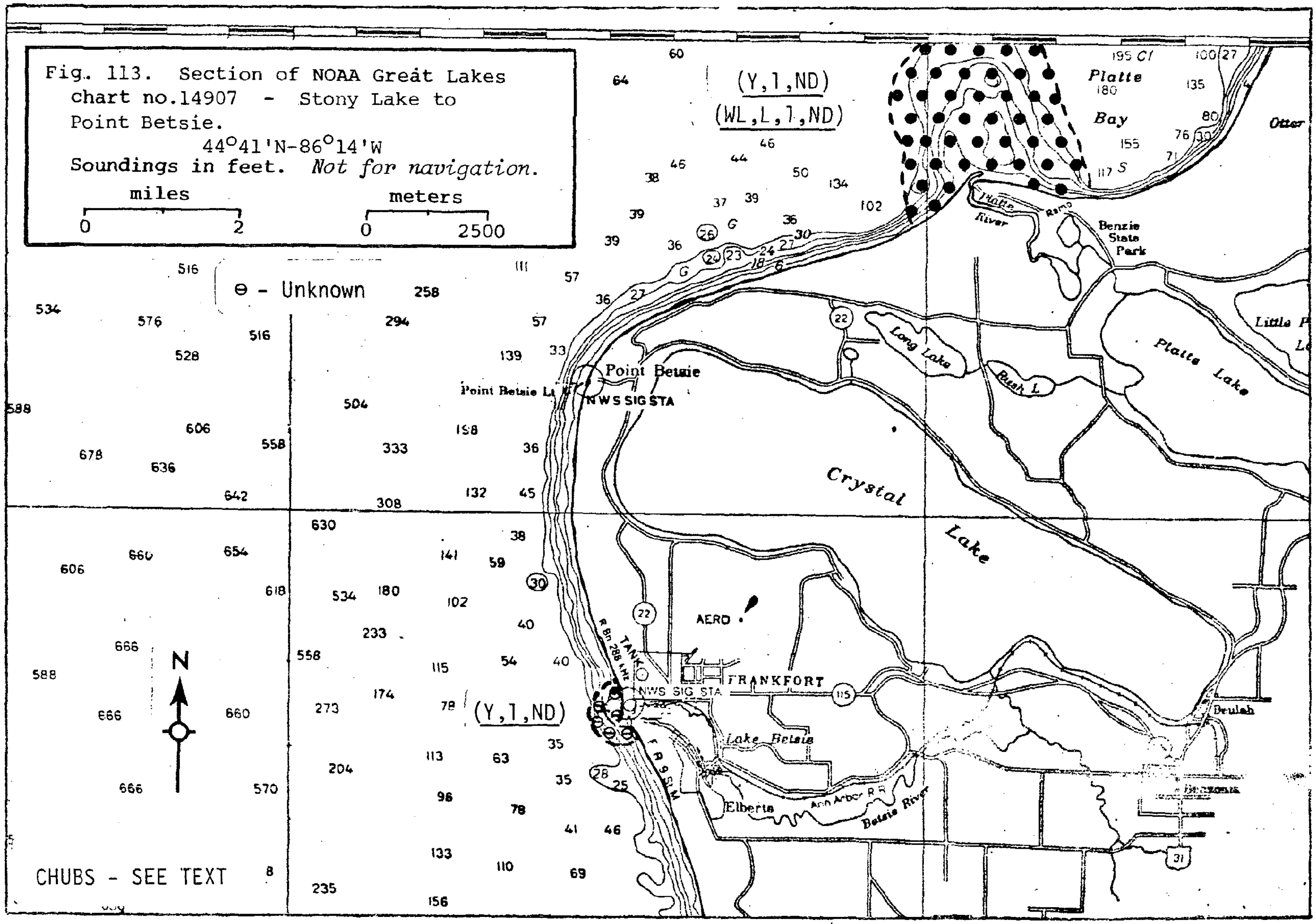



Fig. 113. Section of NOAA Great Lakes chart no.14907 - Stony Lake to Point Betsie.
44°41'N-86°14'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

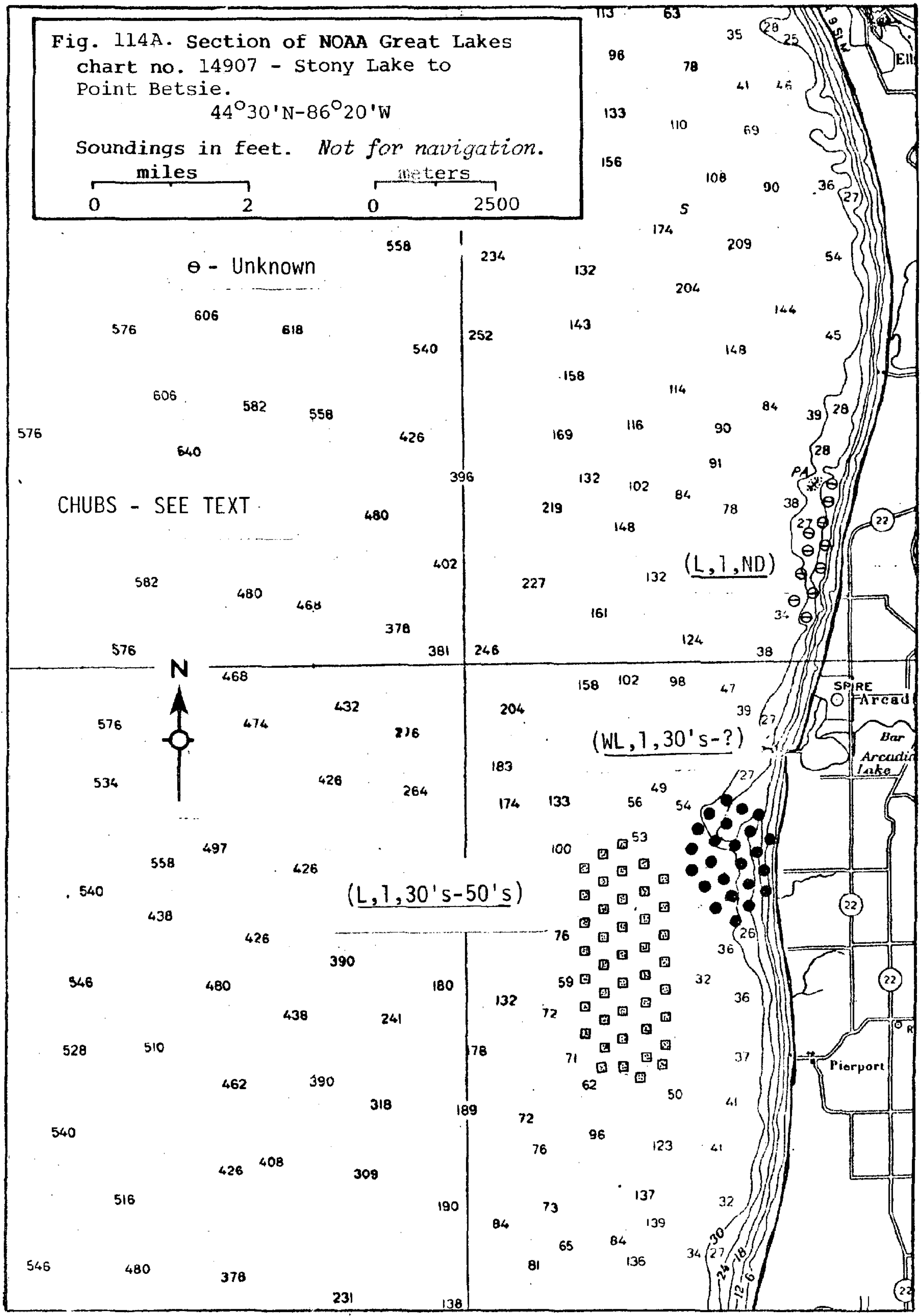
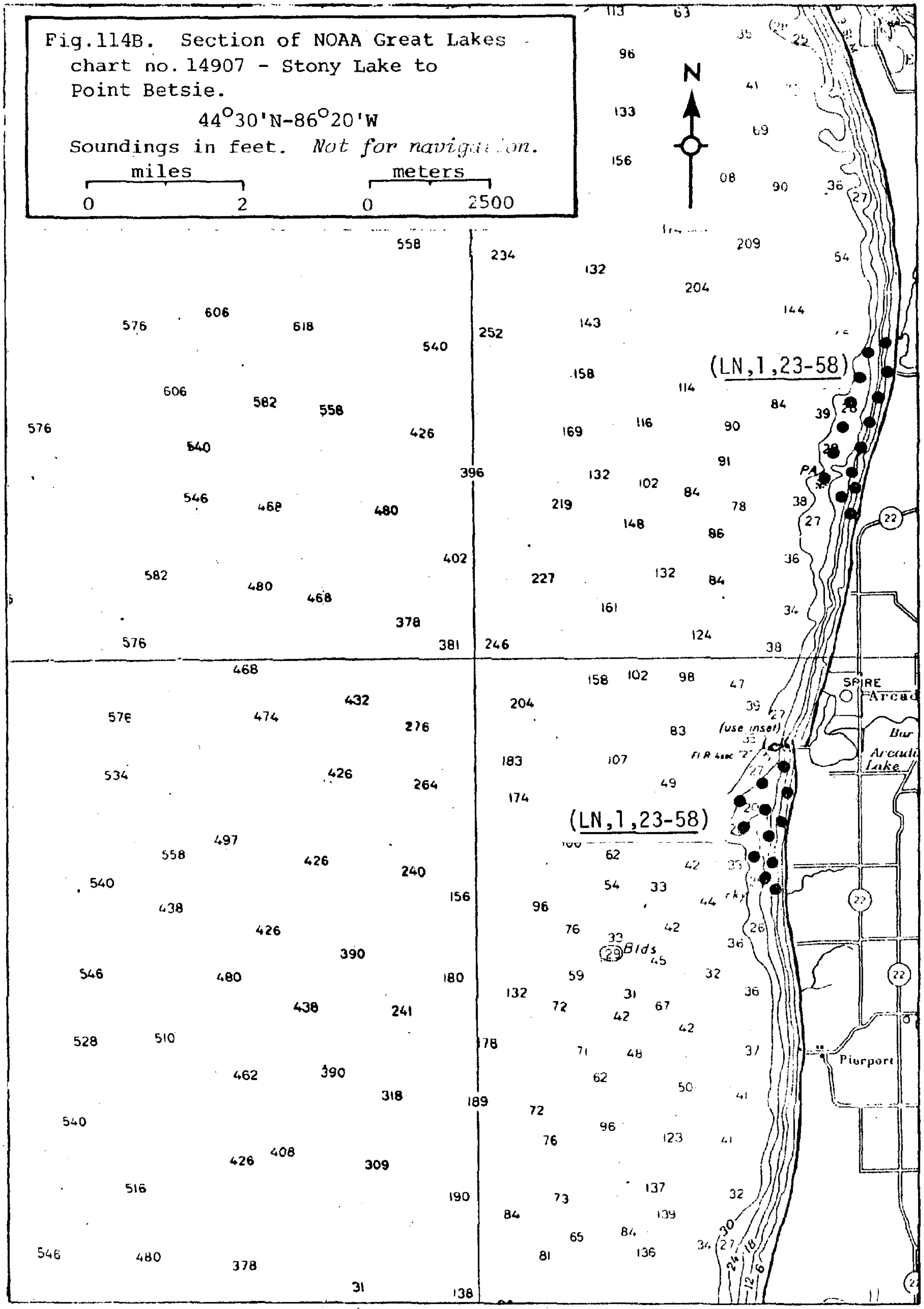



Fig. 114A. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
44°30'N-86°20'W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

Fig.114B. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
44°30'N-86°20'W
Soundings in feet. *Not for navigation.*



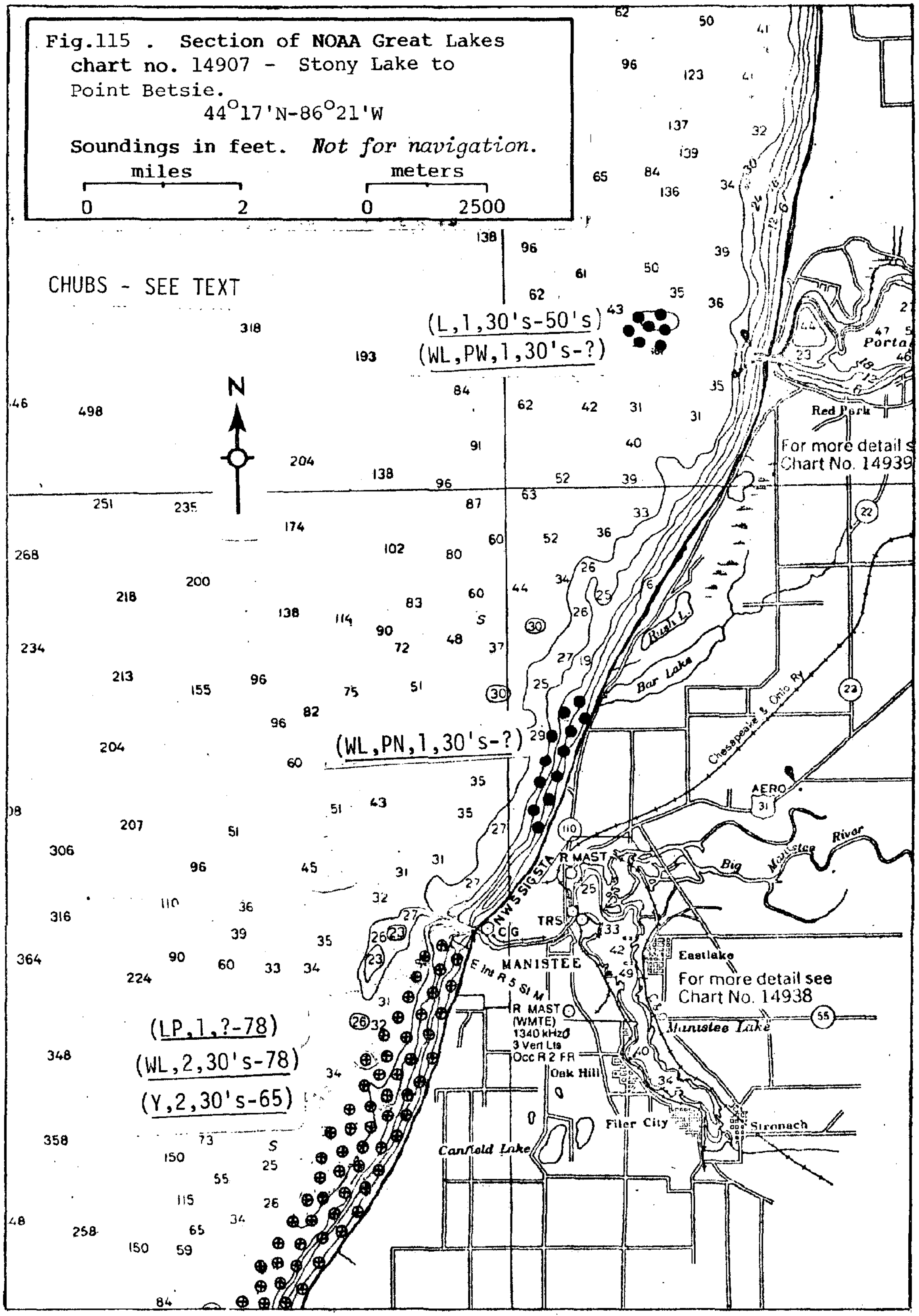



Fig.115 . Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
44°17'N-86°21'W

Soundings in feet. *Not for navigation.*

miles 0 – 2 meters 0 – 2500

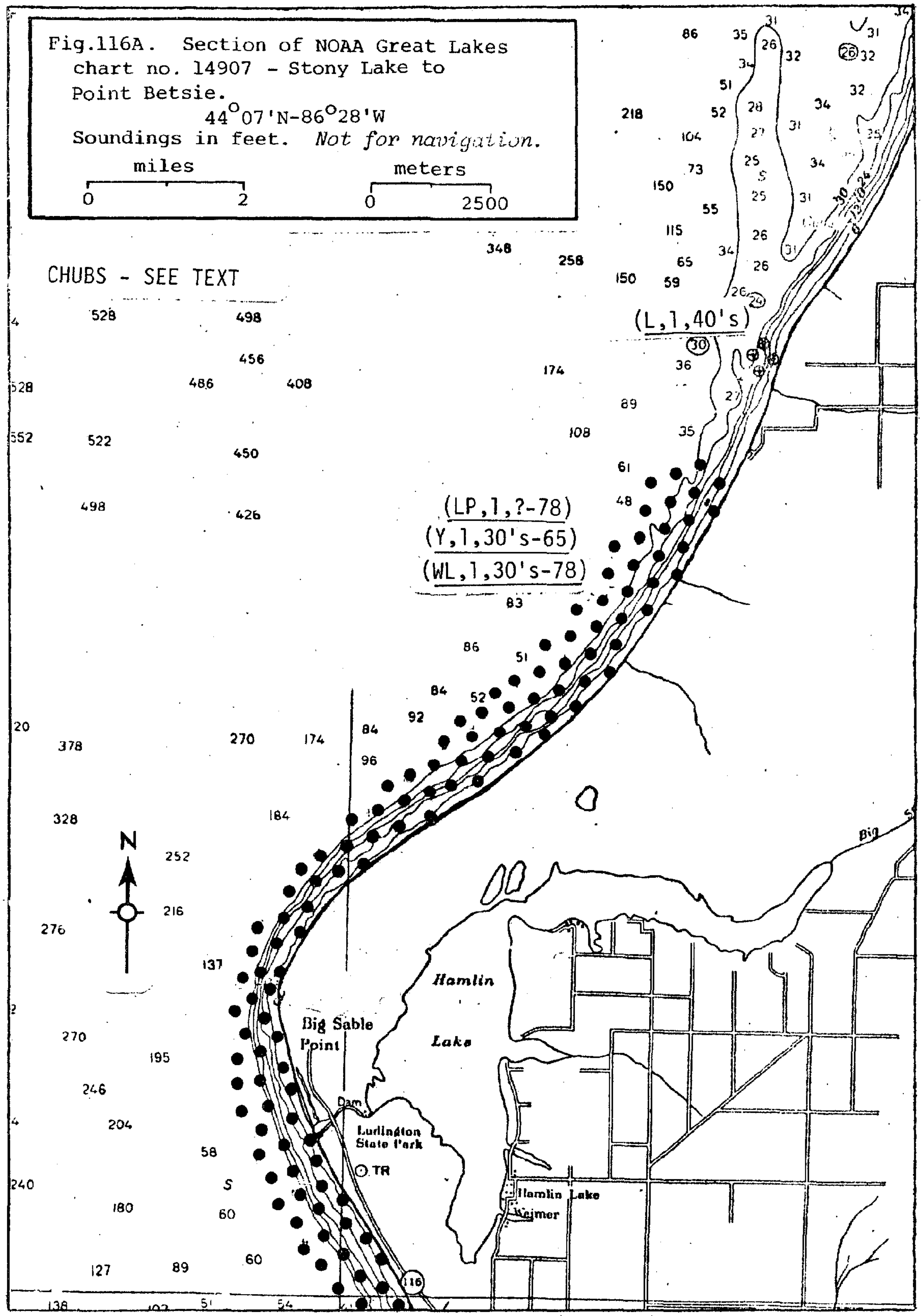



Fig.116A. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
44°07'N-86°28'W
Soundings in feet. *Not for navigation.*
miles 0 2
meters 0 2500

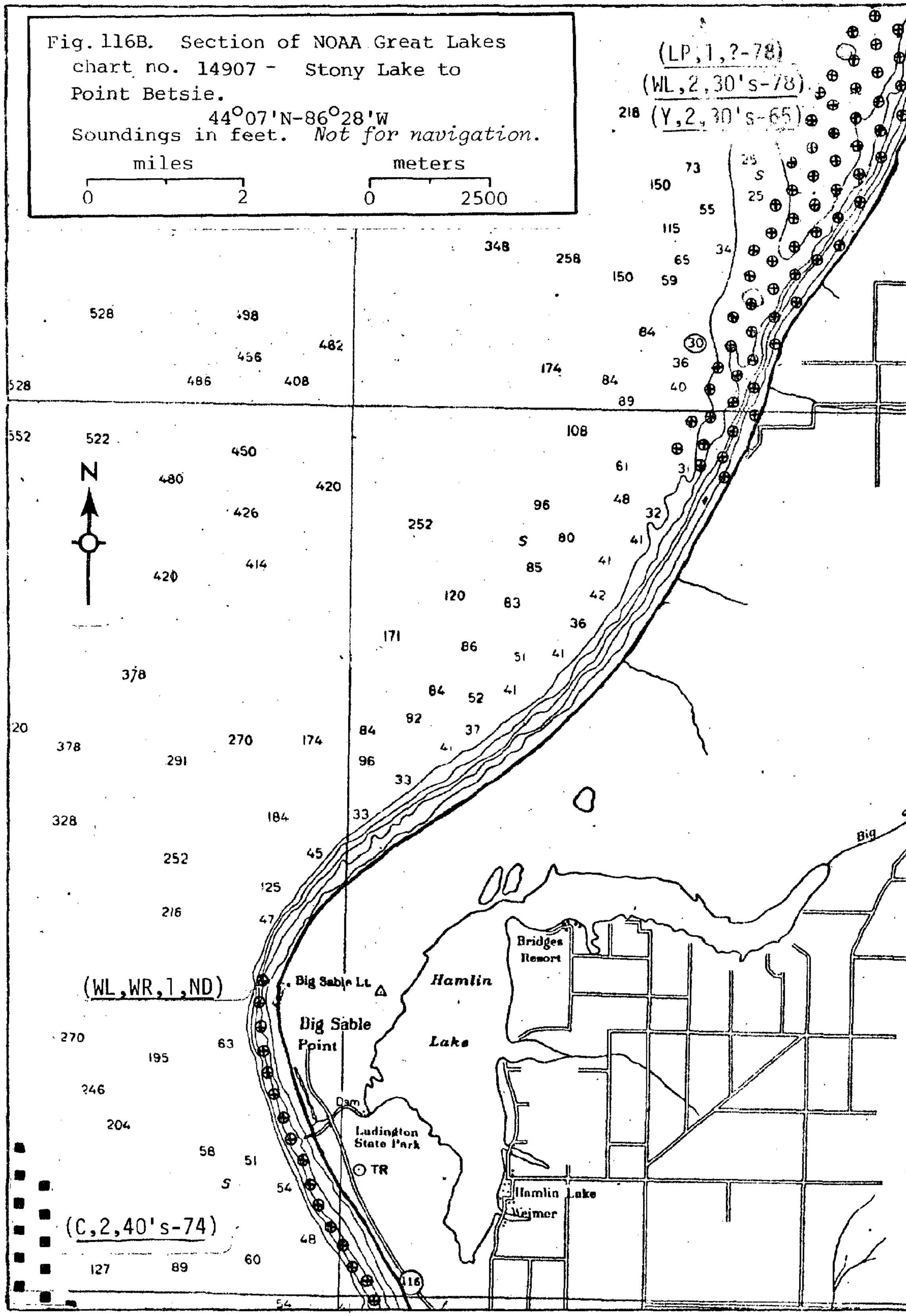



Fig. 116B. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
44°07'N-86°28'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

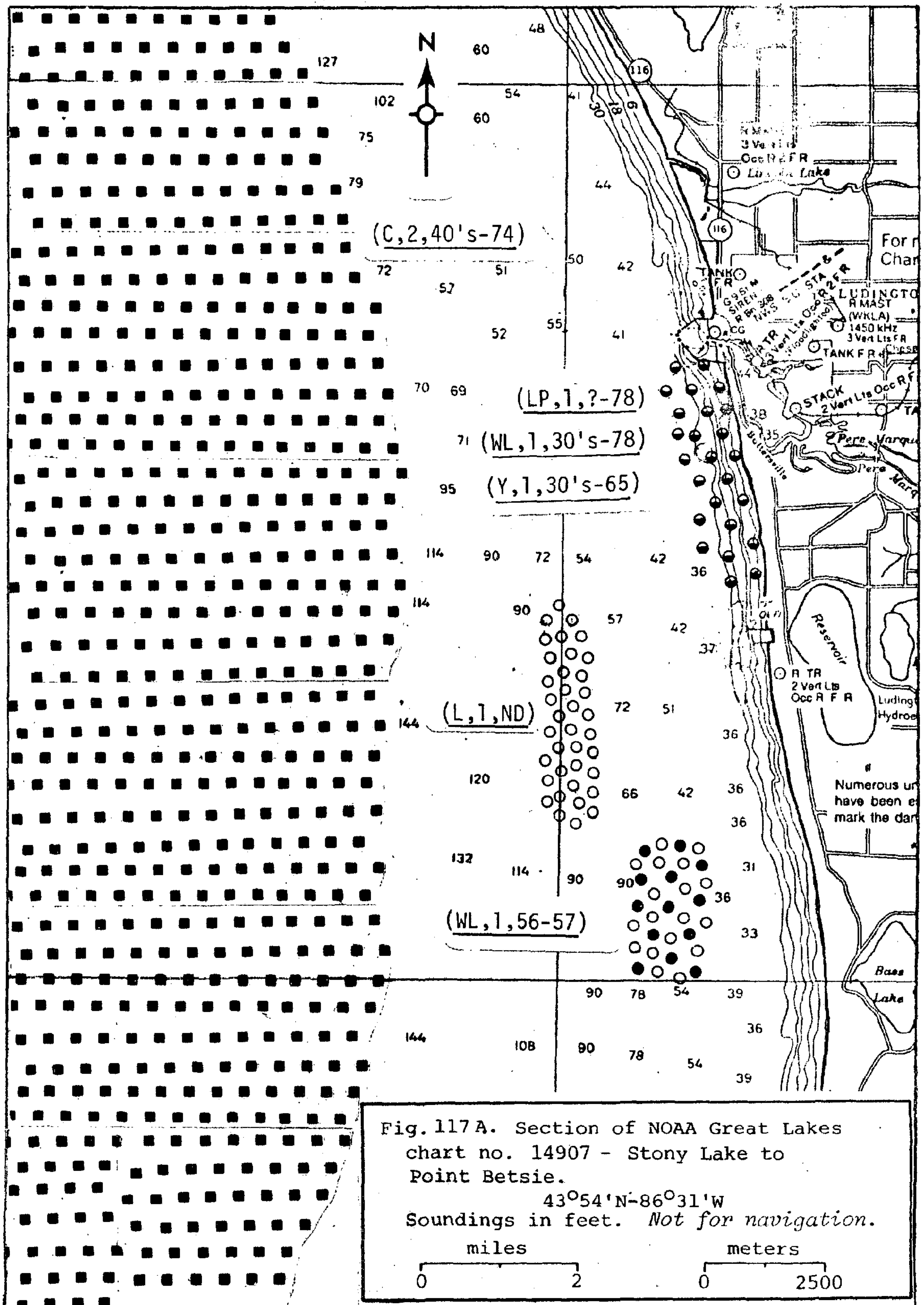



Fig. 117A. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
43°54'N-86°31'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

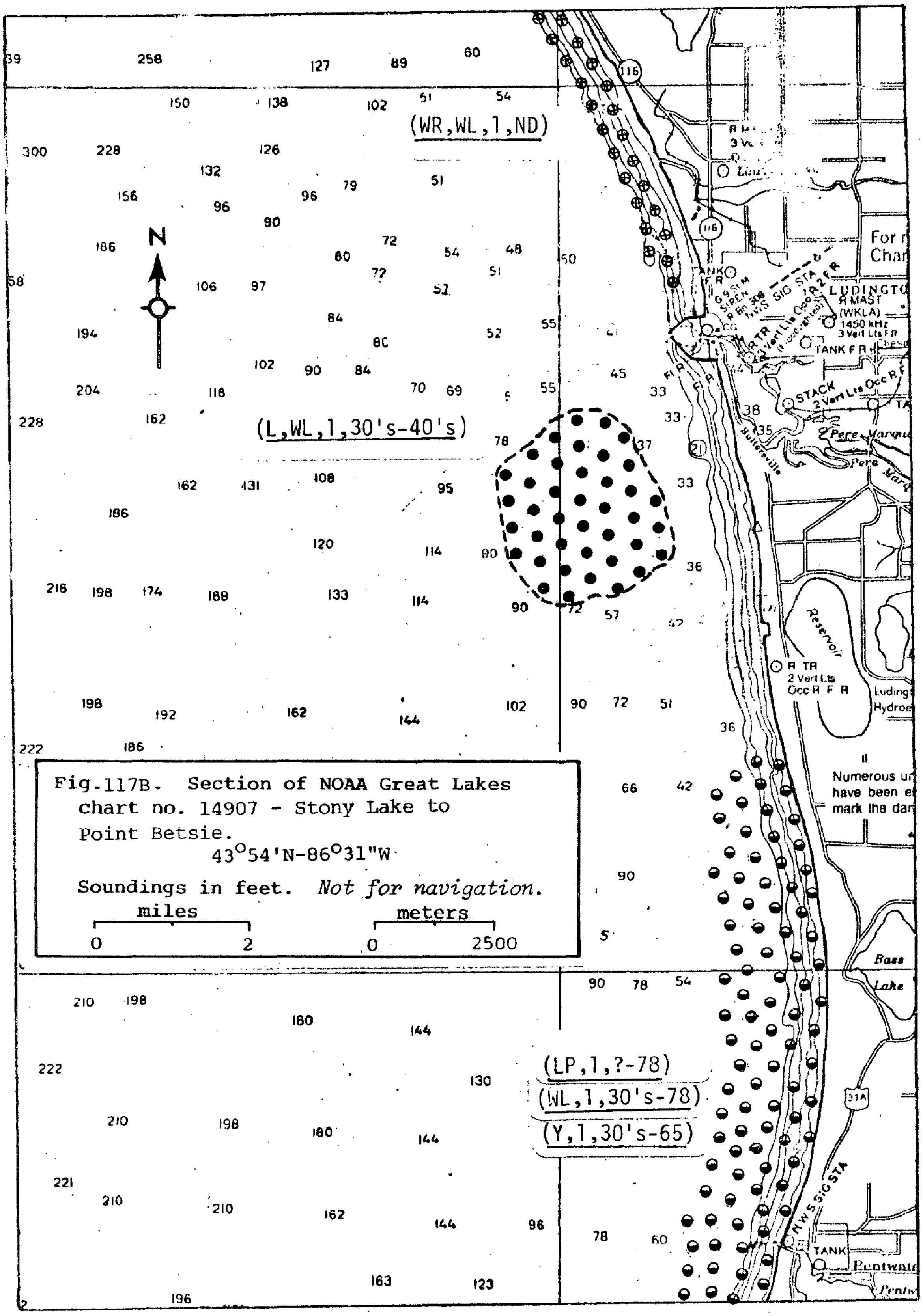



Fig.117B. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
$43^{\circ}54'N-86^{\circ}31"W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

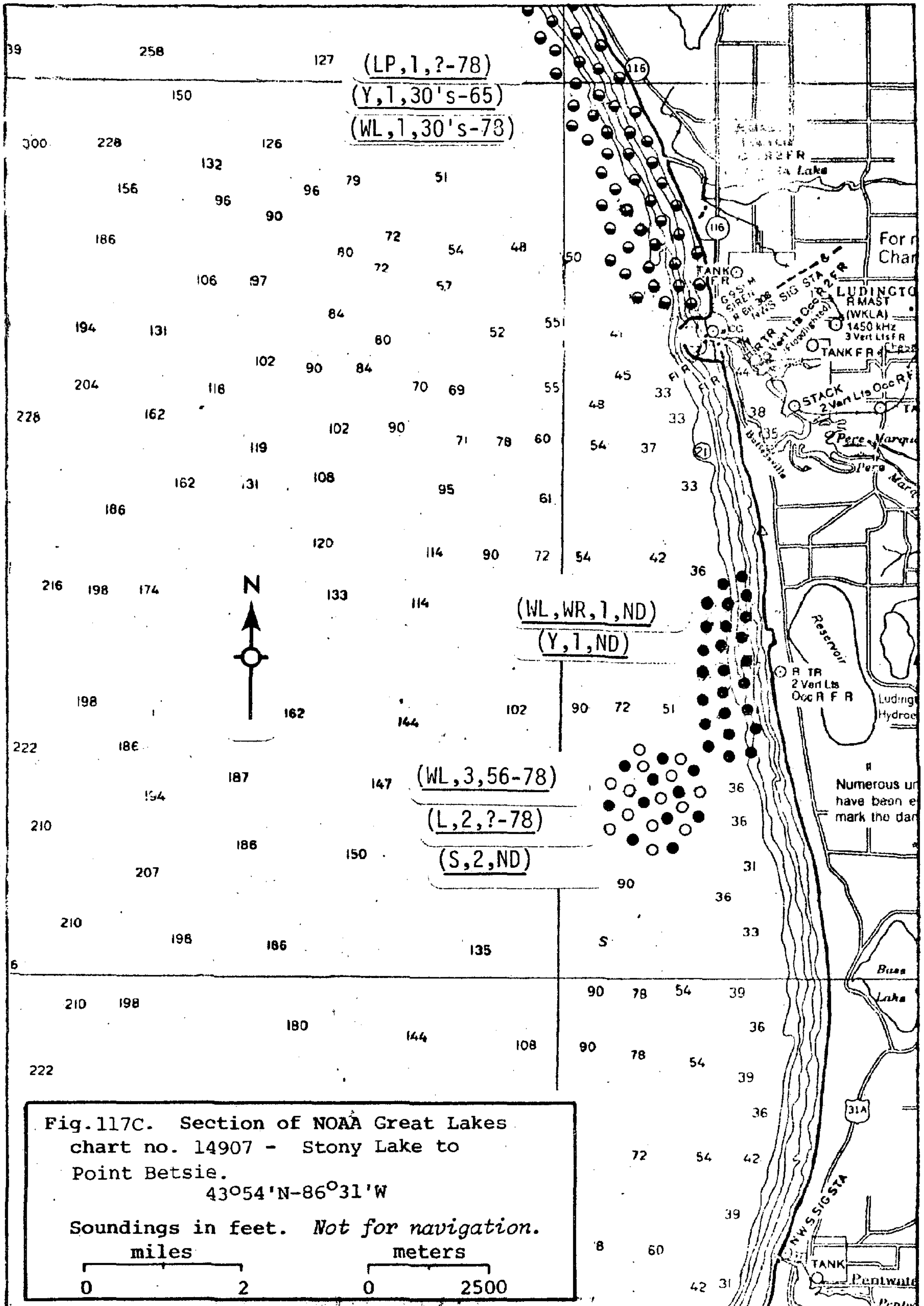



Fig.117C. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
43°54'N-86°31'W

Soundings in feet. *Not for navigation.*

miles: 0 — 2 | meters: 0 — 2500

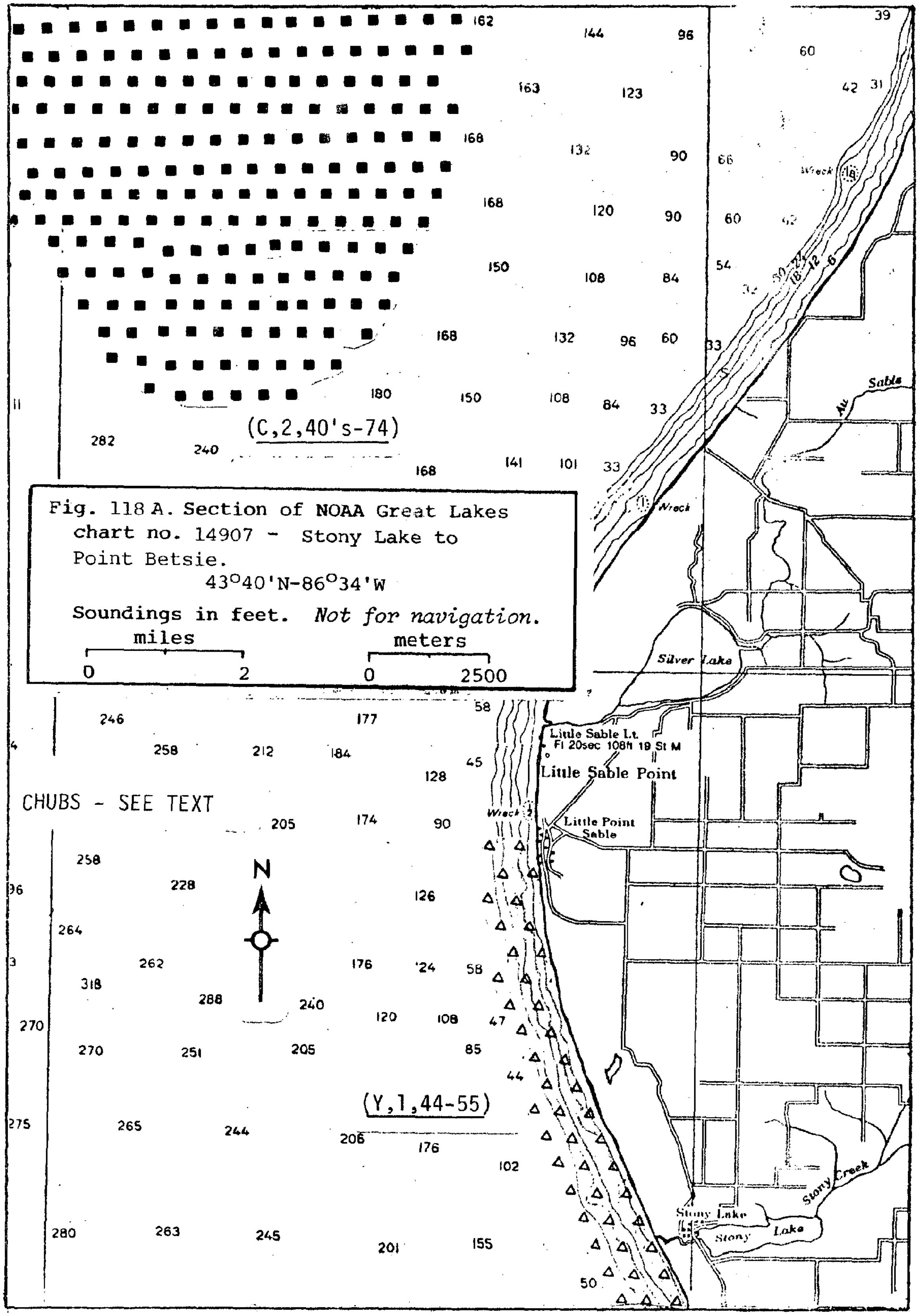



Fig. 118 A. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
43°40'N-86°34'W
Soundings in feet. *Not for navigation.*
miles 0 2   meters 0 2500

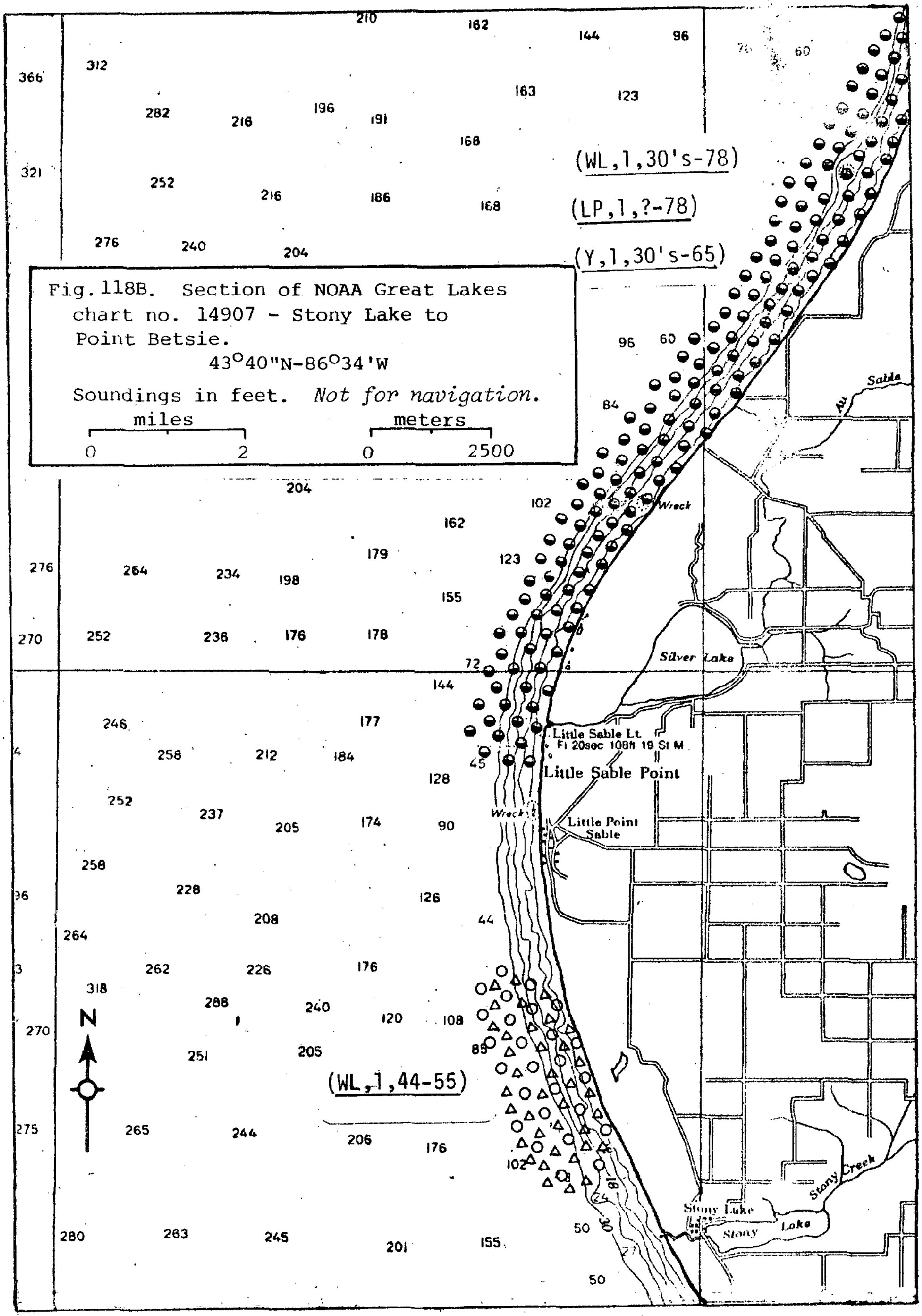



Fig. 118B. Section of NOAA Great Lakes chart no. 14907 - Stony Lake to Point Betsie.
43°40"N-86°34'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

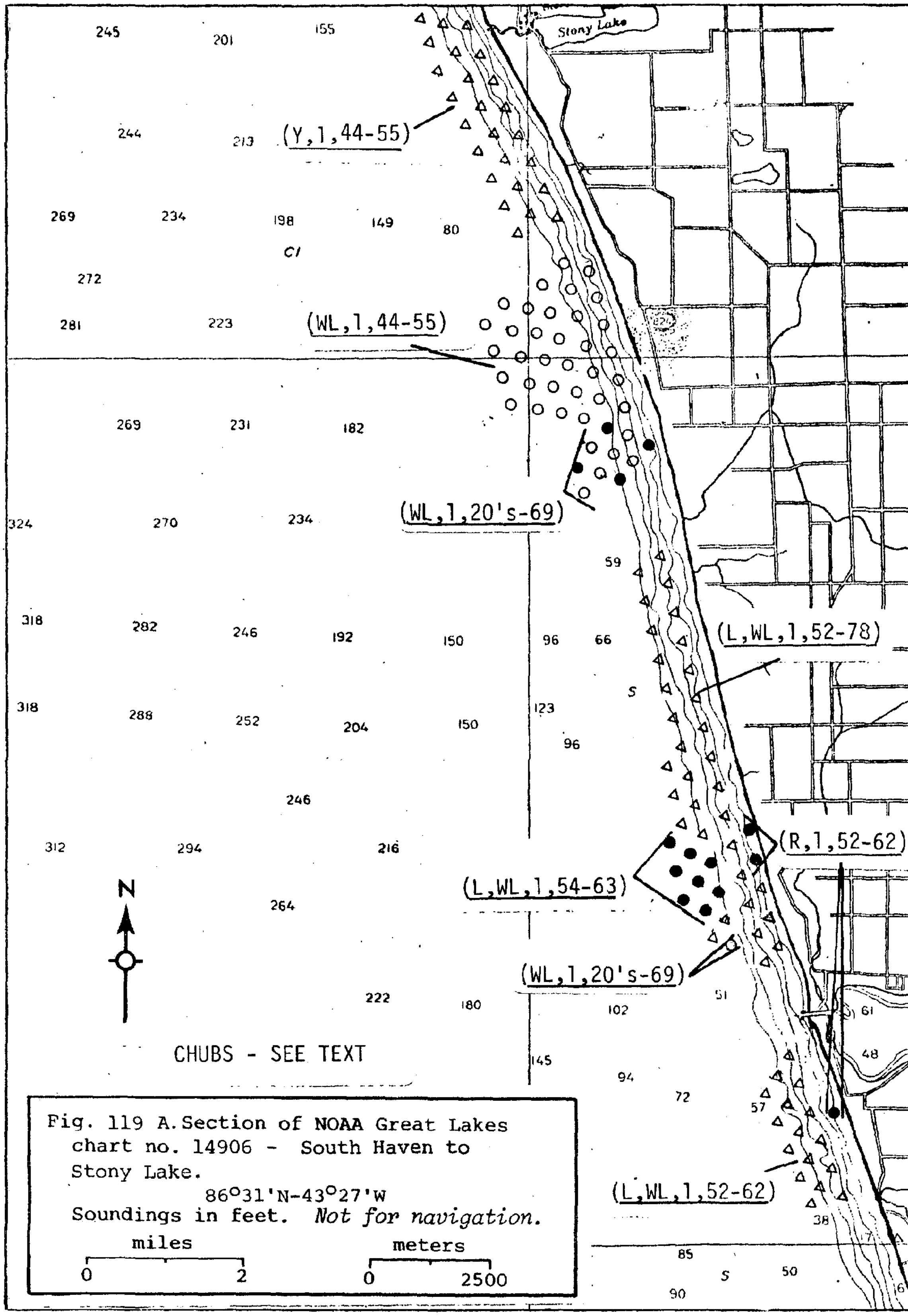



Fig. 119 A. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
$86^{\circ}31'N-43^{\circ}27'W$
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

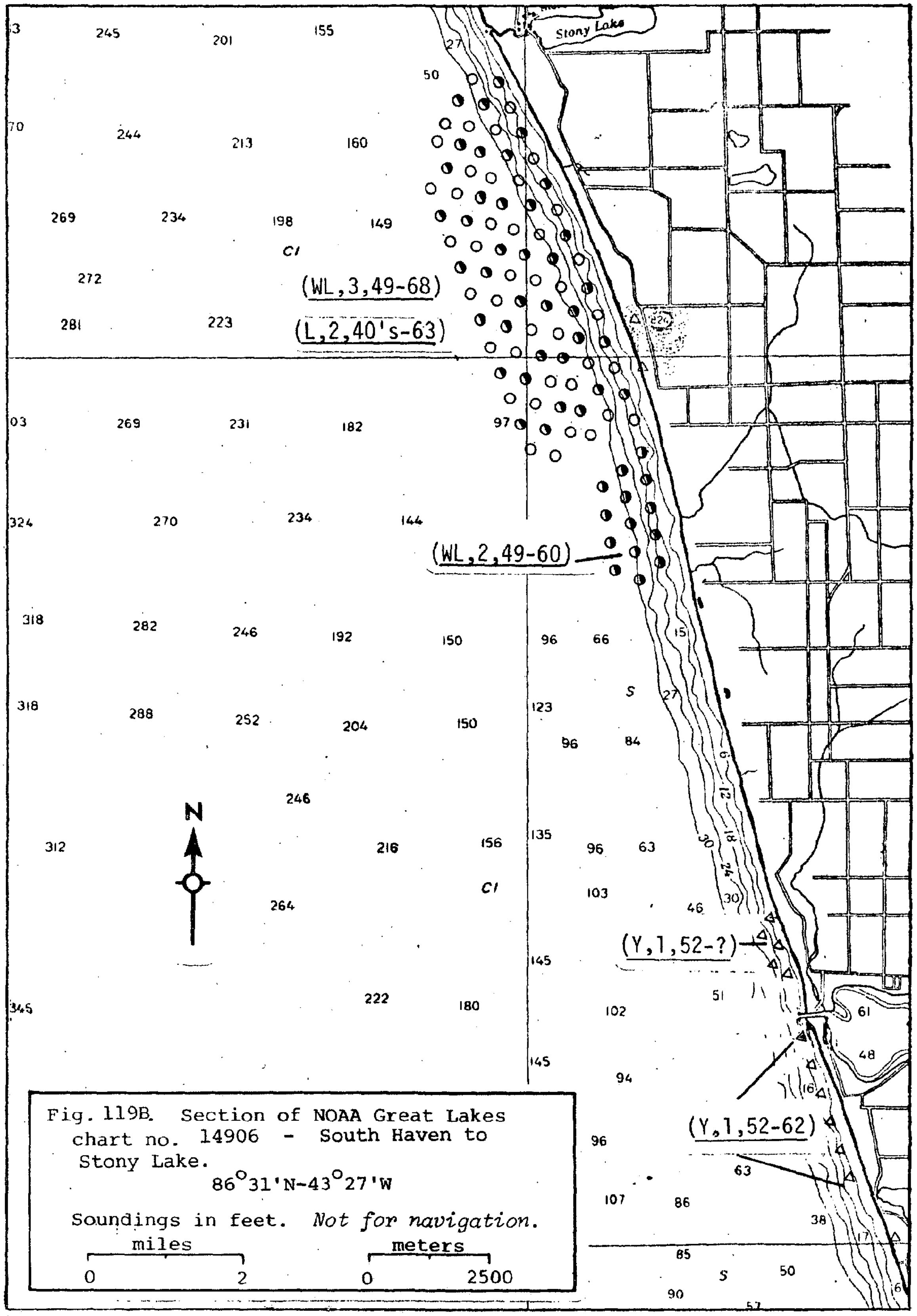



Fig. 119B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°31'N-43°27'W

Soundings in feet. *Not for navigation.*

miles 0 2   meters 0 2500

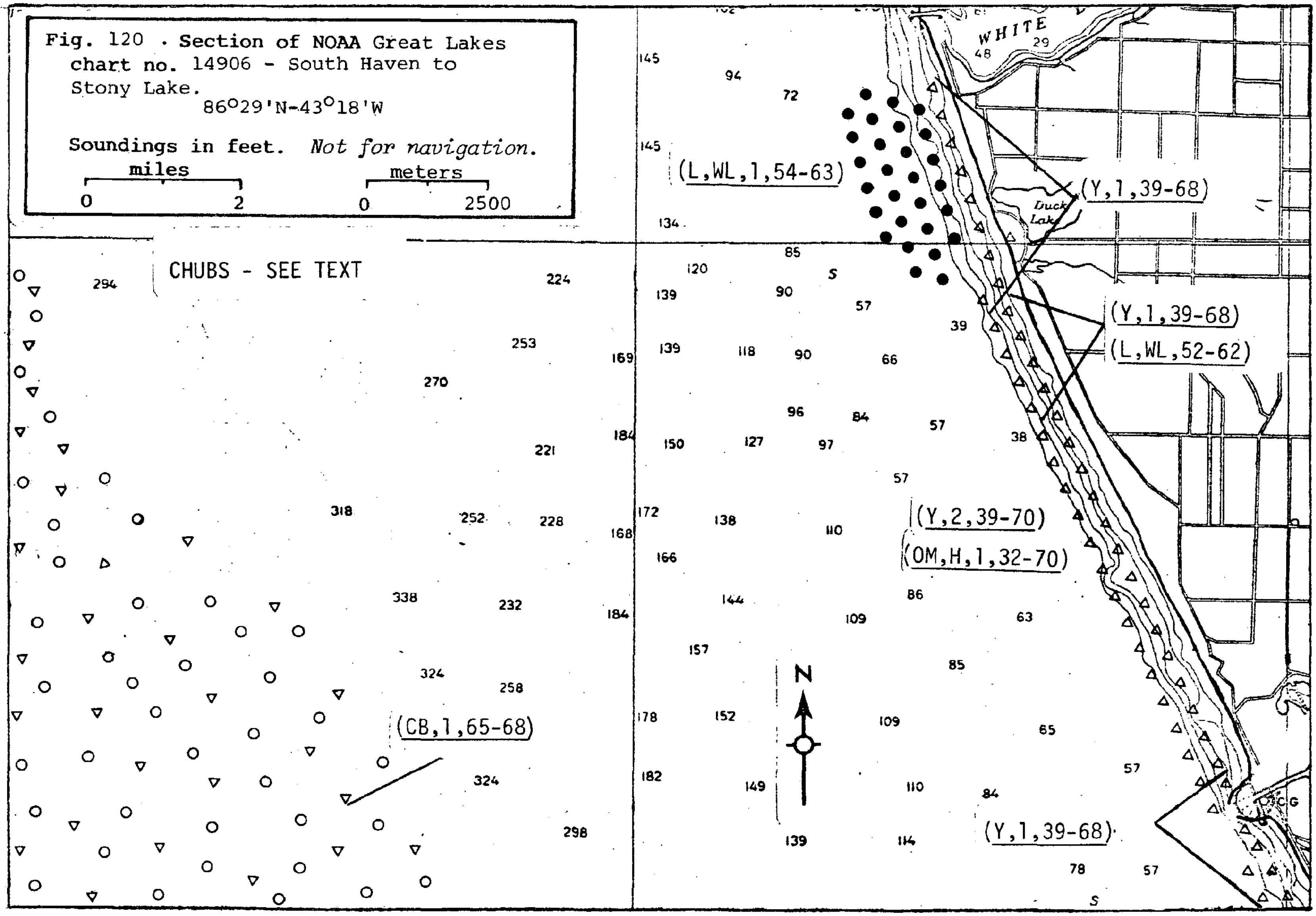



**Fig.** 120 . **Section of NOAA Great Lakes chart no.** 14906 - South Haven to Stony Lake.
86°29'N-43°18'W

**Soundings in feet.** *Not for navigation.*
miles 0 2 meters 0 2500

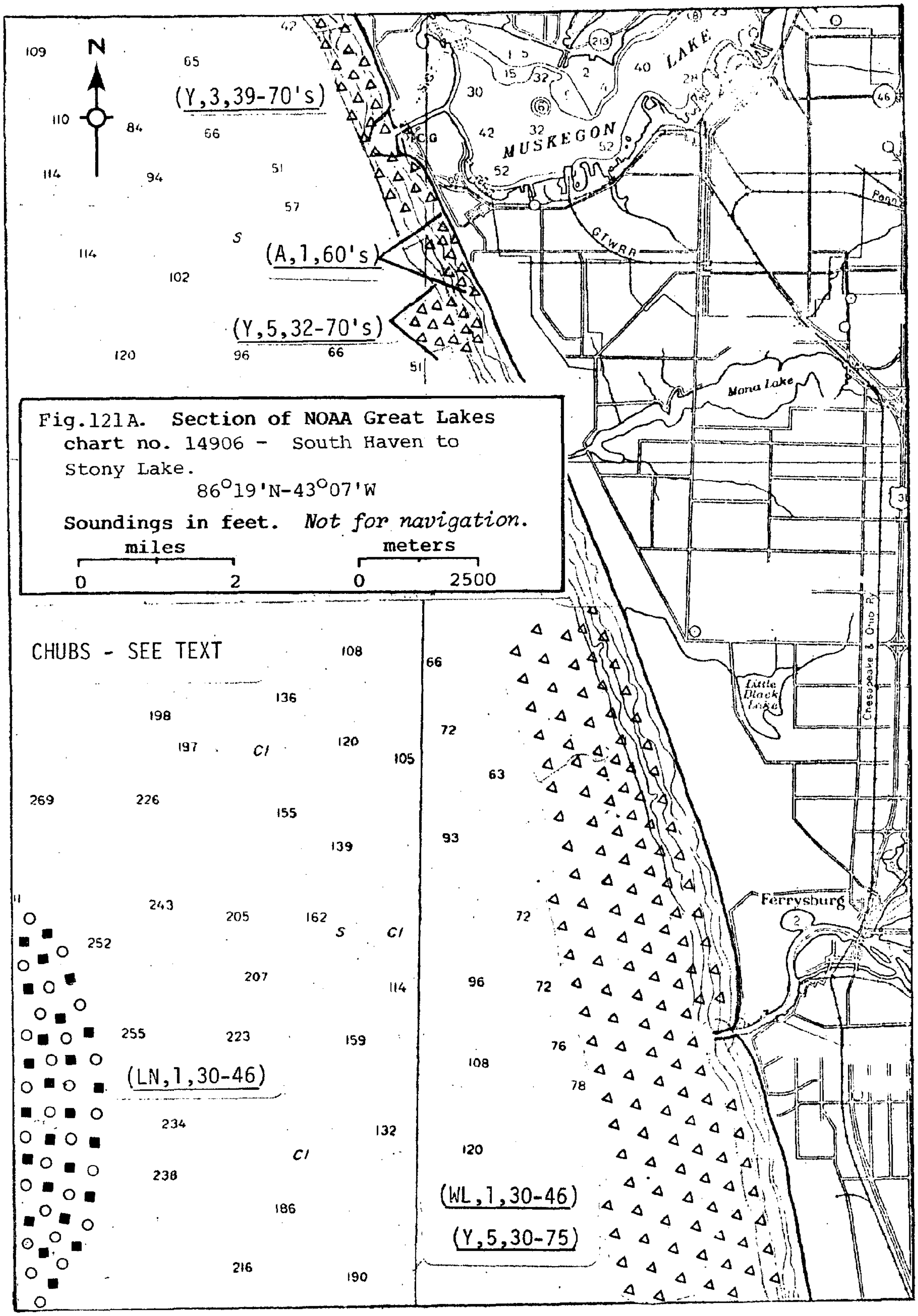



Fig.121A. **Section of NOAA Great Lakes chart no.** 14906 - South Haven to Stony Lake.
86°19'N-43°07'W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

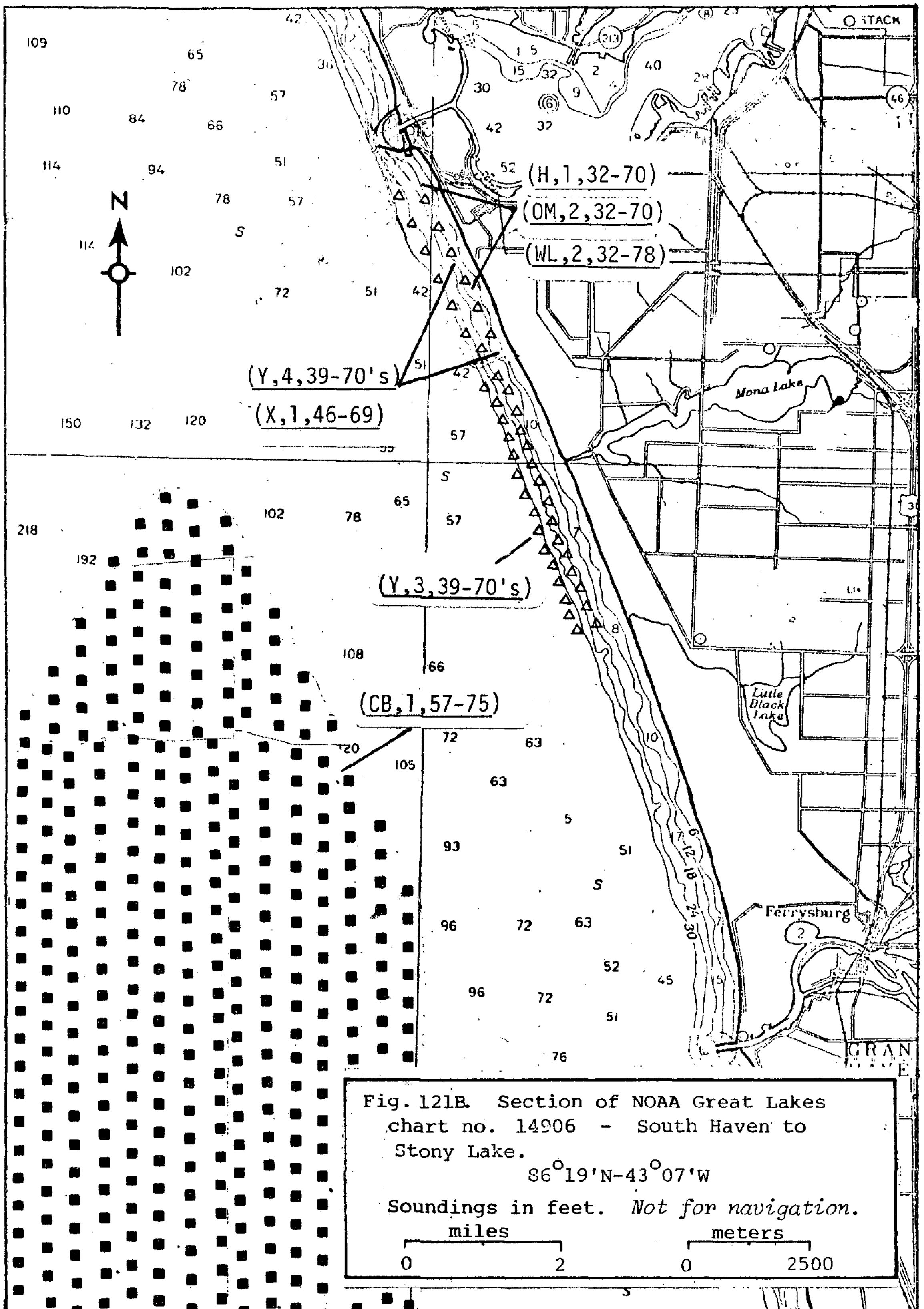



Fig. 121B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°19'N-43°07'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

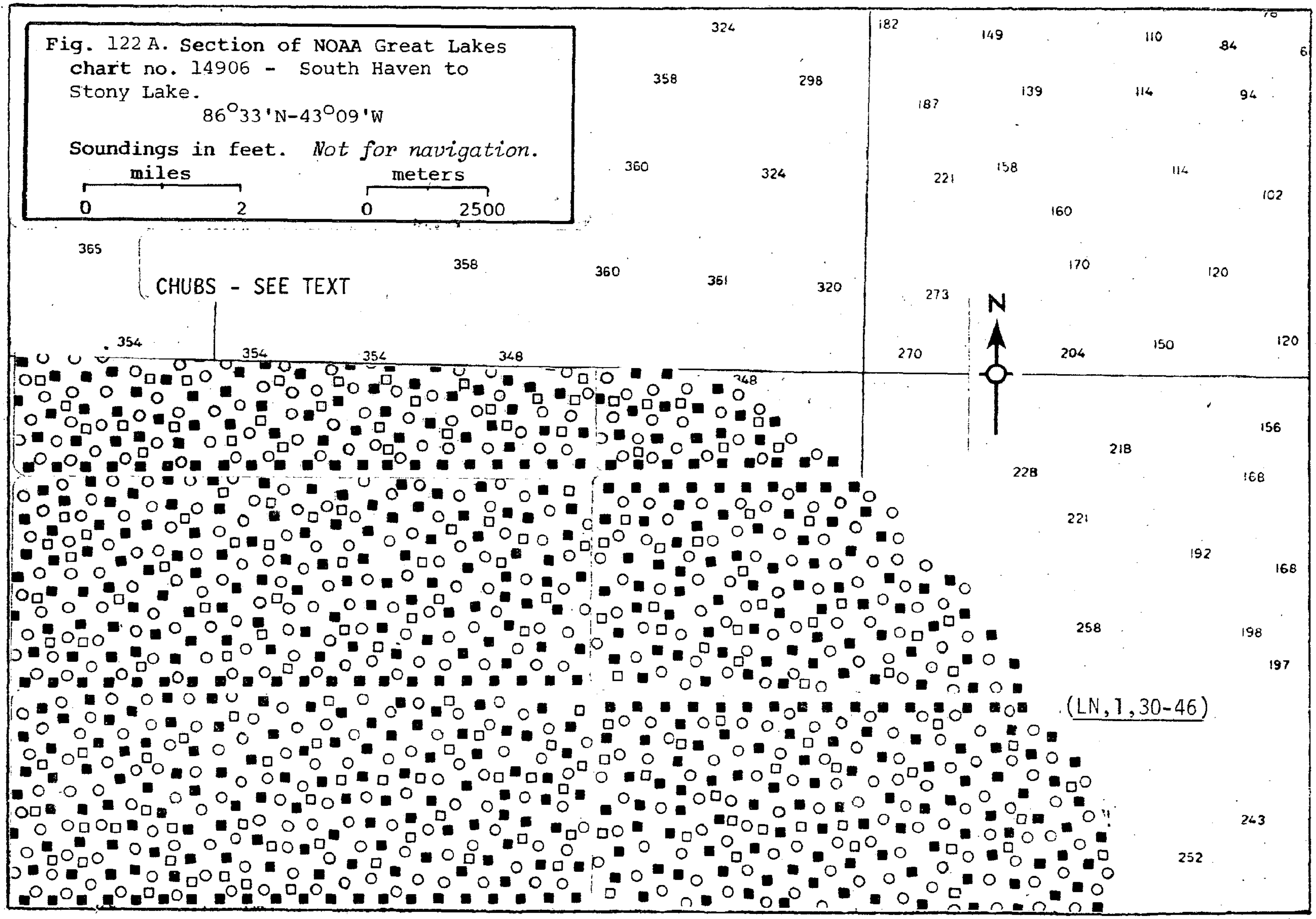



Fig. 122 A. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°33'N-43°09'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

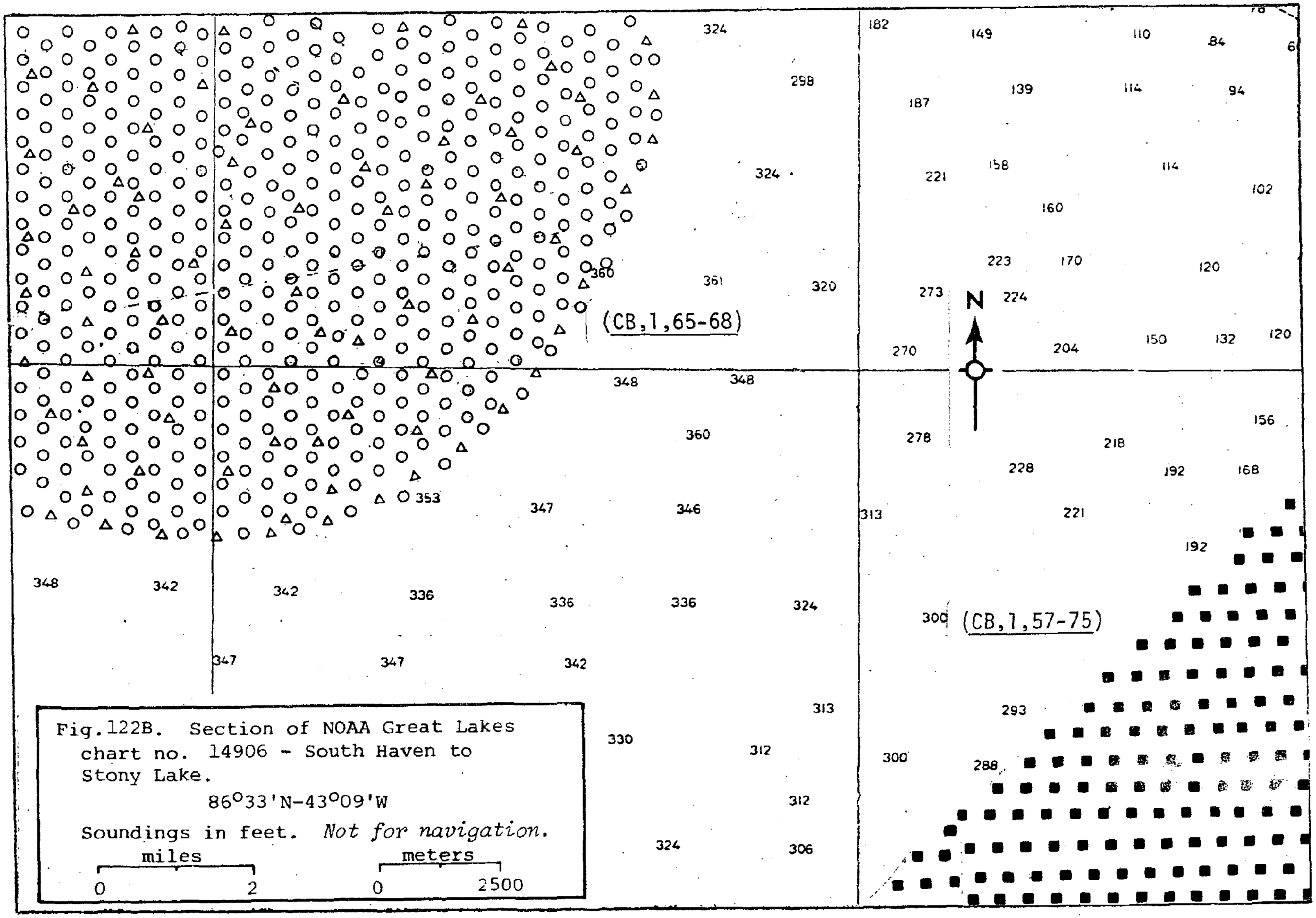



Fig.122B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.

86°33'N-43°09'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

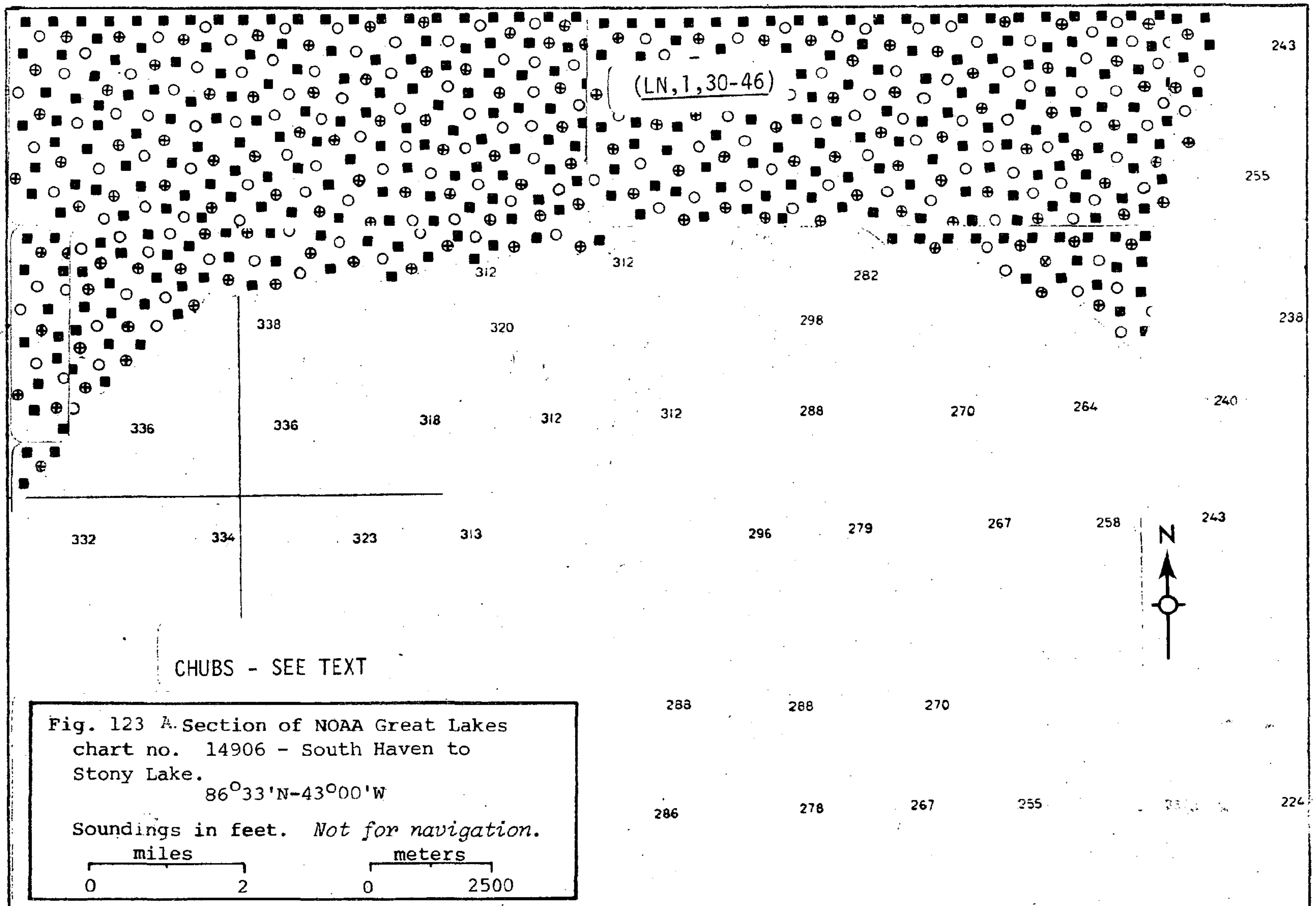



Fig. 123 A Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°33'N-43°00'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

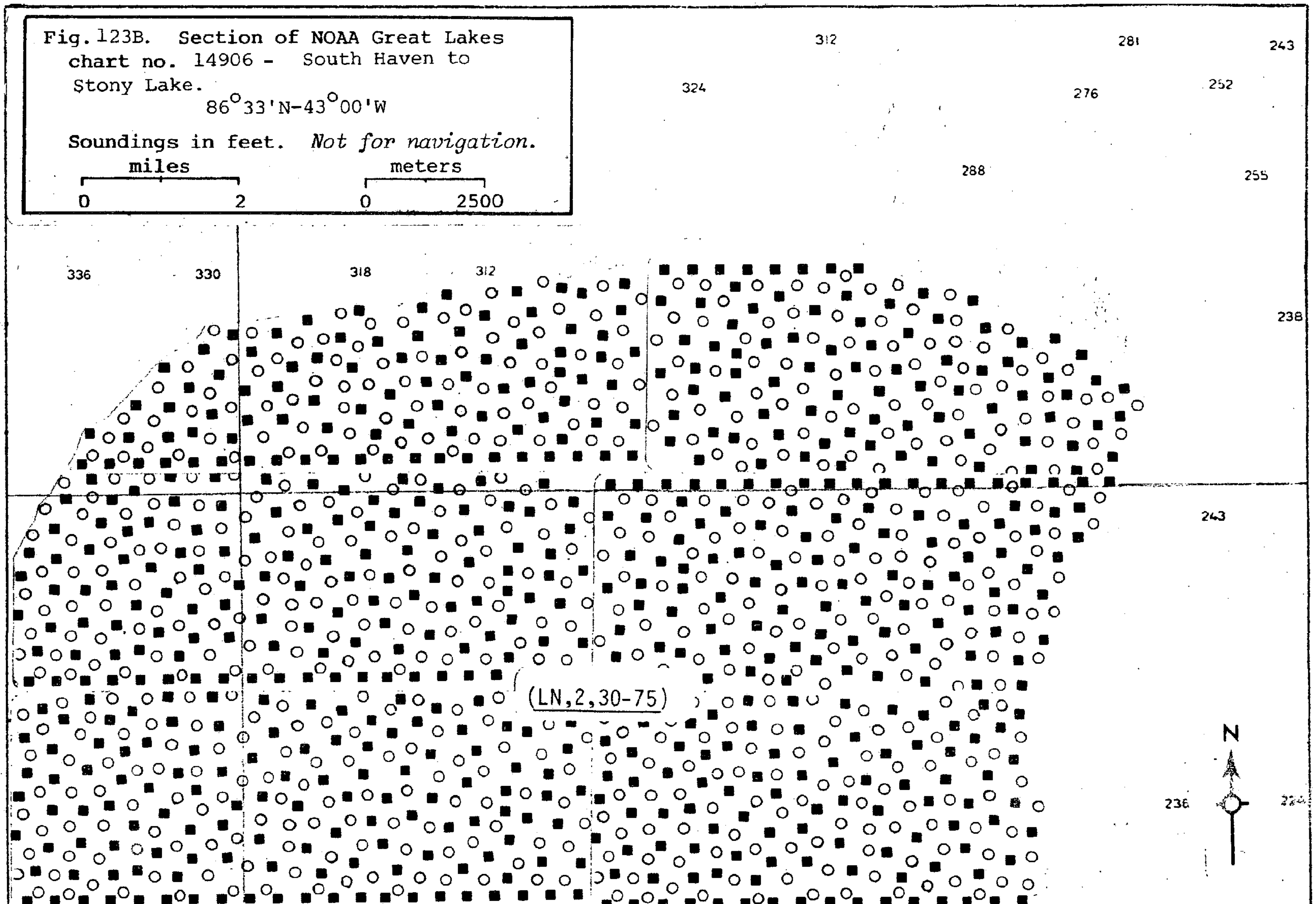



Fig. 123B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
$86^{\circ}33'$N-$43^{\circ}00'$W

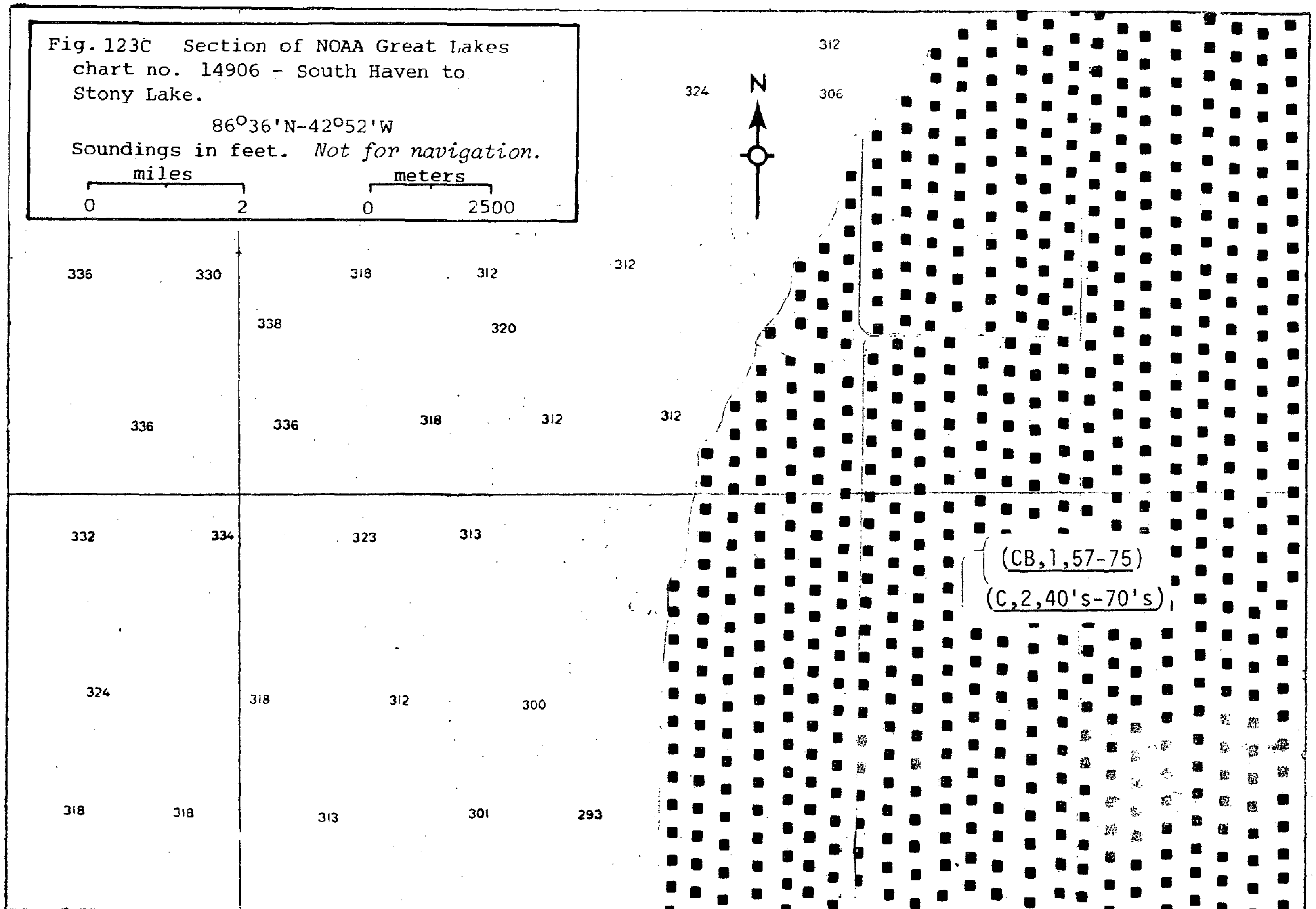
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

Fig. 123C Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.

86°36'N-42°52'W

Soundings in feet. *Not for navigation.*



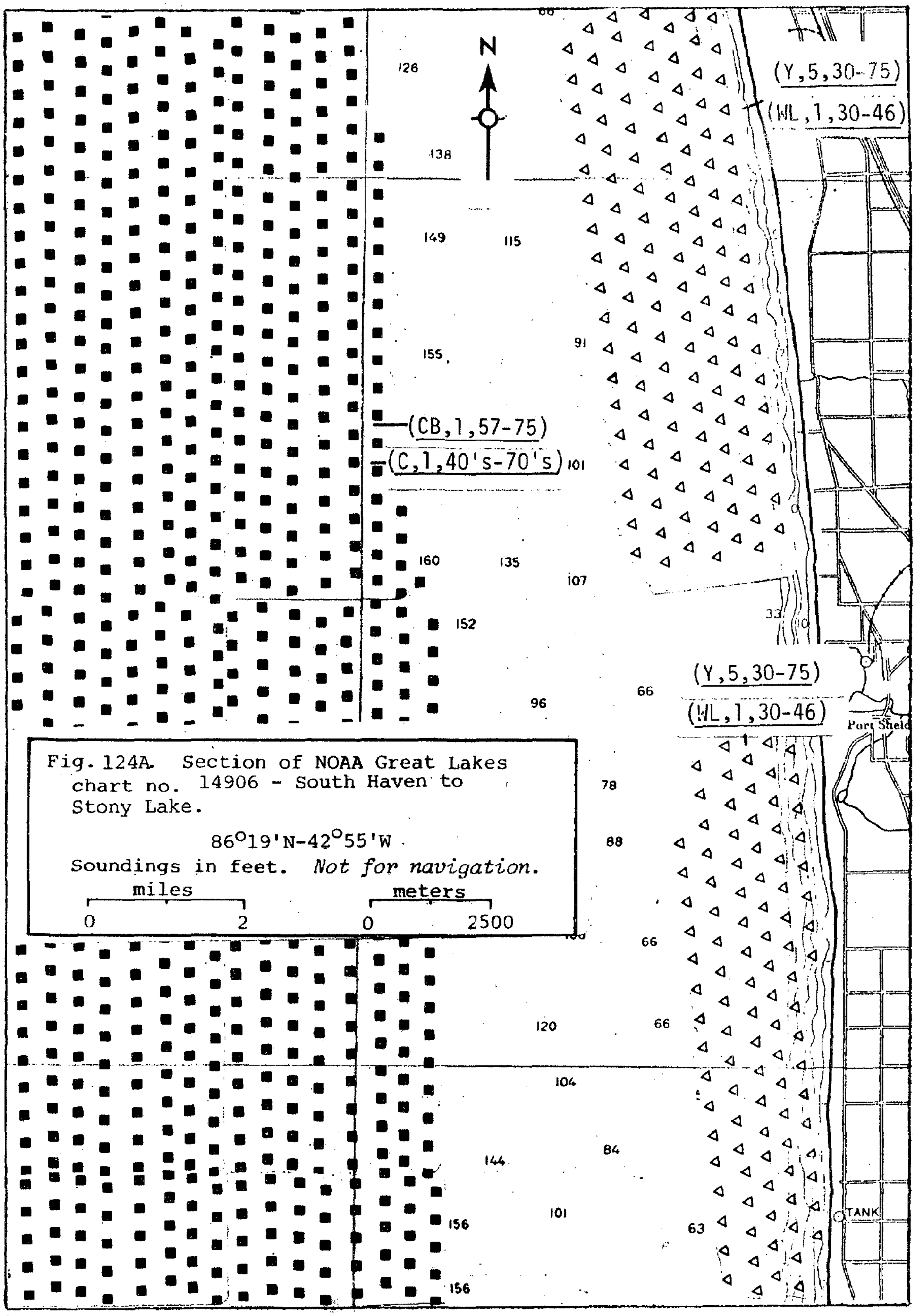



Fig. 124A. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.

86°19'N-42°55'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

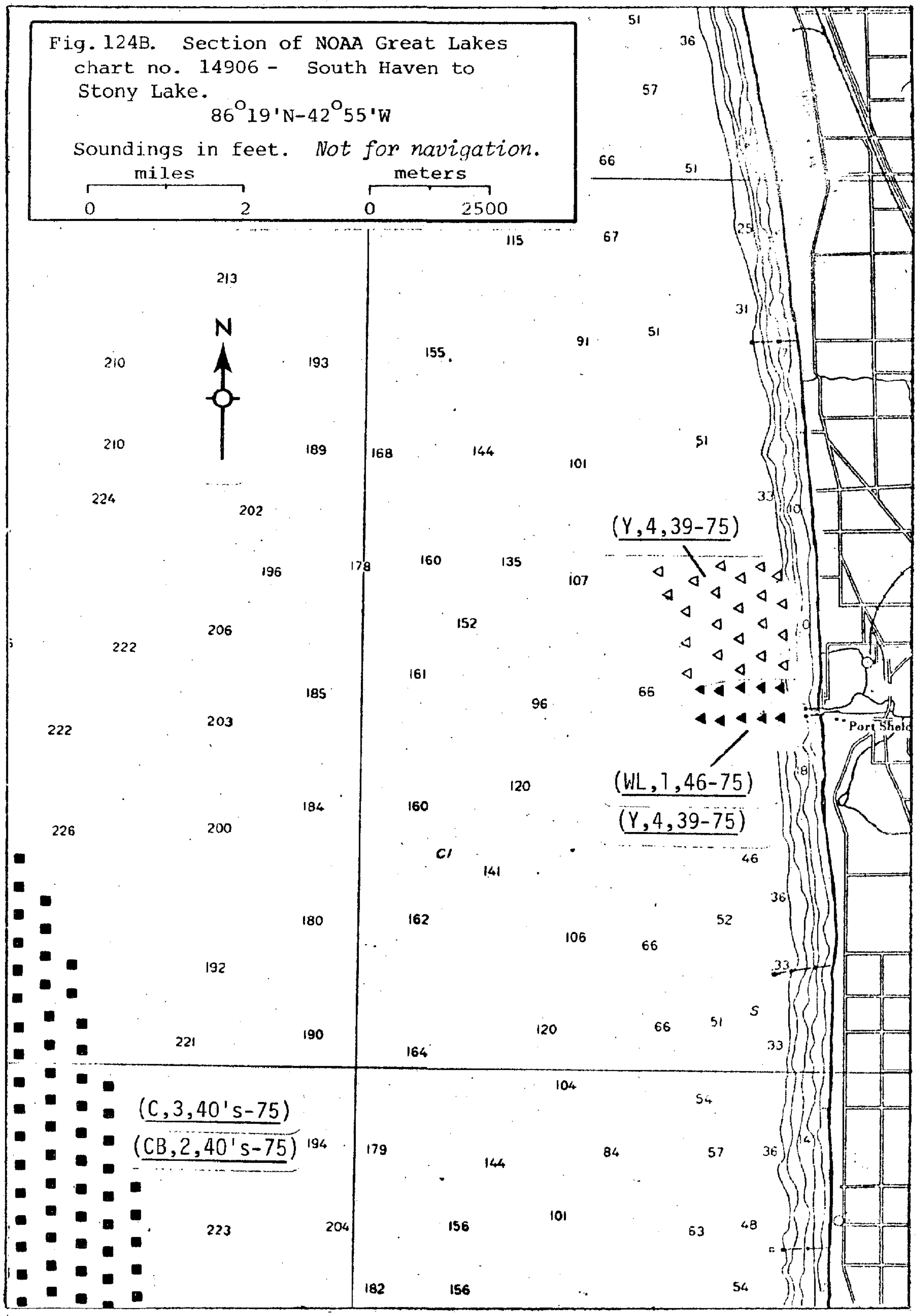



Fig. 124B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°19'N-42°55'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

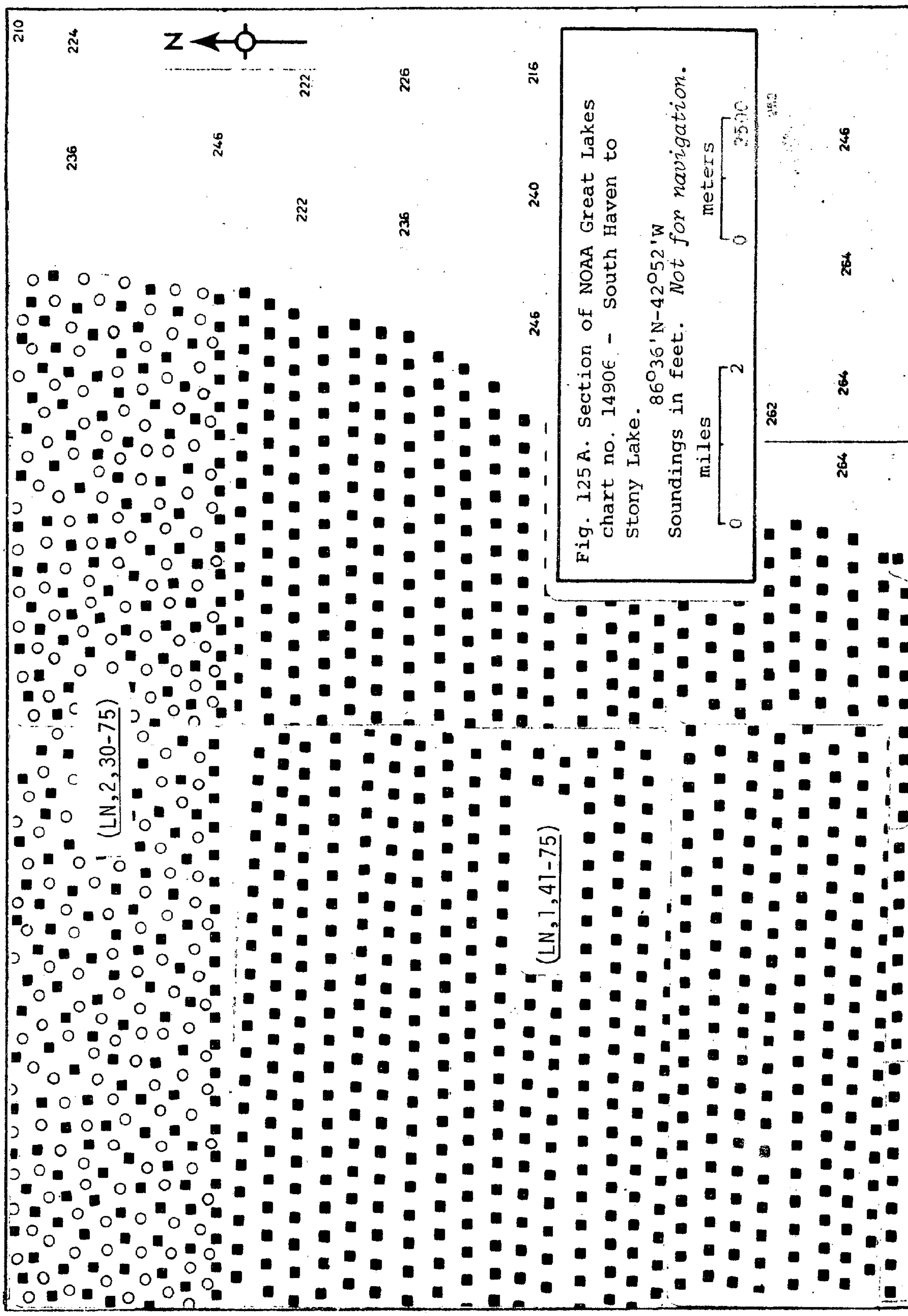



Fig. 125 A. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
$86^{\circ}36'$N-$42^{\circ}52'$W
Soundings in feet. *Not for navigation.*

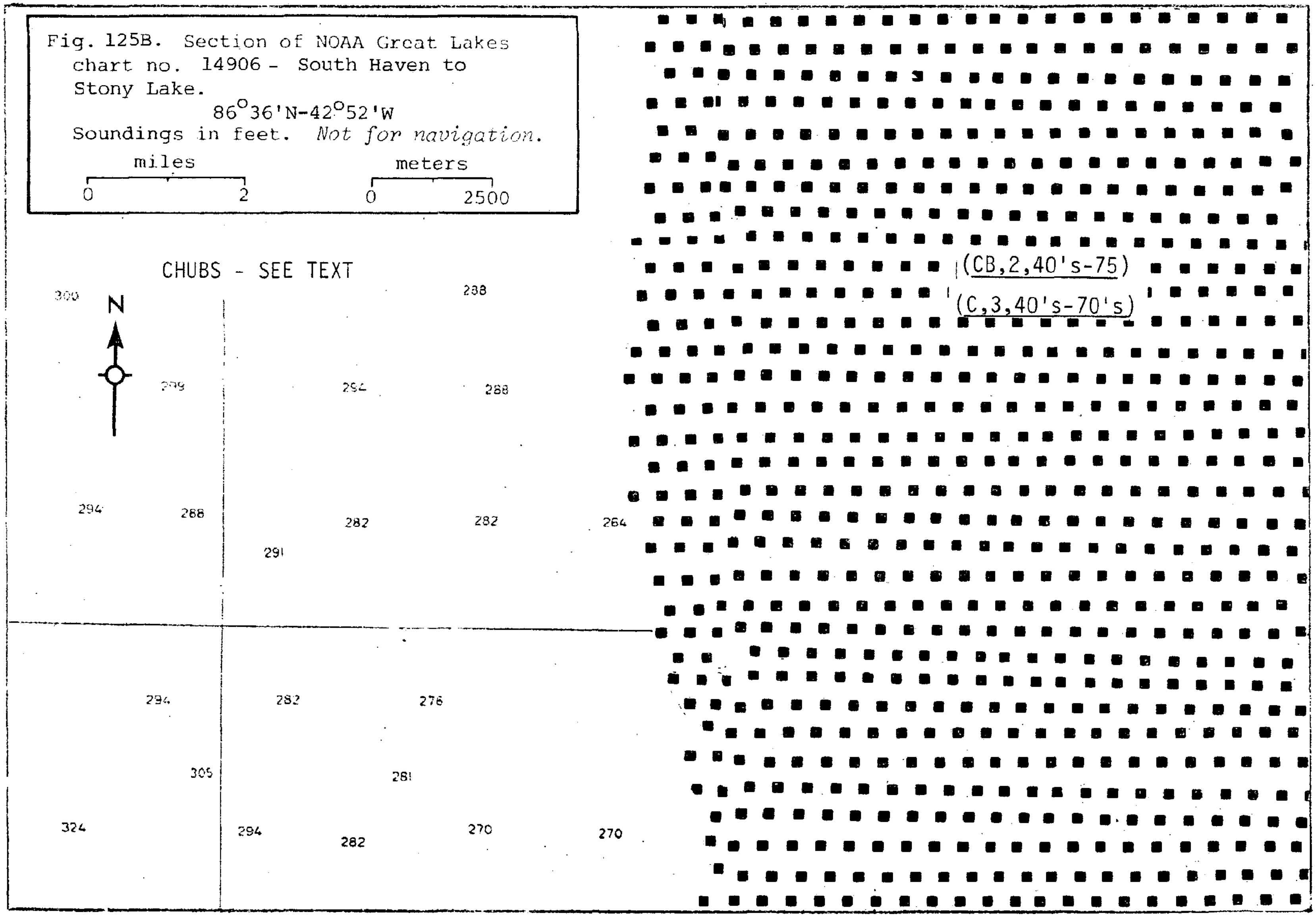



Fig. 125B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°36'N-42°52'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

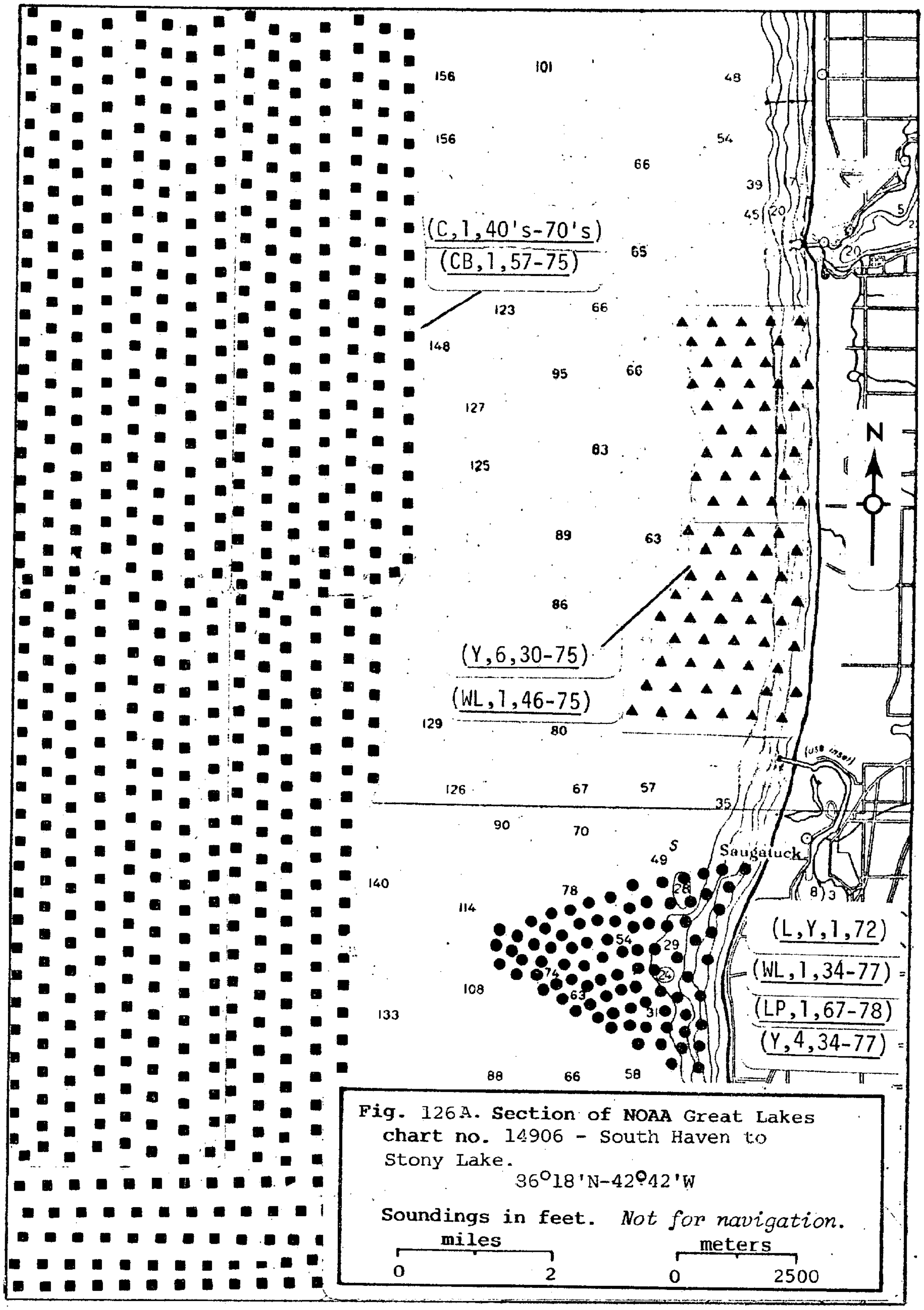



**Fig.** 126A. **Section of NOAA** Great Lakes **chart no.** 14906 - South Haven to Stony Lake.
36°18'N-42°42'W

**Soundings in feet.** *Not for navigation.*

**miles** 0 2 **meters** 0 2500

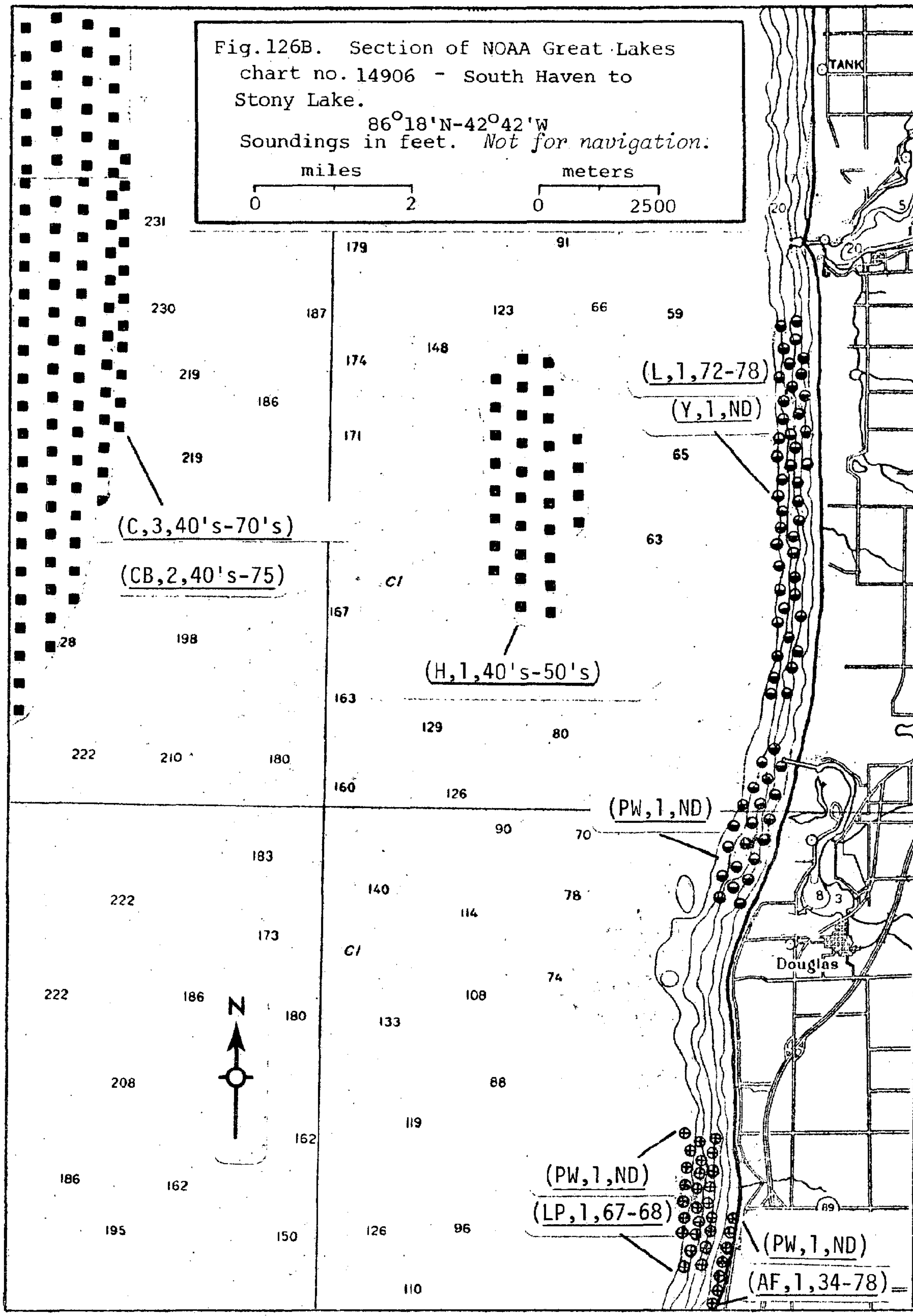



Fig. 126B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°18'N-42°42'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

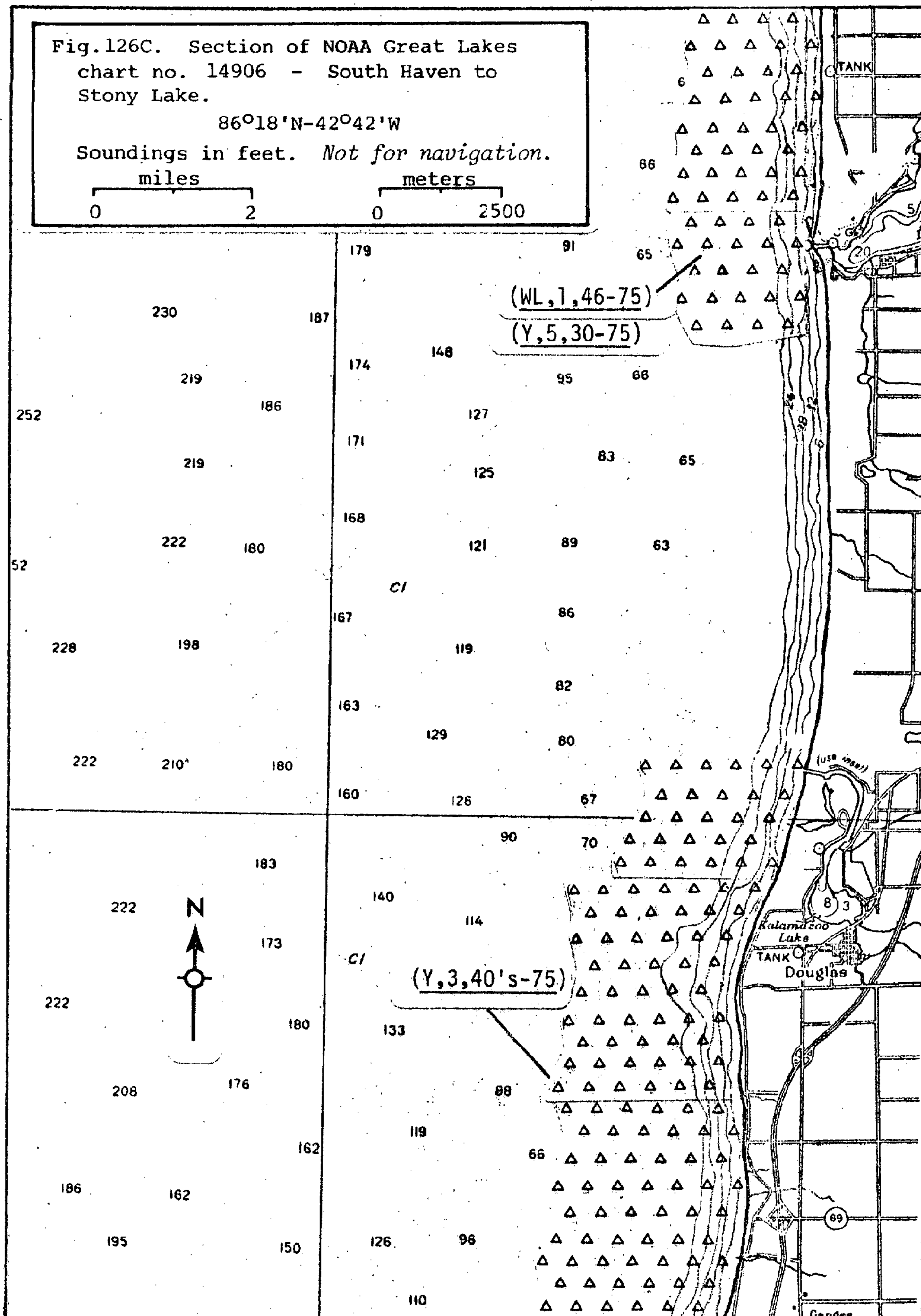



Fig.126C. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.

86°18'N-42°42'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

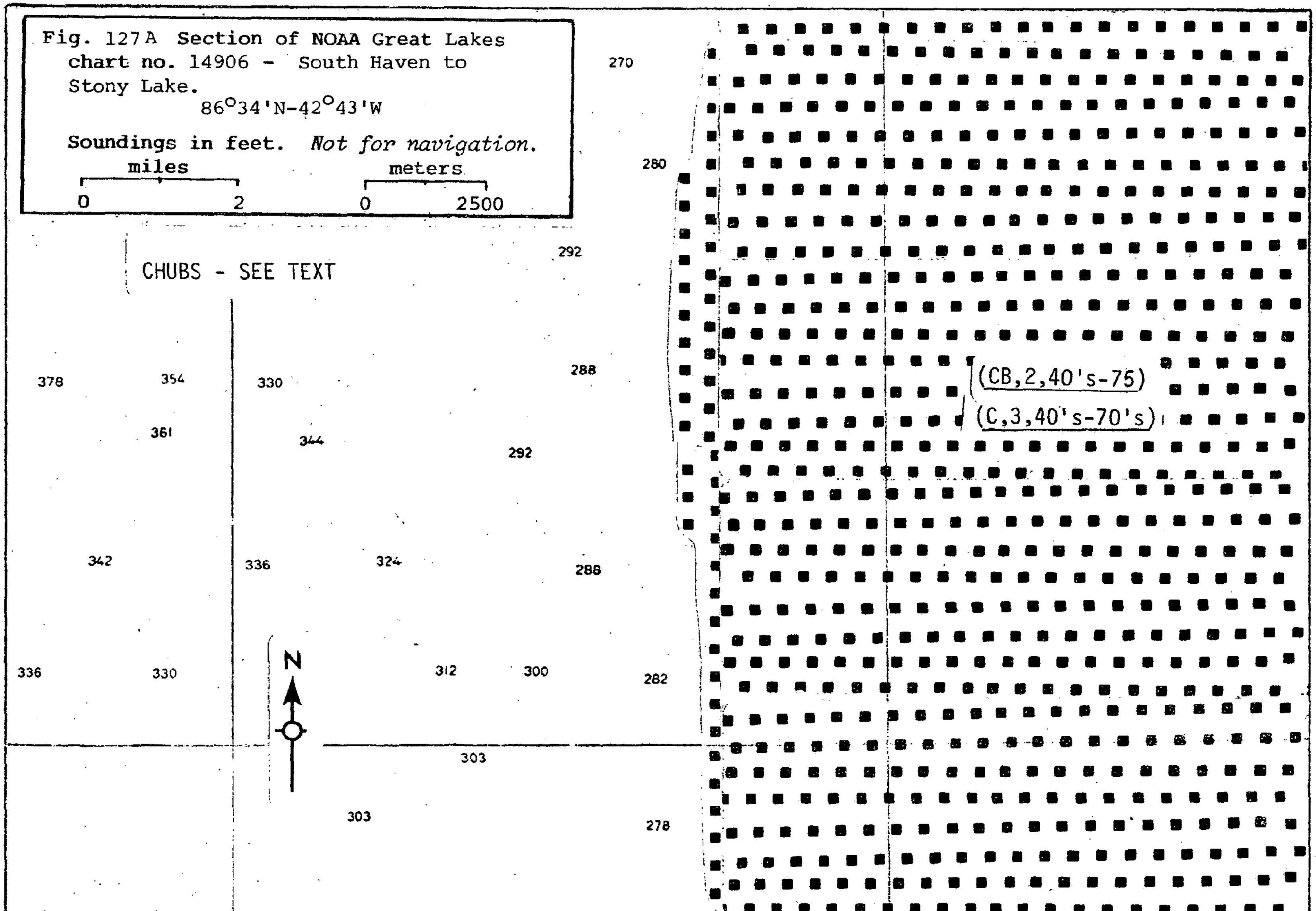



Fig. 127A Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake. $86^{\circ}34'$N-$42^{\circ}43'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

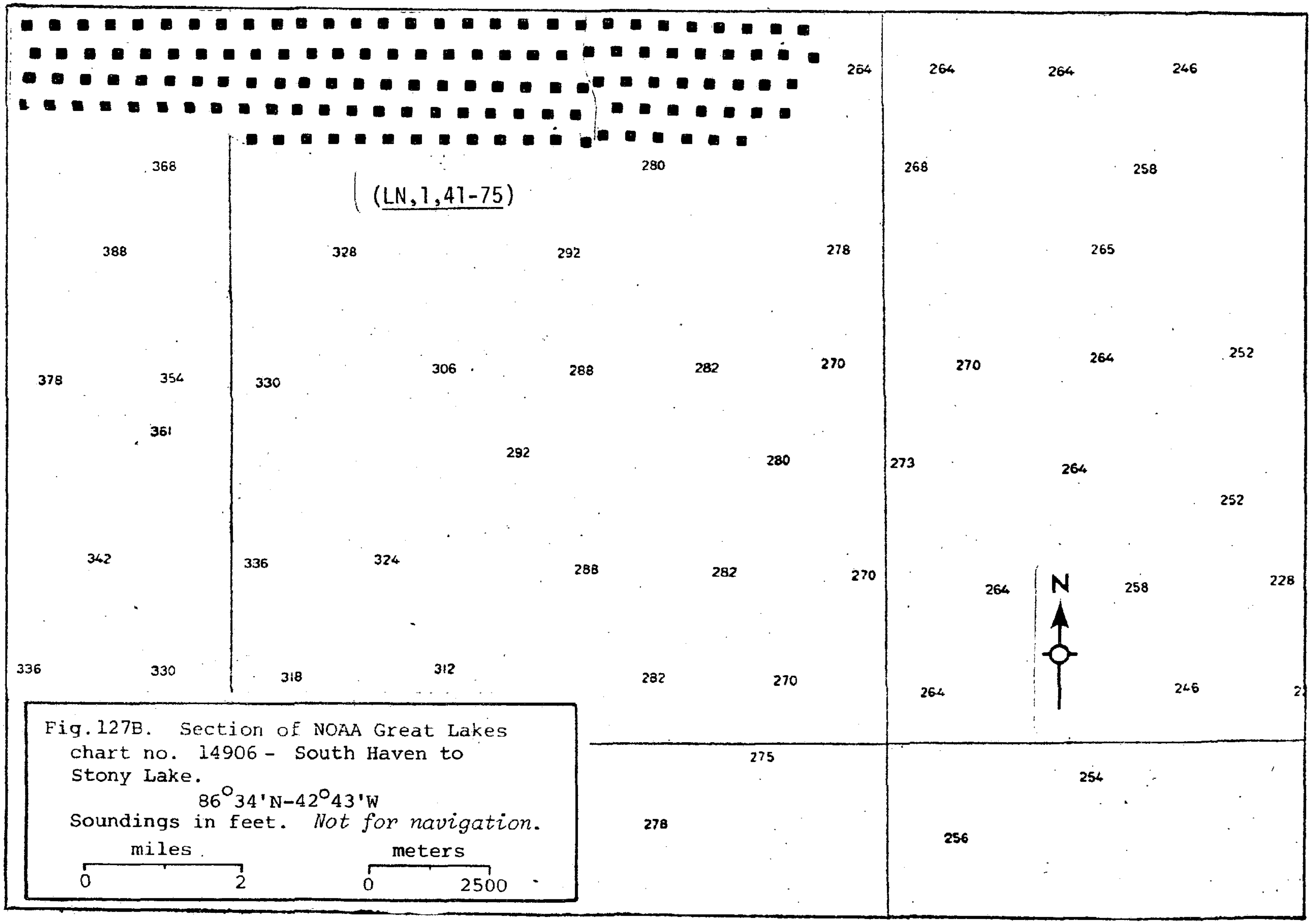



Fig.127B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
$86^{\circ}34'$N-$42^{\circ}43'$W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

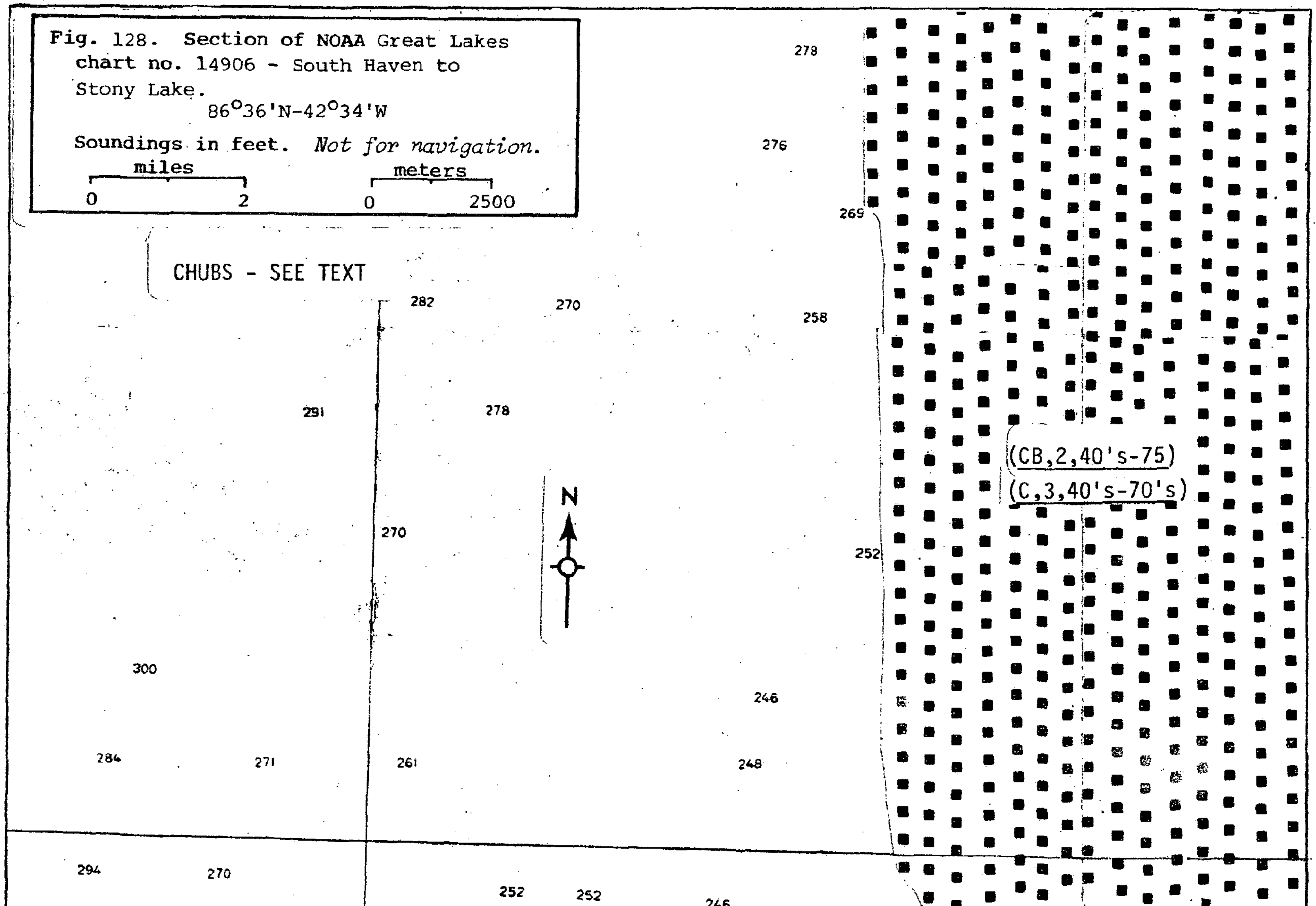



Fig. 128. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°36'N-42°34'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

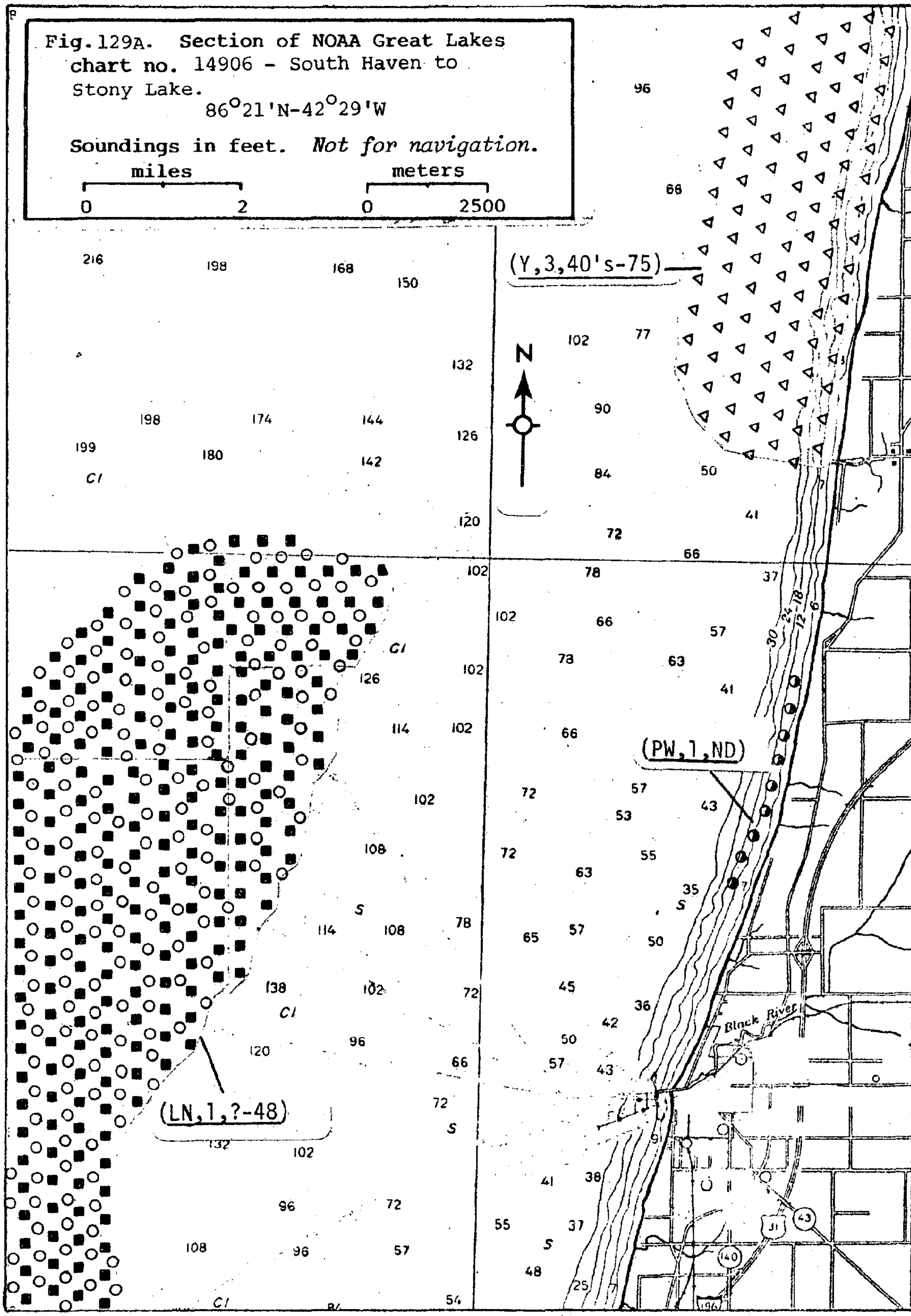



Fig. 129A. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°21'N-42°29'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

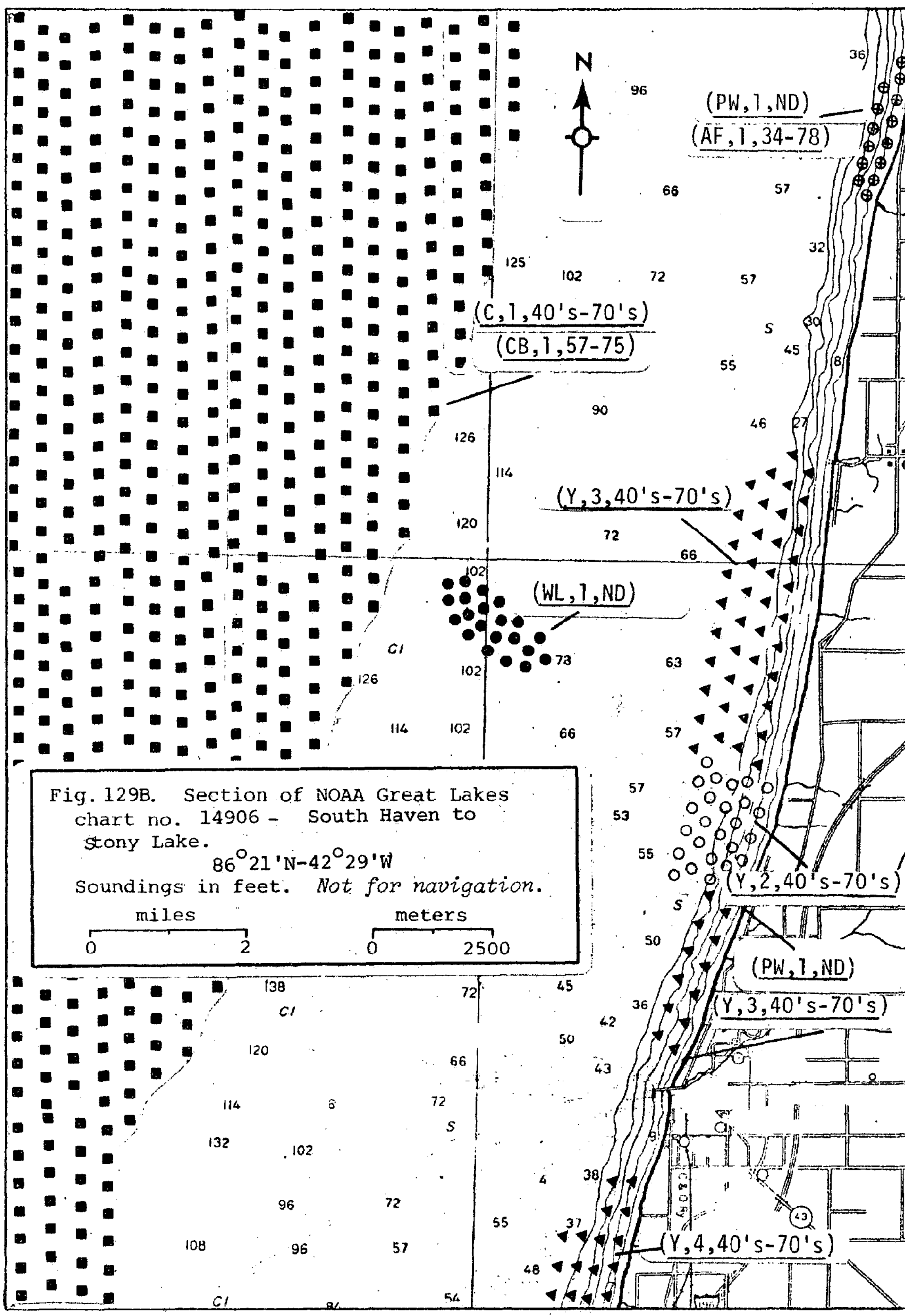



Fig. 129B. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake.
86°21'N-42°29'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

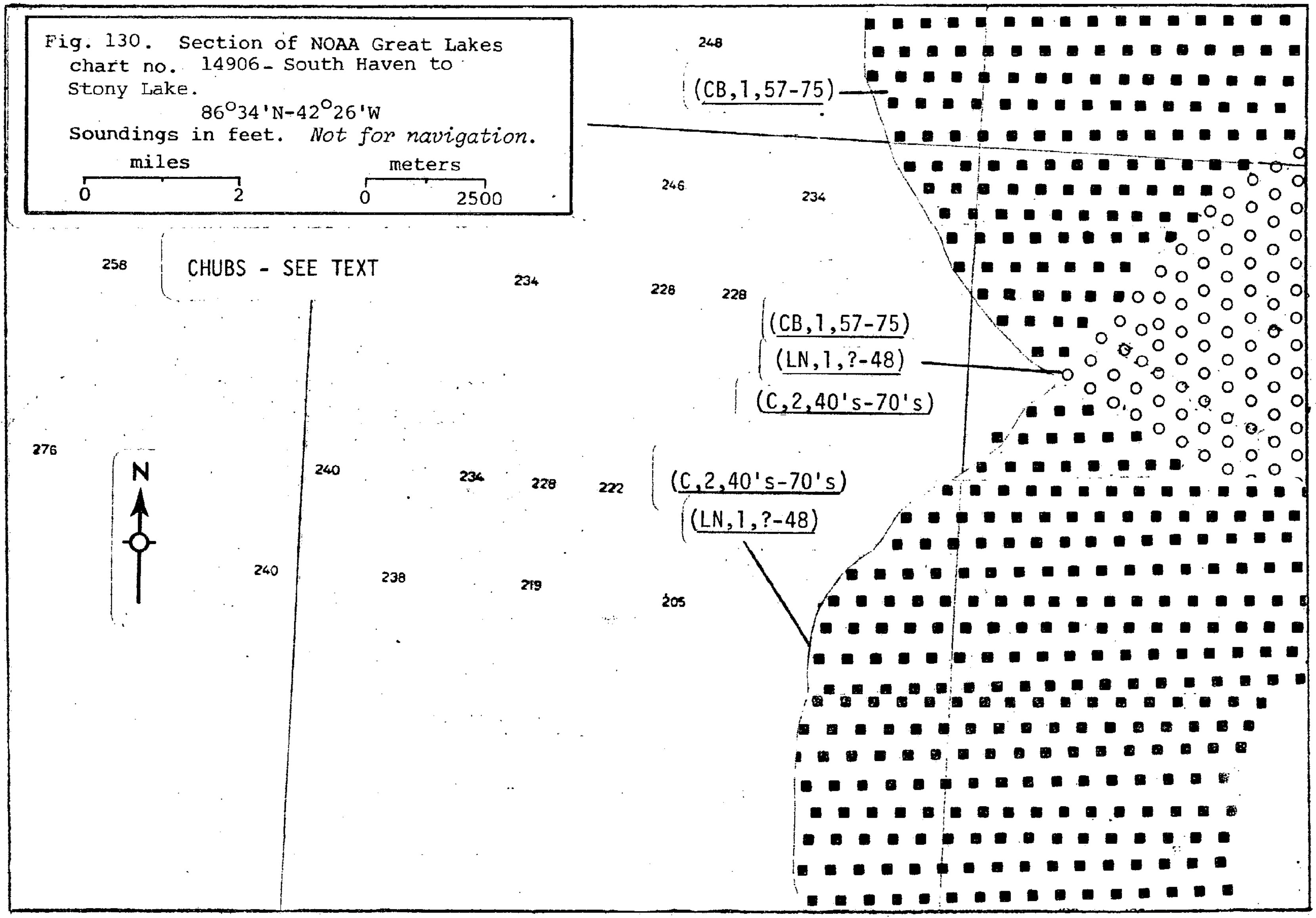



Fig. 130. Section of NOAA Great Lakes chart no. 14906 - South Haven to Stony Lake. 86°34'N-42°26'W Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

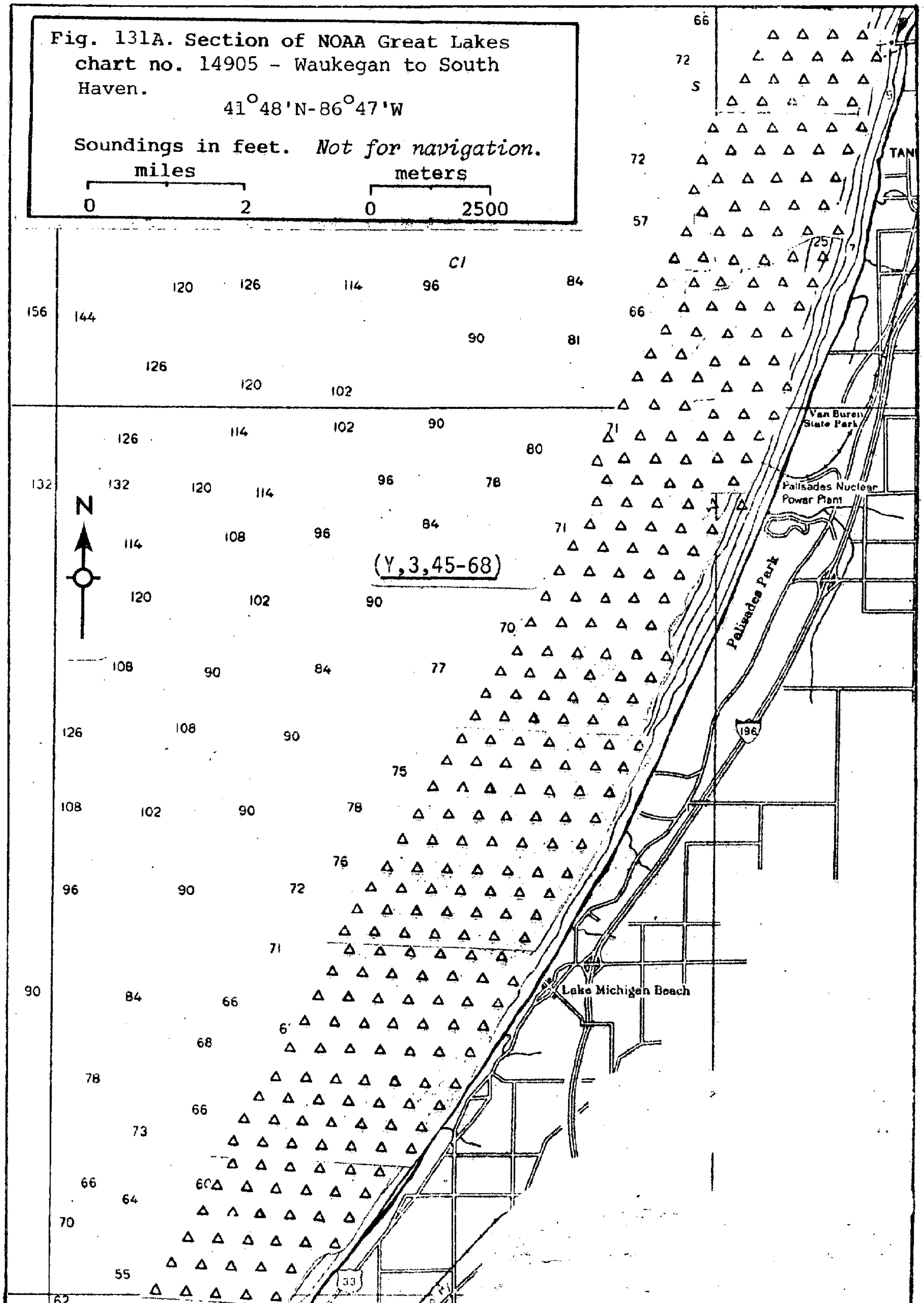



Fig. 131A. Section of NOAA Great Lakes chart no. 14905 - Waukegan to South Haven.
41°48'N-86°47'W

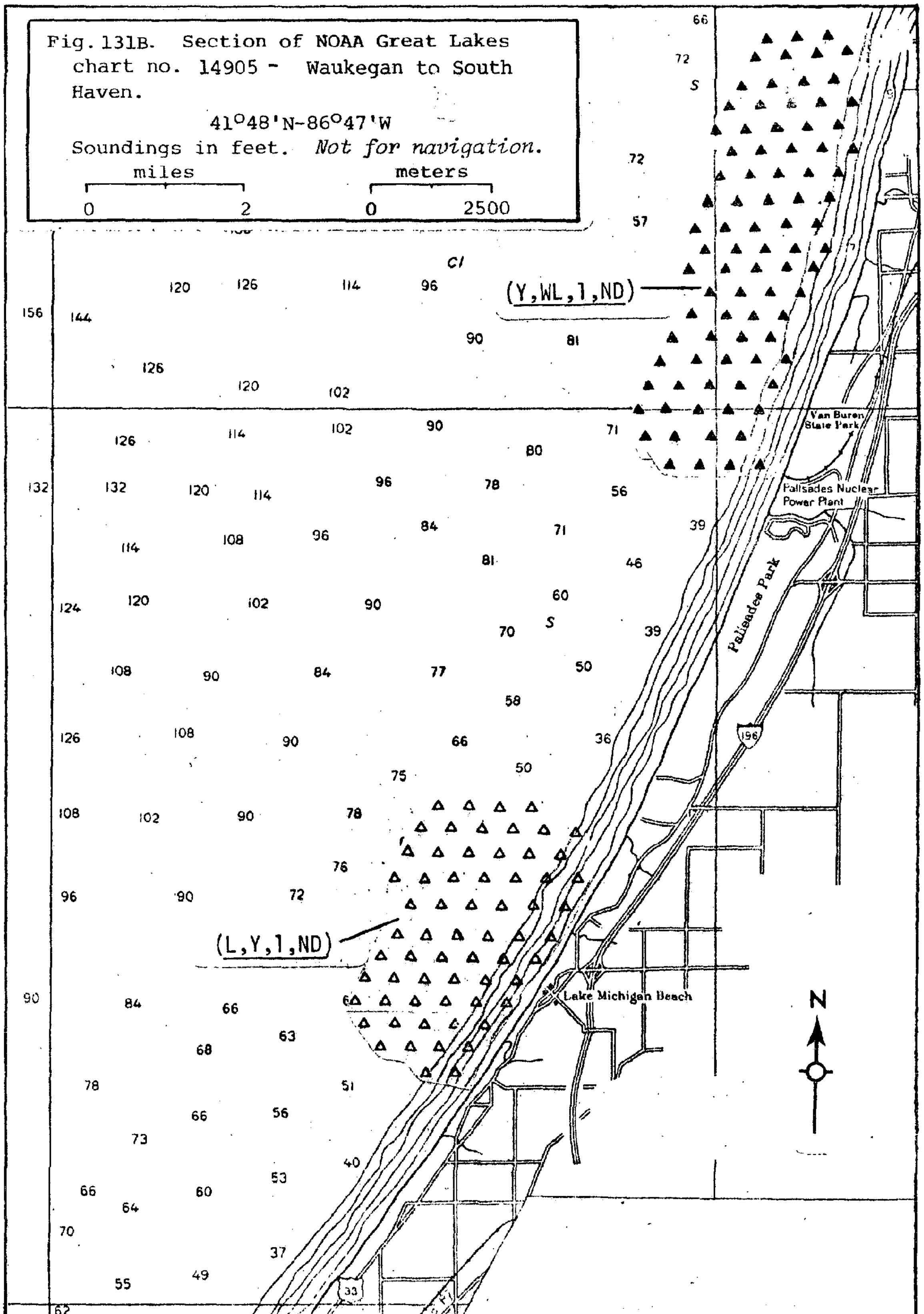
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

Fig. 131B. Section of NOAA Great Lakes chart no. 14905 - Waukegan to South Haven.

41°48'N-86°47'W

Soundings in feet. *Not for navigation.*



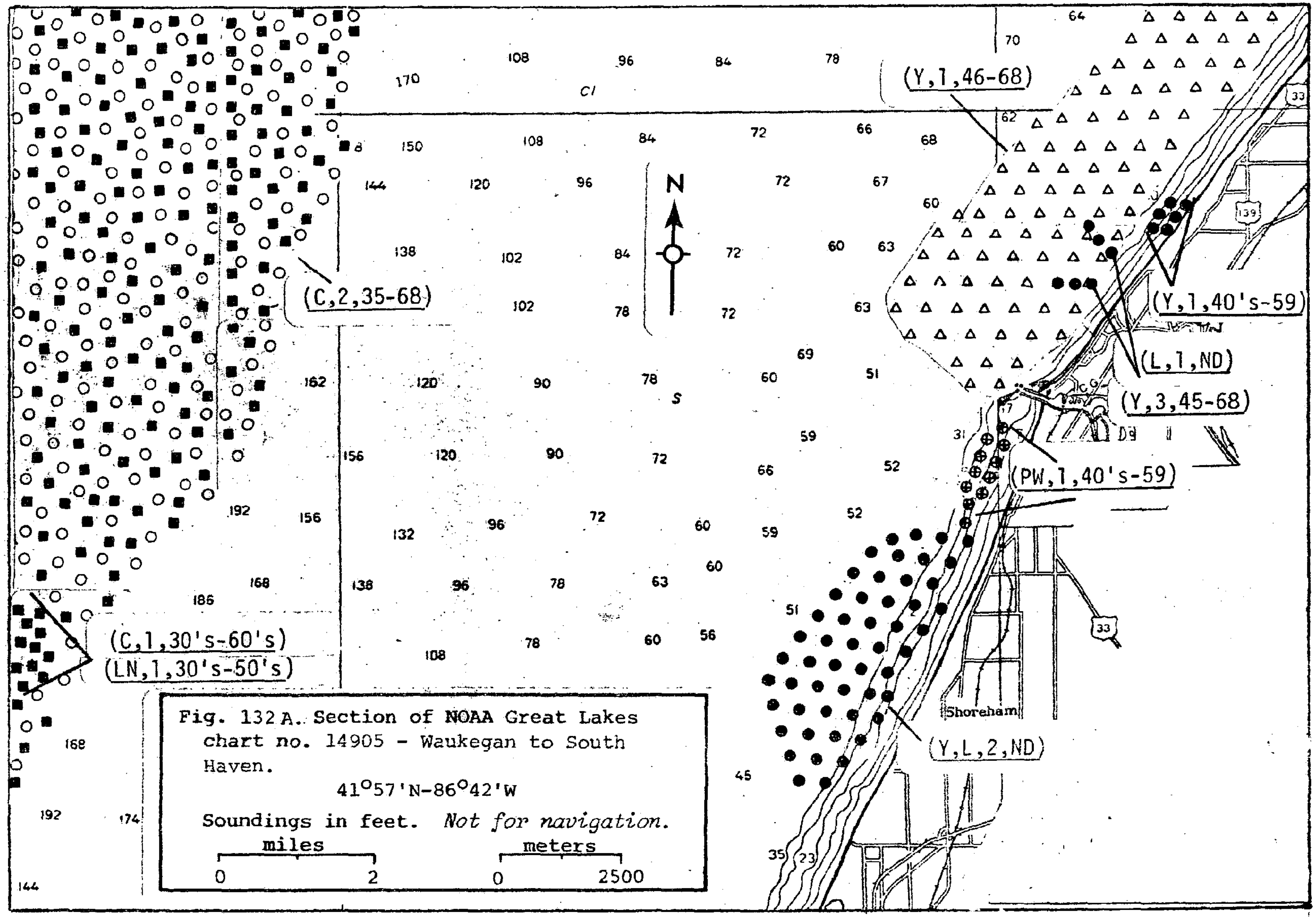



Fig. 132 A. Section of NOAA Great Lakes chart no. 14905 - Waukegan to South Haven.

41°57'N-86°42'W

Soundings in feet. *Not for navigation.*

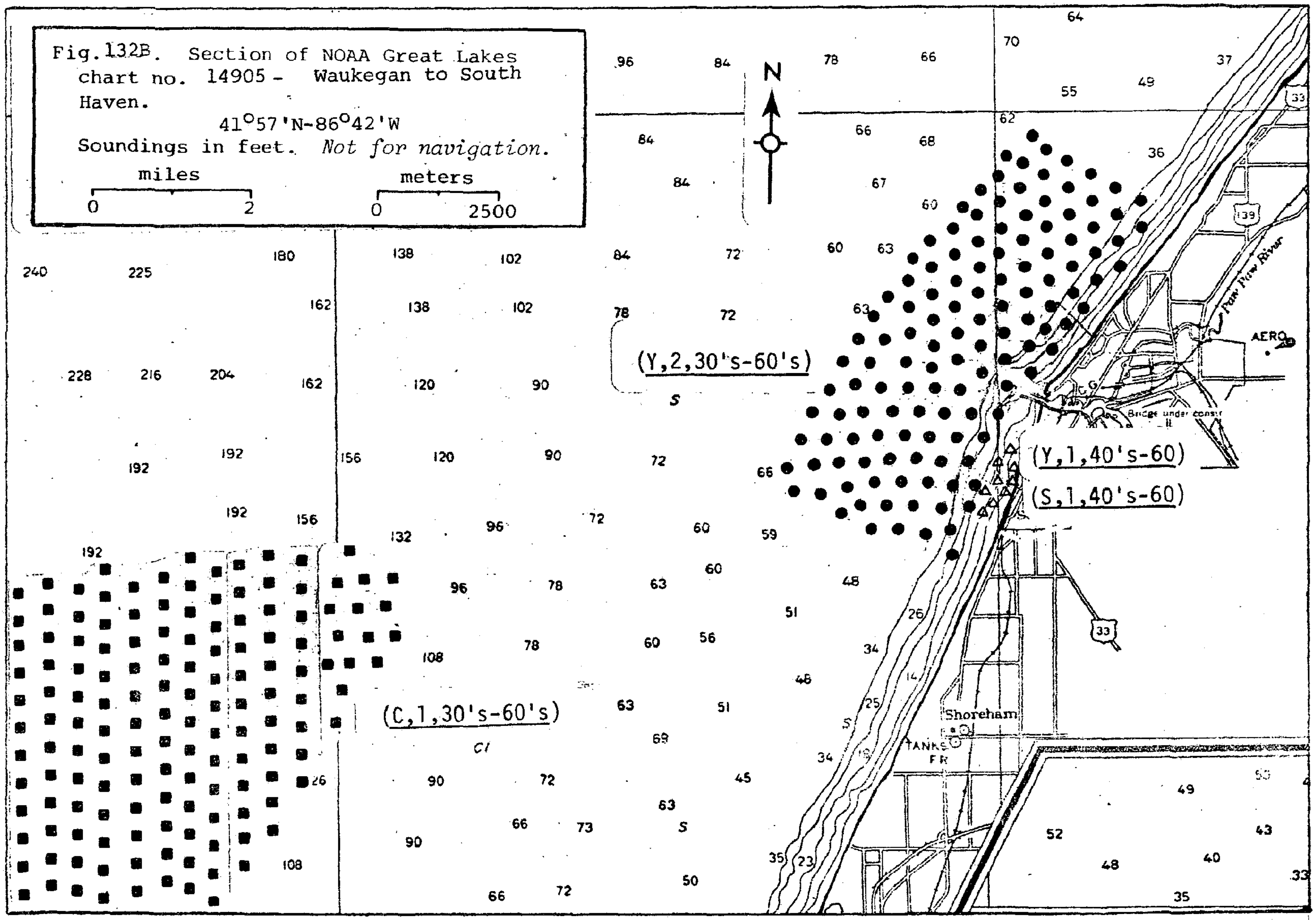



Fig. 132B. Section of NOAA Great Lakes chart no. 14905 - Waukegan to South Haven.
41°57'N-86°42'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

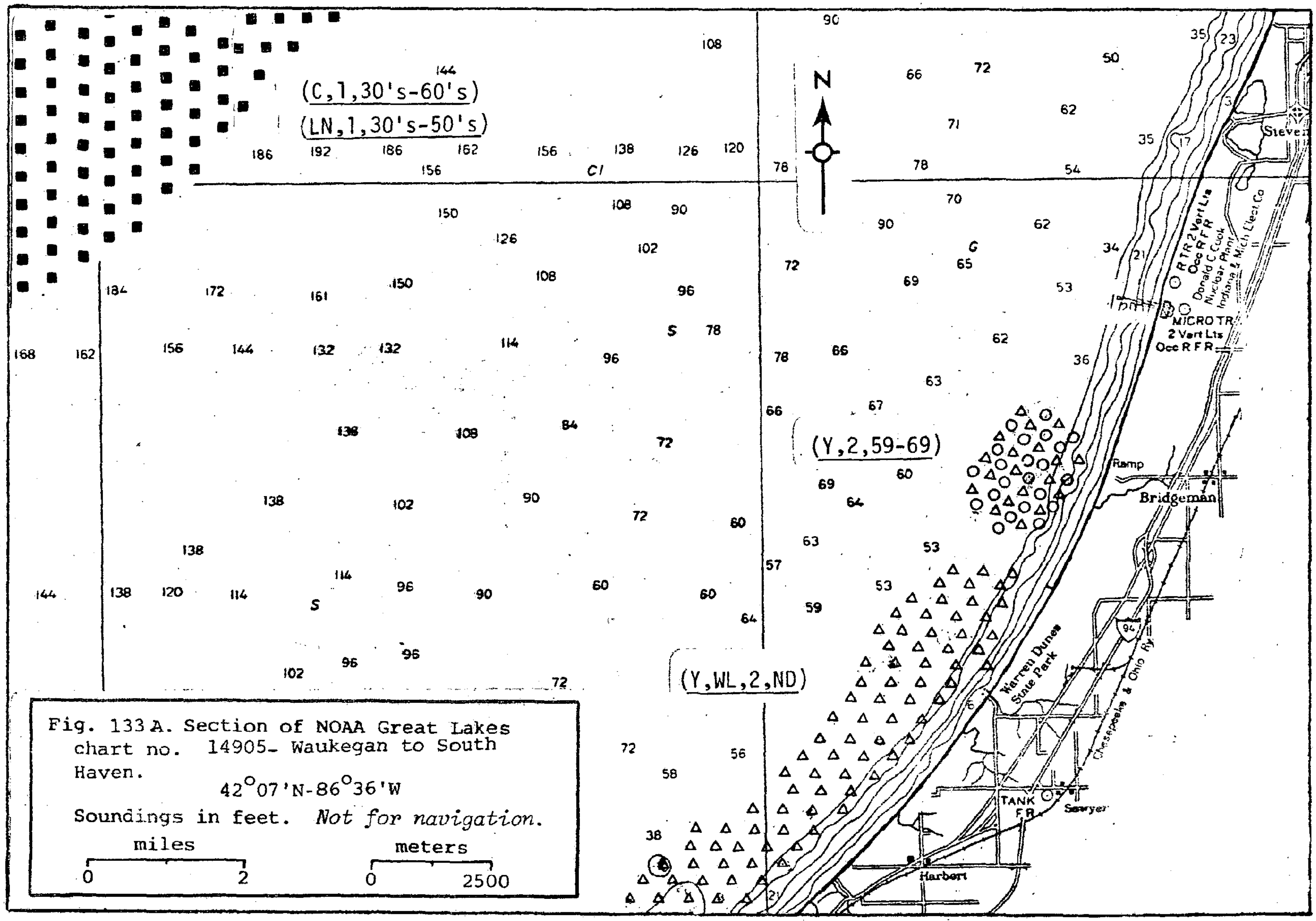



Fig. 133 A. Section of NOAA Great Lakes chart no. 14905- Waukegan to South Haven.
42°07'N-86°36'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

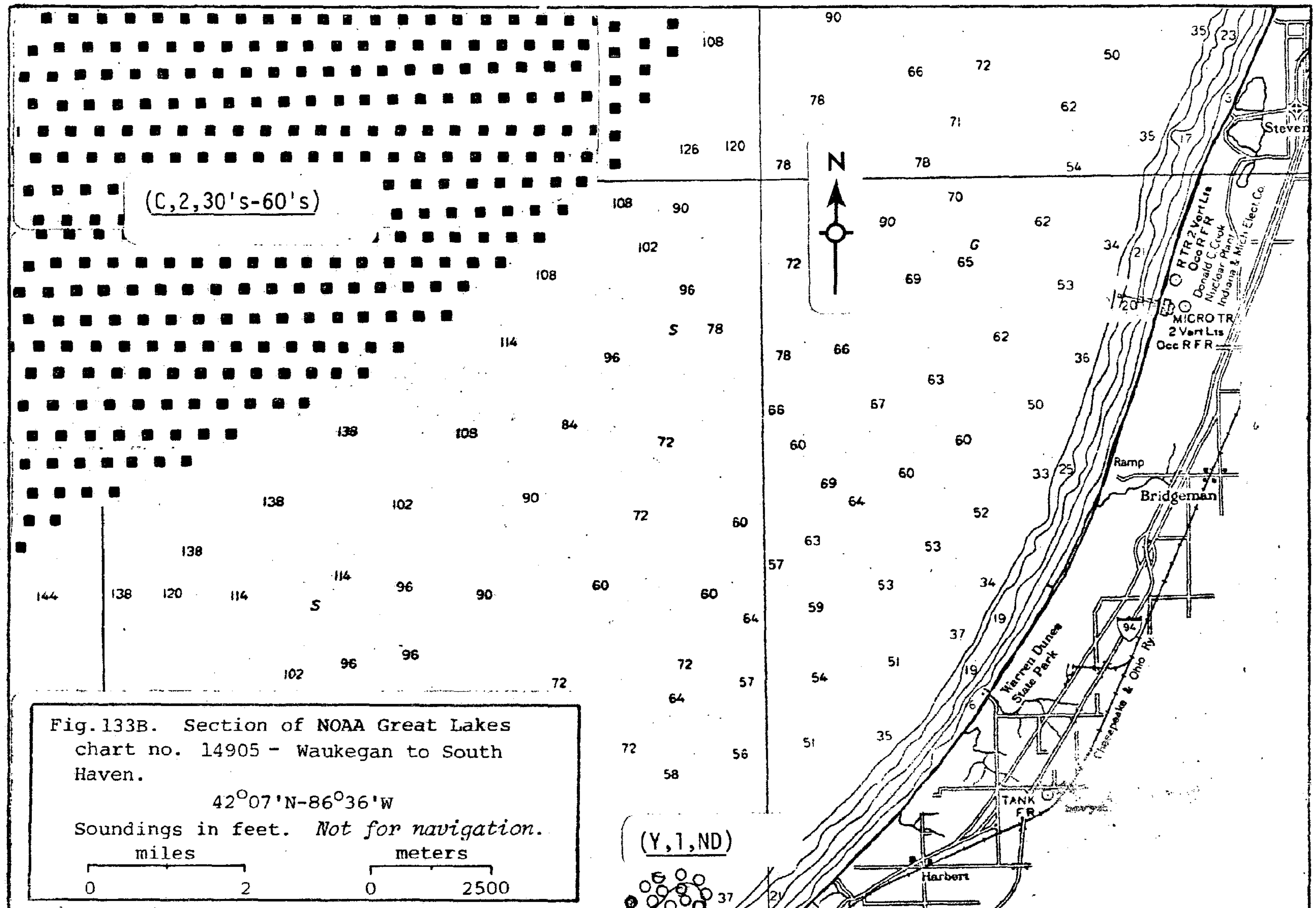



Fig. 133B. Section of NOAA Great Lakes chart no. 14905 - Waukegan to South Haven.

42°07'N-86°36'W

Soundings in feet. *Not for navigation.*

miles 0 2 — meters 0 2500

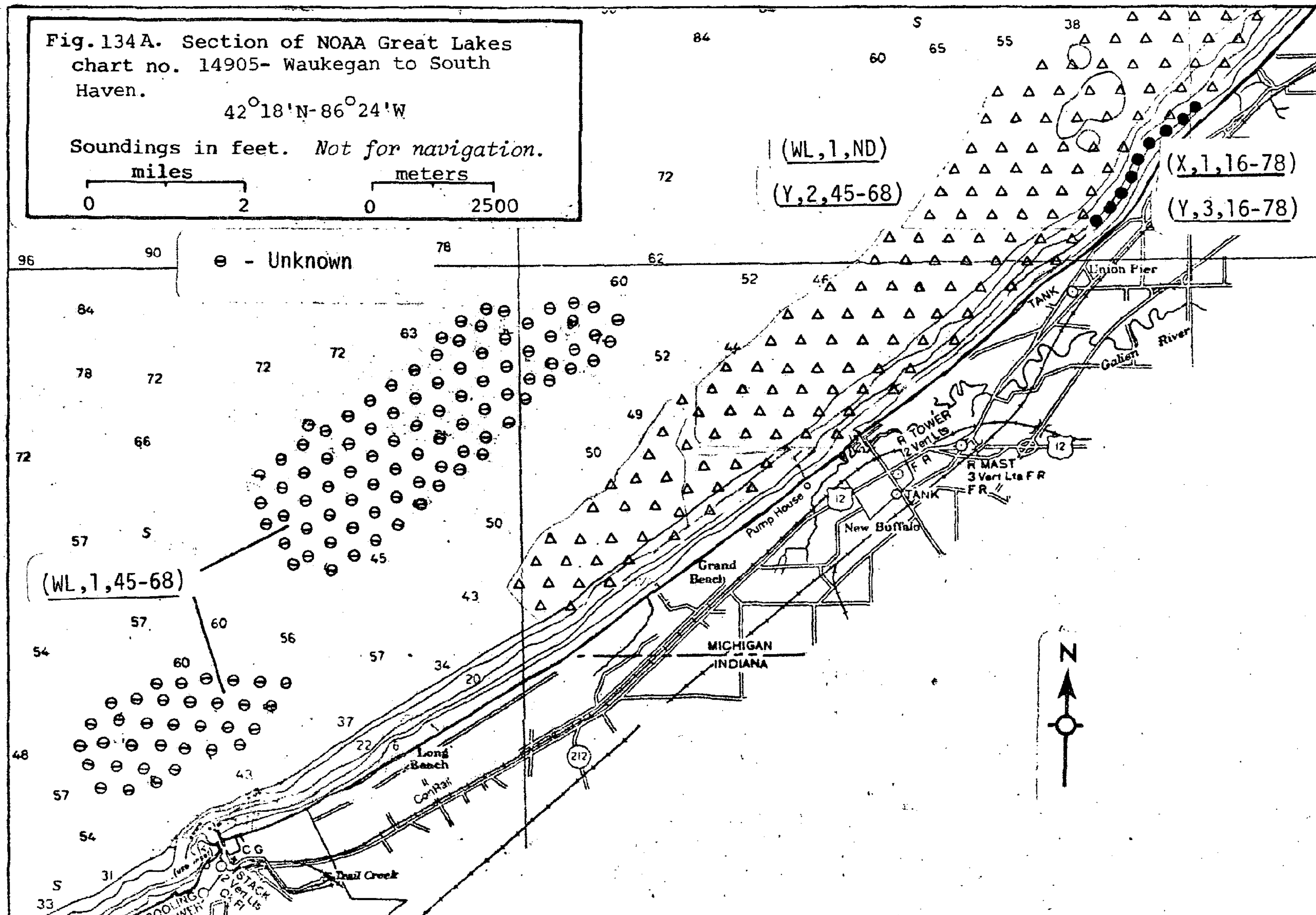



Fig. 134A. Section of NOAA Great Lakes chart no. 14905- Waukegan to South Haven.
42°18'N-86°24'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

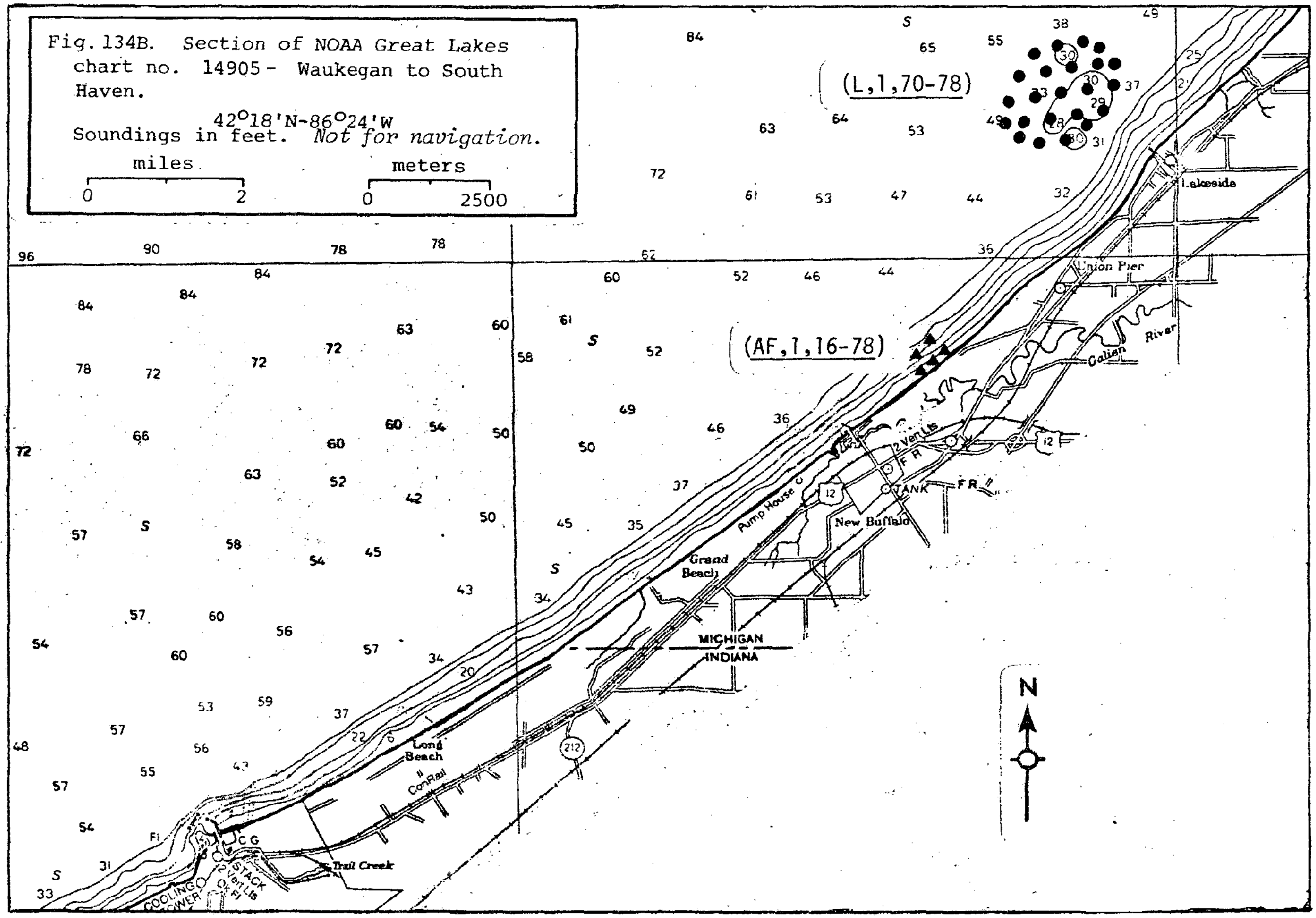



Fig. 134B. Section of NOAA Great Lakes chart no. 14905 - Waukegan to South Haven.

42°18'N-86°24'W

Soundings in feet. *Not for navigation.*

miles 0 2    meters 0 2500

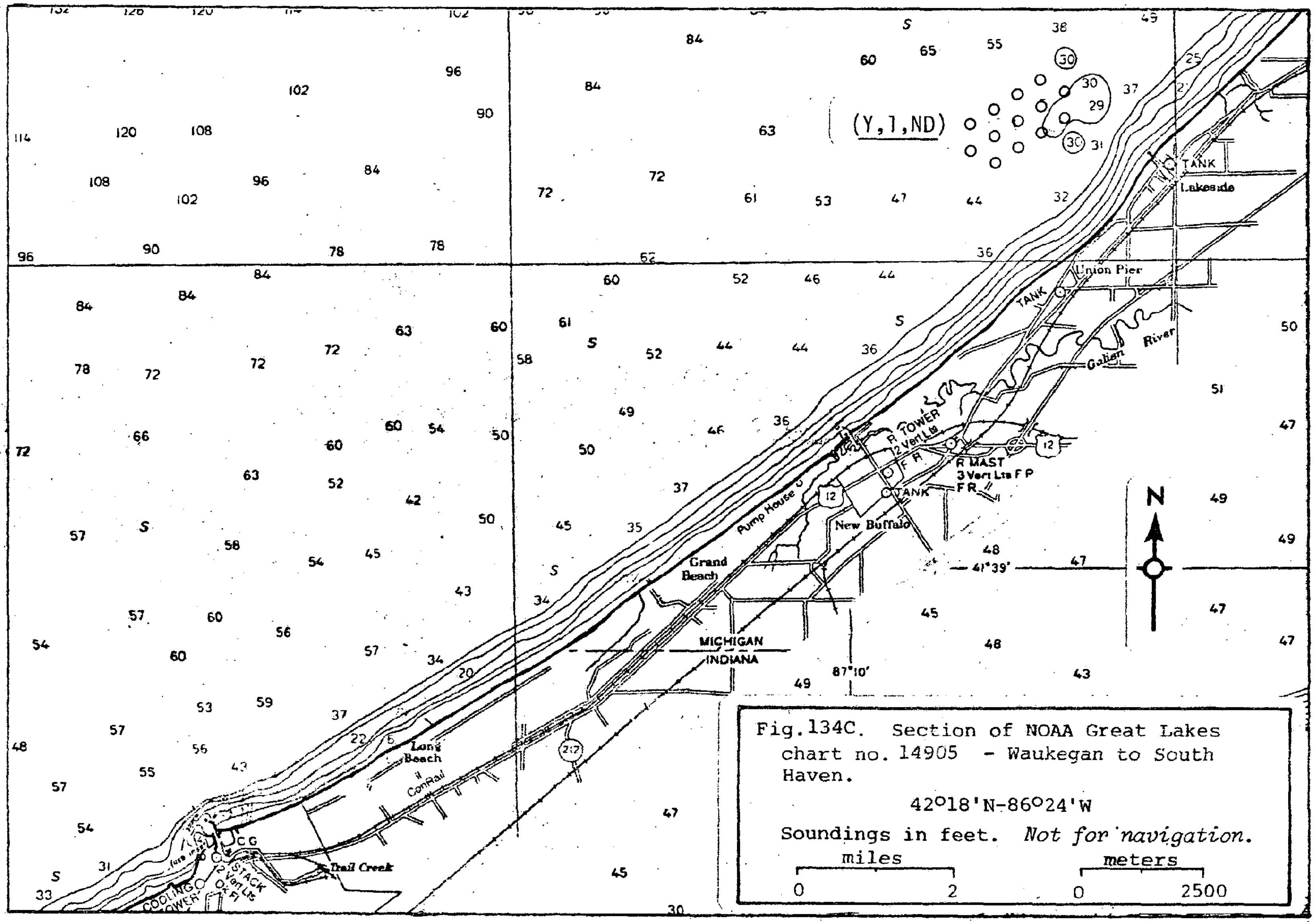



Fig.134C. Section of NOAA Great Lakes chart no. 14905 - Waukegan to South Haven.

42°18'N-86°24'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

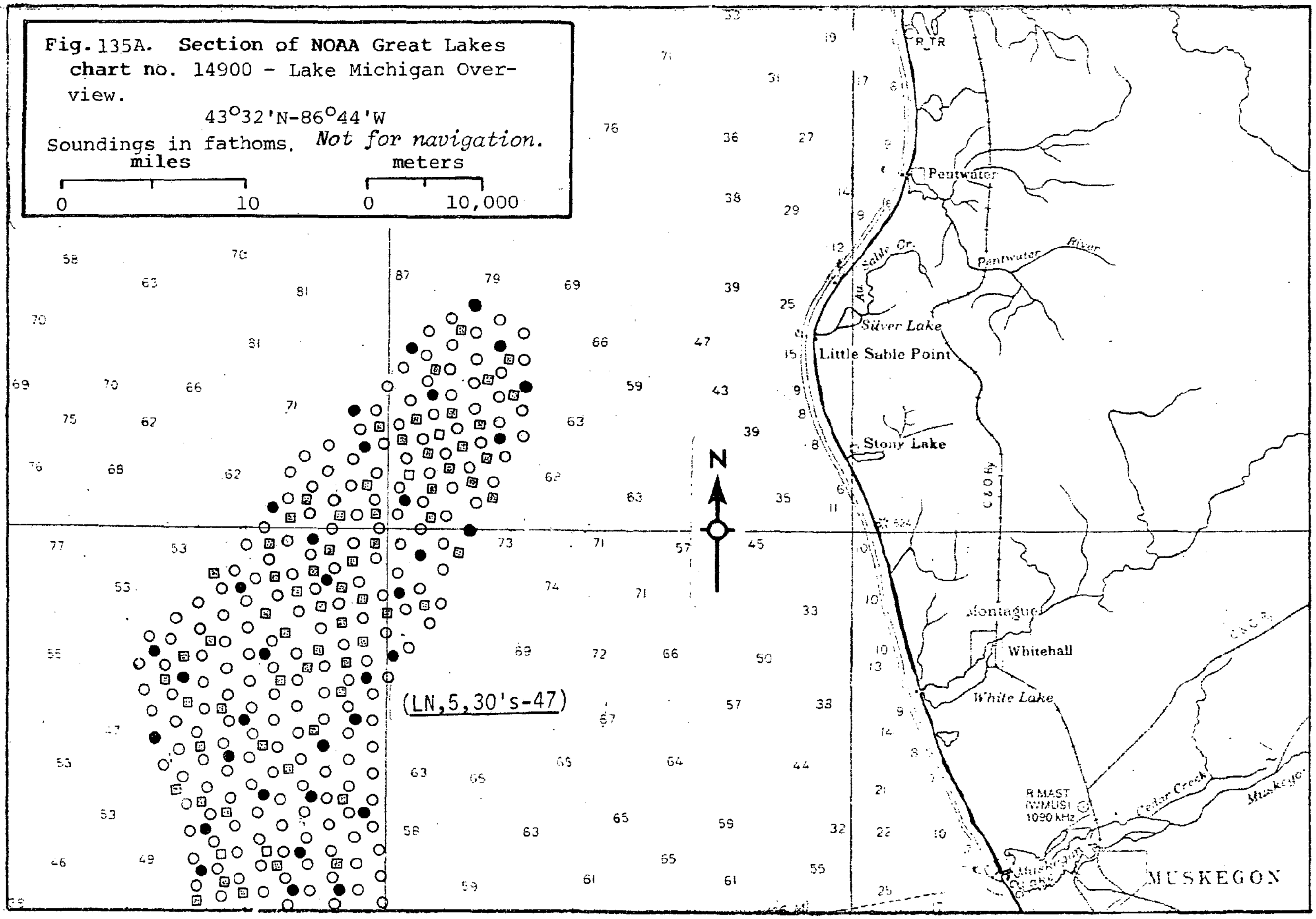



**Fig. 135A. Section of NOAA Great Lakes chart no. 14900 - Lake Michigan Overview.**
43°32'N-86°44'W
Soundings in fathoms. *Not for navigation.*

miles: 0 – 10
meters: 0 – 10,000

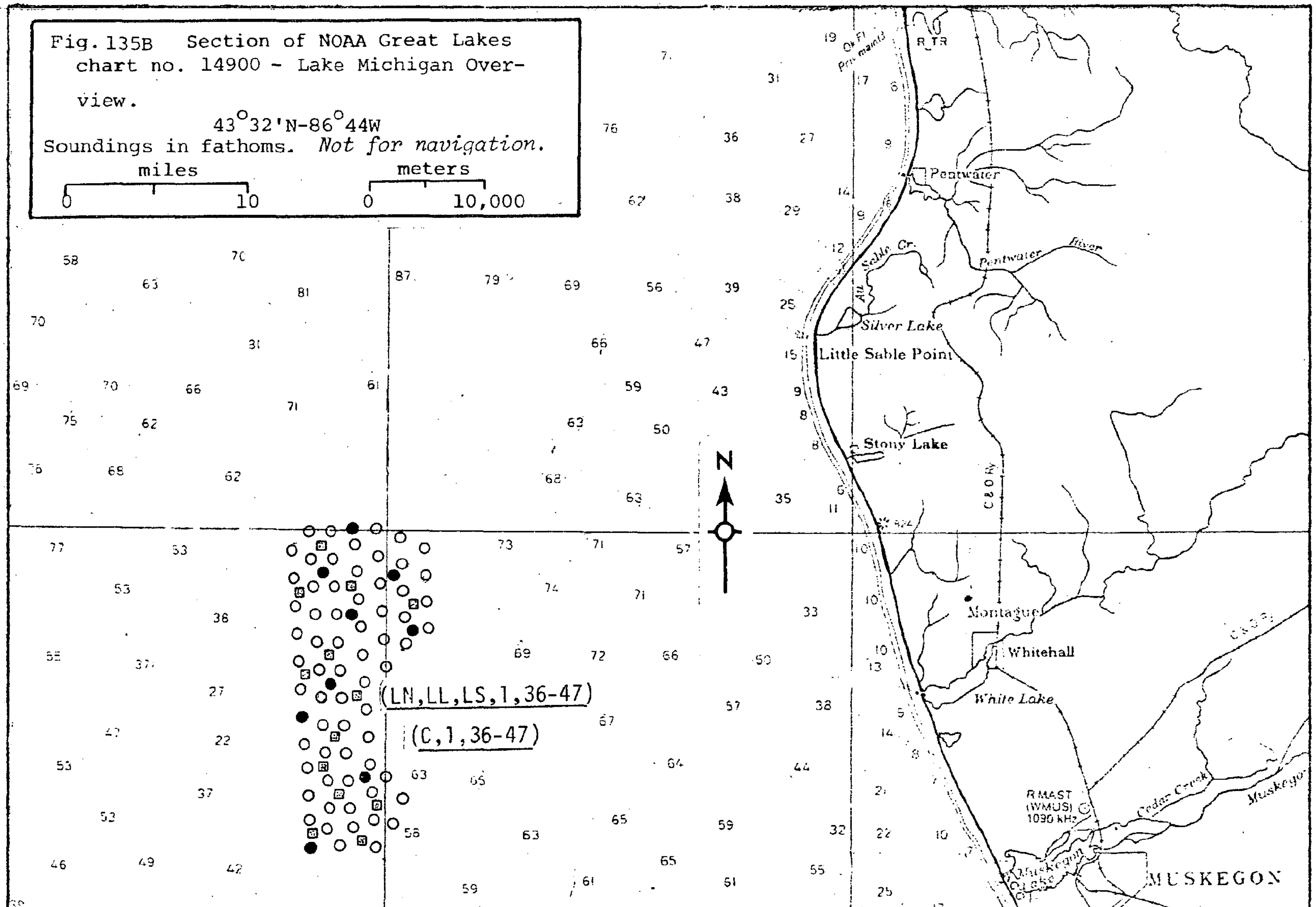



Fig. 135B Section of NOAA Great Lakes chart no. 14900 - Lake Michigan Overview.
43°32'N-86°44W
Soundings in fathoms. *Not for navigation.*
miles 0 10
meters 0 10,000

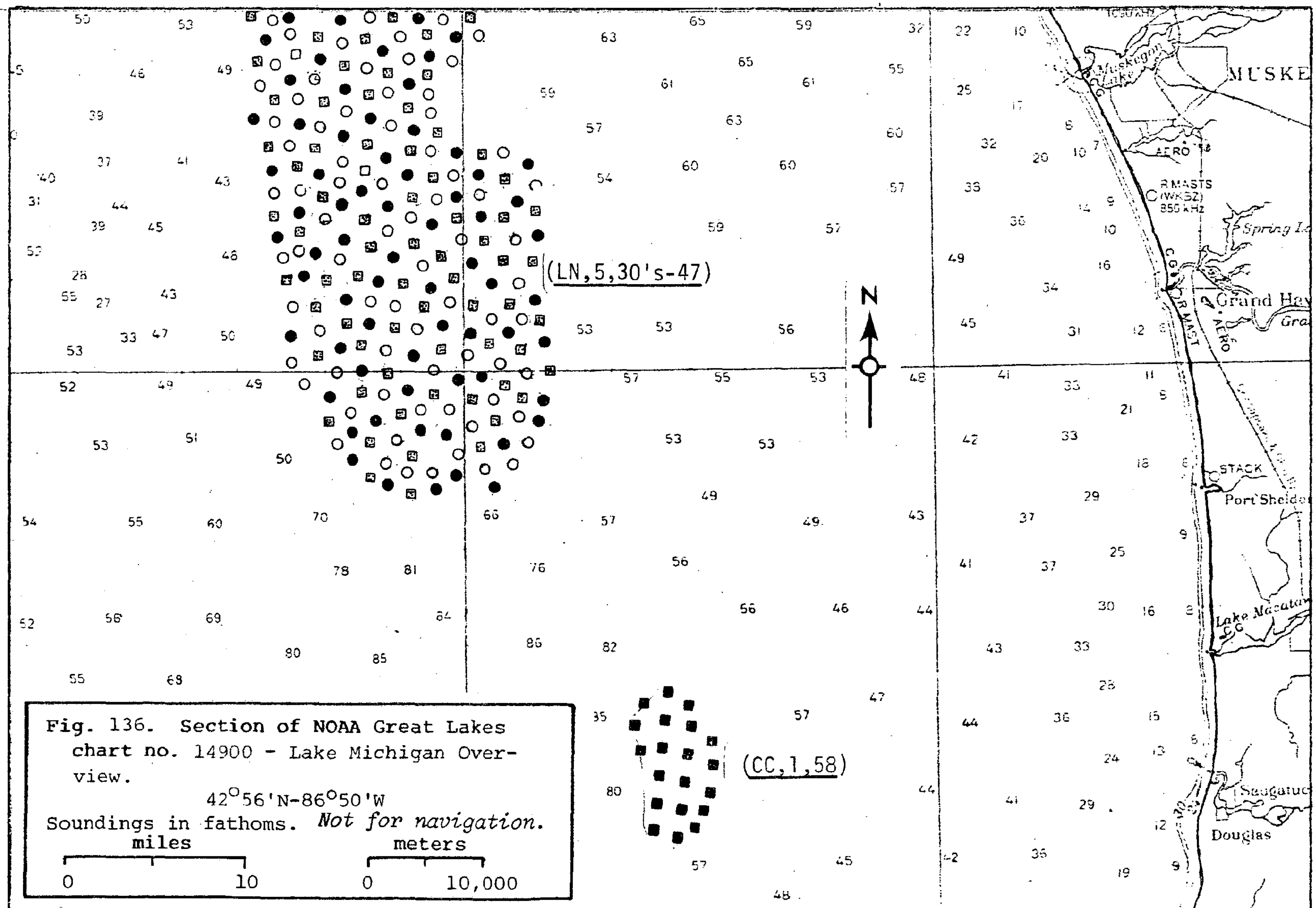



**Fig. 136. Section of NOAA Great Lakes chart no.** 14900 - Lake Michigan Overview.

$42^{\circ}56'N-86^{\circ}50'W$

Soundings in fathoms. *Not for navigation.*

miles 0 10 meters 0 10,000

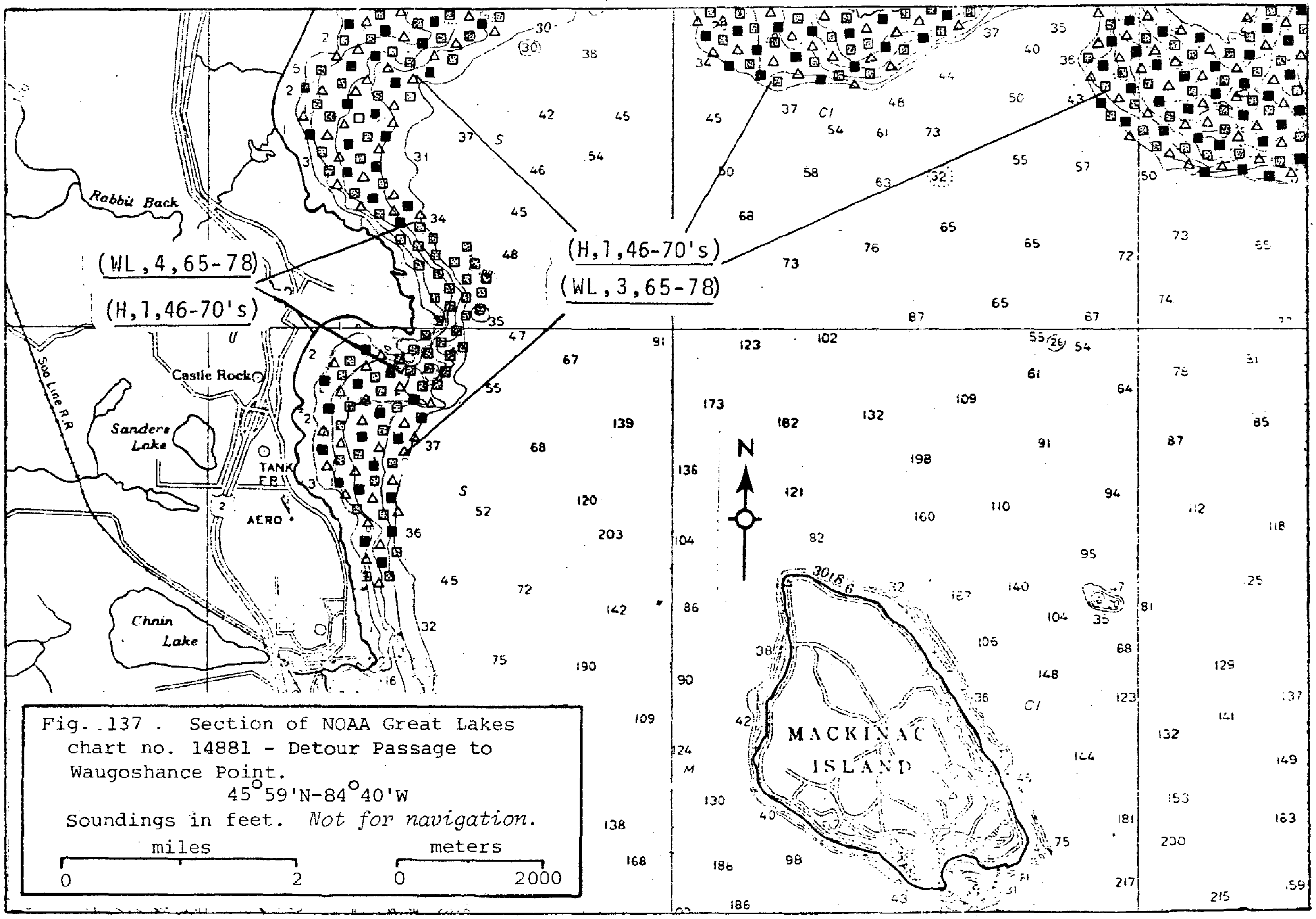



Fig. 137 . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
$45^{\circ}59'N-84^{\circ}40'W$
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

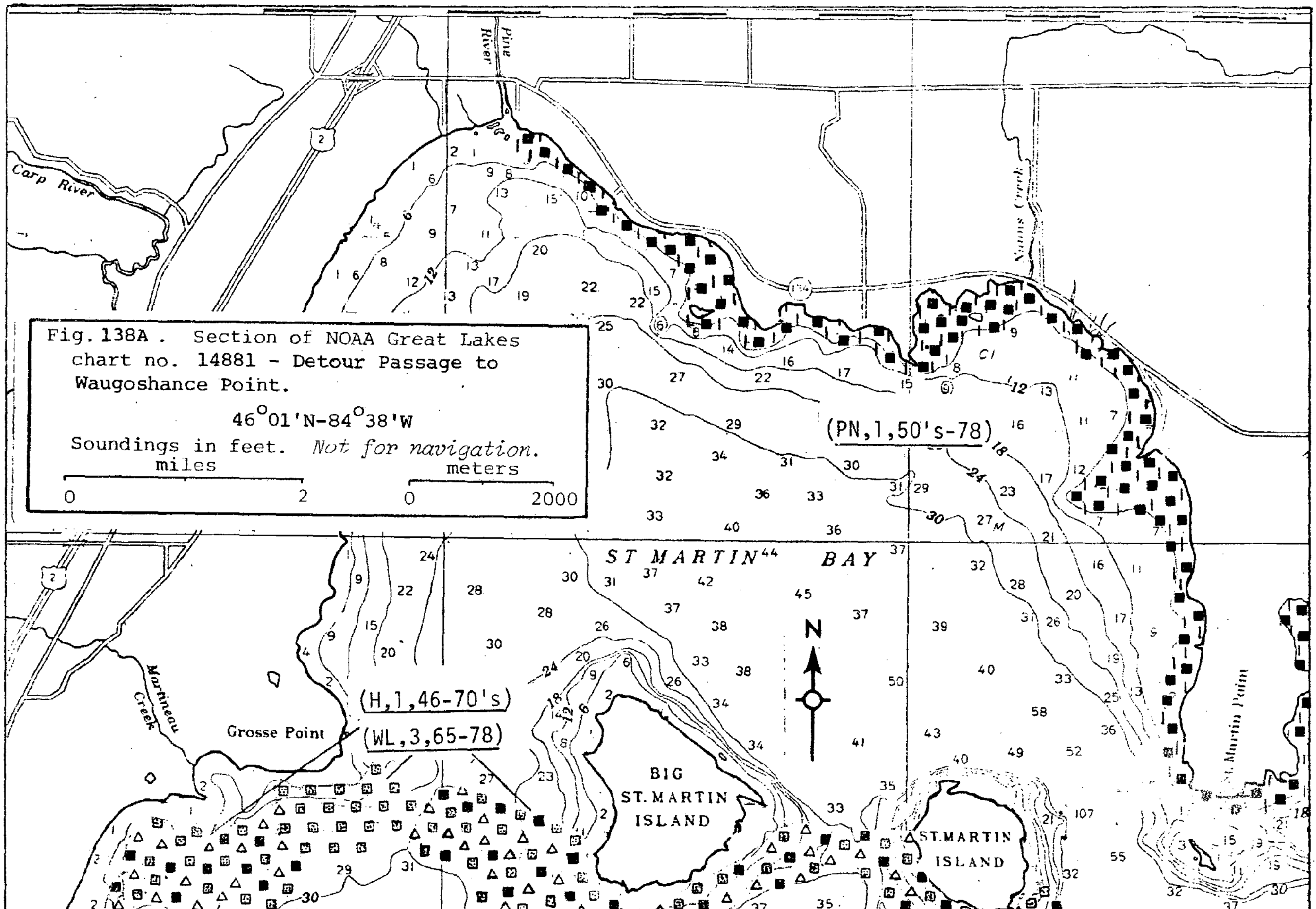



Fig. 138A . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.

46°01'N-84°38'W

Soundings in feet. *Not for navigation.*

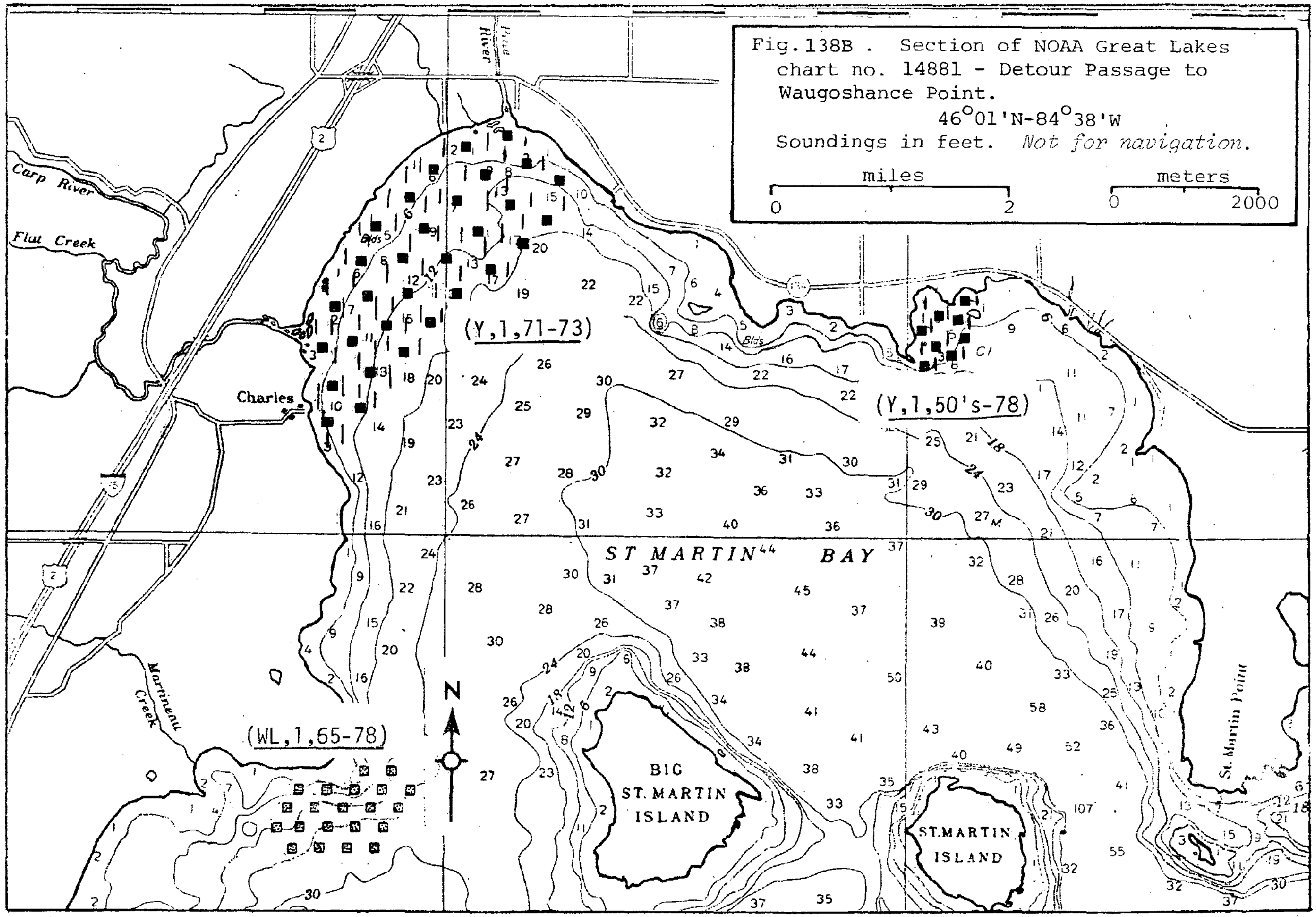



Fig.138B . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
46°01'N-84°38'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

Fig. 139A. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°58'N-84°27'W
Soundings in feet. *Not for navigation.*

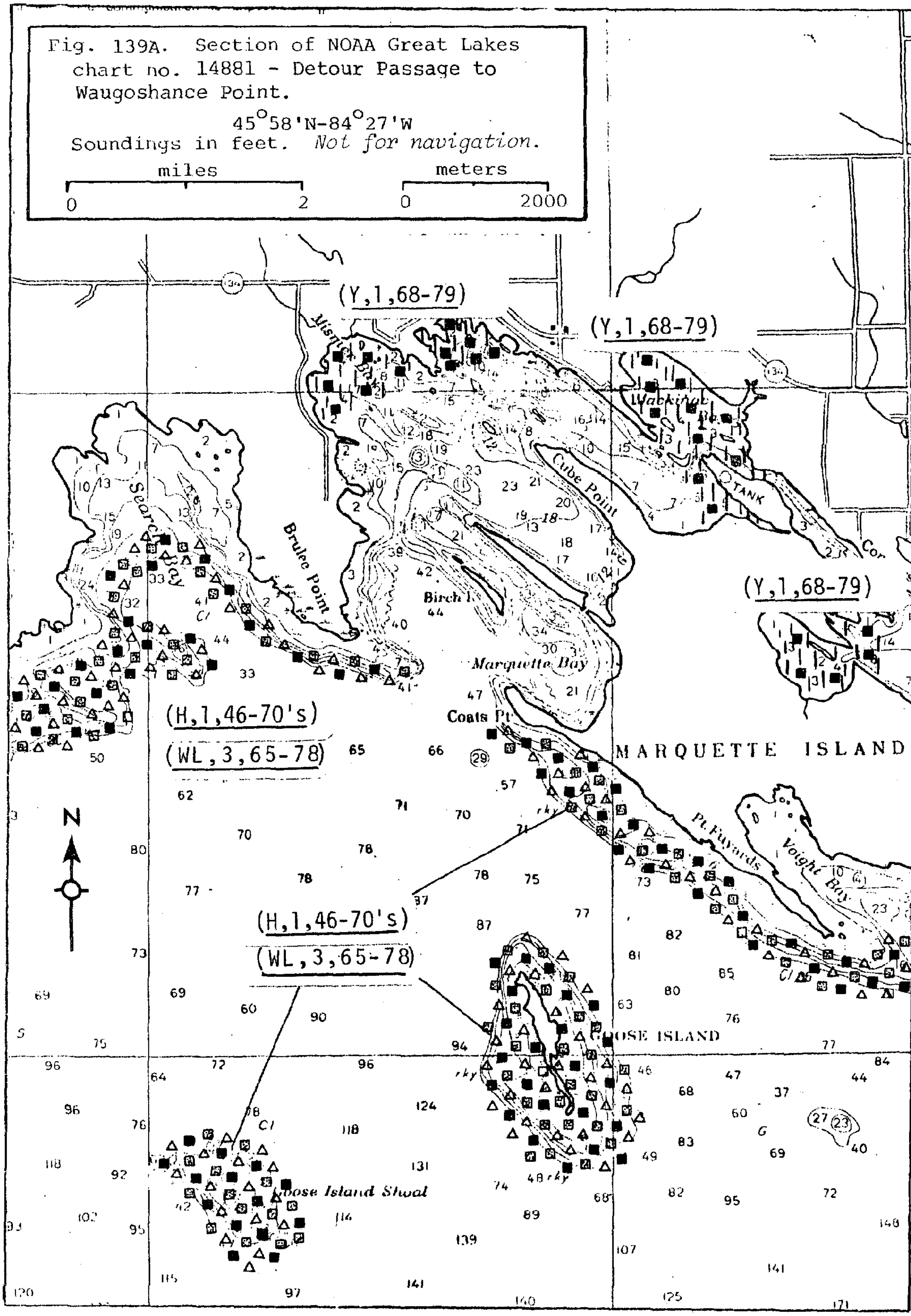


Fig. 139B. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°58'N-84°27'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

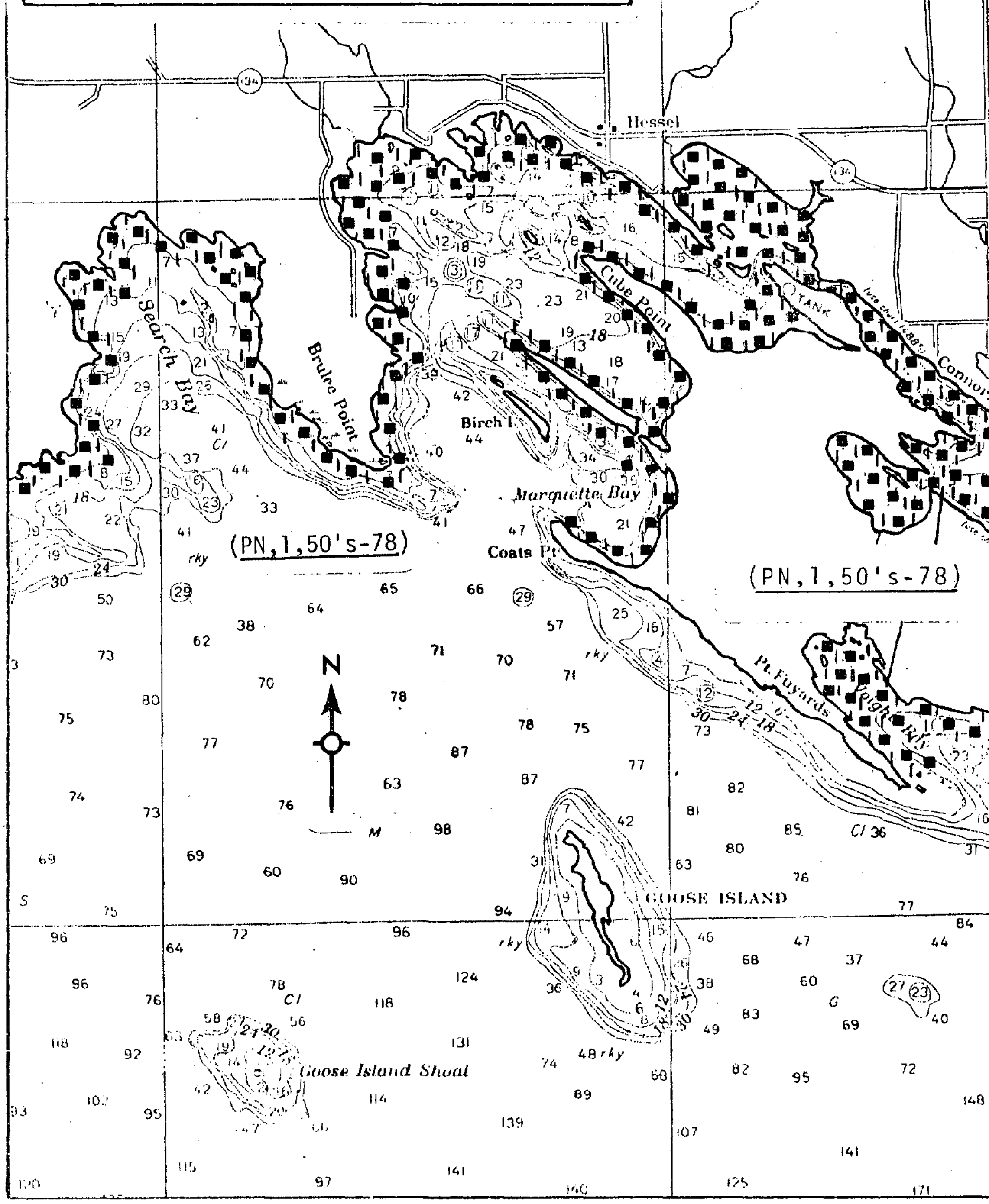


Fig. 139C. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
$45^{\circ}58'N-84^{\circ}27'W$
Soundings in feet. *Not for navigation.*

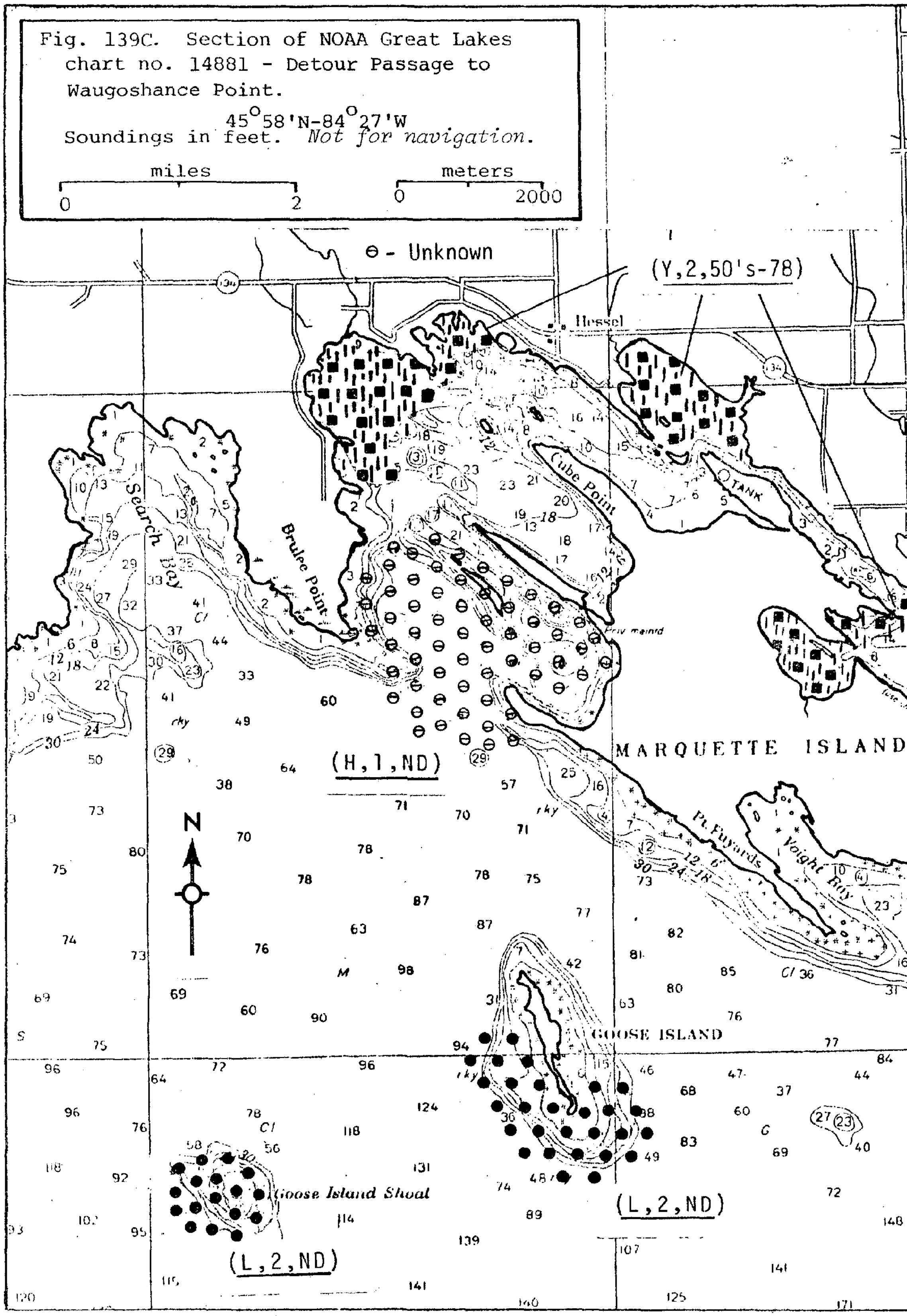
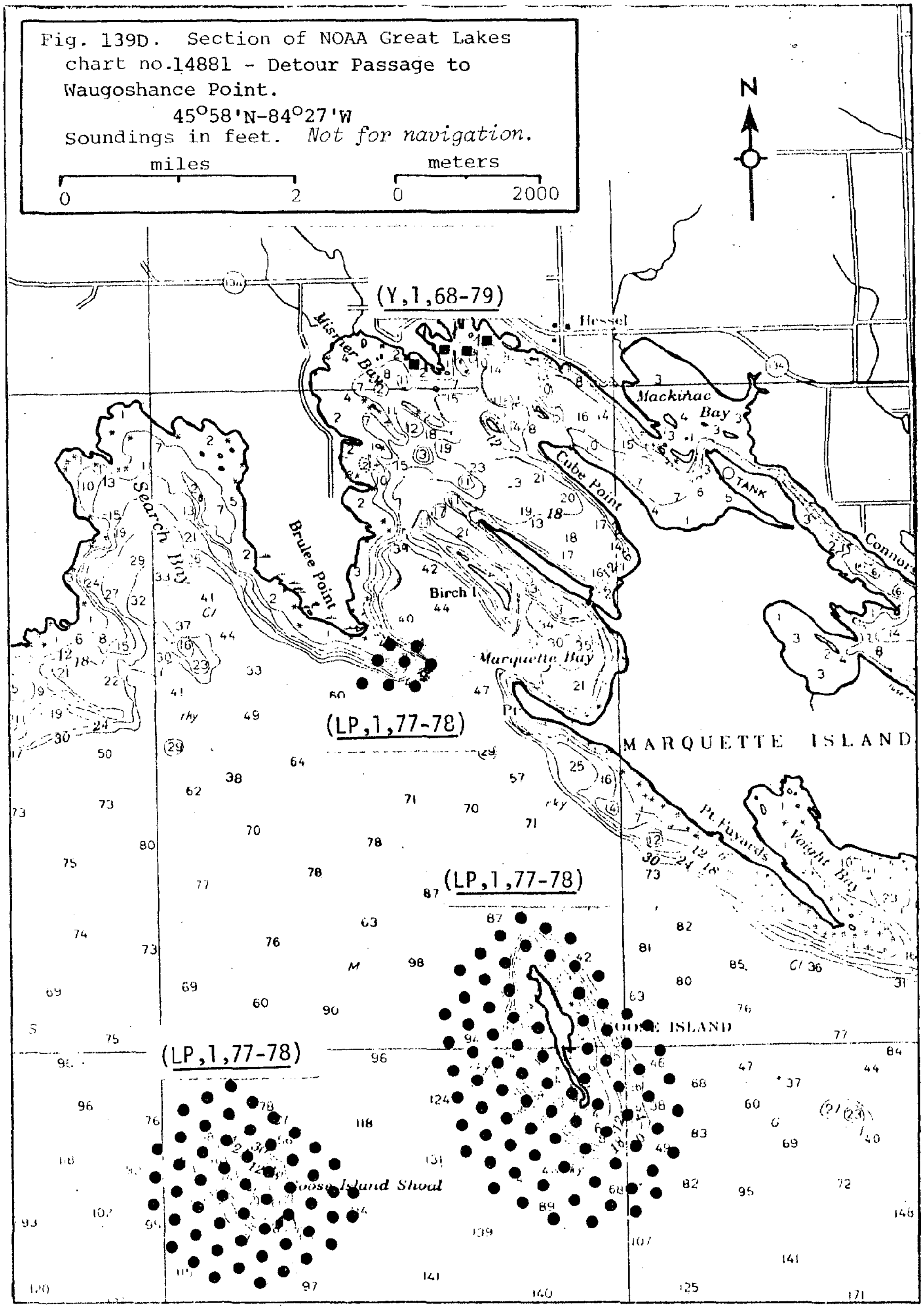


Fig. 139D. Section of NOAA Great Lakes chart no.14881 - Detour Passage to Waugoshance Point.
$45^{o}58'N-84^{o}27'W$
Soundings in feet. *Not for navigation.*



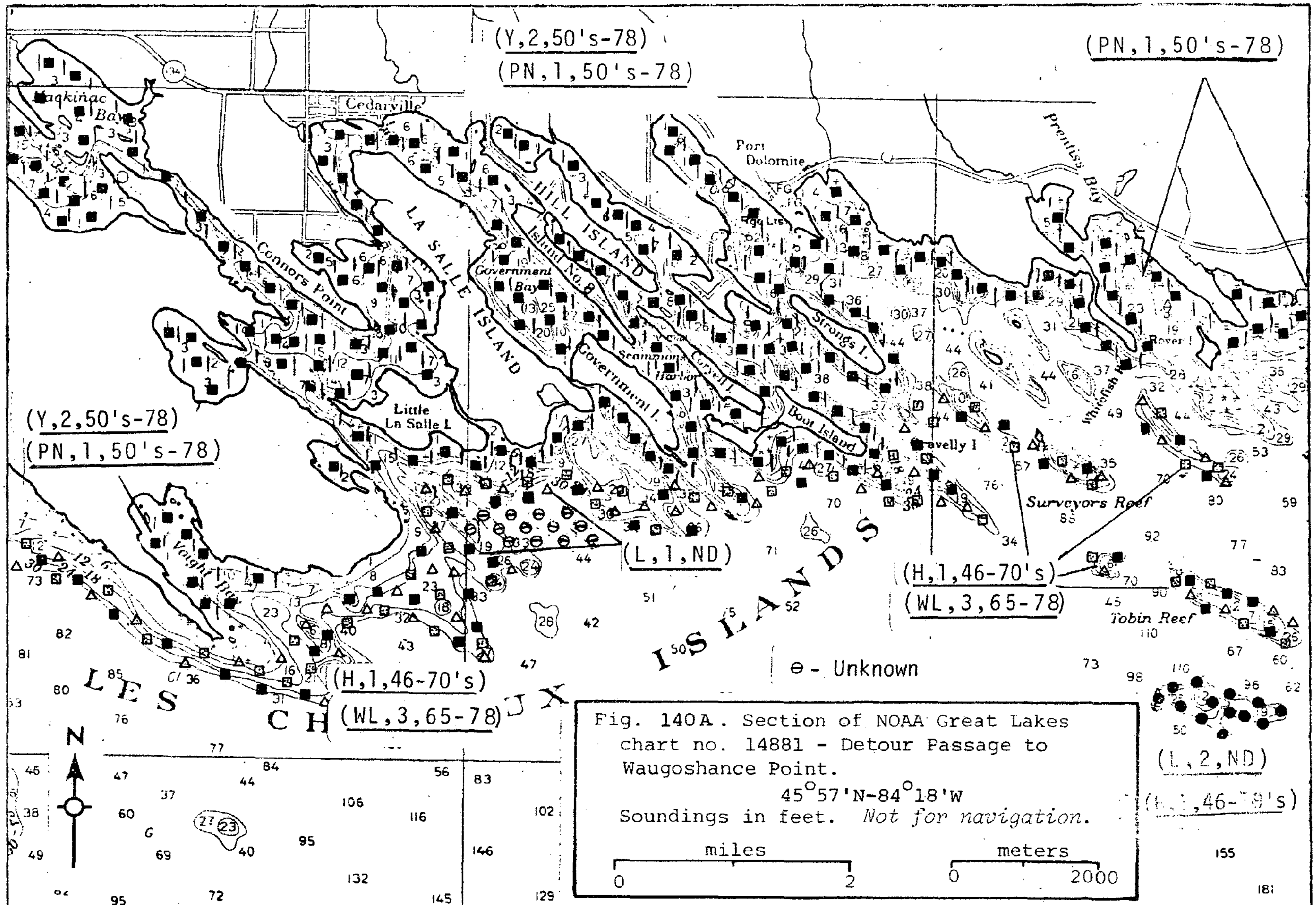



Fig. 140A. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°57'N-84°18'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

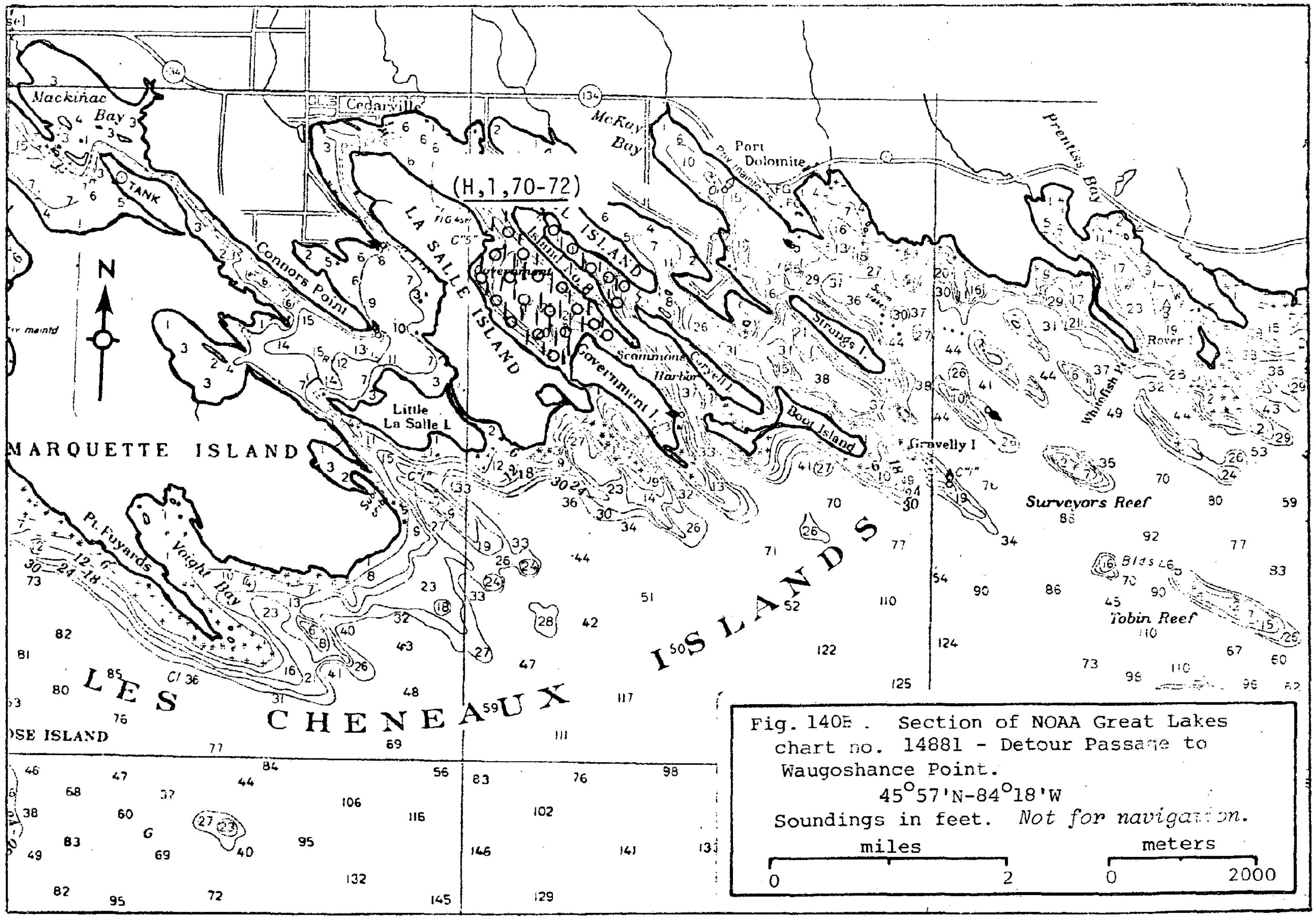



Fig. 140B . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°57'N-84°18'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

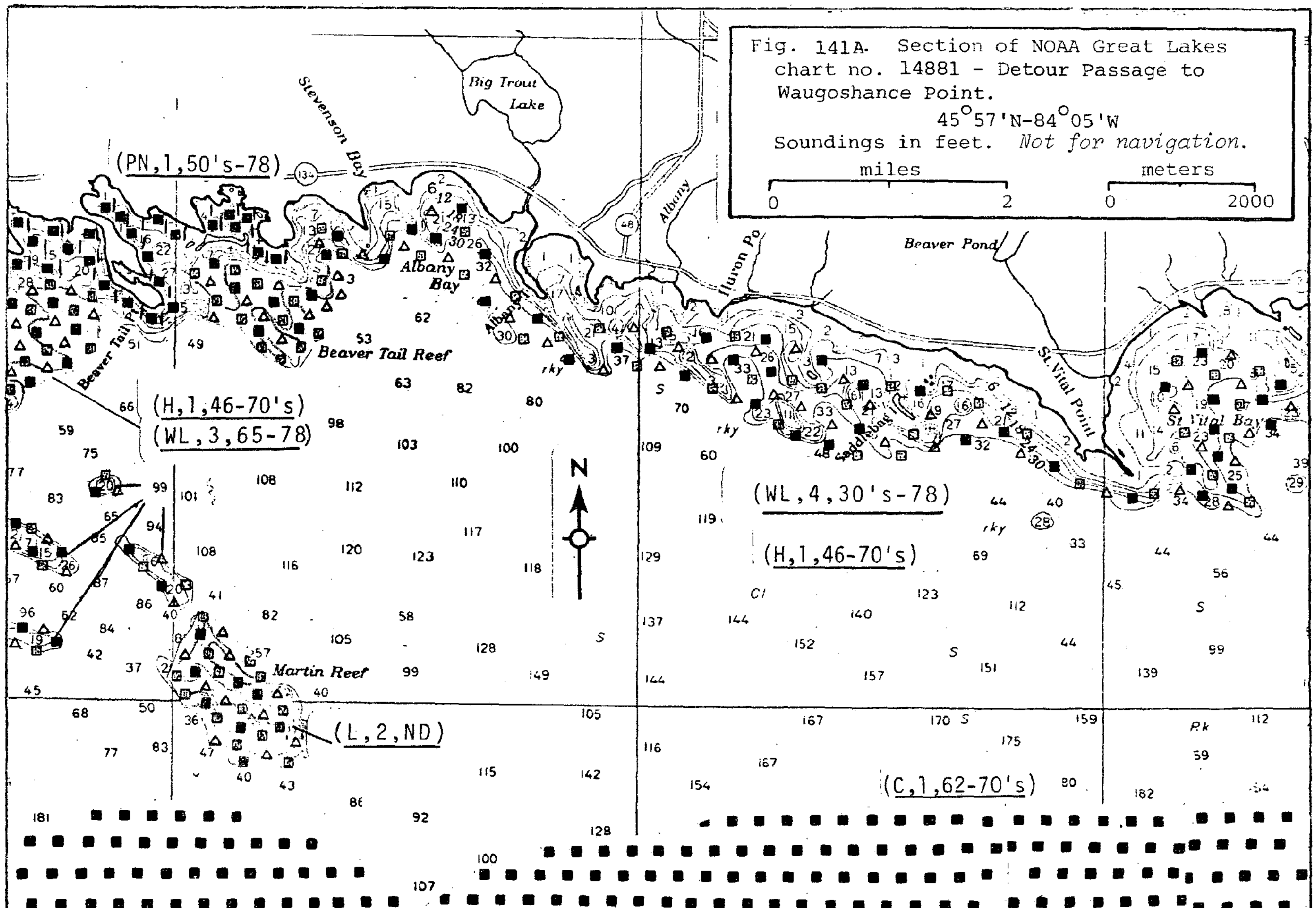



Fig. 141A. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°57'N-84°05'W
Soundings in feet. *Not for navigation.*

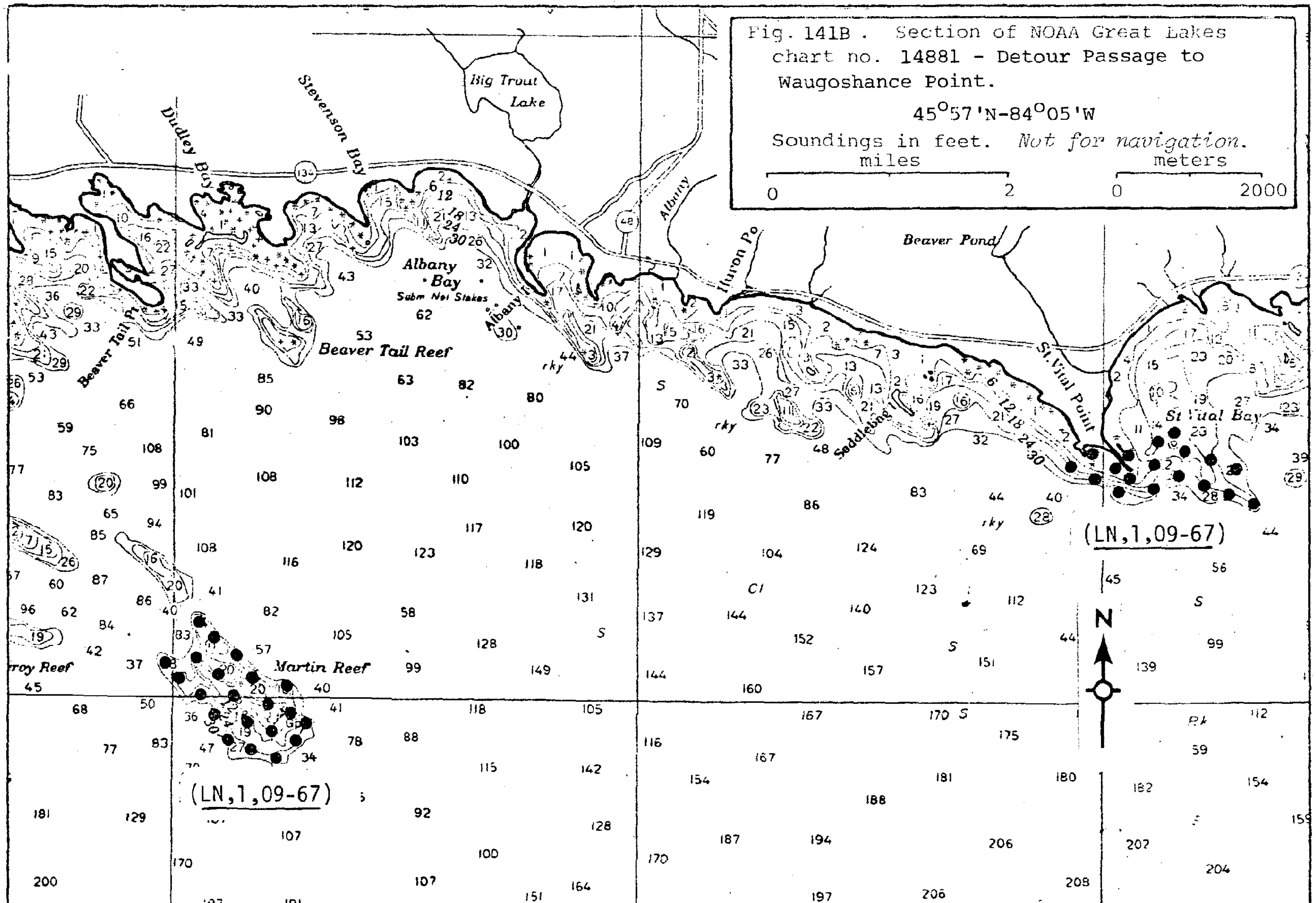


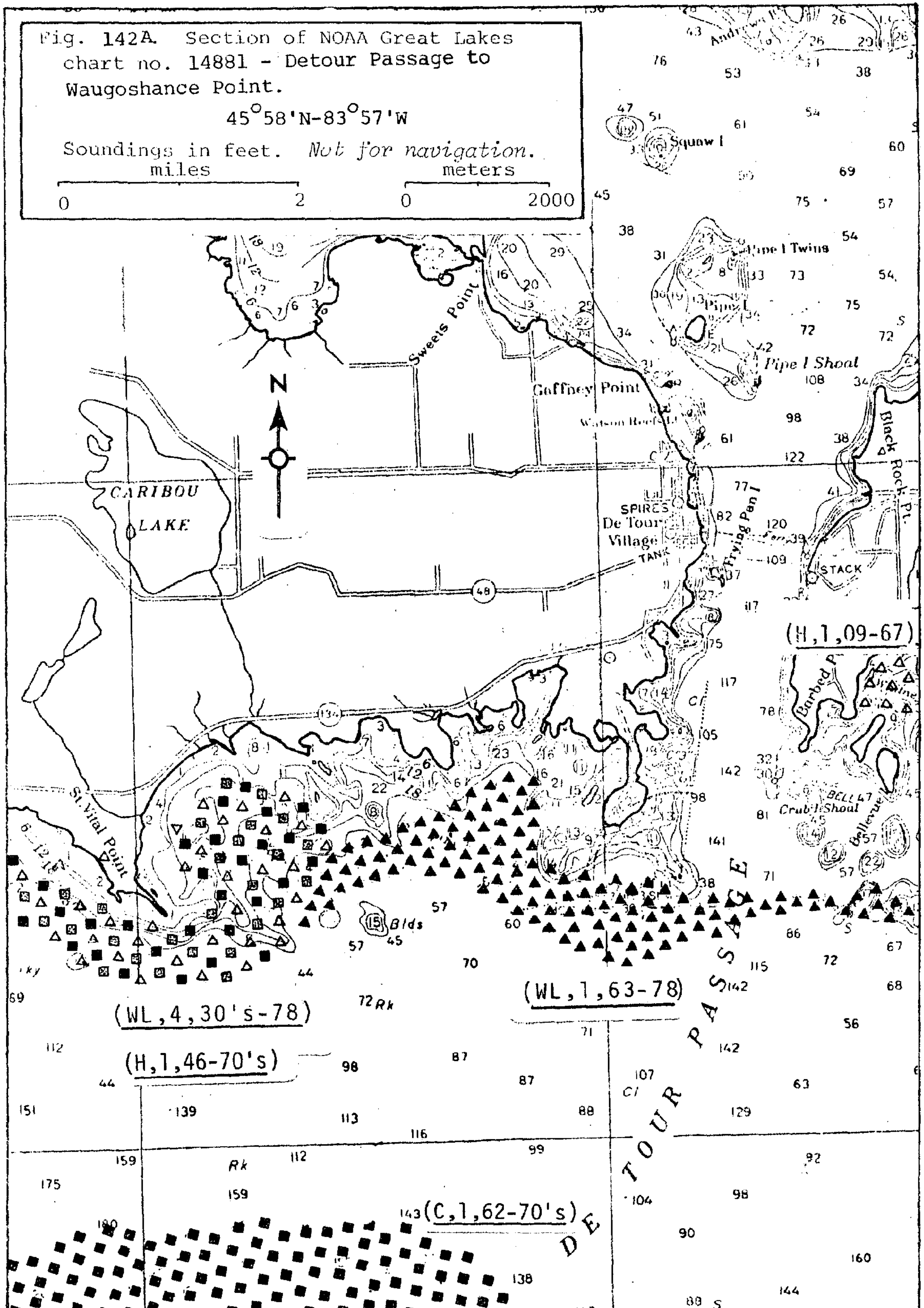

Fig. 141B . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.

45°57'N-84°05'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

Fig. 142A. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°58'N-83°57'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000



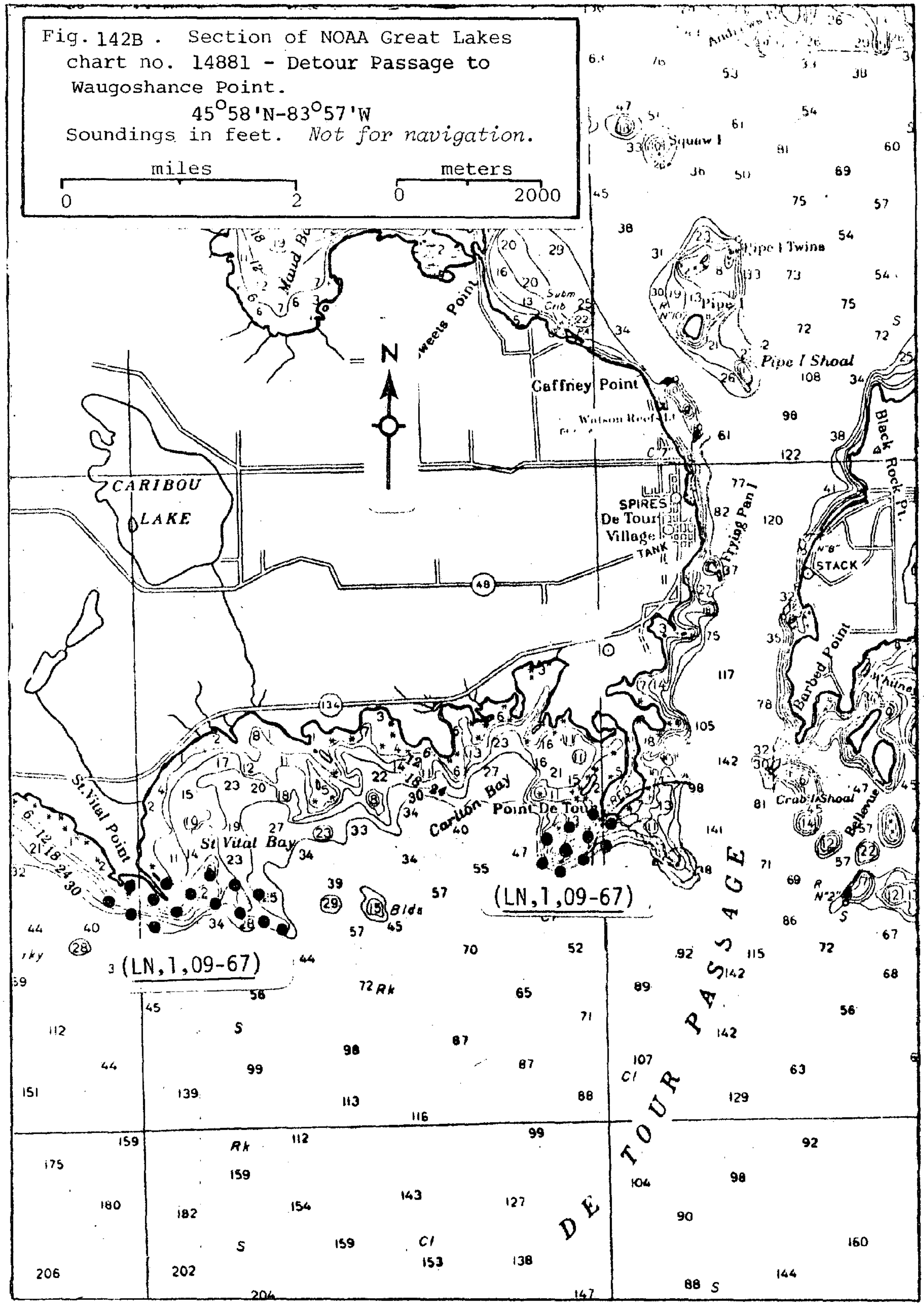


Fig. 142B . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°58'N-83°57'W
Soundings in feet. Not for navigation.
miles
0
2
meters
0
2000
CARIBOU LAKE
Caffney Point
Pipe I Shoal
Pipe I
Squaw I
Black Rock Pt.
SPIRES
De Tour Village
TANK
STACK
Frying Pan I
Barbed Point
Crab I Shoal
St Vital Point
St Vital Bay
Carlton Bay
Point De Tour
(LN,1,09-67)
(LN,1,09-67)
DE TOUR PASSAGE

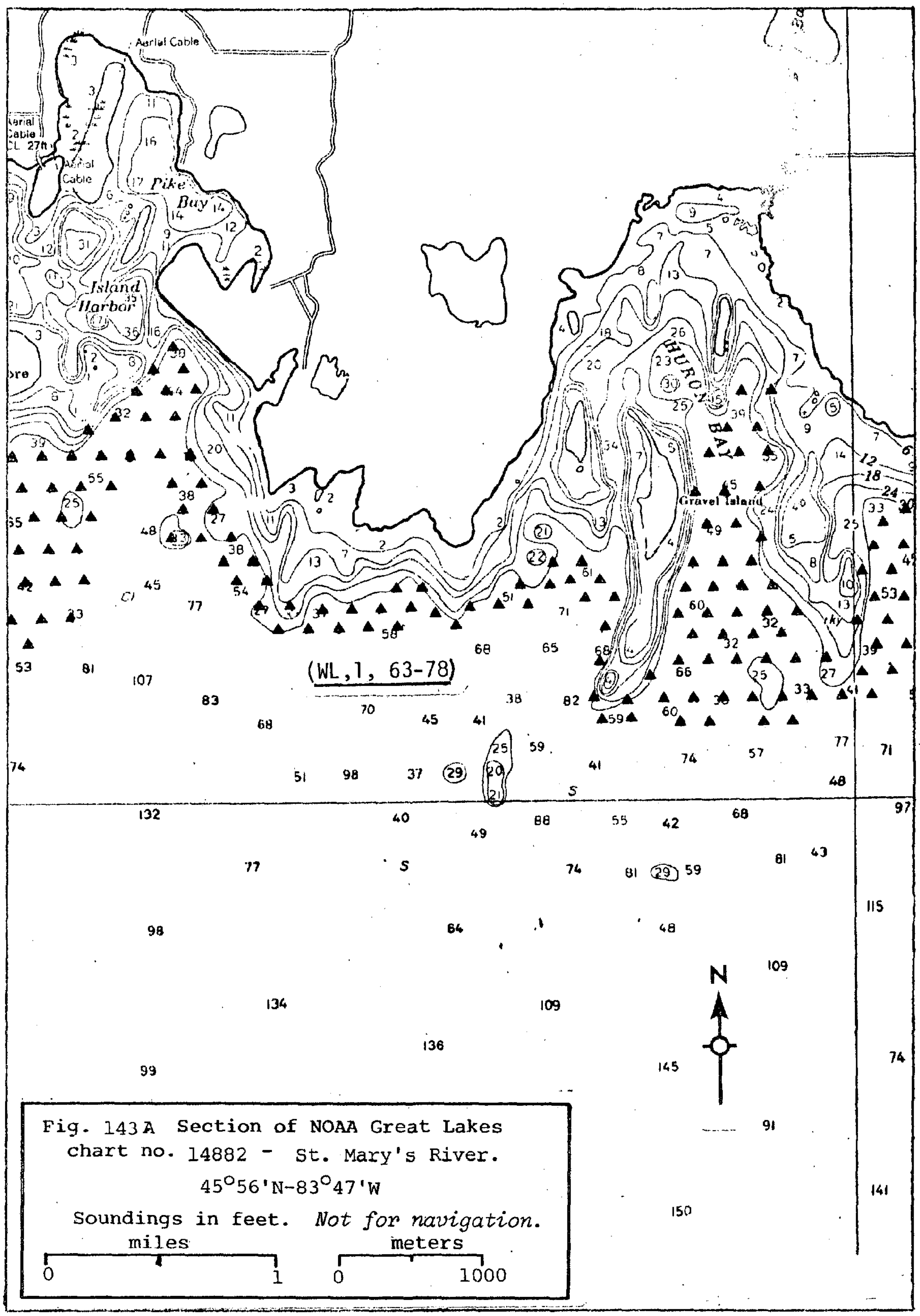



Fig. 143A Section of NOAA Great Lakes chart no. 14882 - St. Mary's River. 45°56'N-83°47'W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

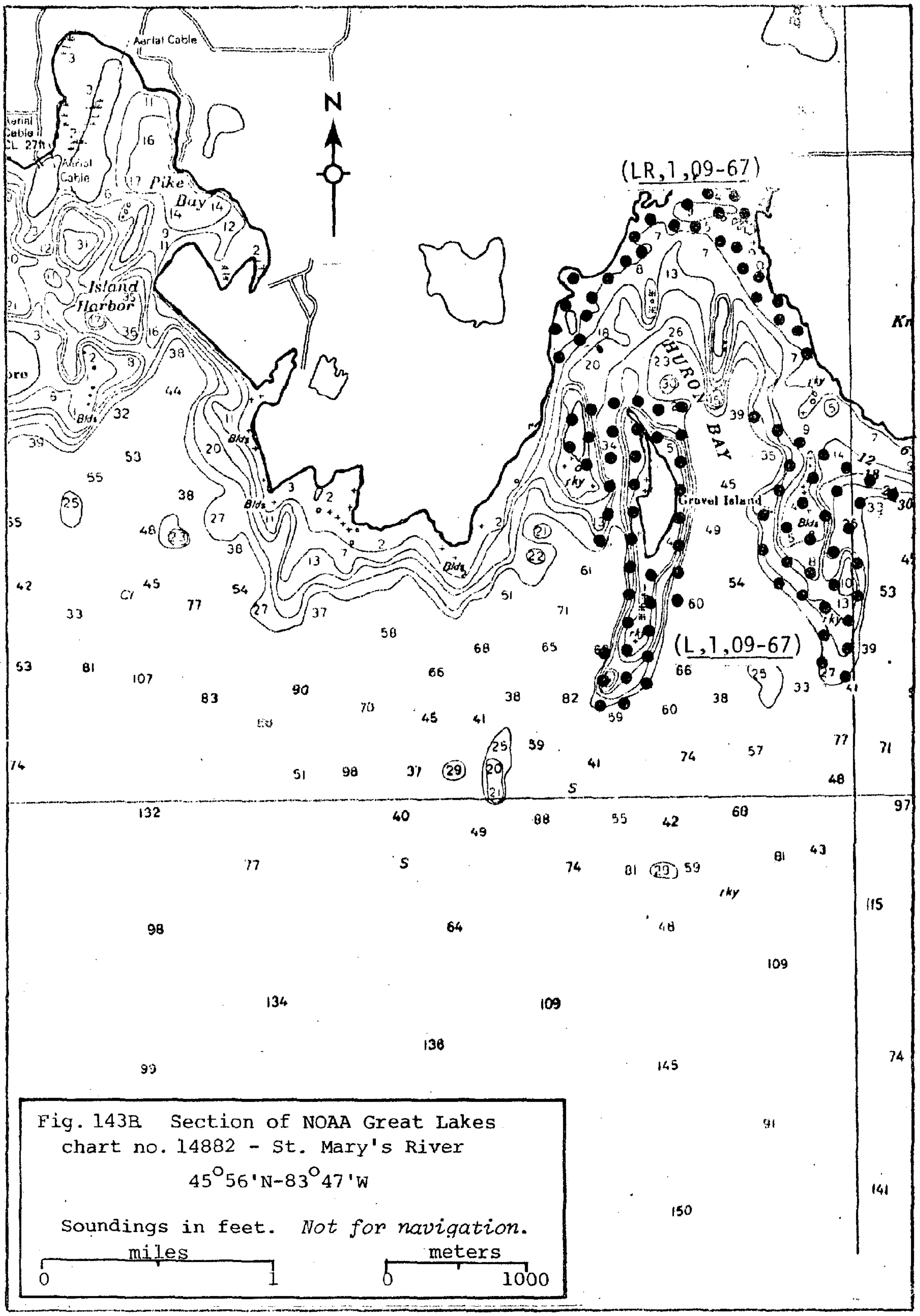



Fig. 143B Section of NOAA Great Lakes chart no. 14882 - St. Mary's River
$45^{\circ}56'N-83^{\circ}47'W$

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

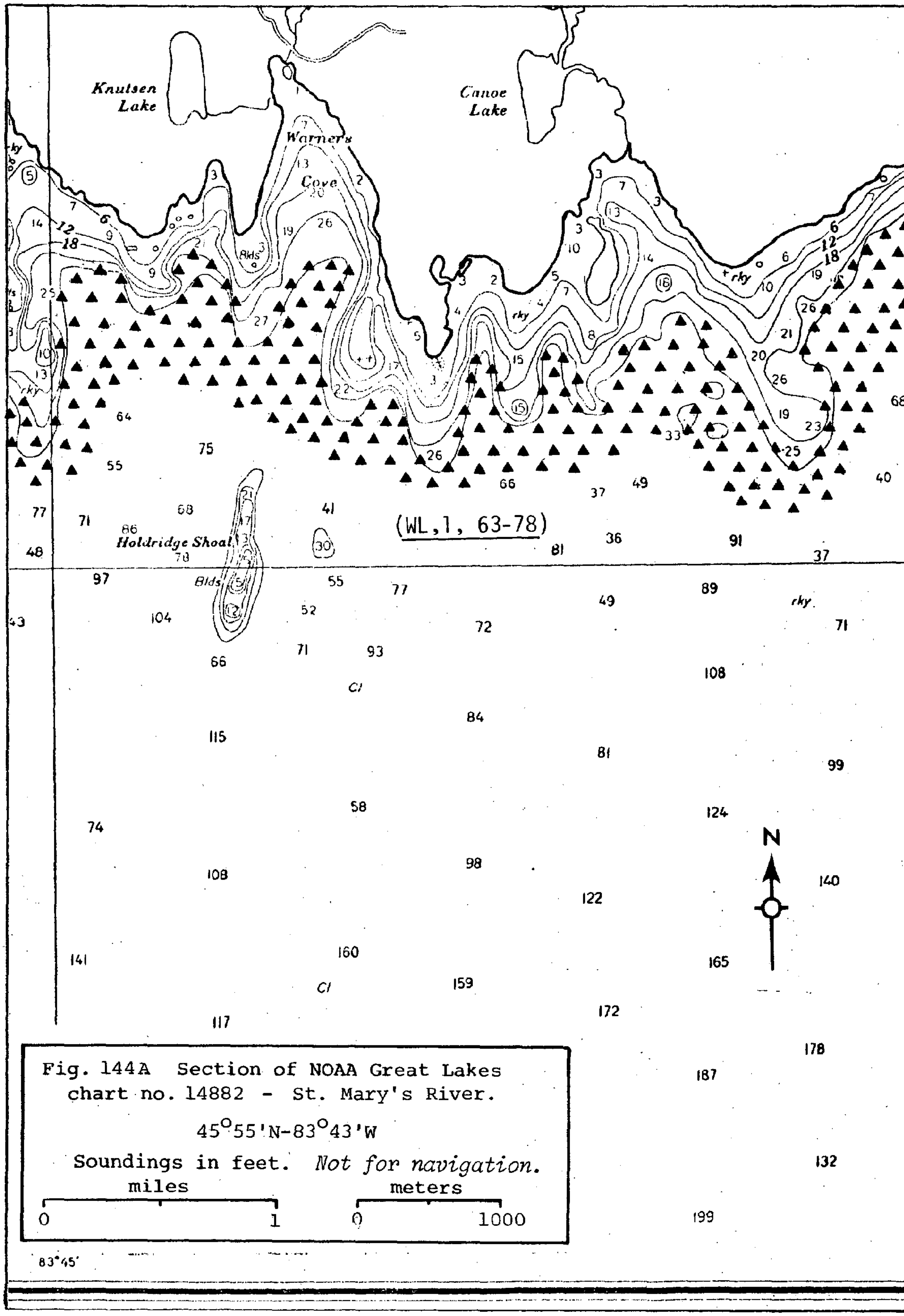



Fig. 144A Section of NOAA Great Lakes chart no. 14882 - St. Mary's River.

45°55'N-83°43'W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

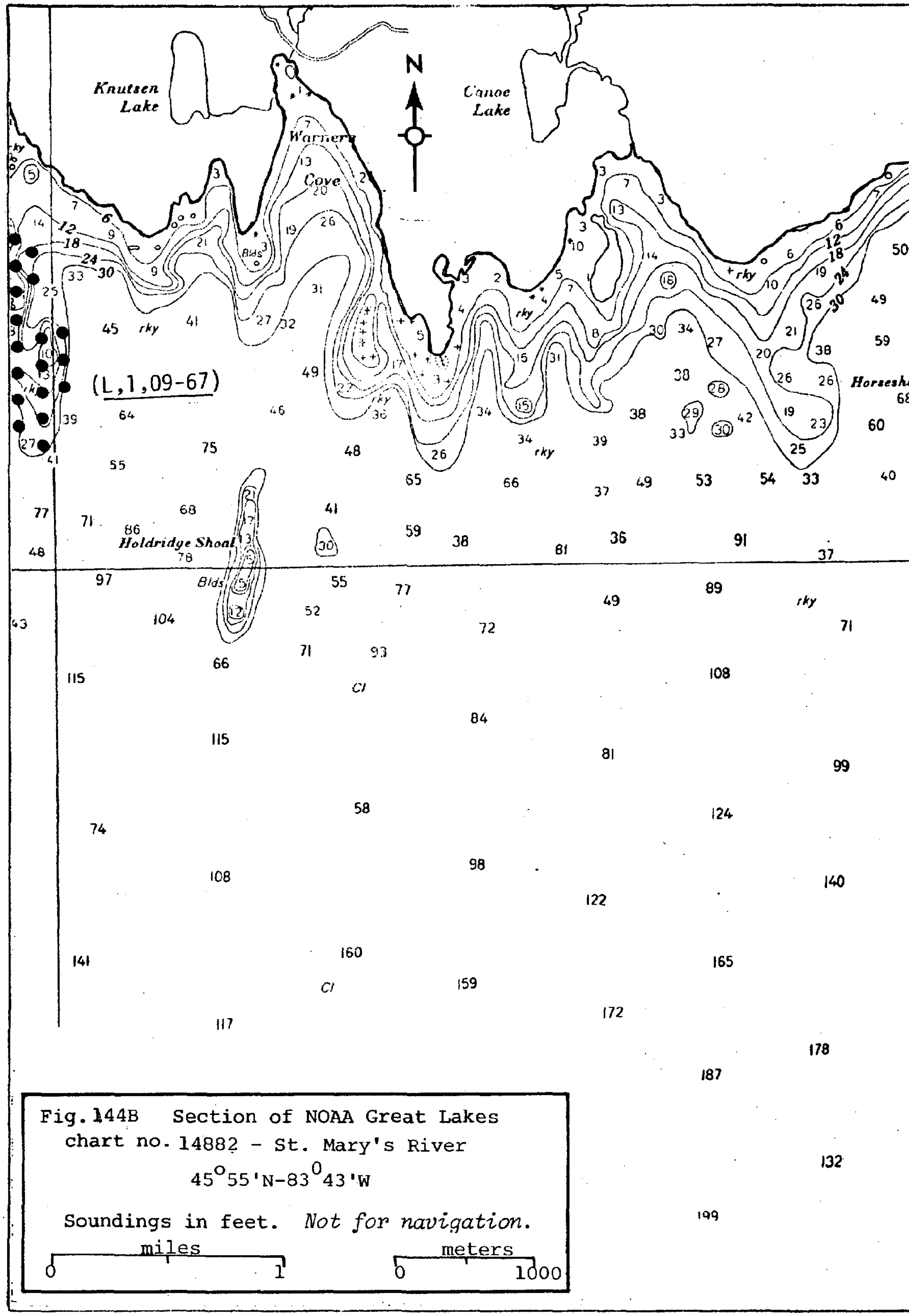



Fig. 144B Section of NOAA Great Lakes chart no. 14882 - St. Mary's River

45°55'N-83°43'W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

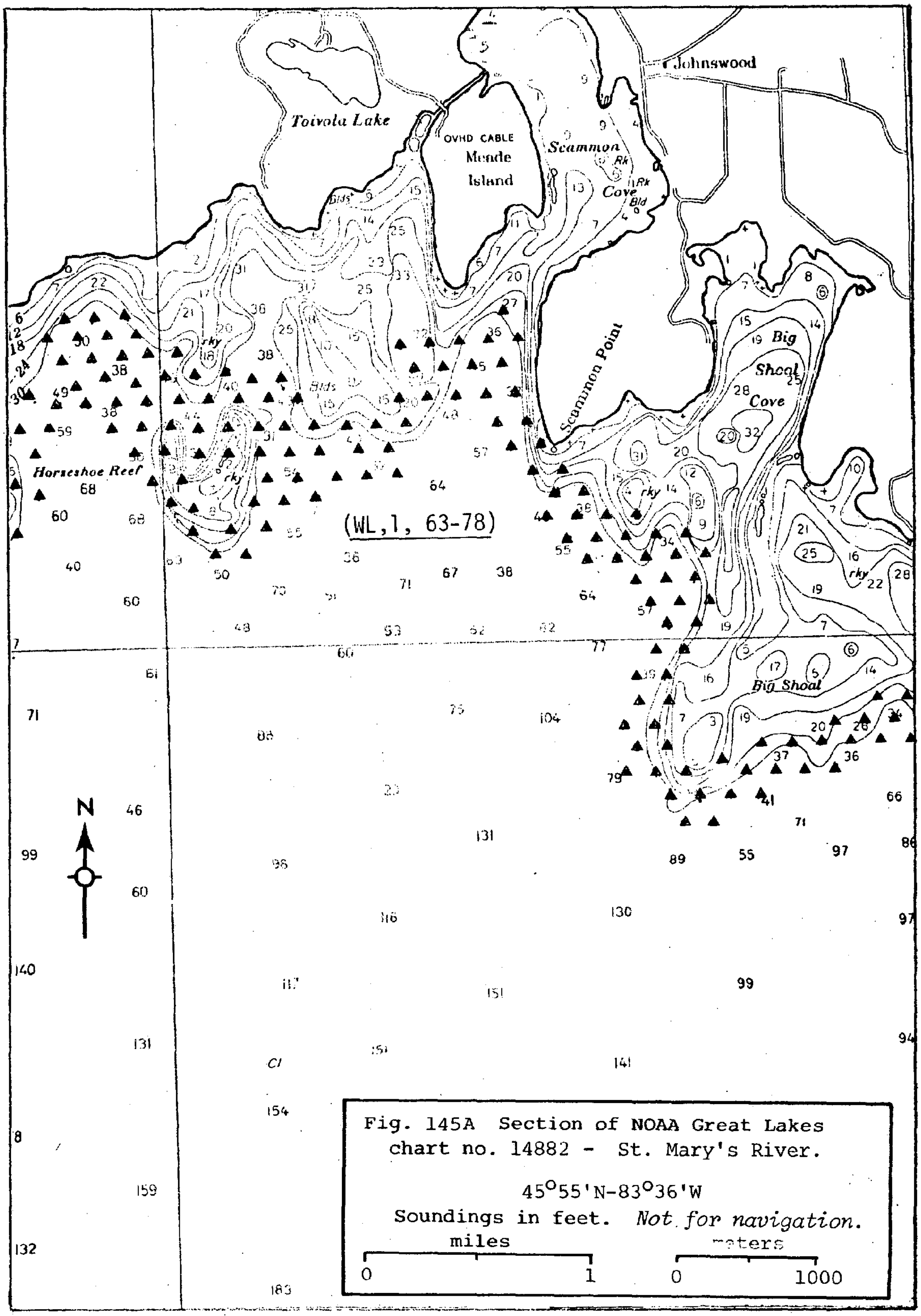



Fig. 145A Section of NOAA Great Lakes chart no. 14882 - St. Mary's River.

45°55'N-83°36'W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

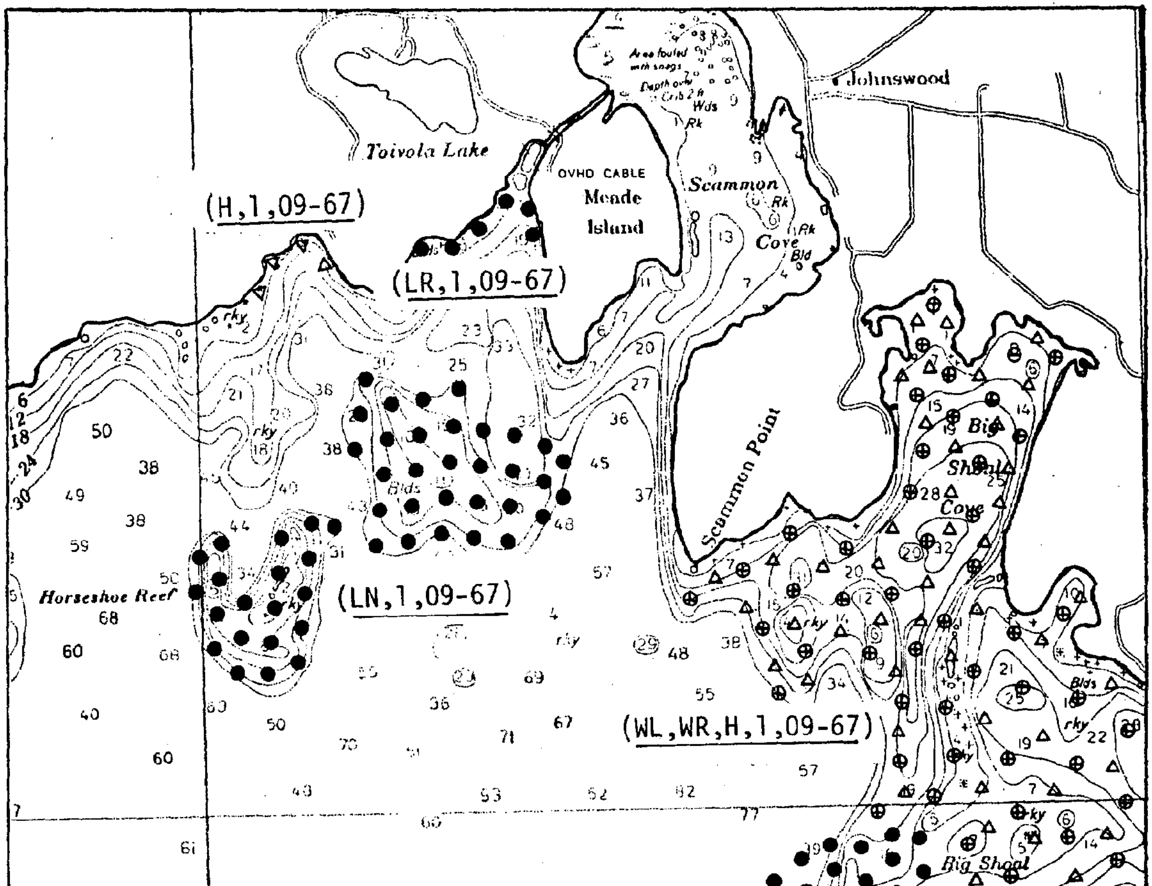



Fig. 145B. Section of NOAA Great Lakes chart no. 14882 - St. Mary's River.

$45^{\circ}55'$N-$83^{\circ}36'$W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

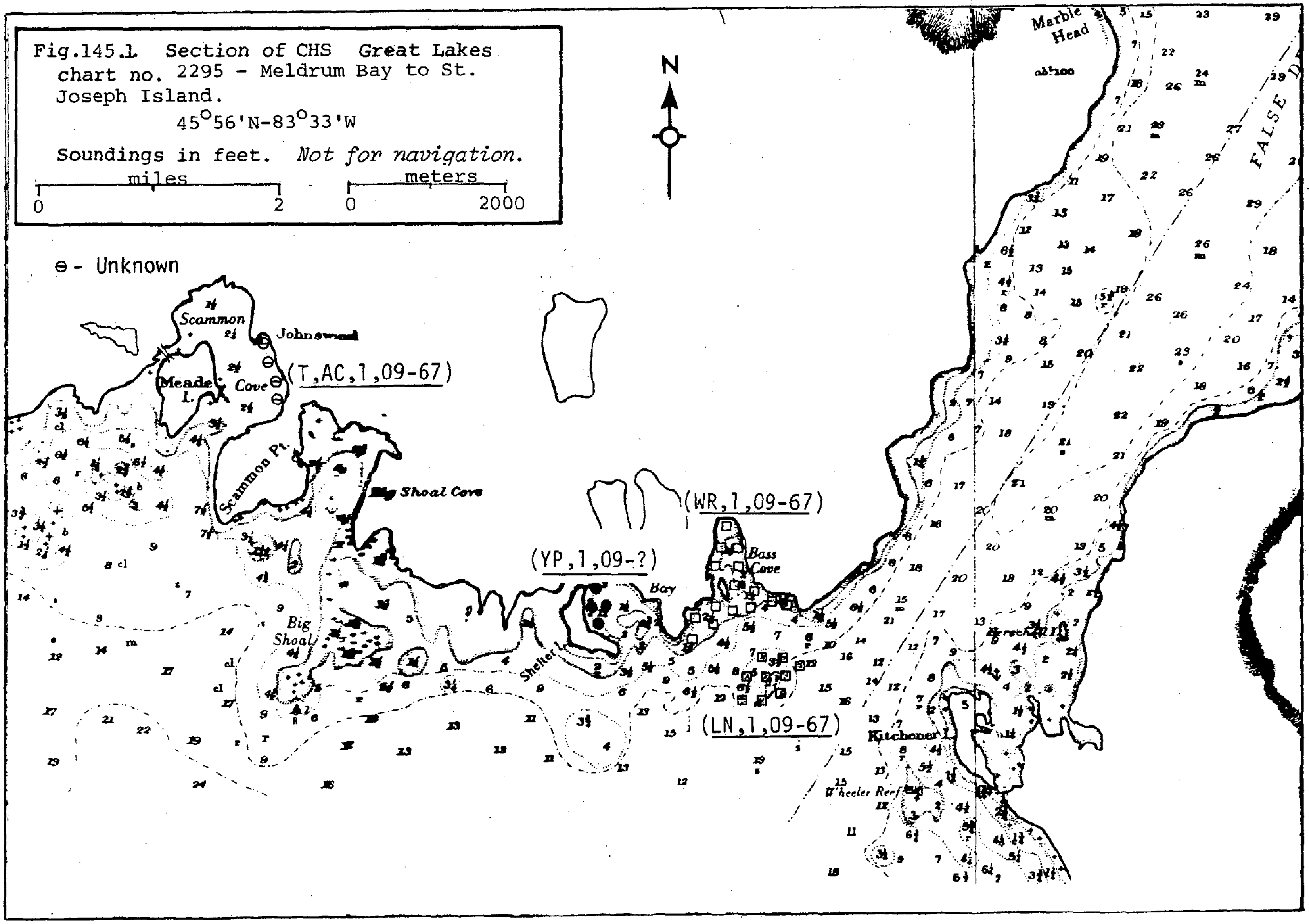



Fig.145.1 Section of CHS Great Lakes chart no. 2295 - Meldrum Bay to St. Joseph Island.
45°56'N-83°33'W

Soundings in feet. *Not for navigation.*

miles 0 — 2   meters 0 — 2000

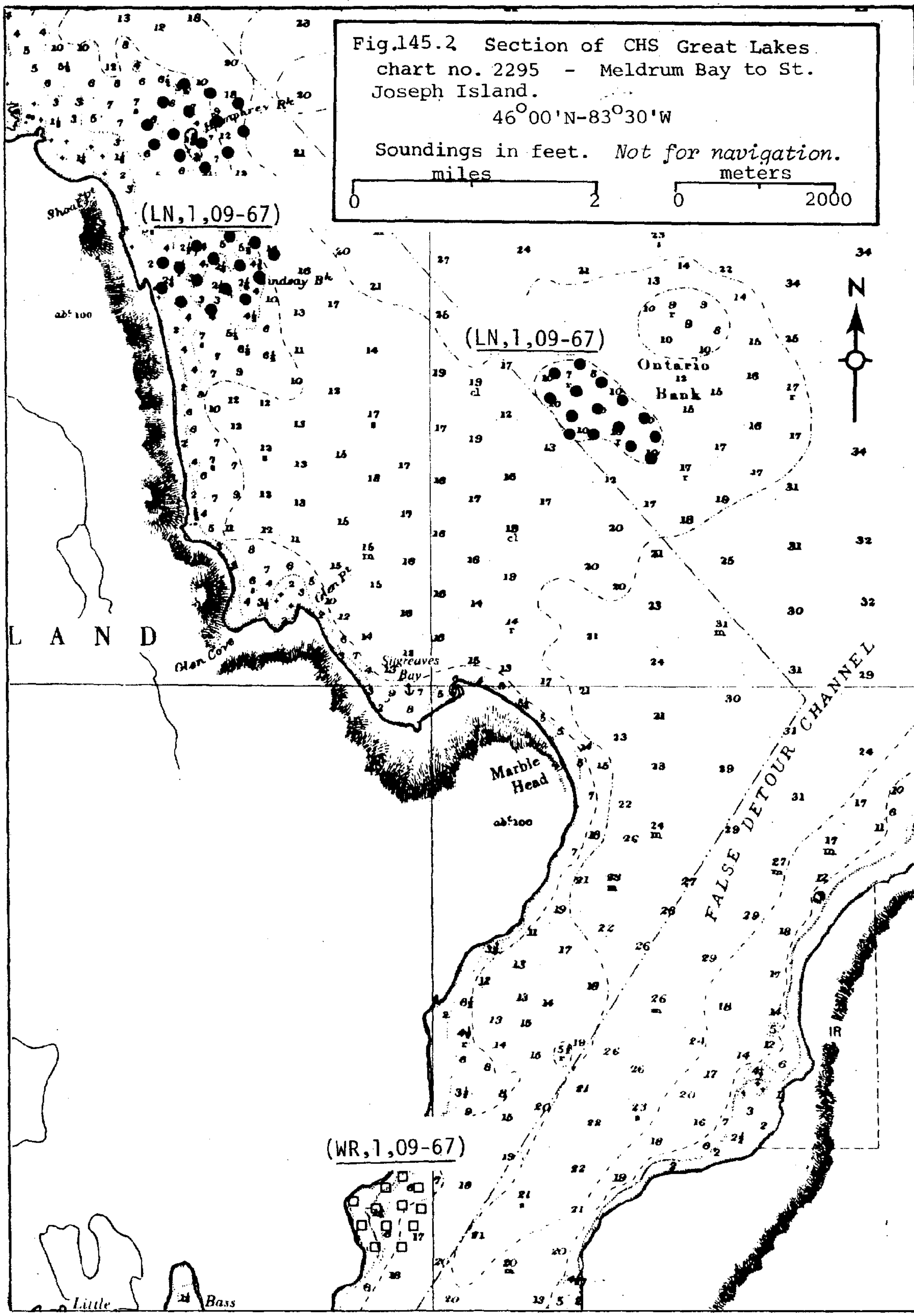



Fig.145.2 Section of CHS Great Lakes chart no. 2295 - Meldrum Bay to St. Joseph Island.
46°00'N-83°30'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

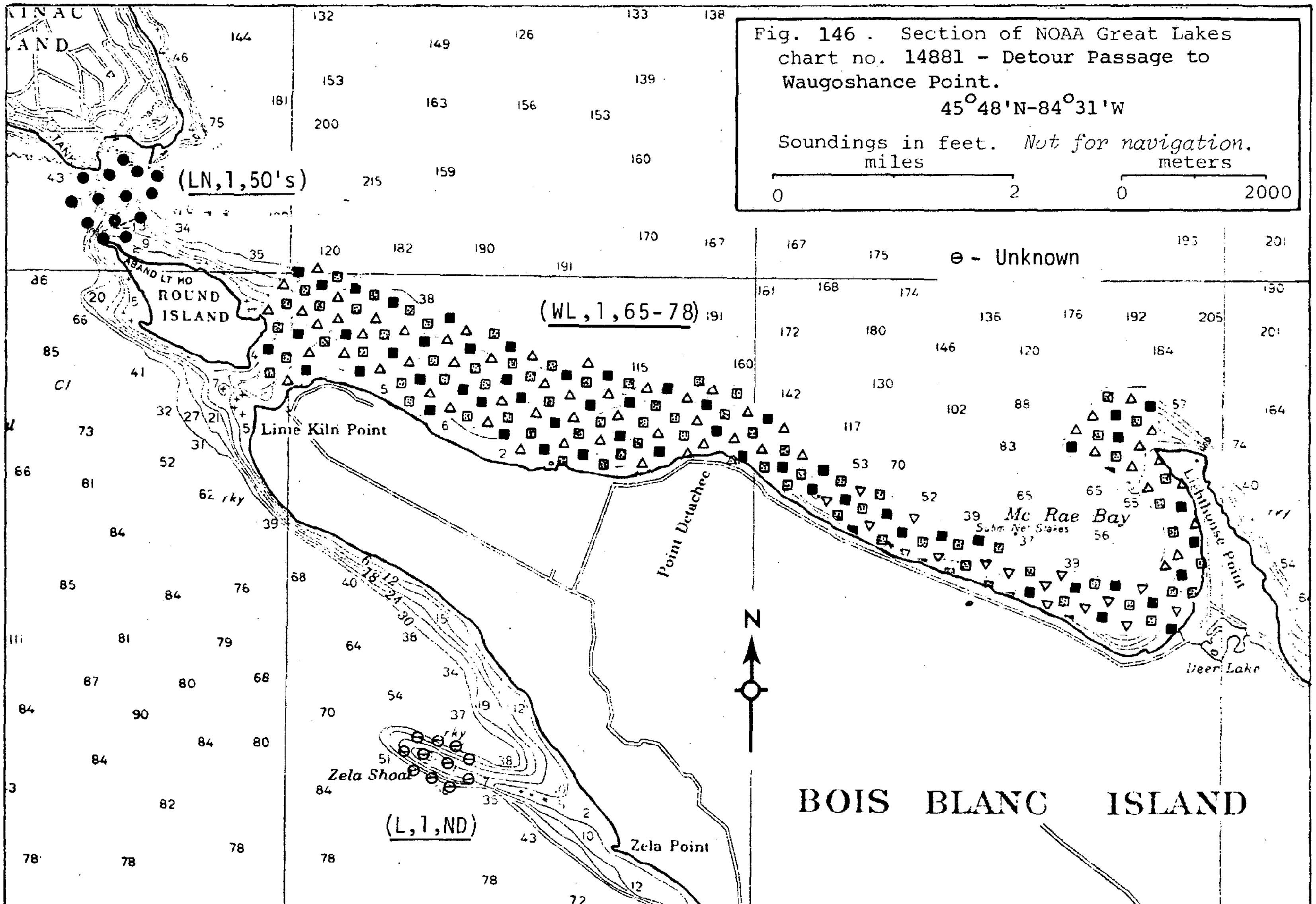



Fig. 146 . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°48'N-84°31'W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

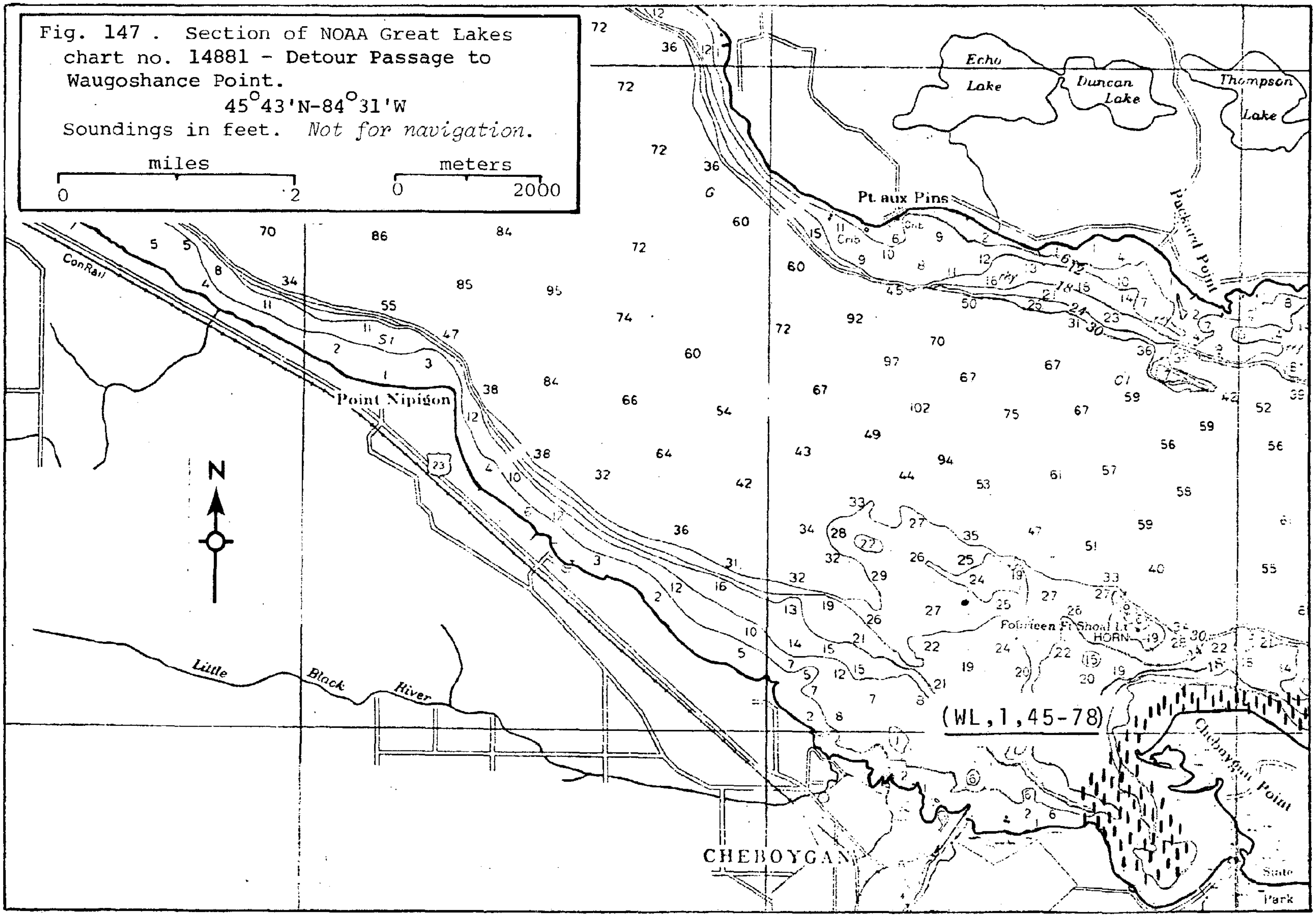



Fig. 147 . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°43'N-84°31'W
Soundings in feet. *Not for navigation.*

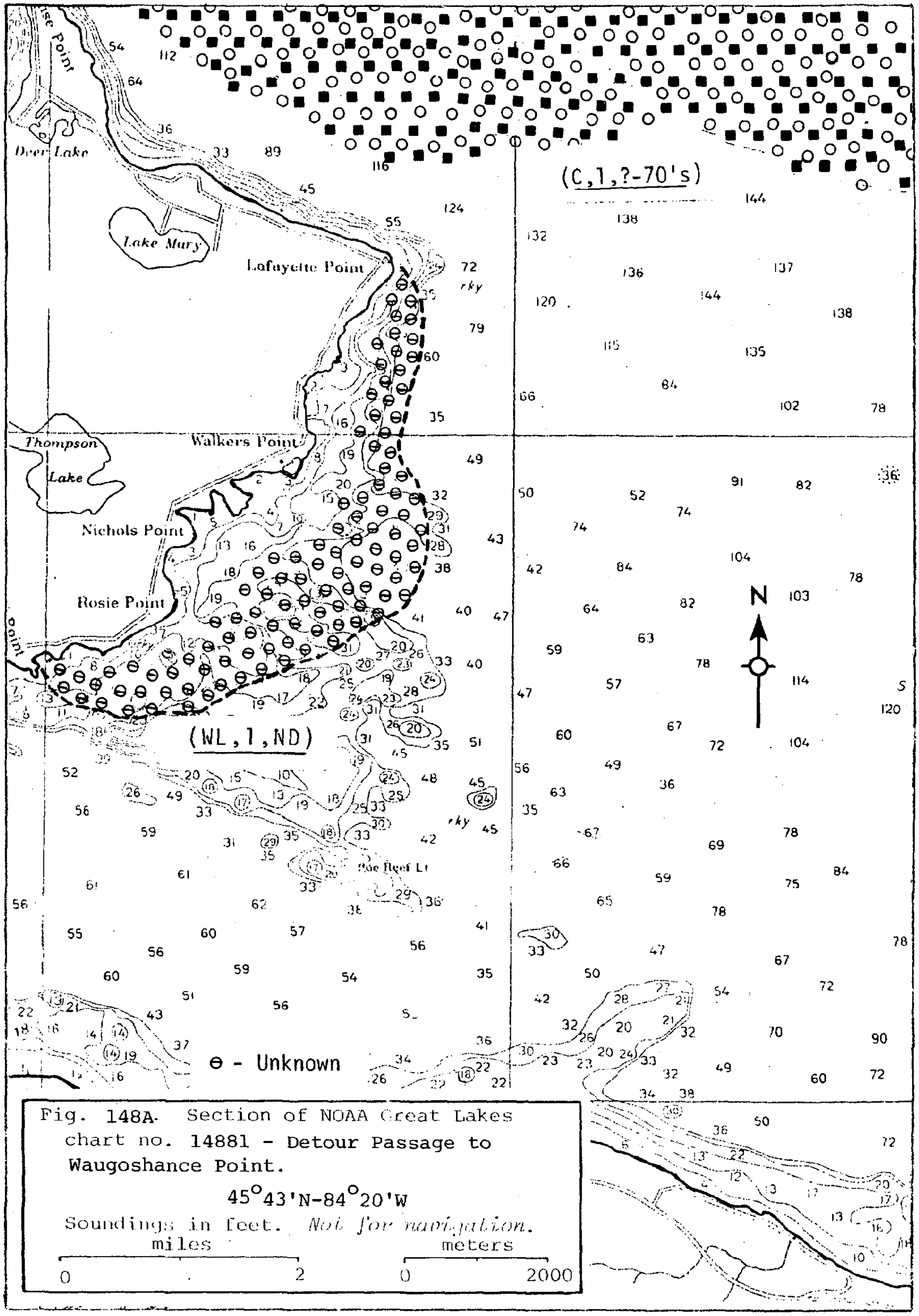


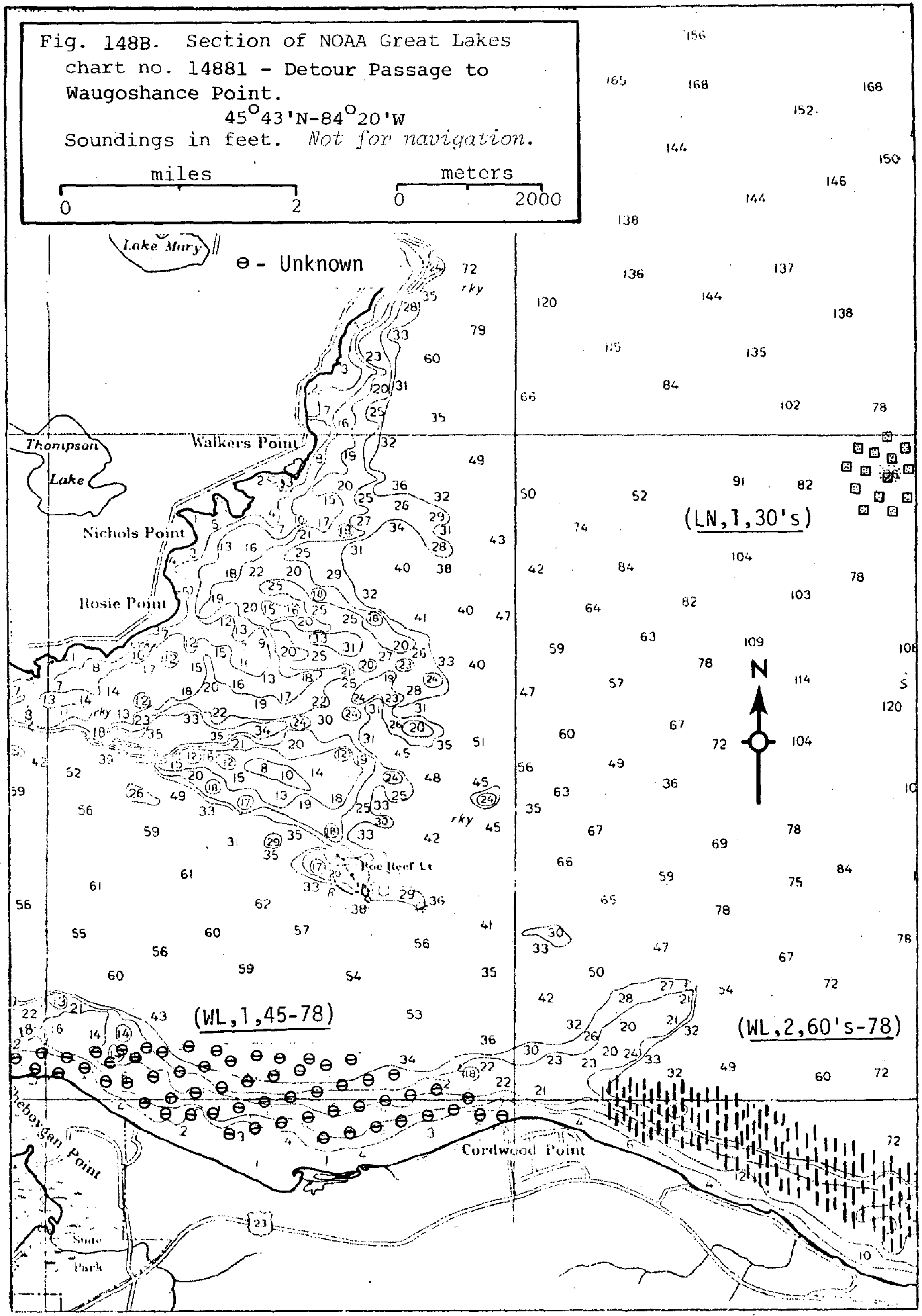

Fig. 148A. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.

45°43'N-84°20'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

Fig. 148B. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°43'N-84°20'W
Soundings in feet. *Not for navigation.*



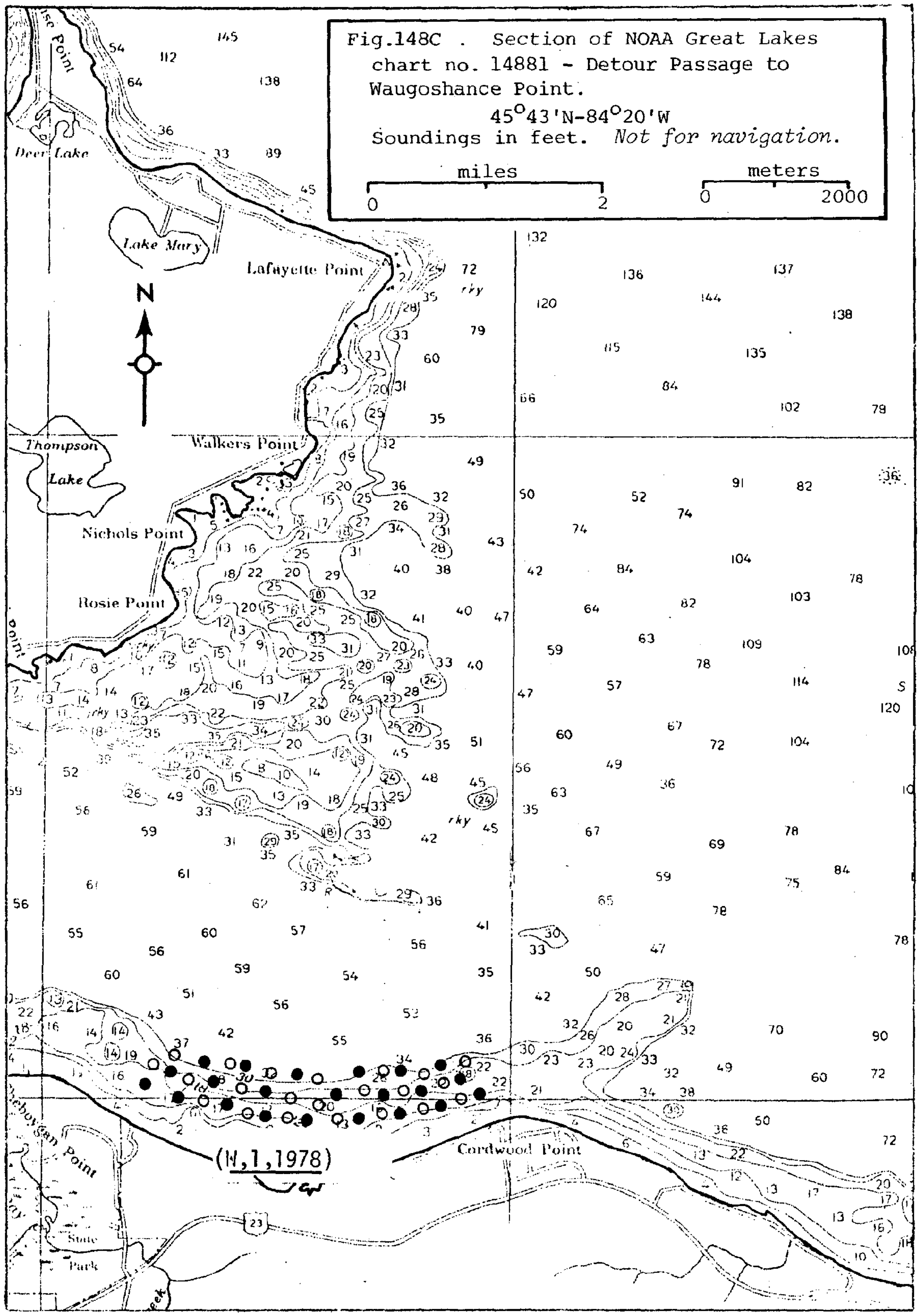



Fig.148C . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
$45^{\circ}43'$N-$84^{\circ}20'$W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

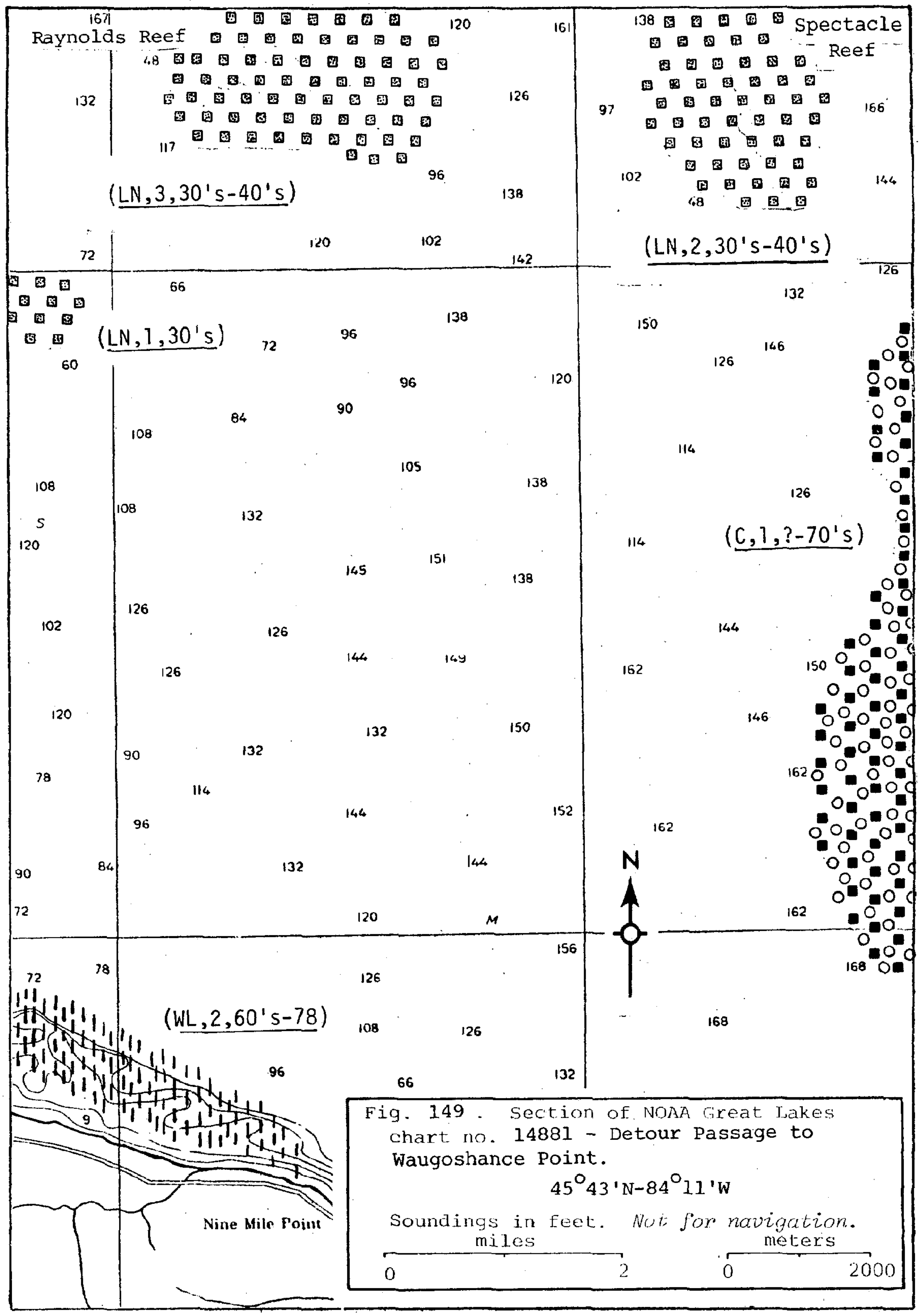



Fig. 149 . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
$45^{\circ}43'$N-$84^{\circ}11'$W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2000

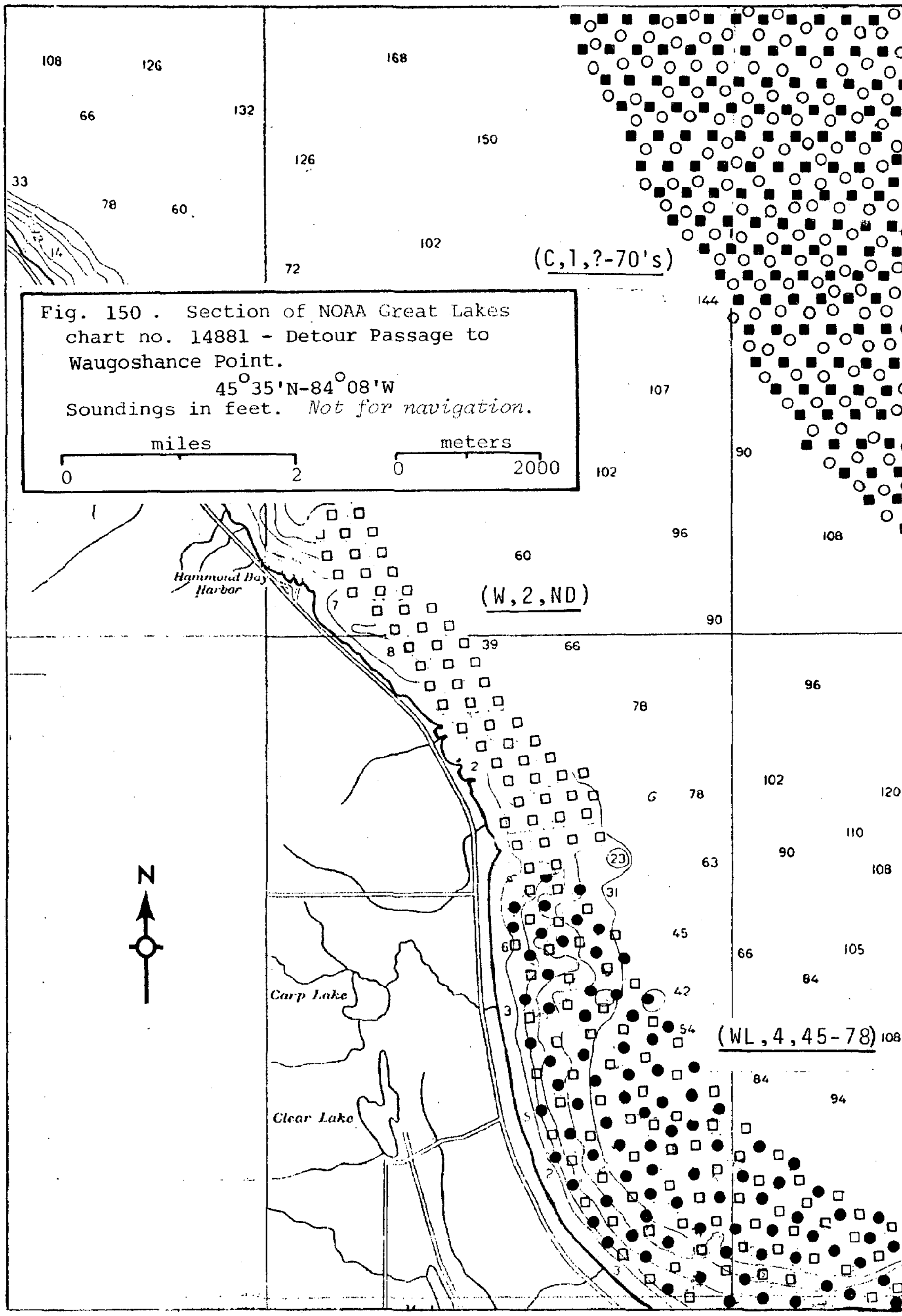



Fig. 150. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
$45^{\circ}35'$N-$84^{\circ}08'$W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

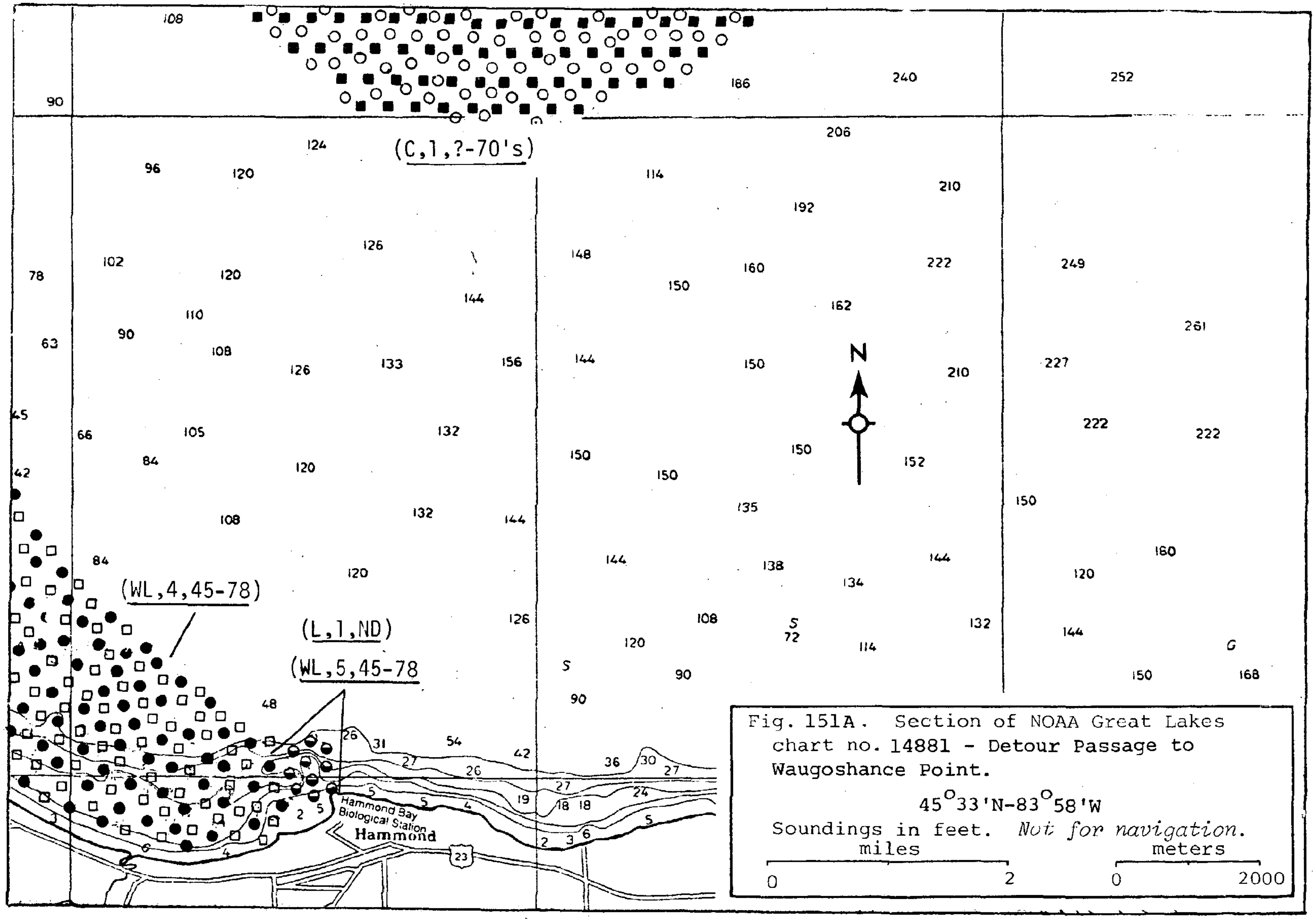



Fig. 151A. Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.

$45^{\circ}33'$N-$83^{\circ}58'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2000

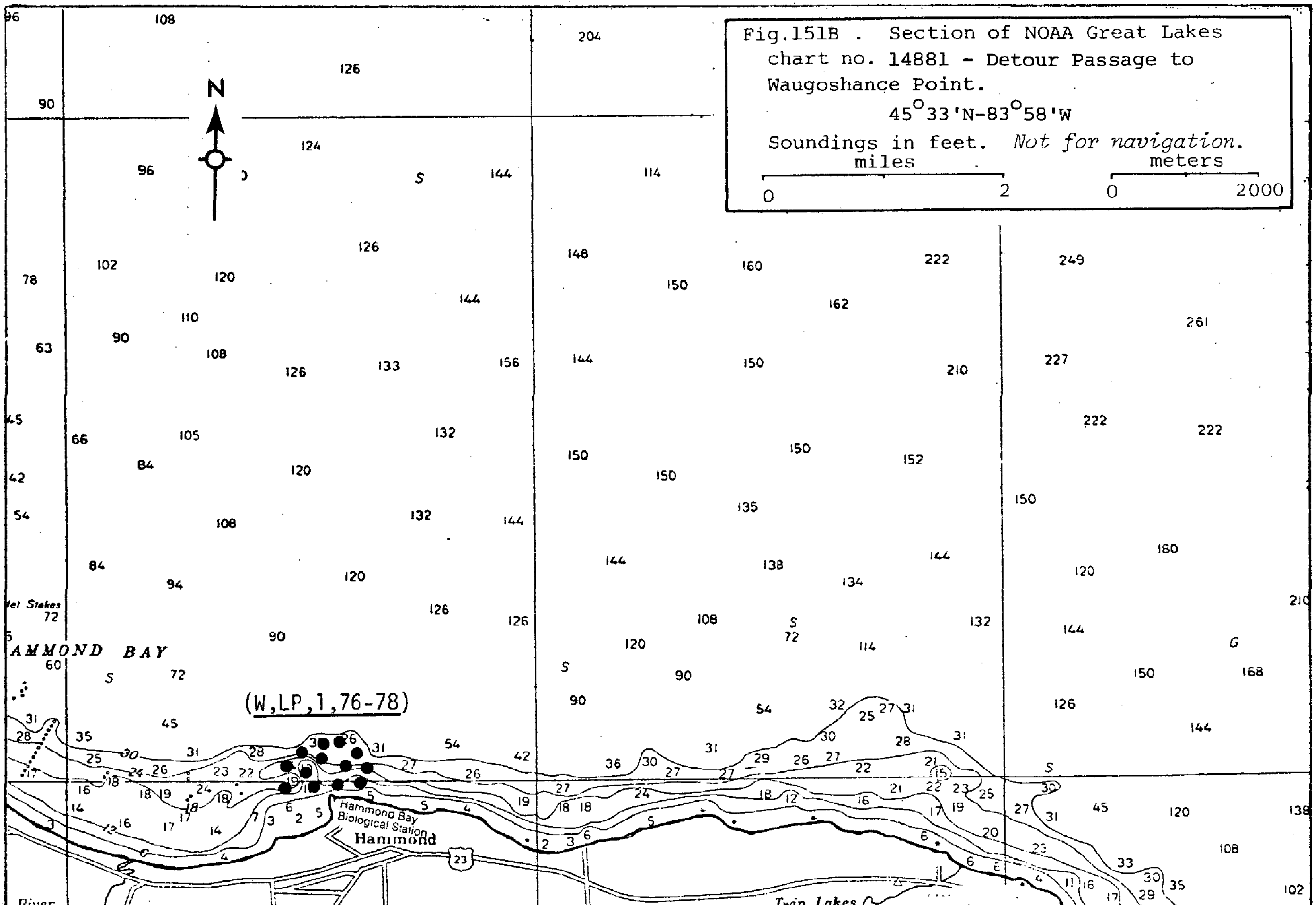



Fig.151B . Section of NOAA Great Lakes chart no. 14881 - Detour Passage to Waugoshance Point.
45°33'N-83°58'W
Soundings in feet. *Not for navigation.*
miles 0 2
meters 0 2000

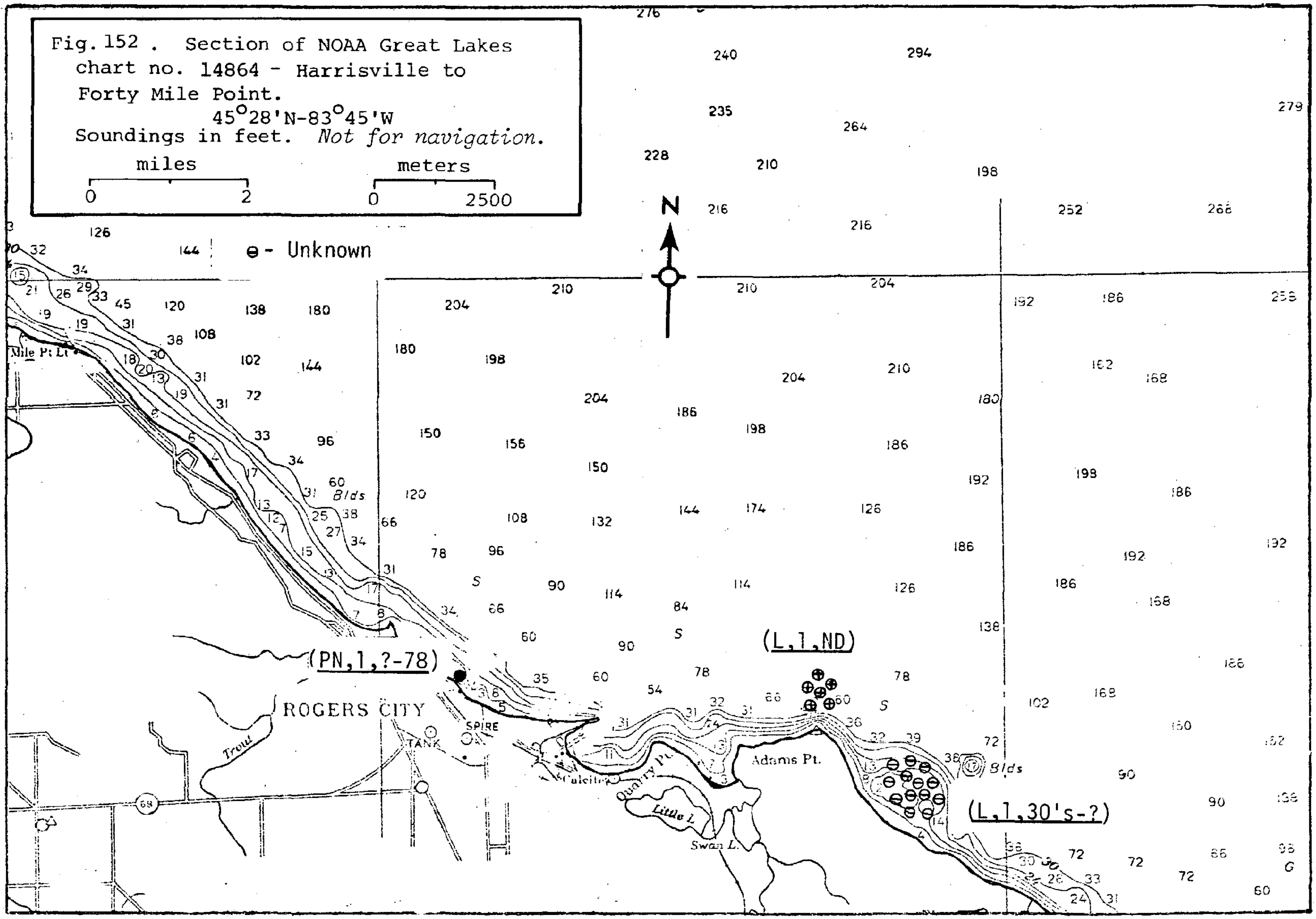
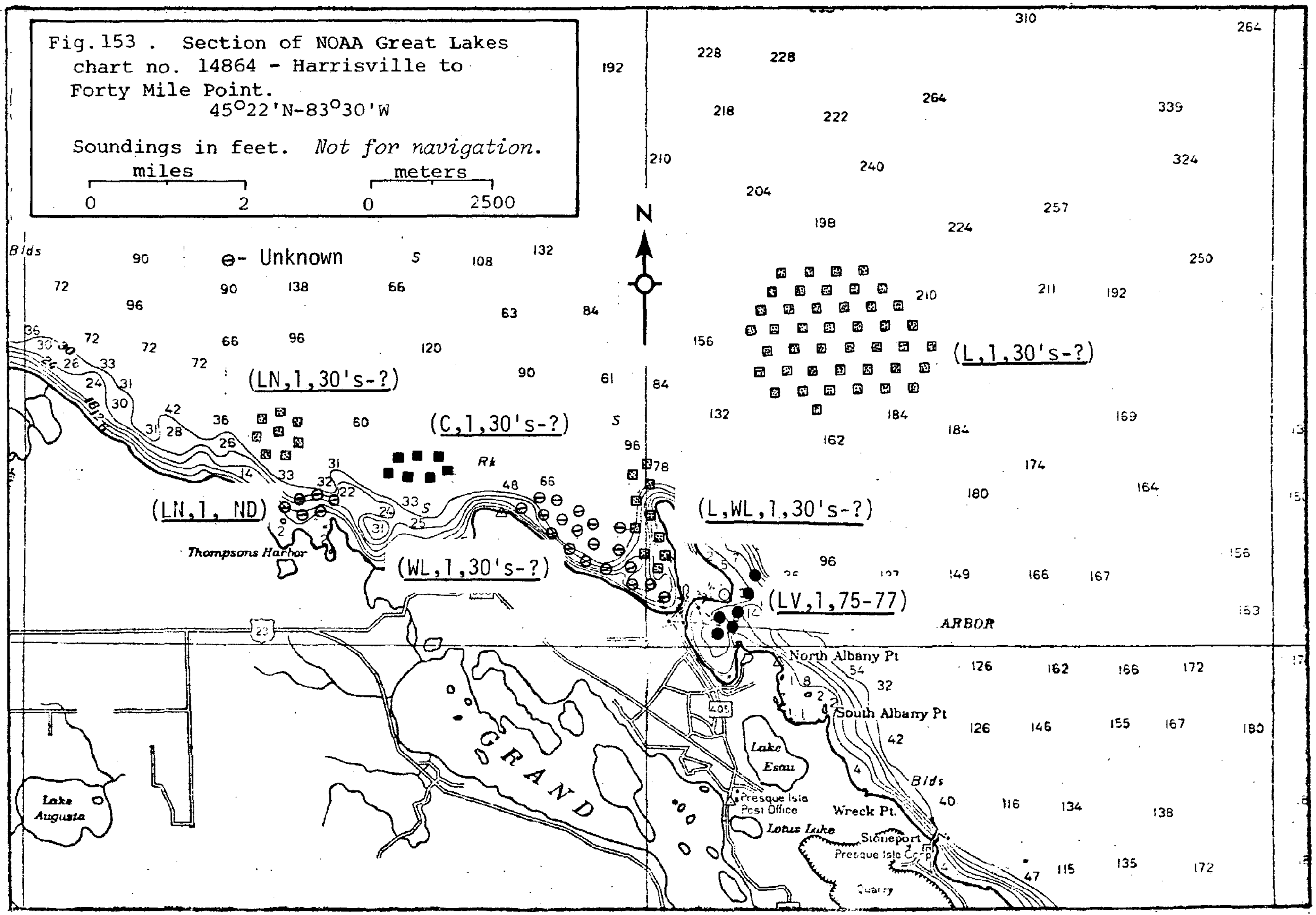



Fig. 152 . Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
45°28'N-83°45'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

Fig. 153 . Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
45°22'N-83°30'W

Soundings in feet. *Not for navigation.*



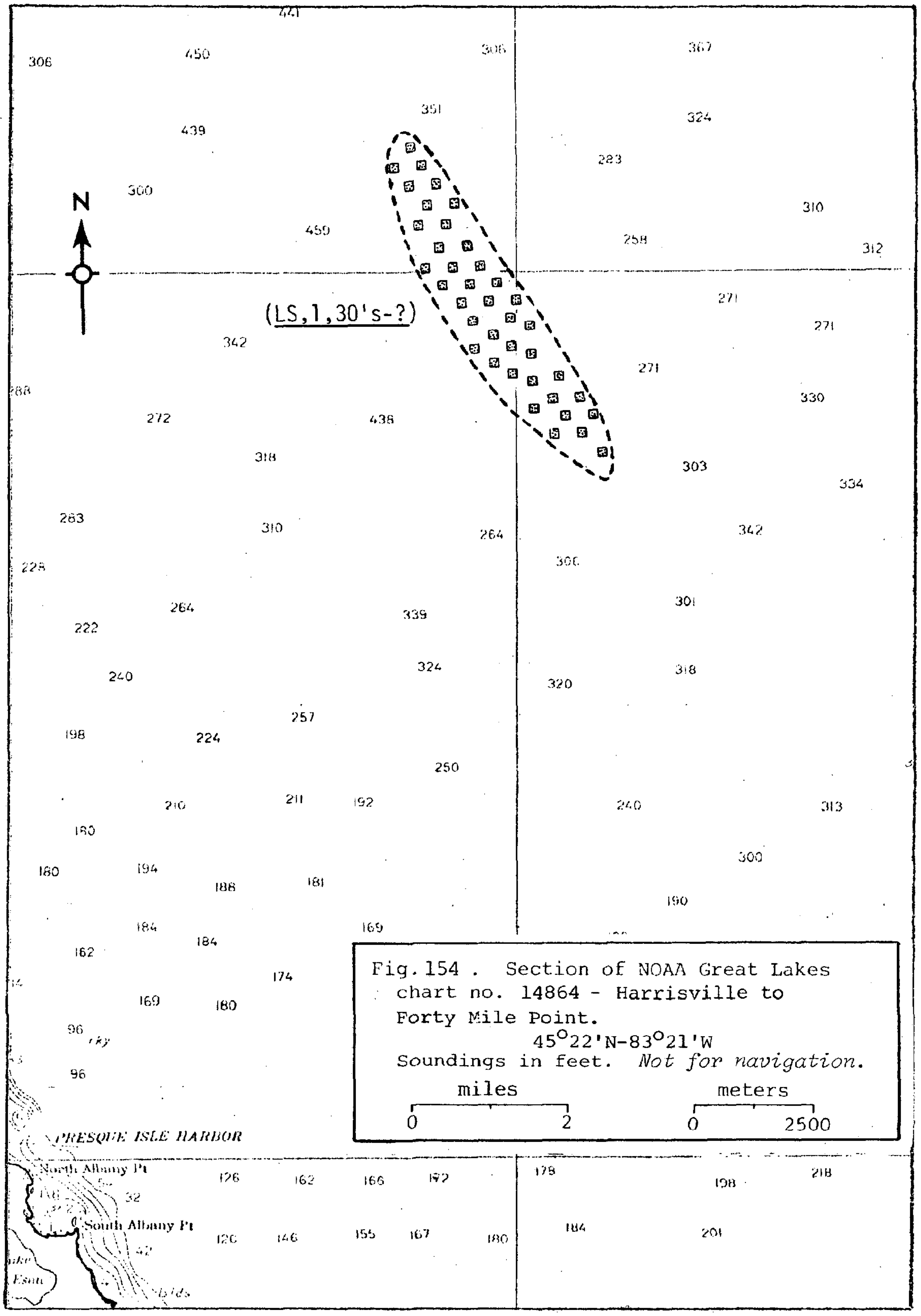



Fig. 154 . Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
45°22'N-83°21'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

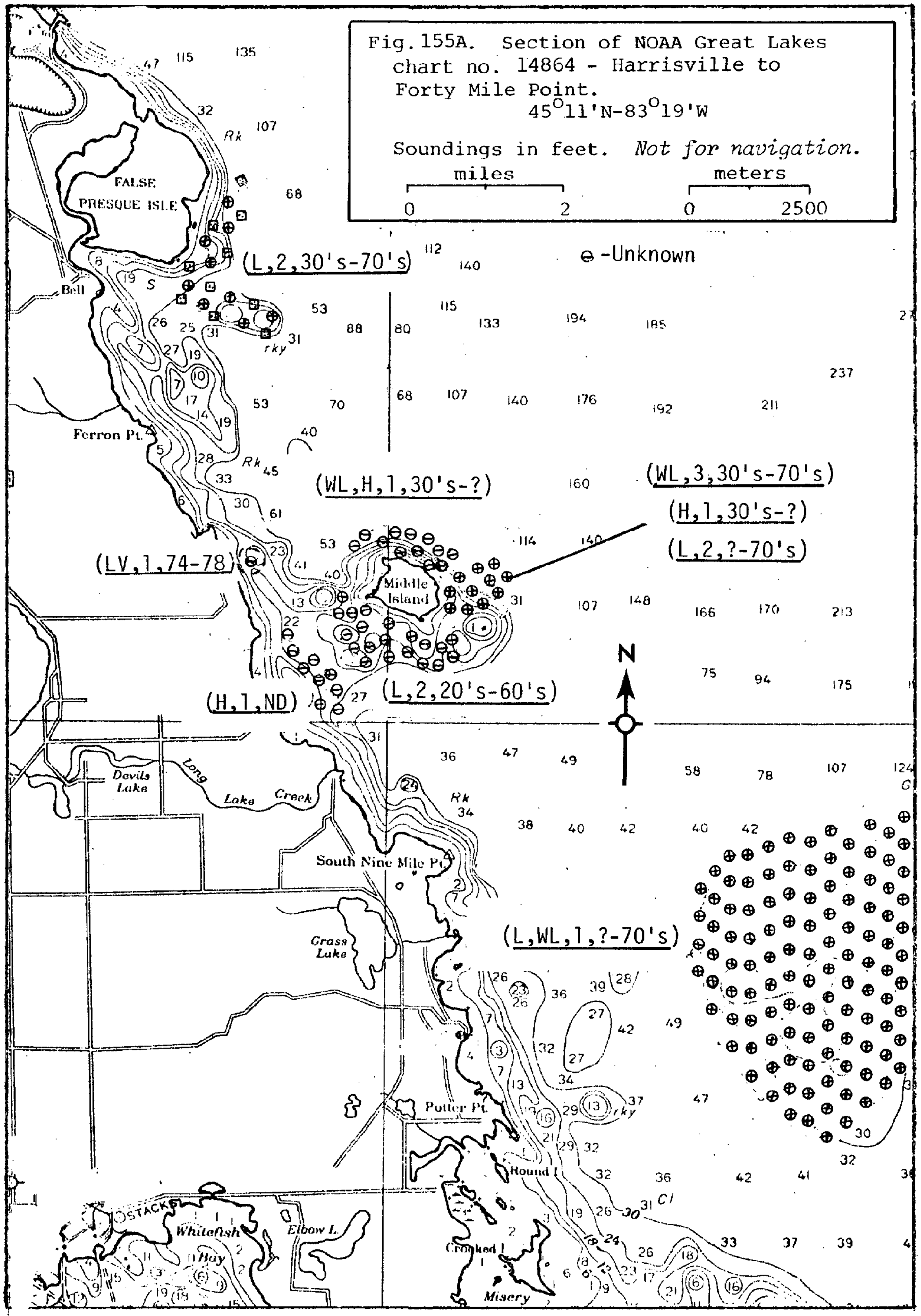


Fig. 155A. Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point. 45°11'N-83°19'W
Soundings in feet. *Not for navigation.*
miles
0 2
meters
0 2500
⊖ -Unknown
(L,2,30's-70's)
(WL,H,1,30's-?)
(WL,3,30's-70's)
(H,1,30's-?)
(L,2,?-70's)
(LV,1,74-78)
(H,1,ND)
(L,2,20's-60's)
(L,WL,1,?-70's)
FALSE PRESQUE ISLE
Ferron Pt.
Middle Island
Devils Lake
Long Lake Creek
South Nine Mile Pt.
Grass Lake
Potter Pt.
Round I.
Whitefish Bay
Elbow L.
Crooked I.
Misery
STACK
N

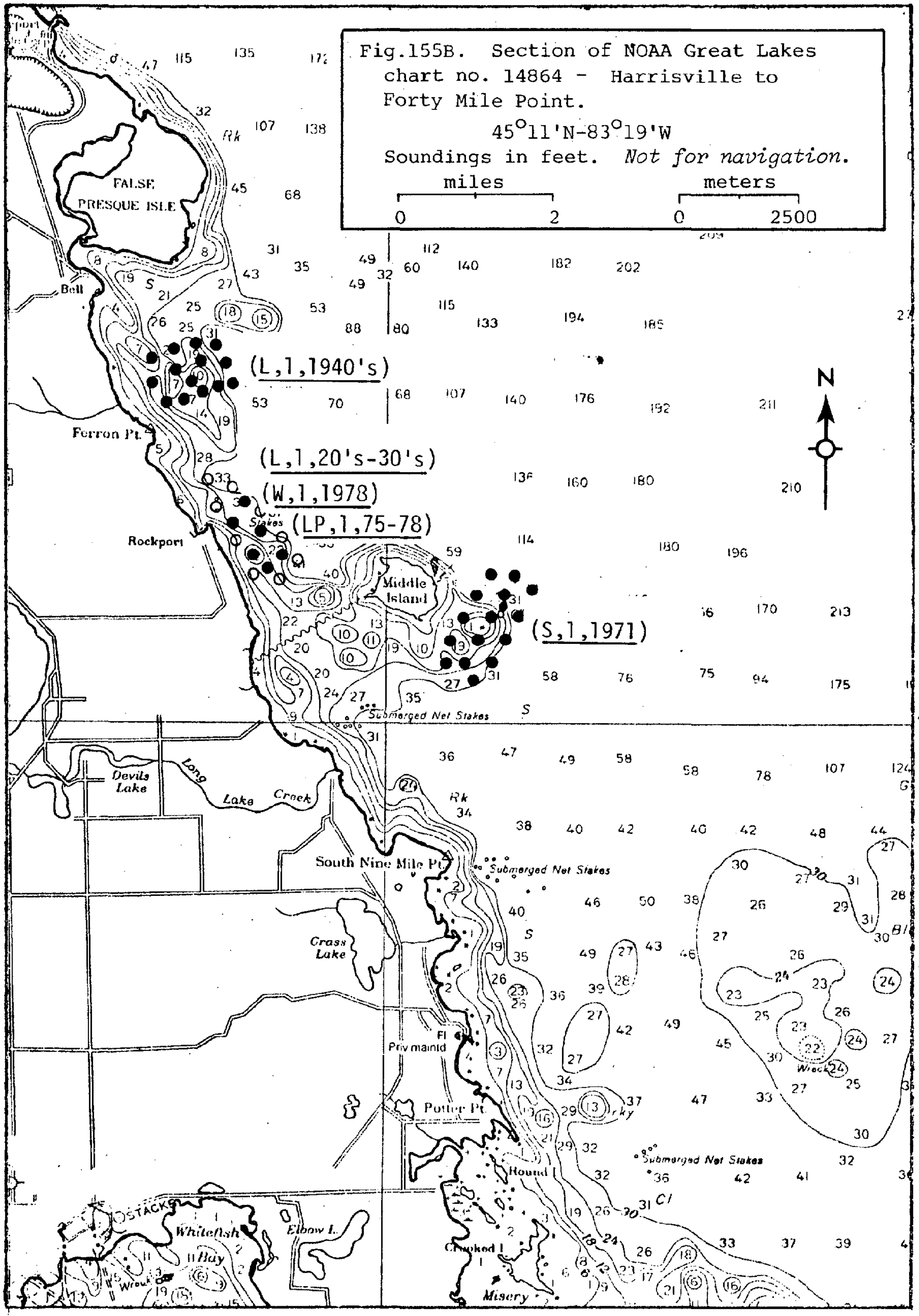
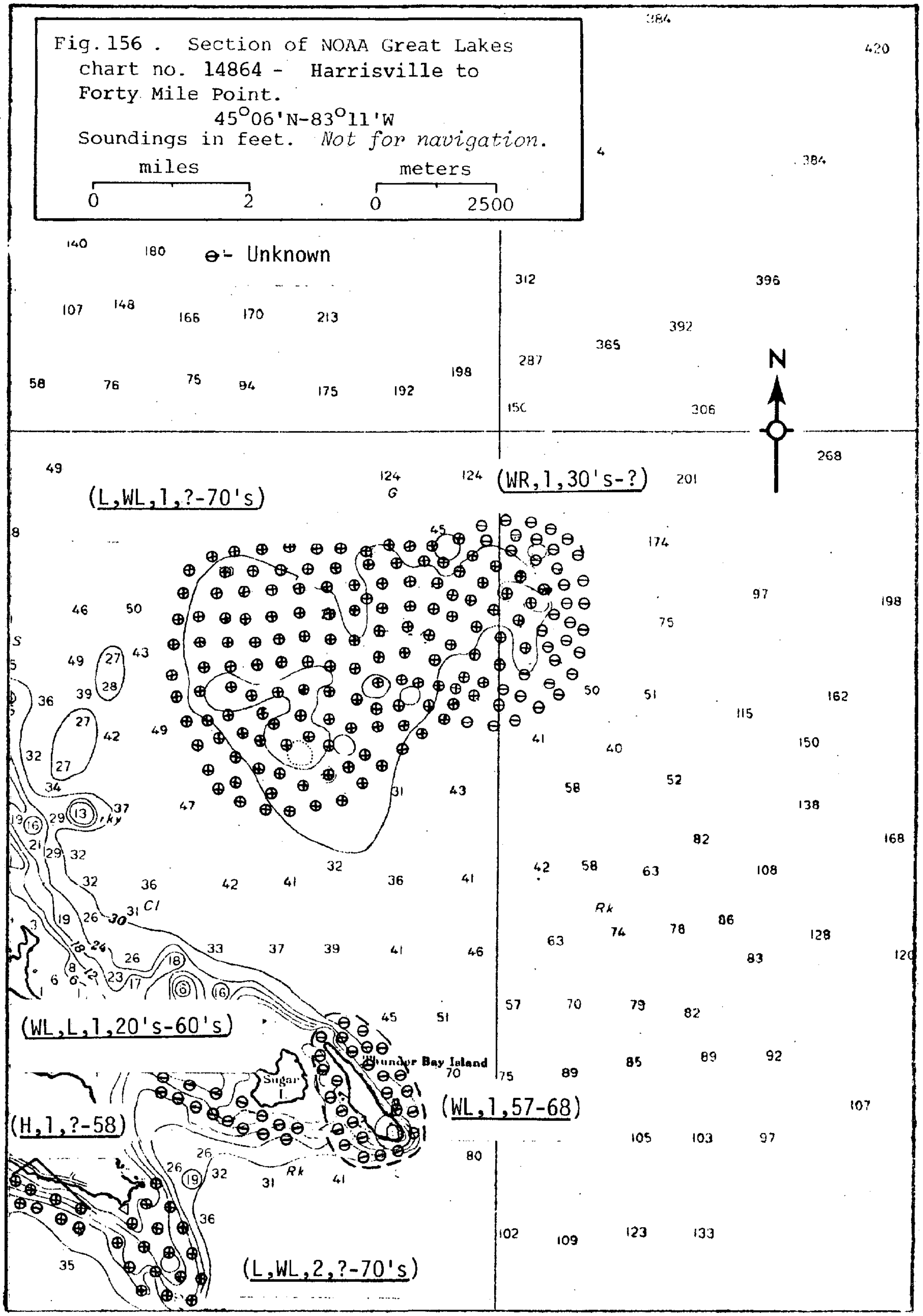


Fig.155B. Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
45°11'N-83°19'W
Soundings in feet. *Not for navigation.*
miles
0 2
meters
0 2500
N
FALSE PRESQUE ISLE
Bell
Ferron Pt.
Rockport
Middle Island
(L,1,1940's)
(L,1,20's-30's)
(W,1,1978)
(LP,1,75-78)
(S,1,1971)
Submerged Net Stakes
Devils Lake
Long Lake Creek
South Nine Mile Pt.
Grass Lake
Potter Pt.
Whitefish Bay
Elbow L.
Crooked I.
Misery
STACKS
Wreck

Fig. 156 . Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
45°06'N-83°11'W
Soundings in feet. *Not for navigation.*



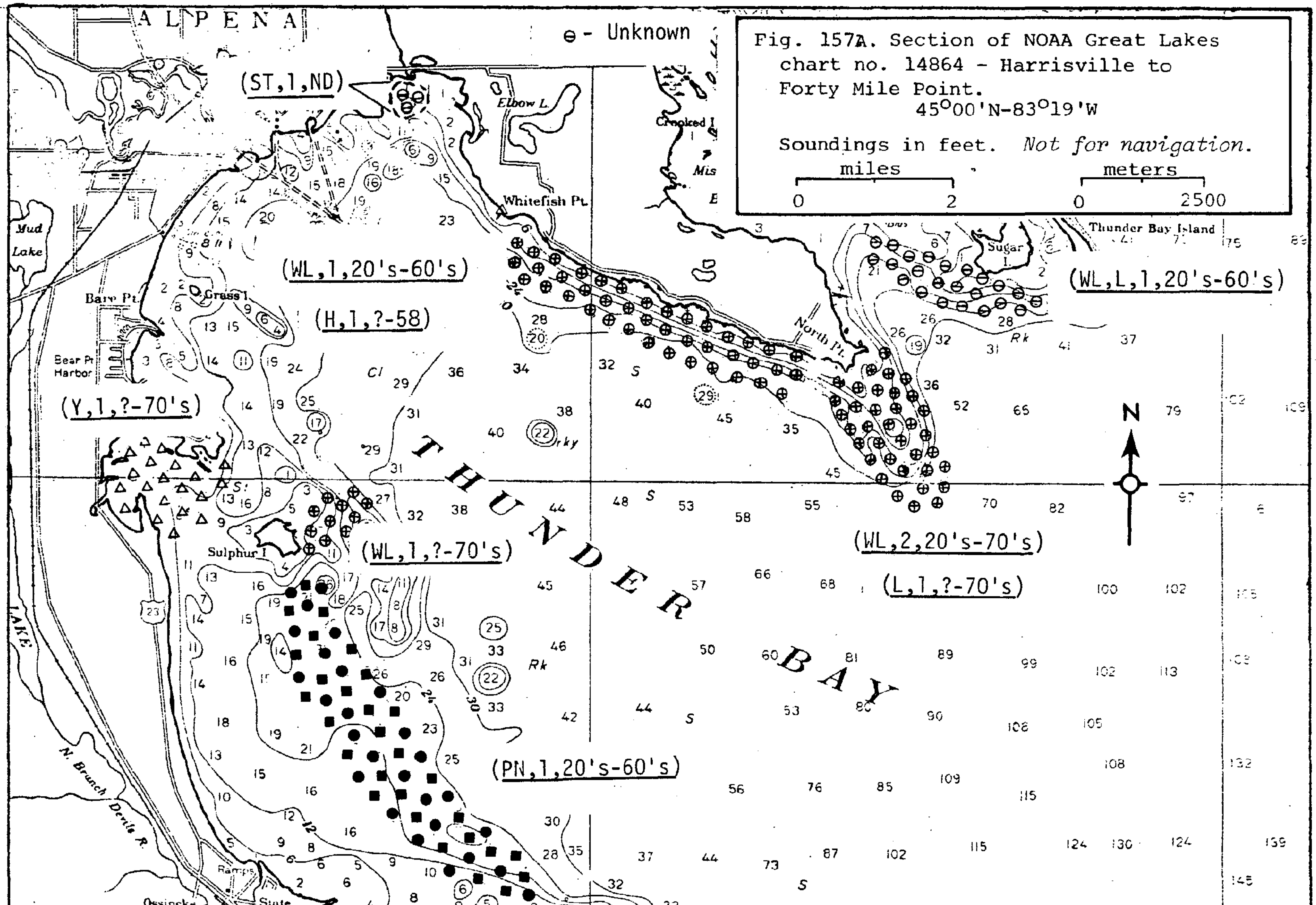



Fig. 157A. Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
45°00'N-83°19'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

469

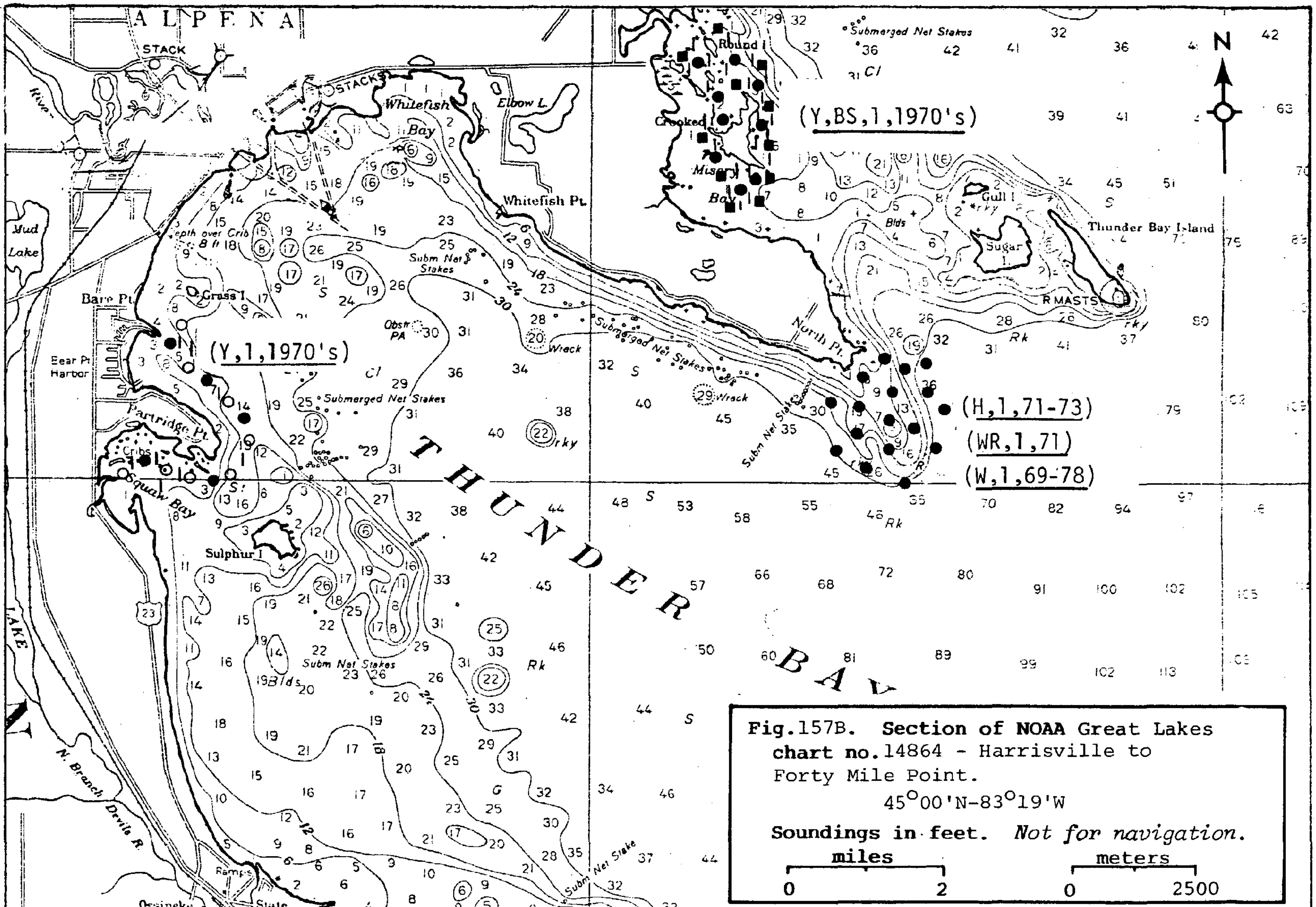



Fig.157B. **Section of NOAA** Great Lakes **chart no.**14864 - Harrisville to Forty Mile Point.
45°00'N-83°19'W

**Soundings in feet.** *Not for navigation.*

**miles** 0 2 **meters** 0 2500

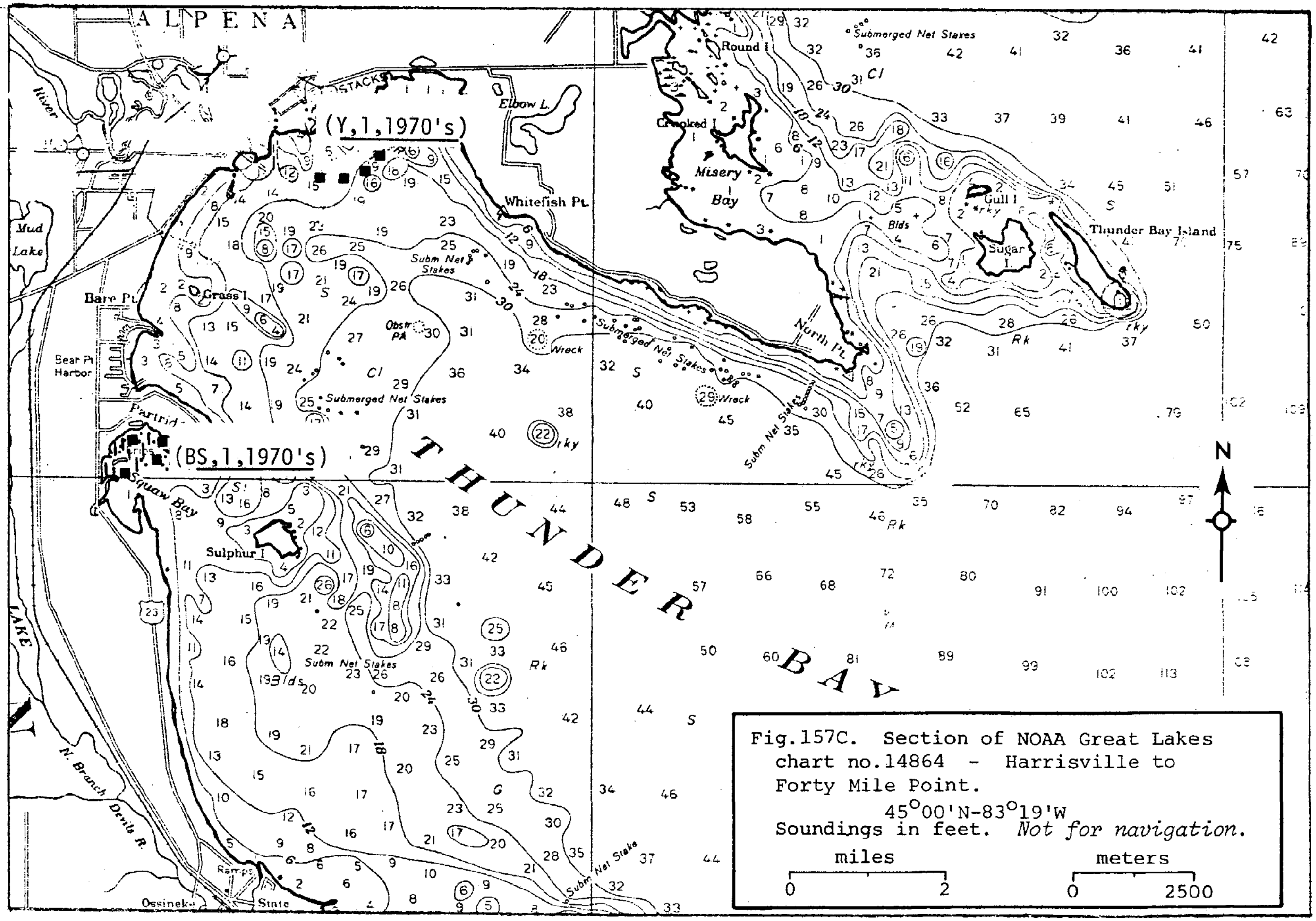



Fig.157C. Section of NOAA Great Lakes chart no.14864 - Harrisville to Forty Mile Point.
45°00'N-83°19'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

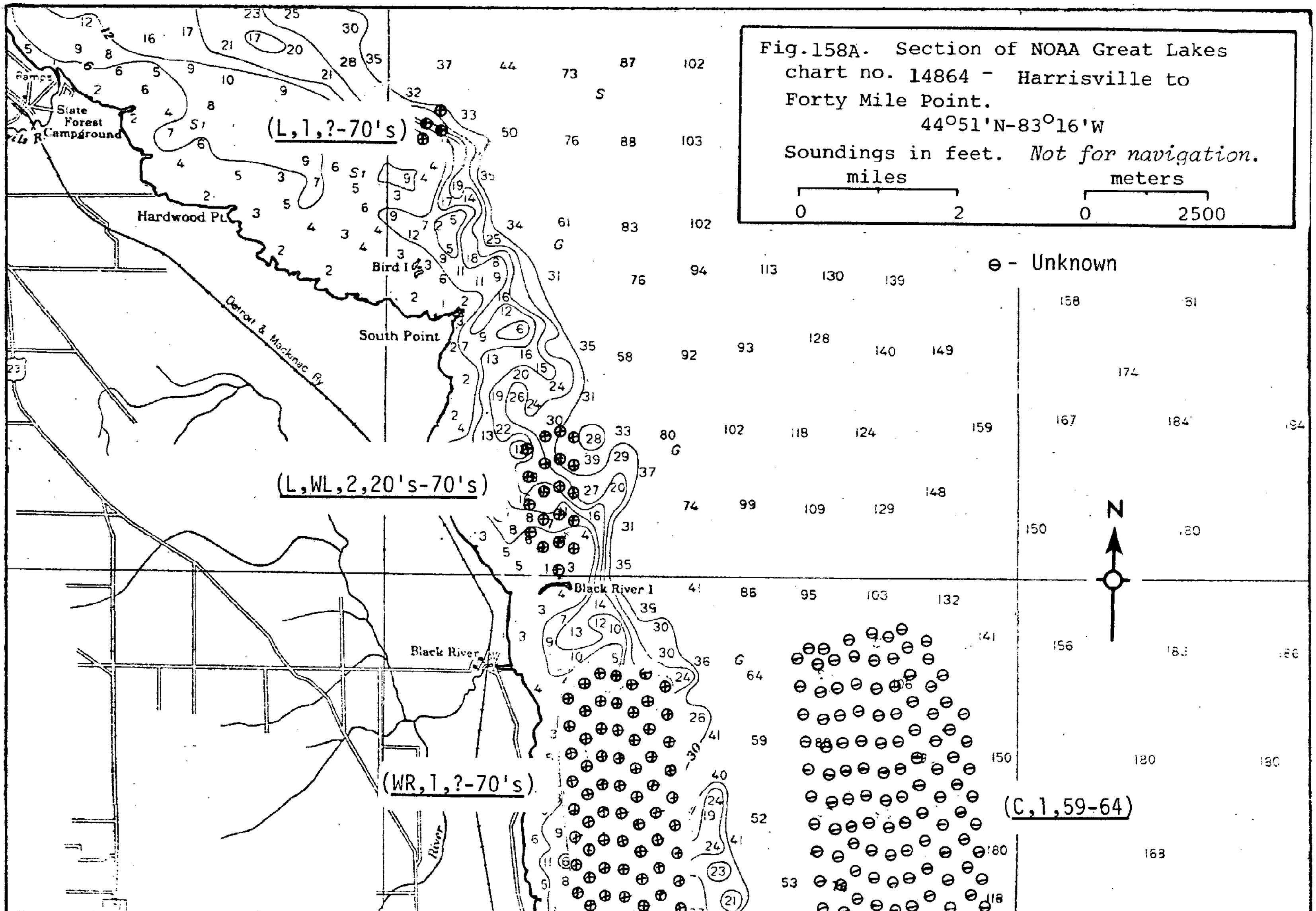



Fig.158A. Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
44°51'N-83°16'W

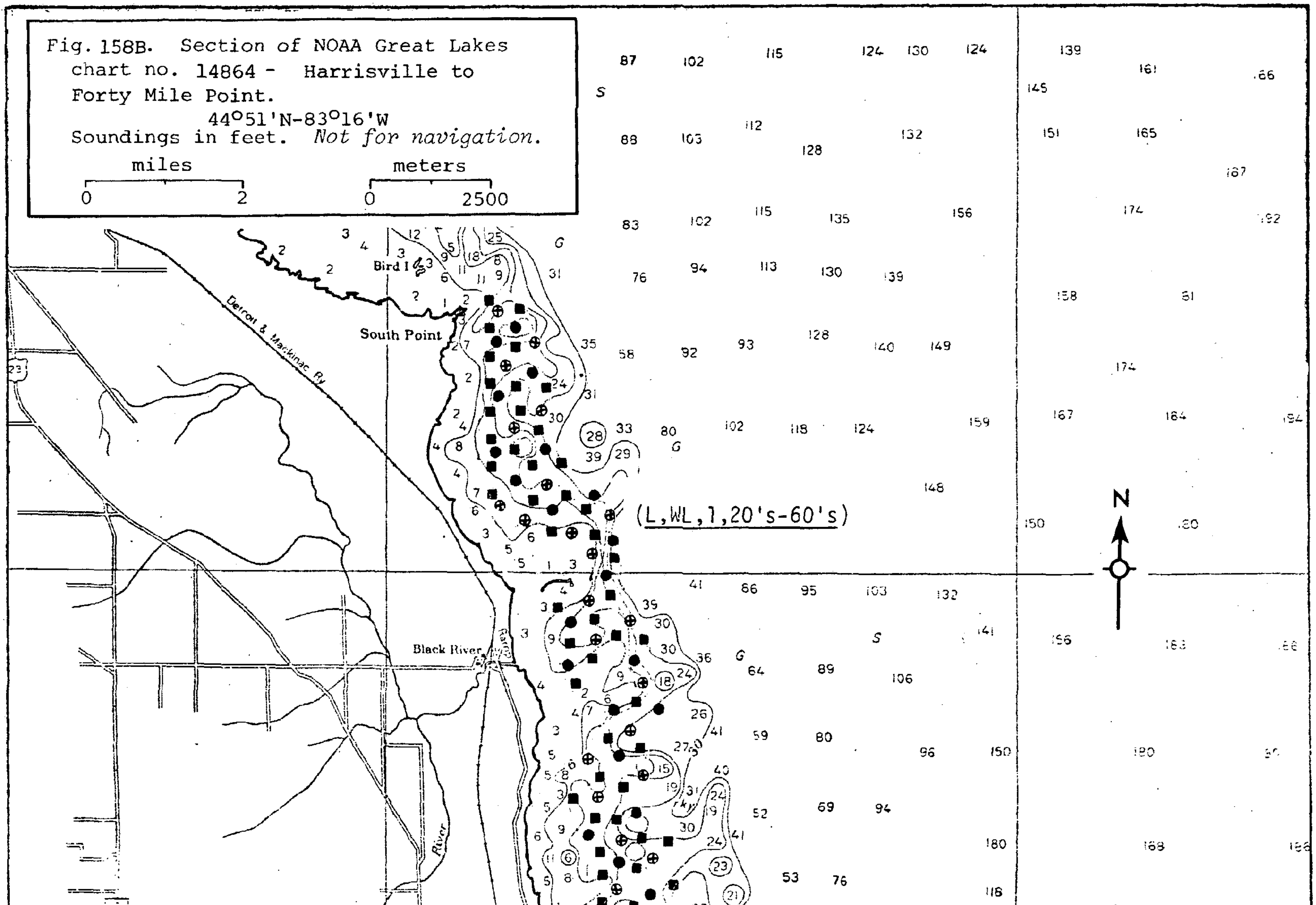



Fig. 158B. Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
44°51'N-83°16'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

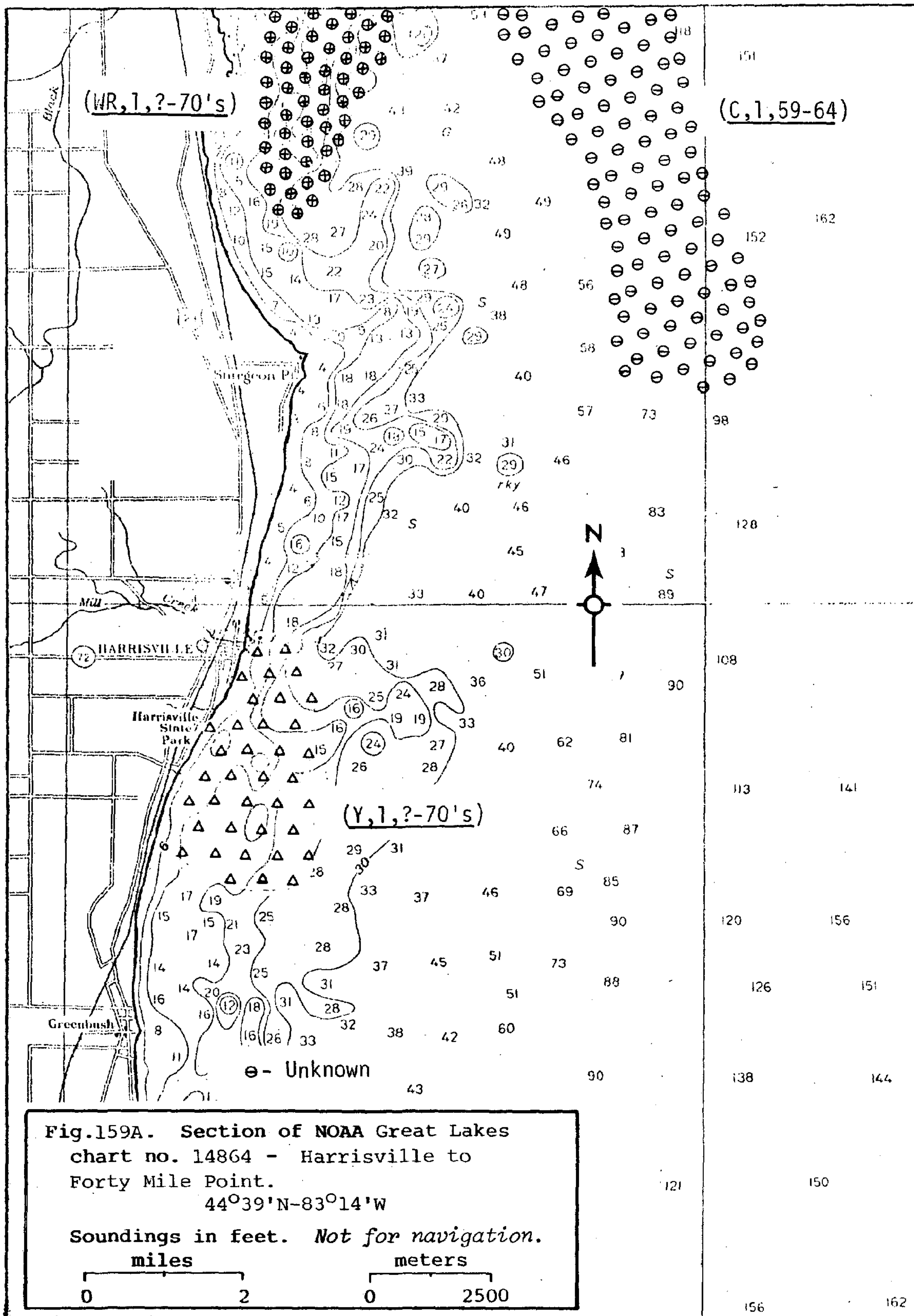



**Fig.159A. Section of NOAA** Great Lakes
**chart no.** 14864 - Harrisville to
Forty Mile Point.
44°39'N-83°14'W

**Soundings in feet.** *Not for navigation.*

miles 0 – 2     meters 0 – 2500

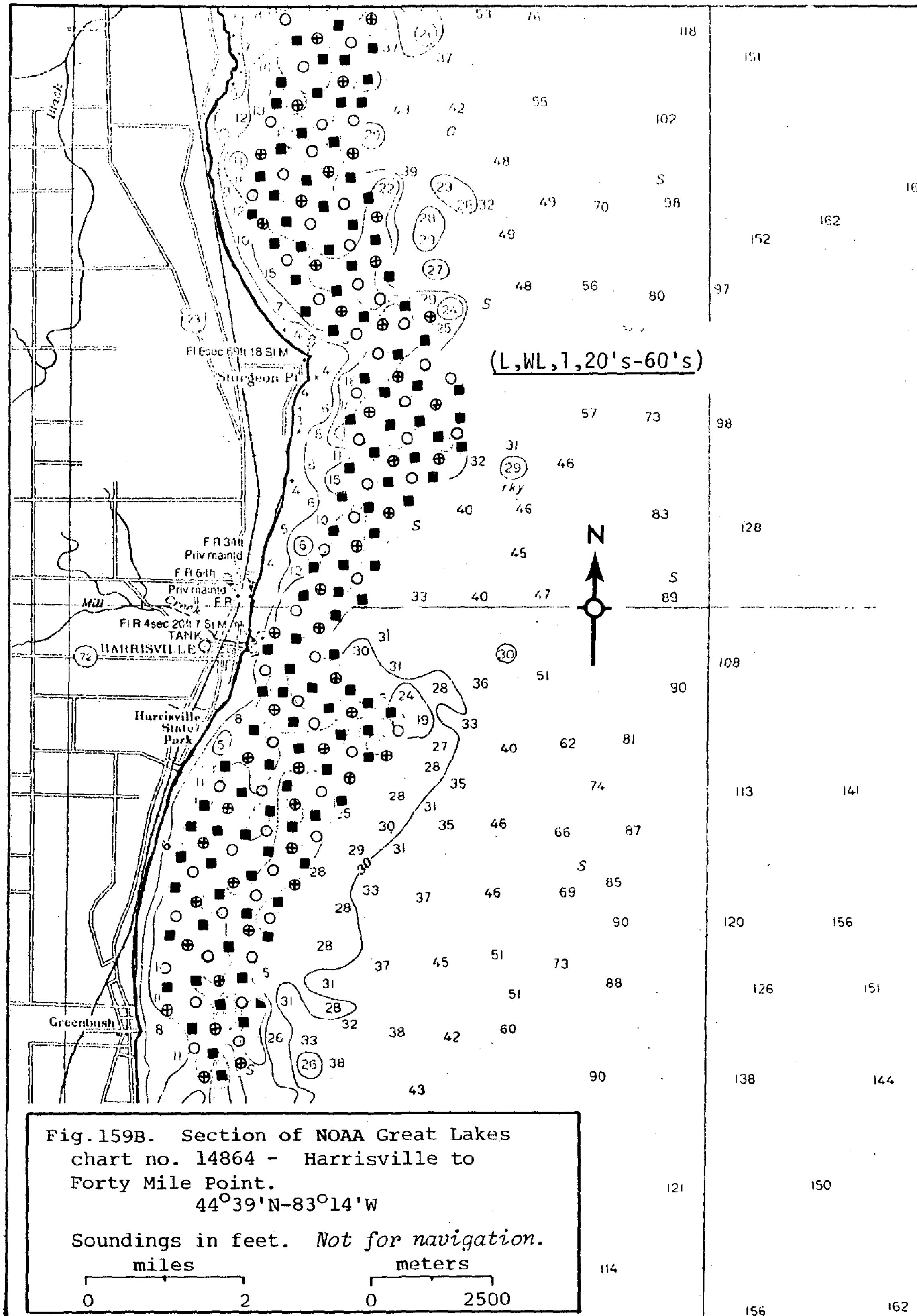



Fig.159B. Section of NOAA Great Lakes chart no. 14864 - Harrisville to Forty Mile Point.
44°39'N-83°14'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

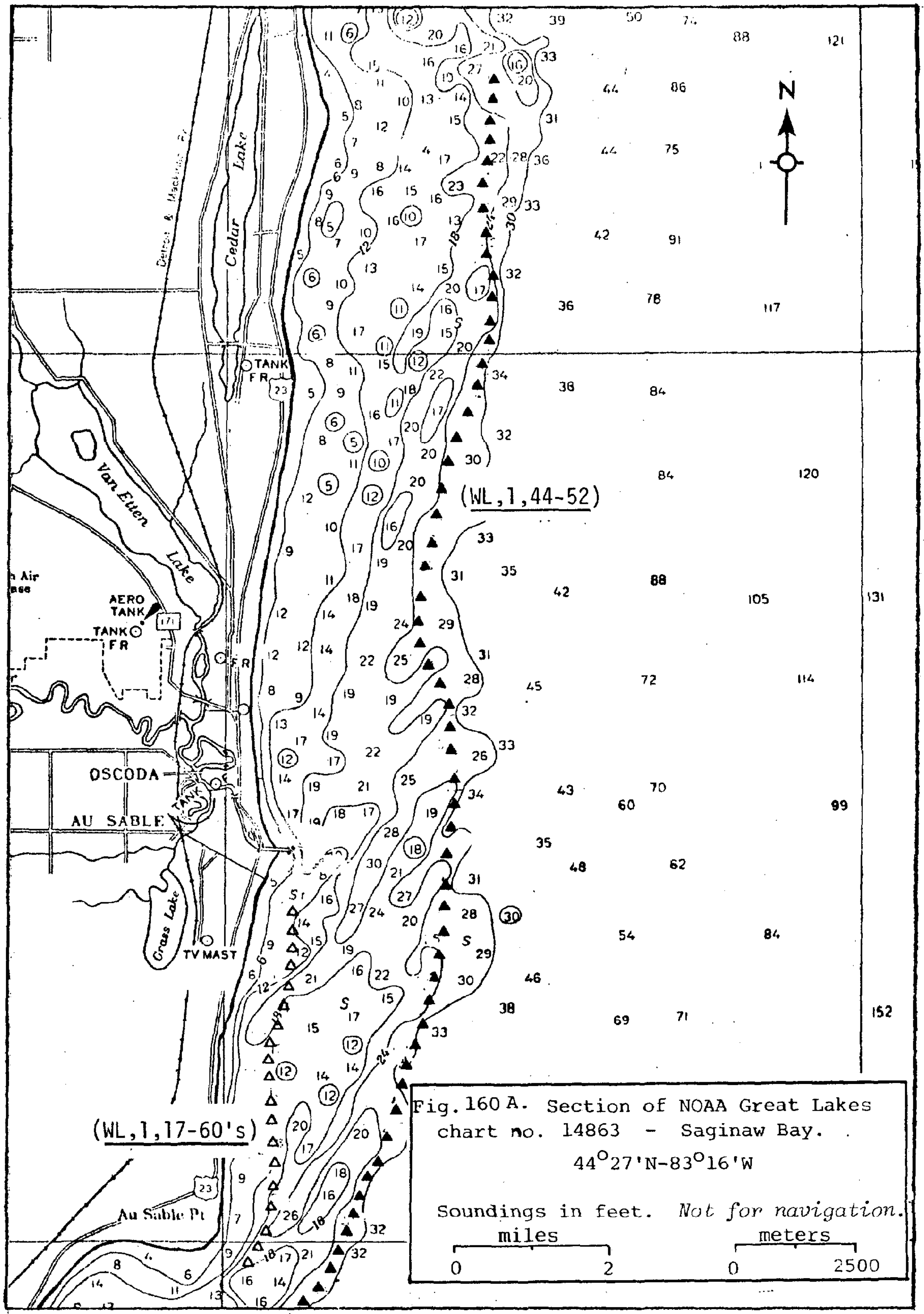



Fig. 160 A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
44°27'N-83°16'W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

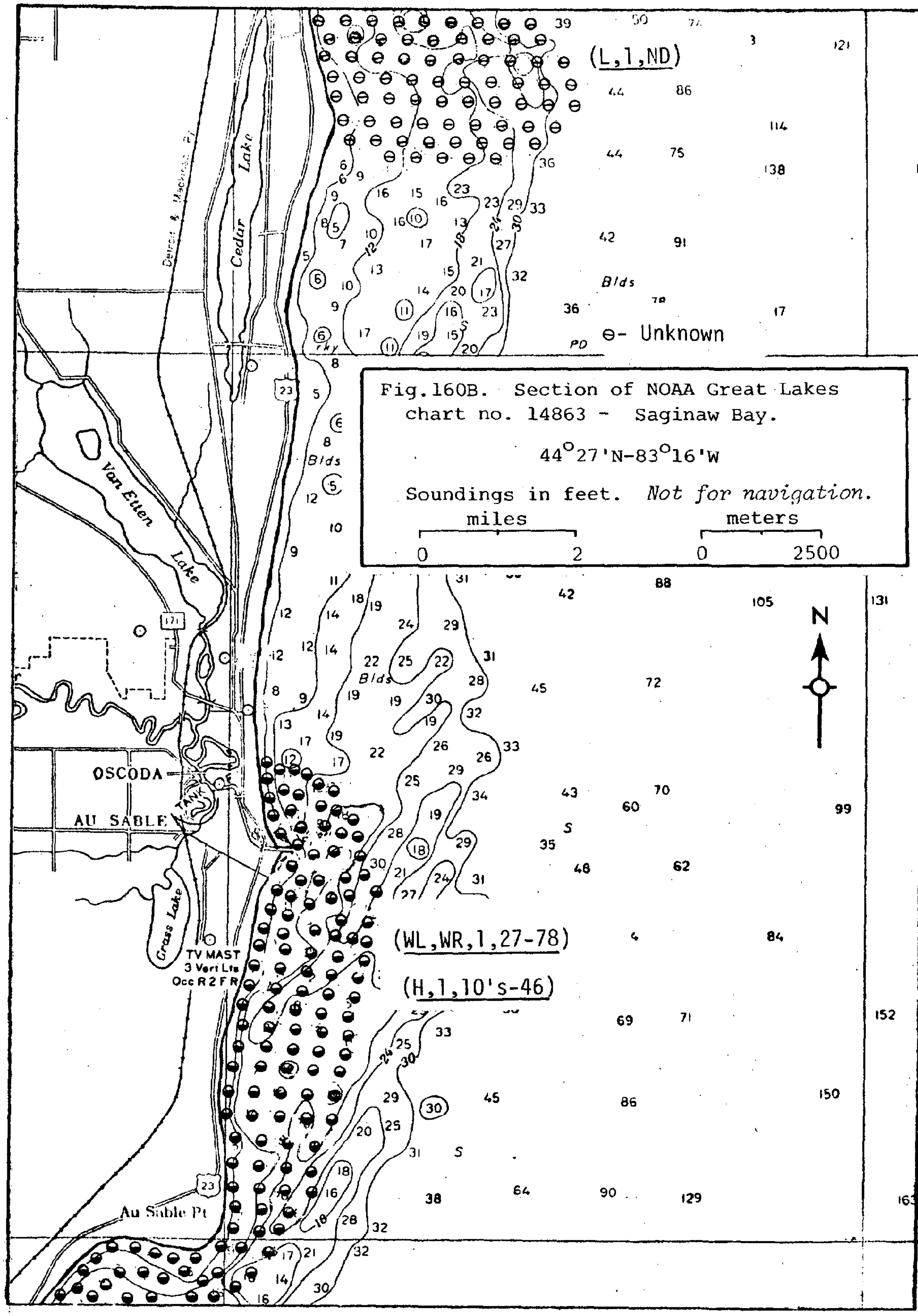



Fig.160B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

44°27'N-83°16'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

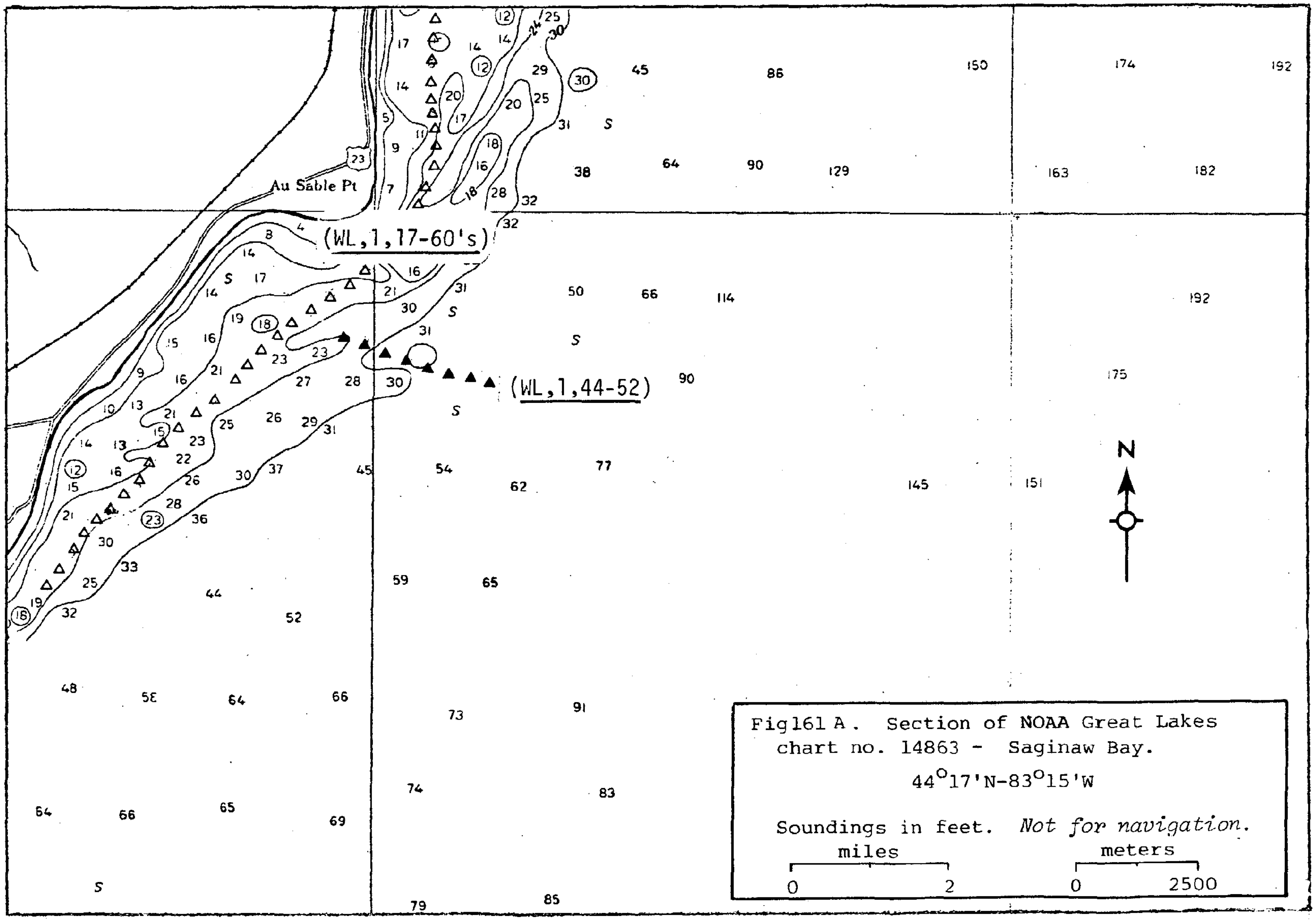



Fig161 A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
$44^{o}17'N-83^{o}15'W$

Soundings in feet. *Not for navigation.*
miles 0 2
meters 0 2500

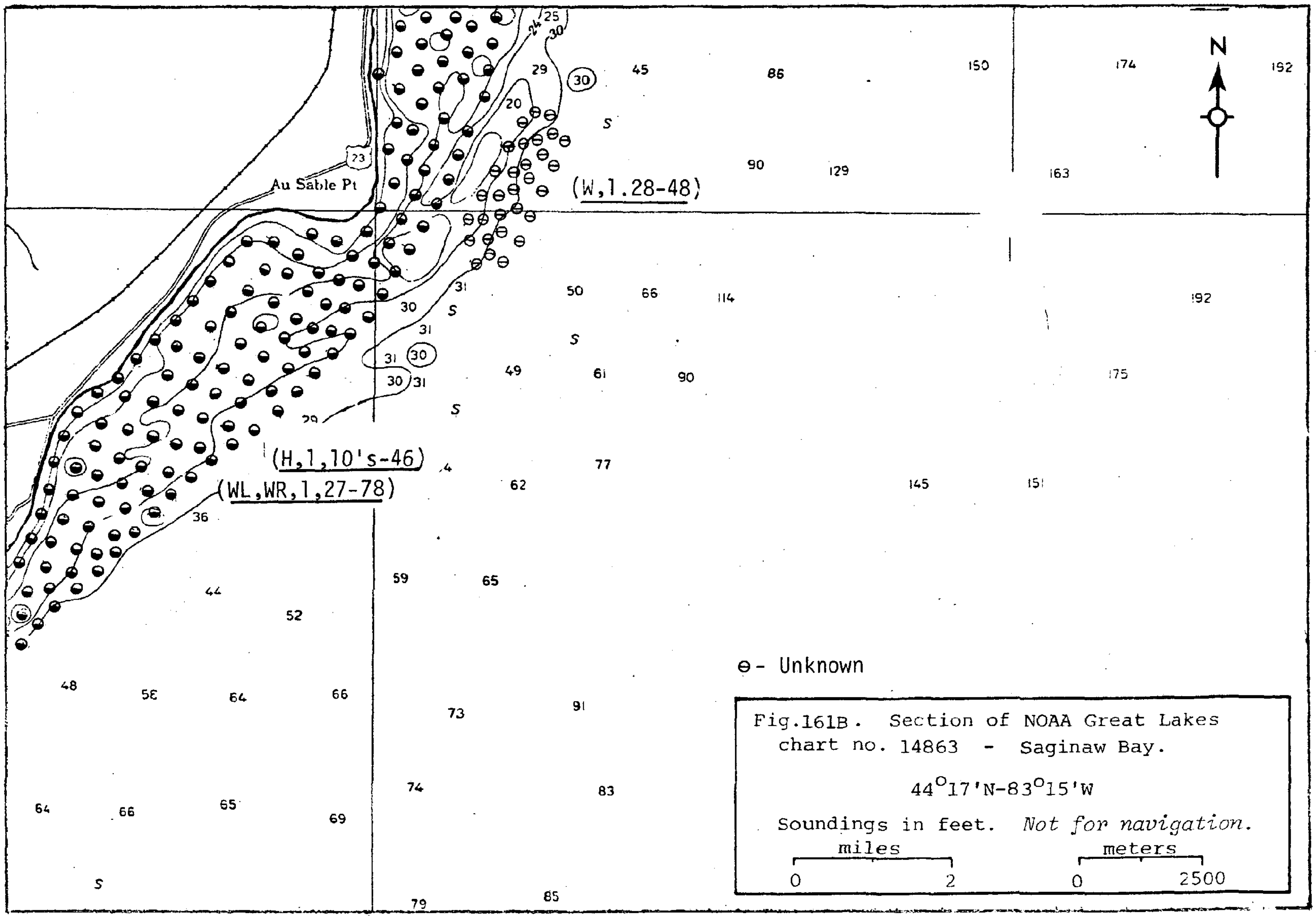



Fig.161B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

$44^{o}17'N-83^{o}15'W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

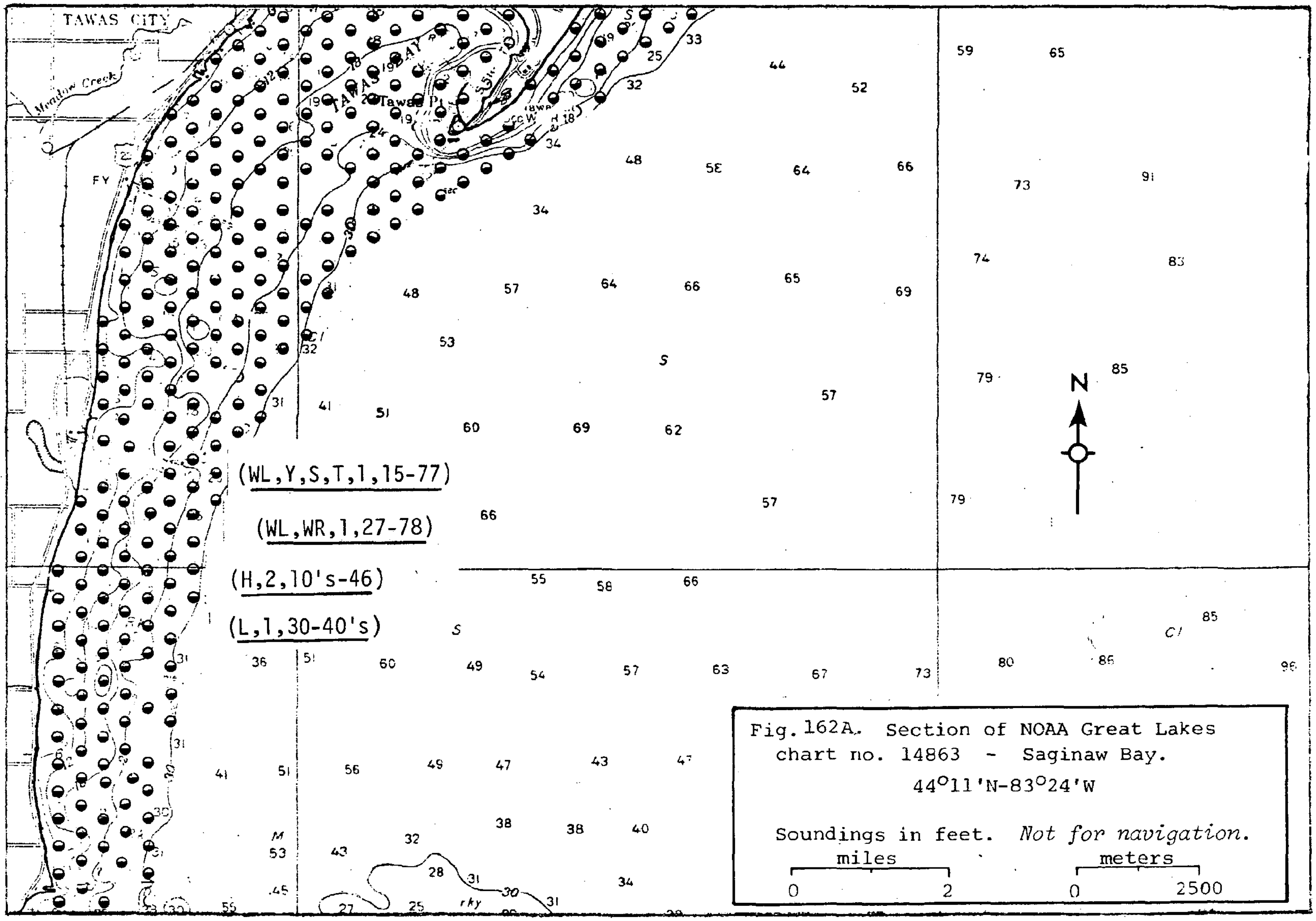



Fig. 162A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
44°11'N-83°24'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

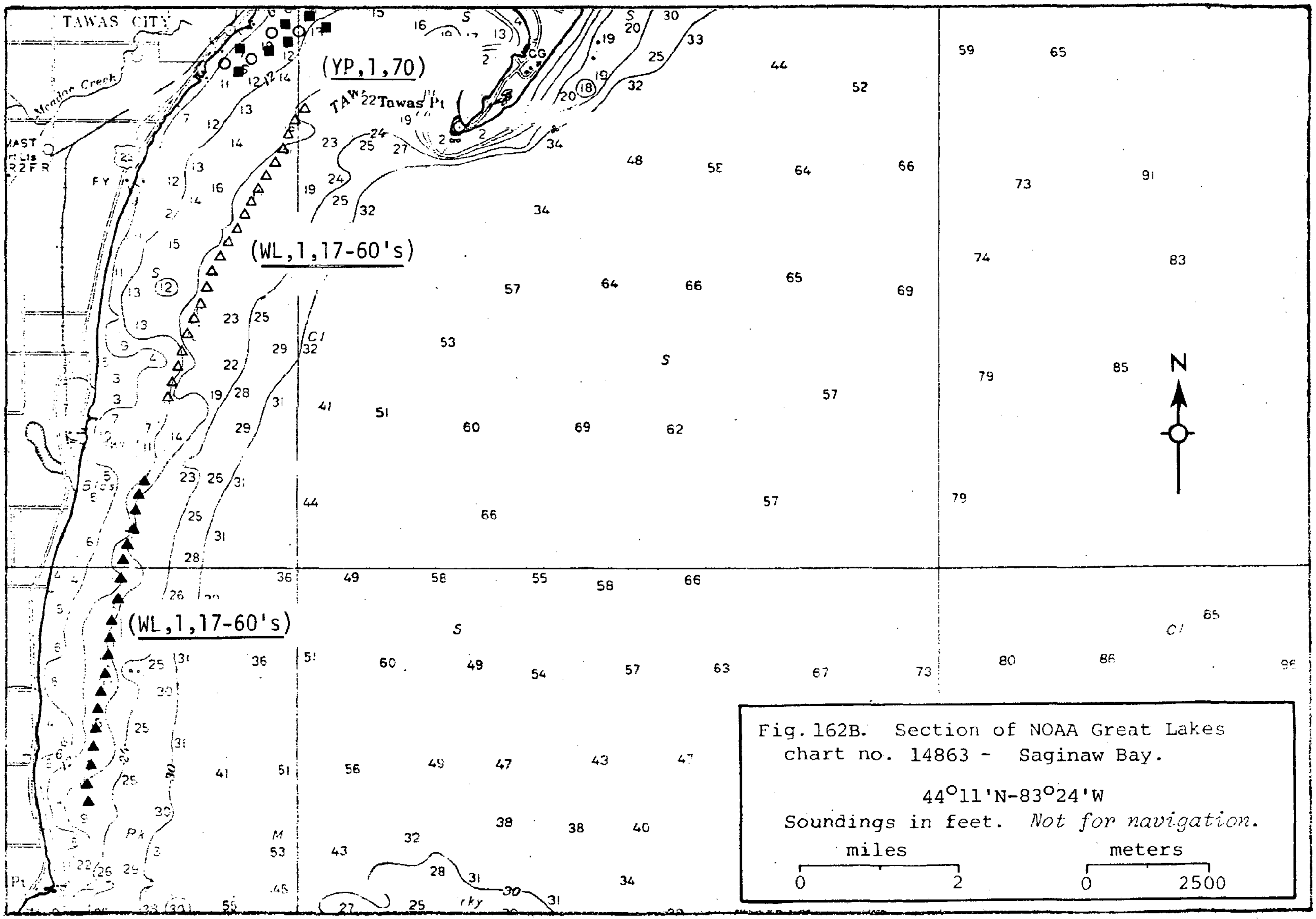



Fig. 162B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

44°11'N-83°24'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

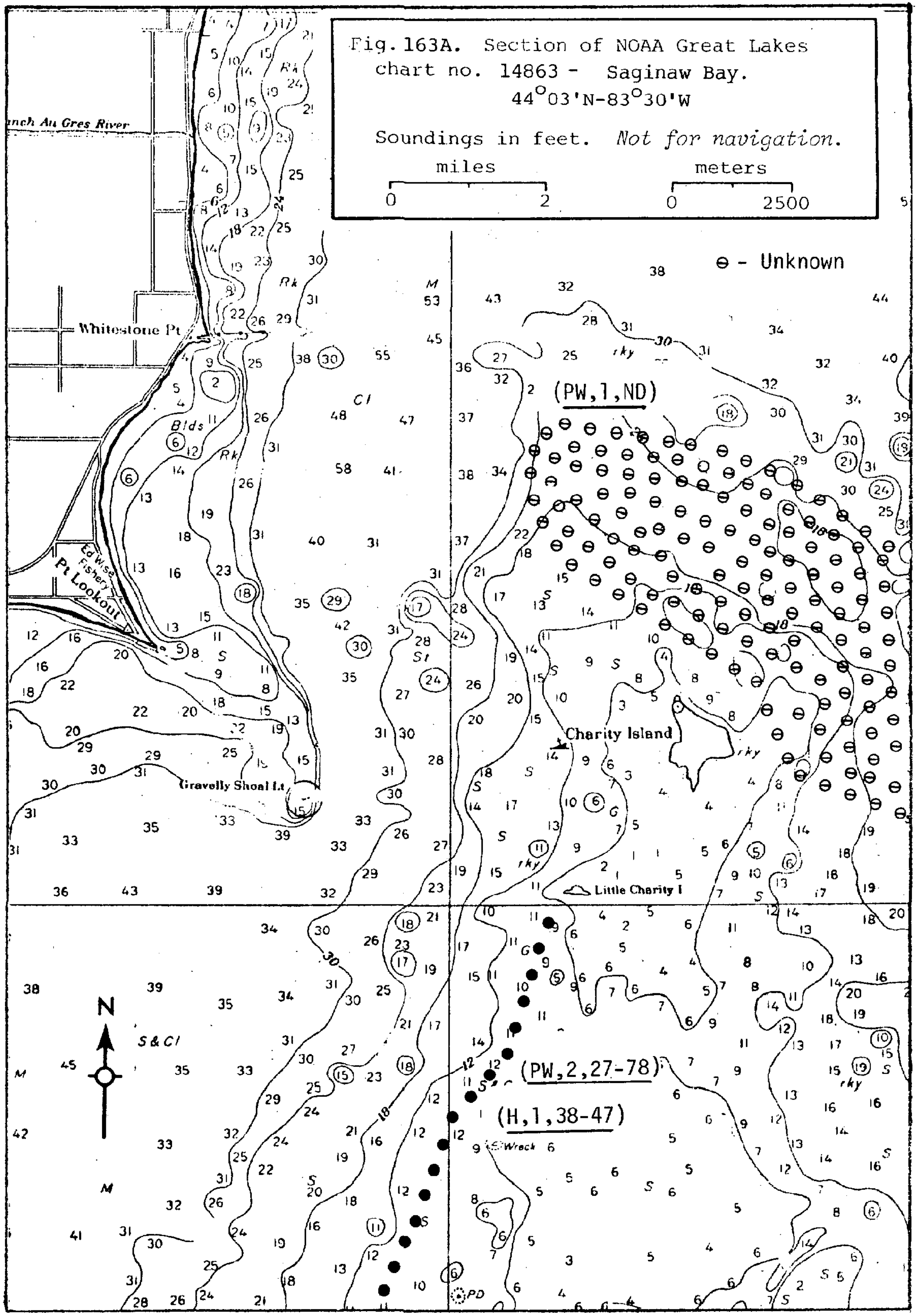



Fig. 163A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay. 44°03'N-83°30'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

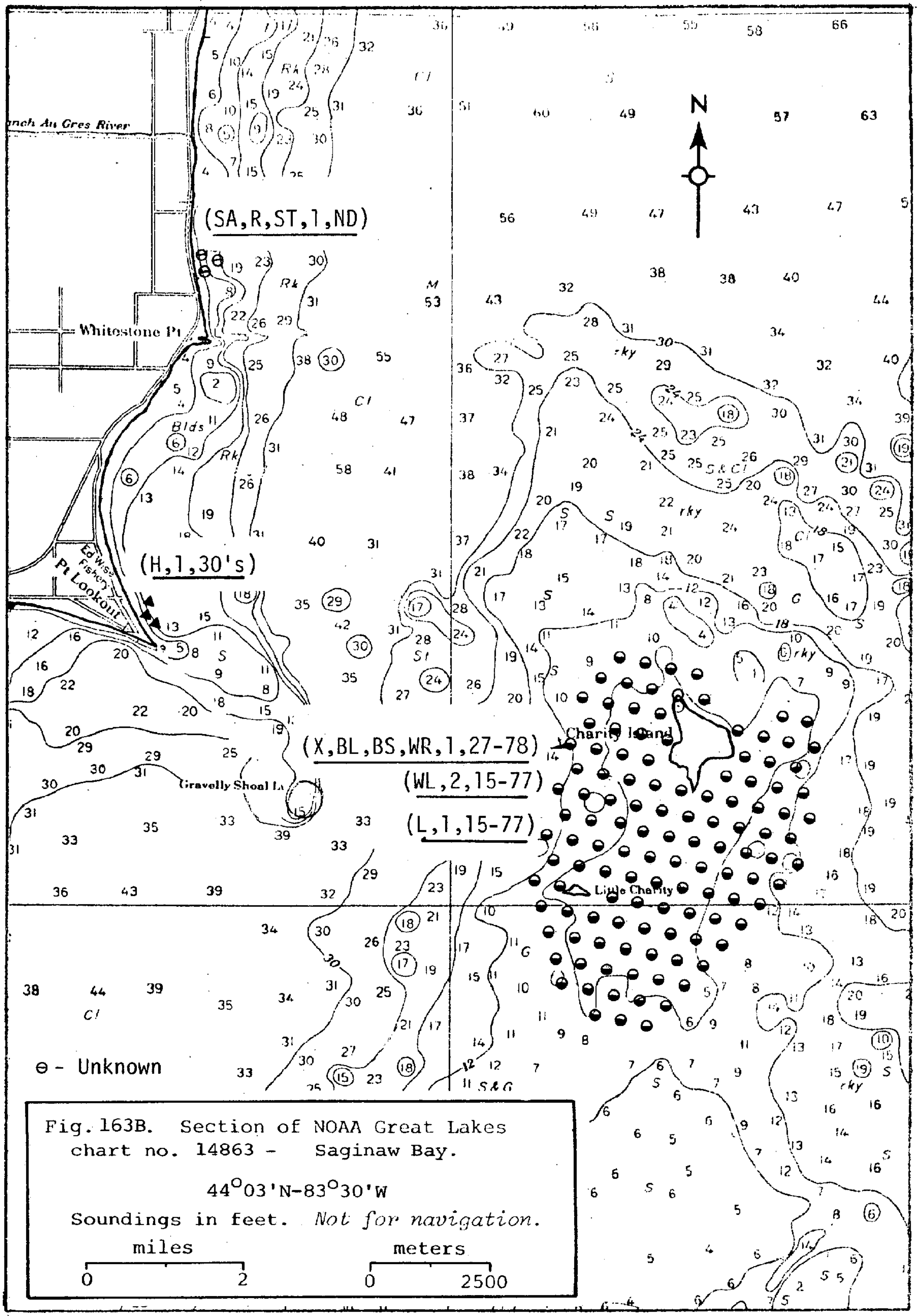



Fig. 163B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

44°03'N-83°30'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

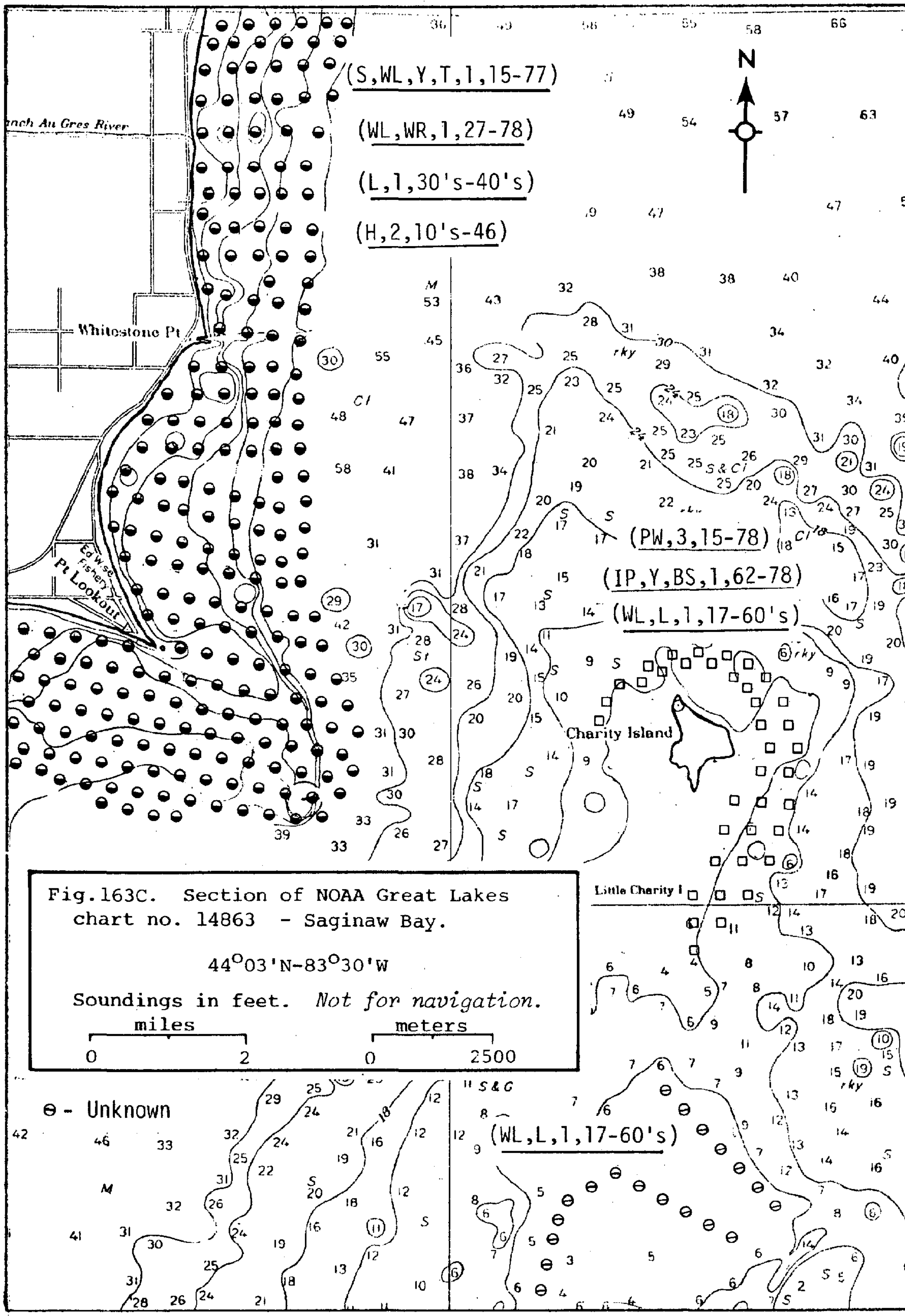



Fig.163C. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

44°03'N-83°30'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

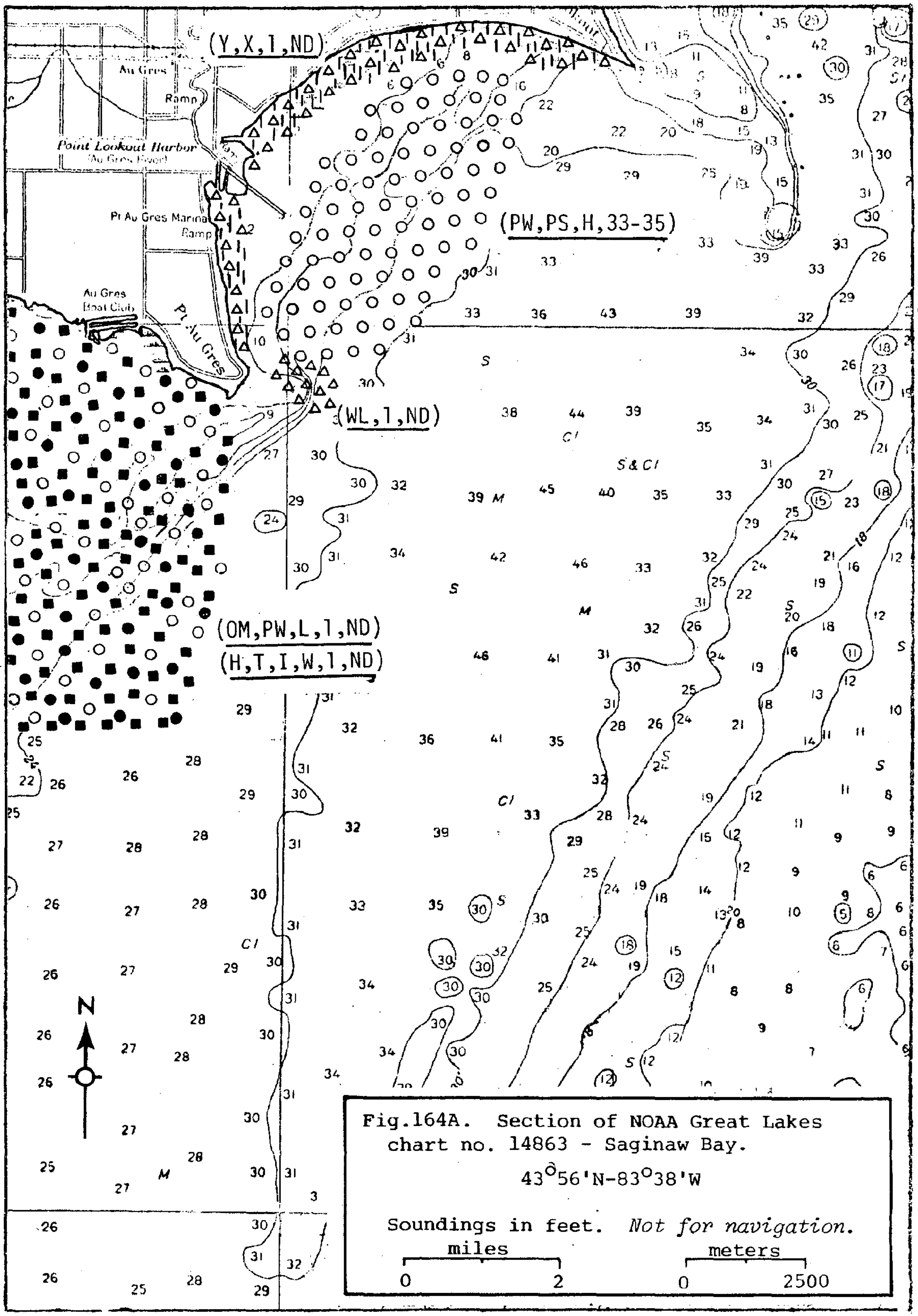



Fig.164A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
43°56'N-83°38'W

Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

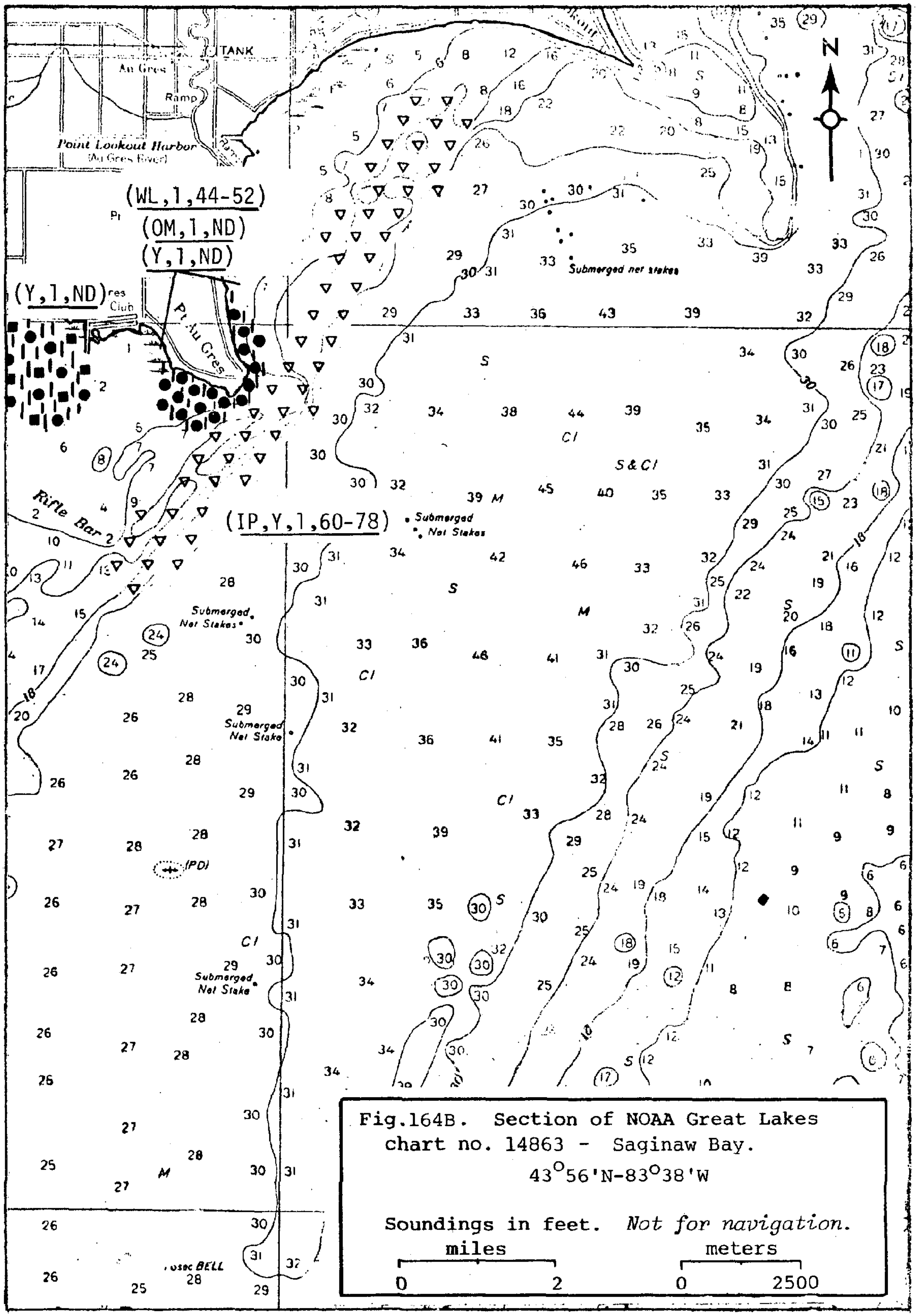



Fig.164B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay. $43^{\circ}56'$N-$83^{\circ}38'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

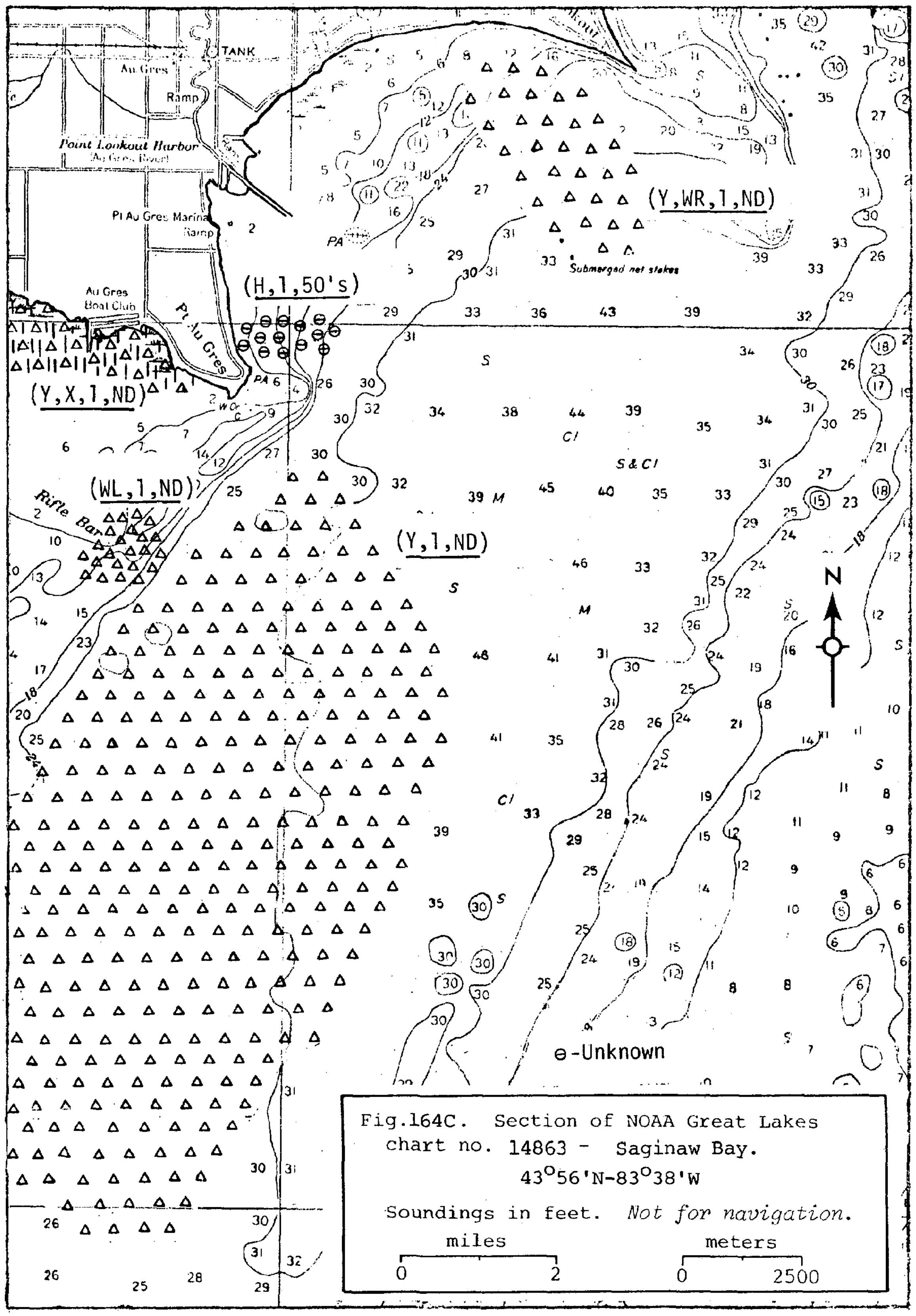



Fig.164C. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
$43^{\circ}56'$N-$83^{\circ}38'$W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

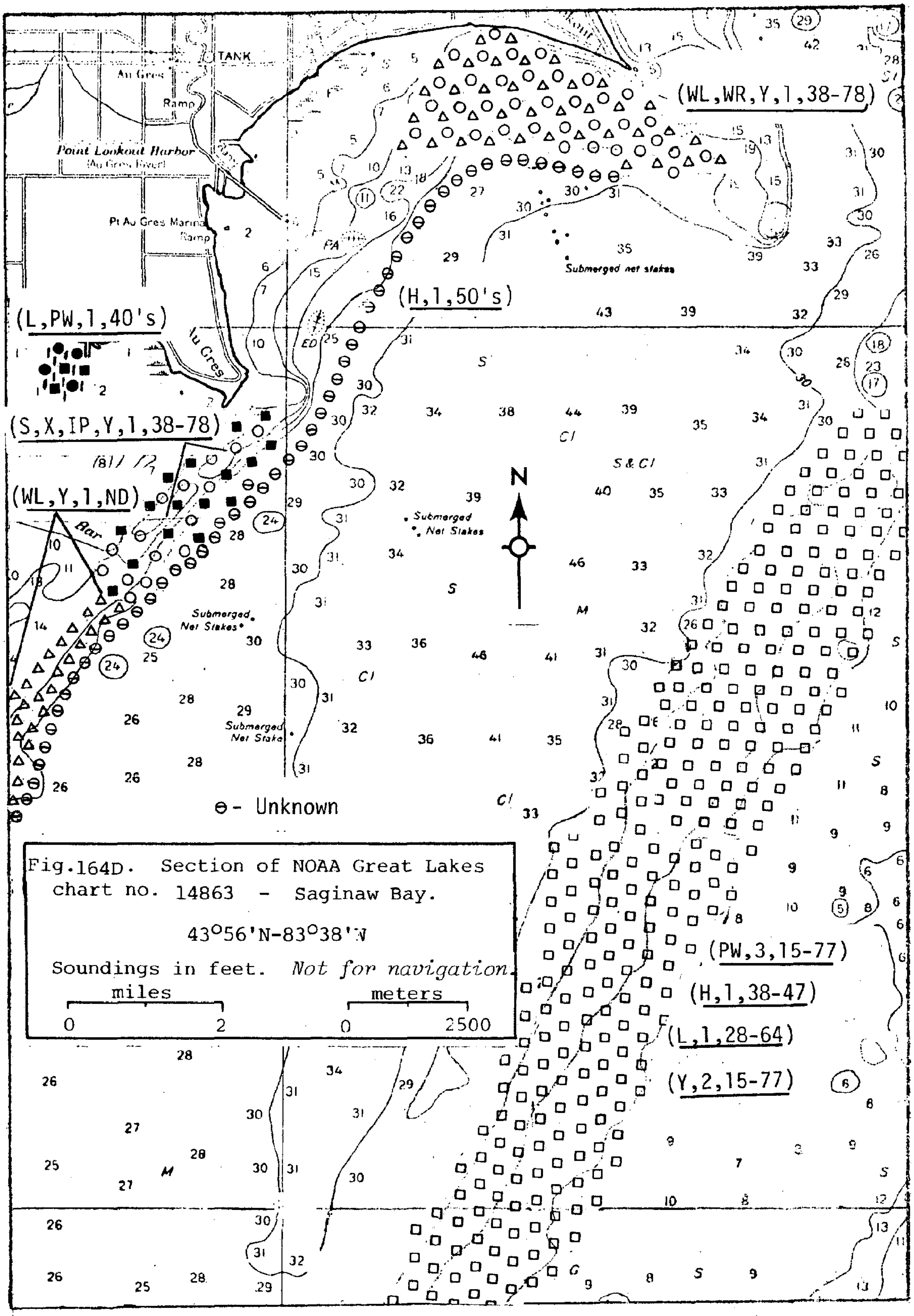



Fig.164D. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

43°56'N-83°38'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

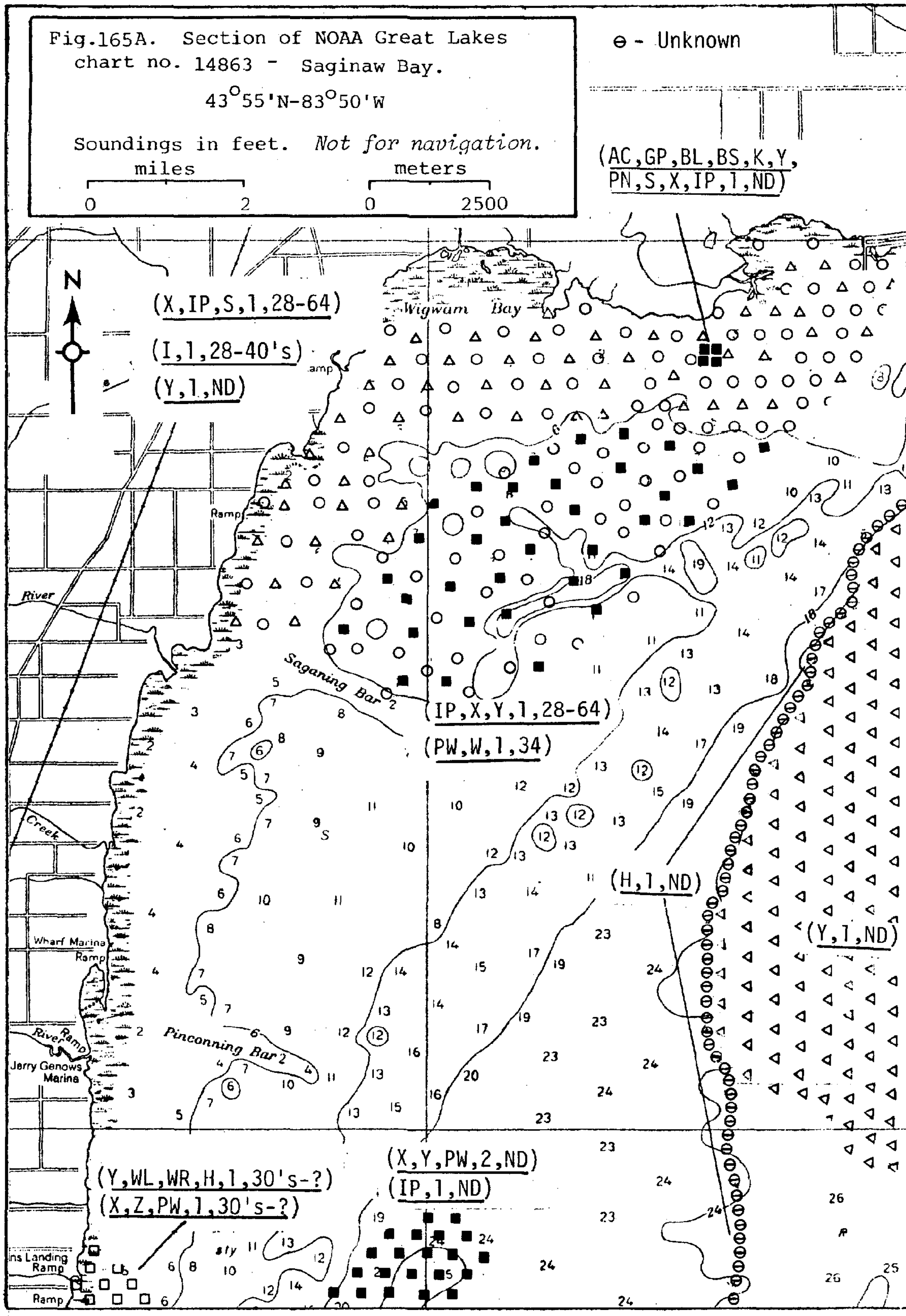



Fig.165A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
43°55'N-83°50'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

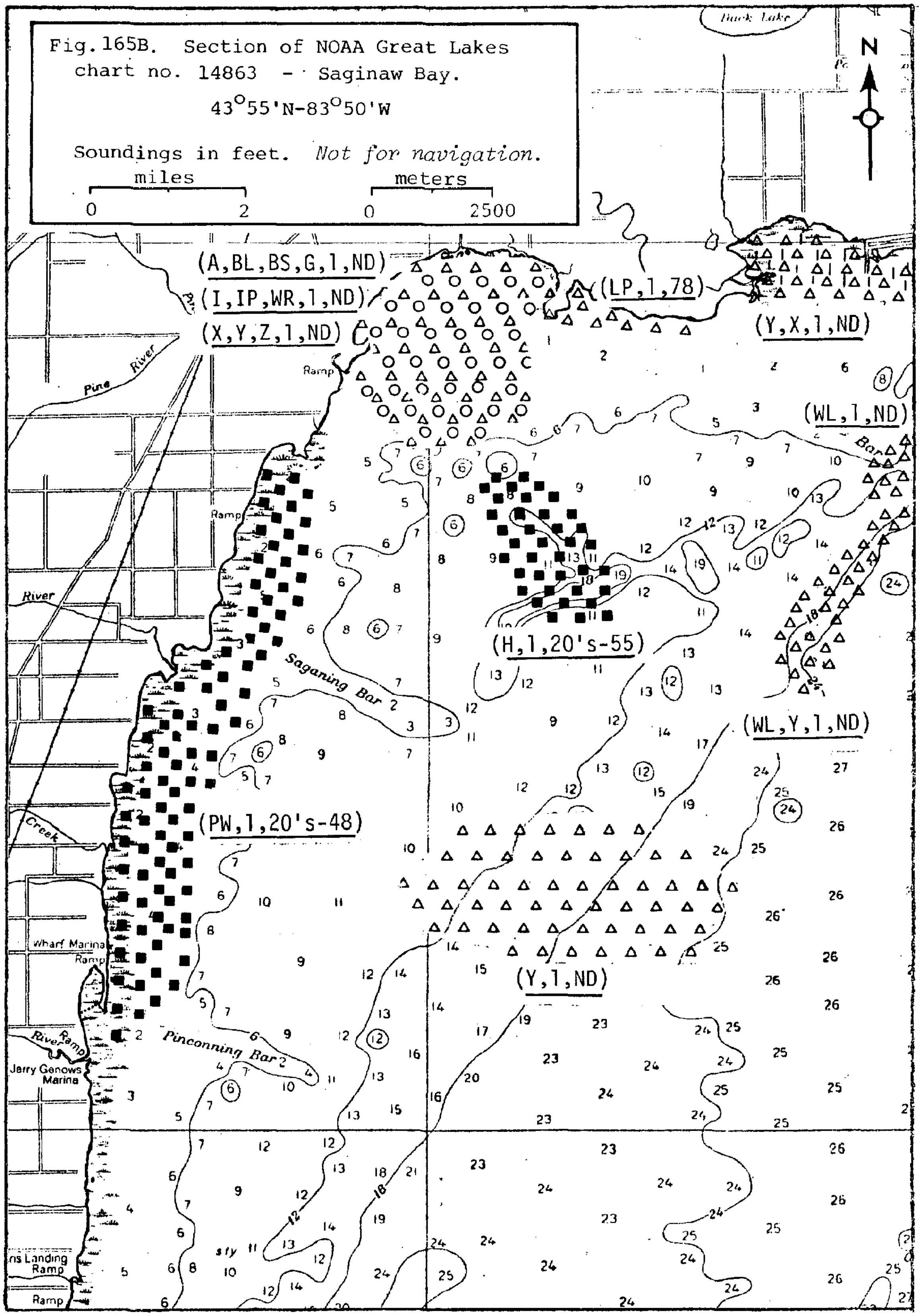



Fig. 165B. Section of NOAA Great Lakes chart no. 14863 – Saginaw Bay. 43°55'N-83°50'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

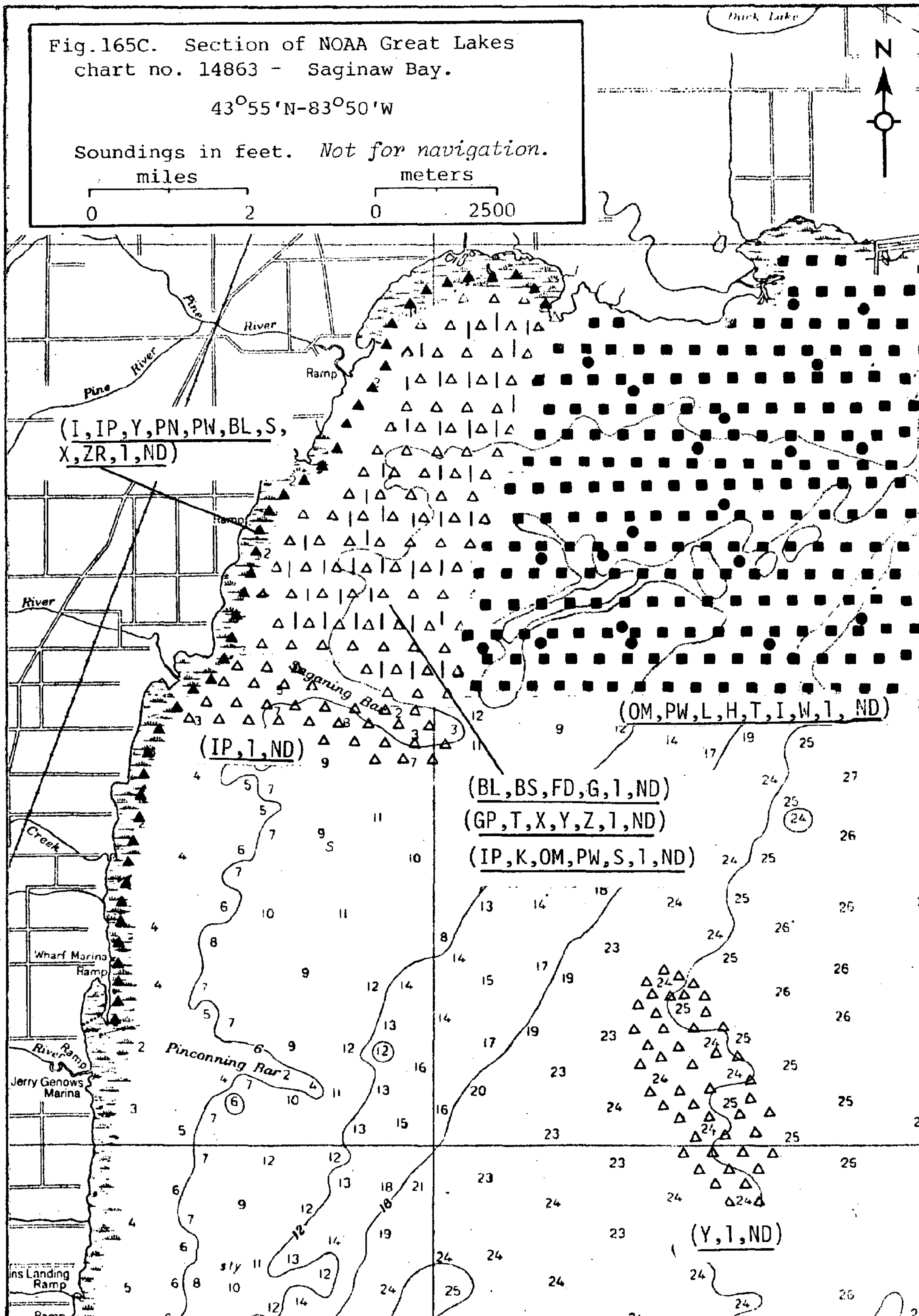



Fig.165C. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

43°55'N-83°50'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

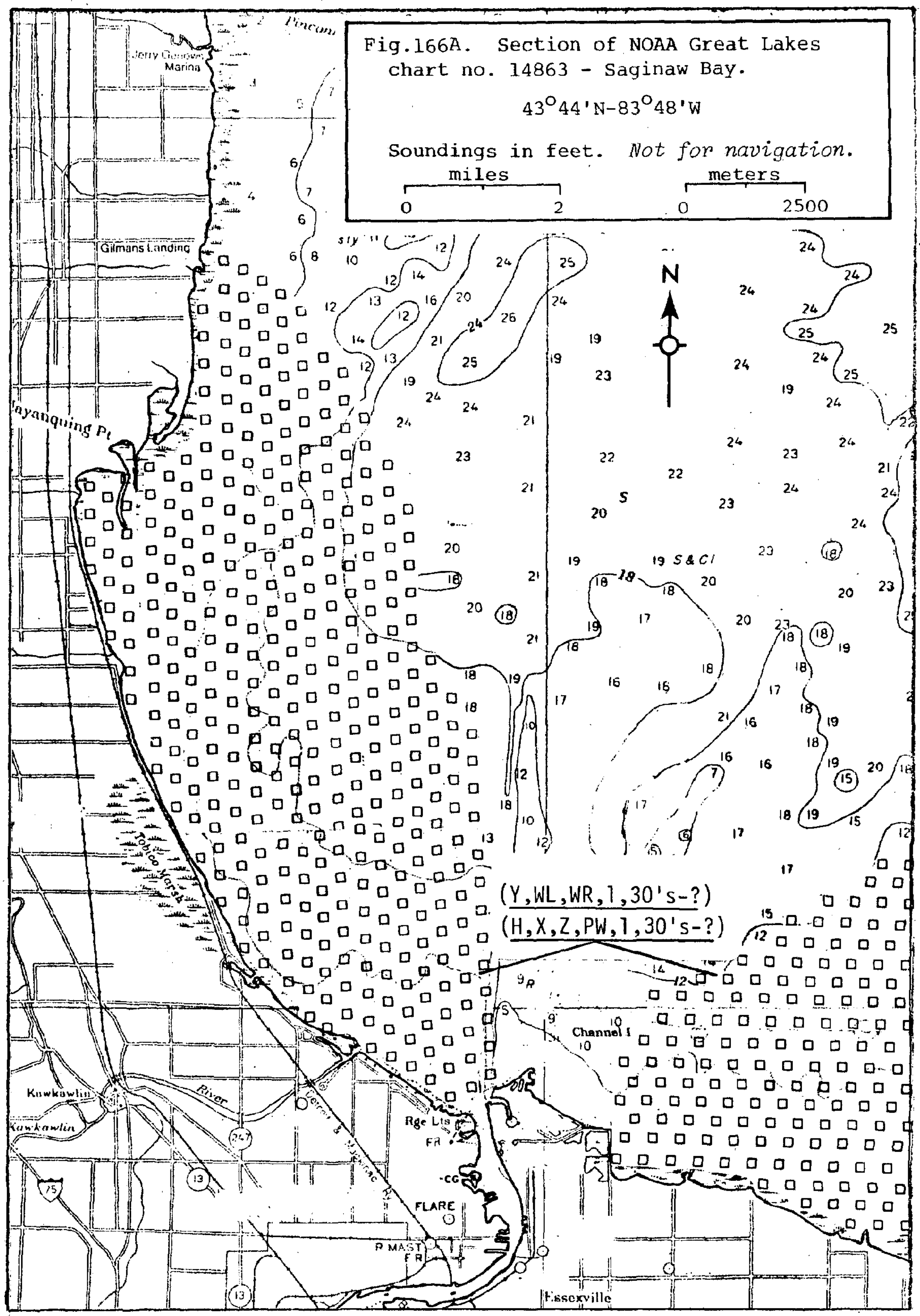


Fig.166A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
43°44'N-83°48'W
Soundings in feet. Not for navigation.
miles
0
2
meters
0
2500
N
Gilmans Landing
Kawkawlin
River
Channel
Rge Lts
FLARE
Essexville
(Y,WL,WR,1,30's-?)
(H,X,Z,PW,1,30's-?)

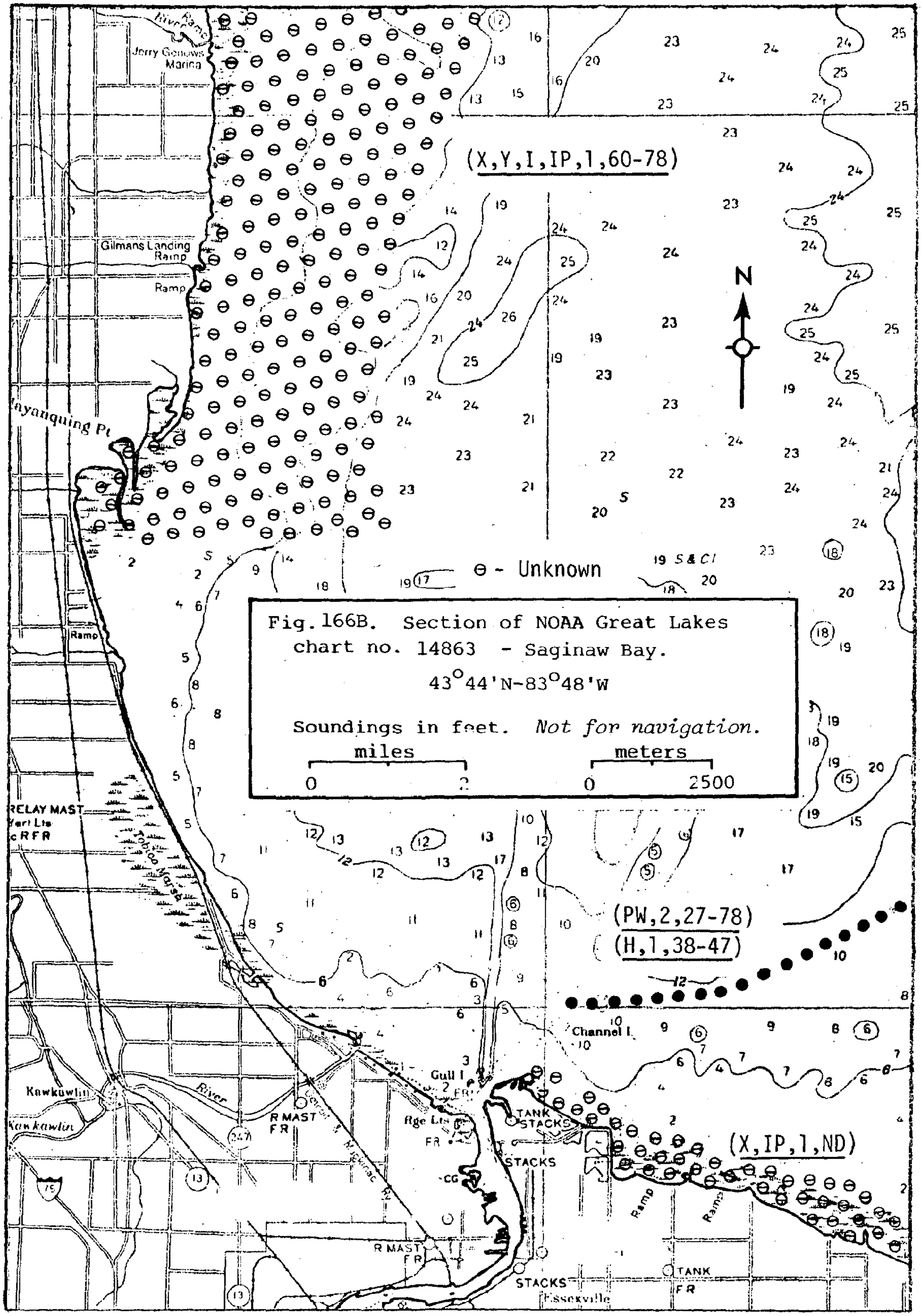



Fig. 166B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
43°44'N-83°48'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

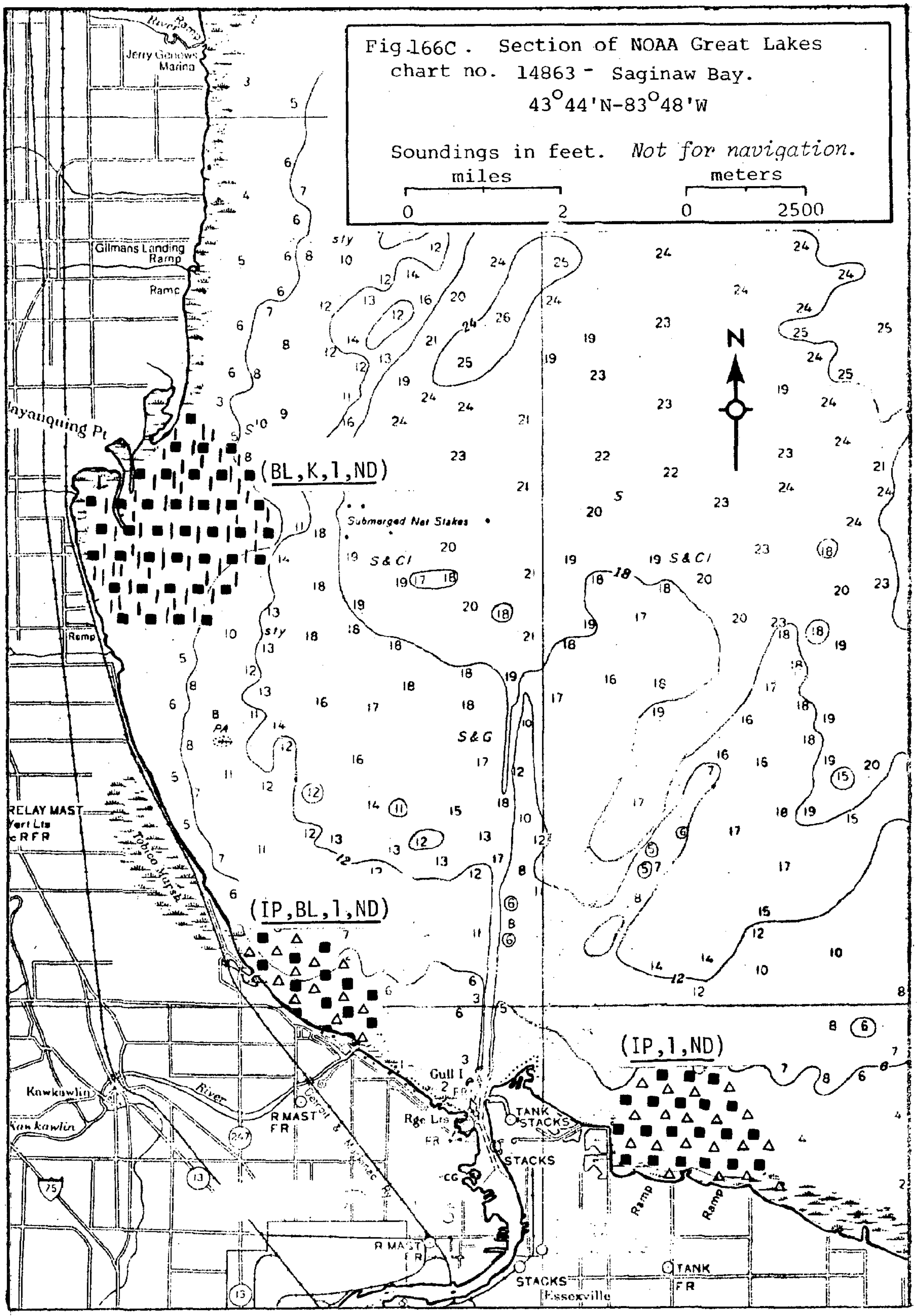



Fig.166C. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay. 43°44'N-83°48'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

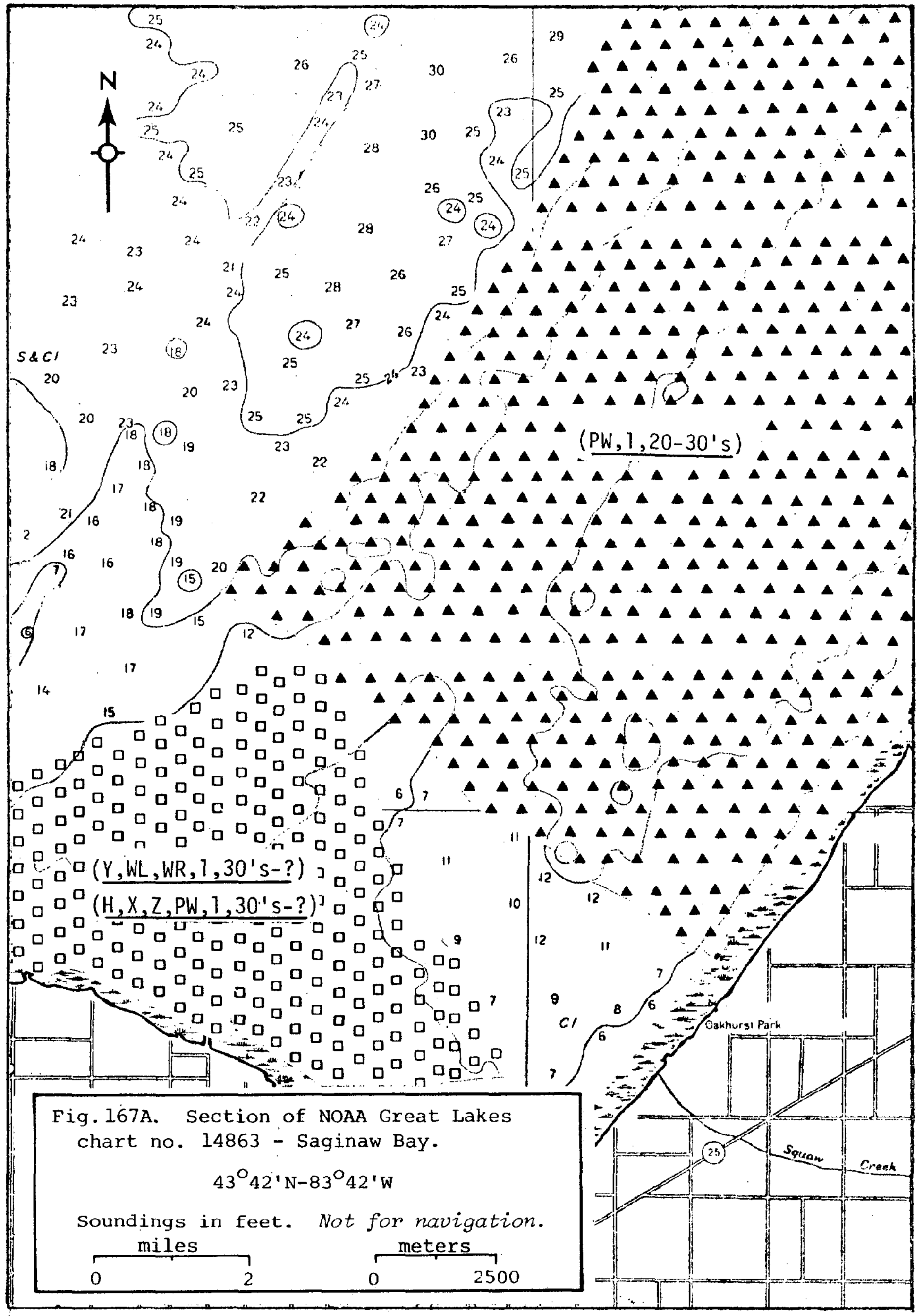



Fig. 167A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

43°42'N-83°42'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

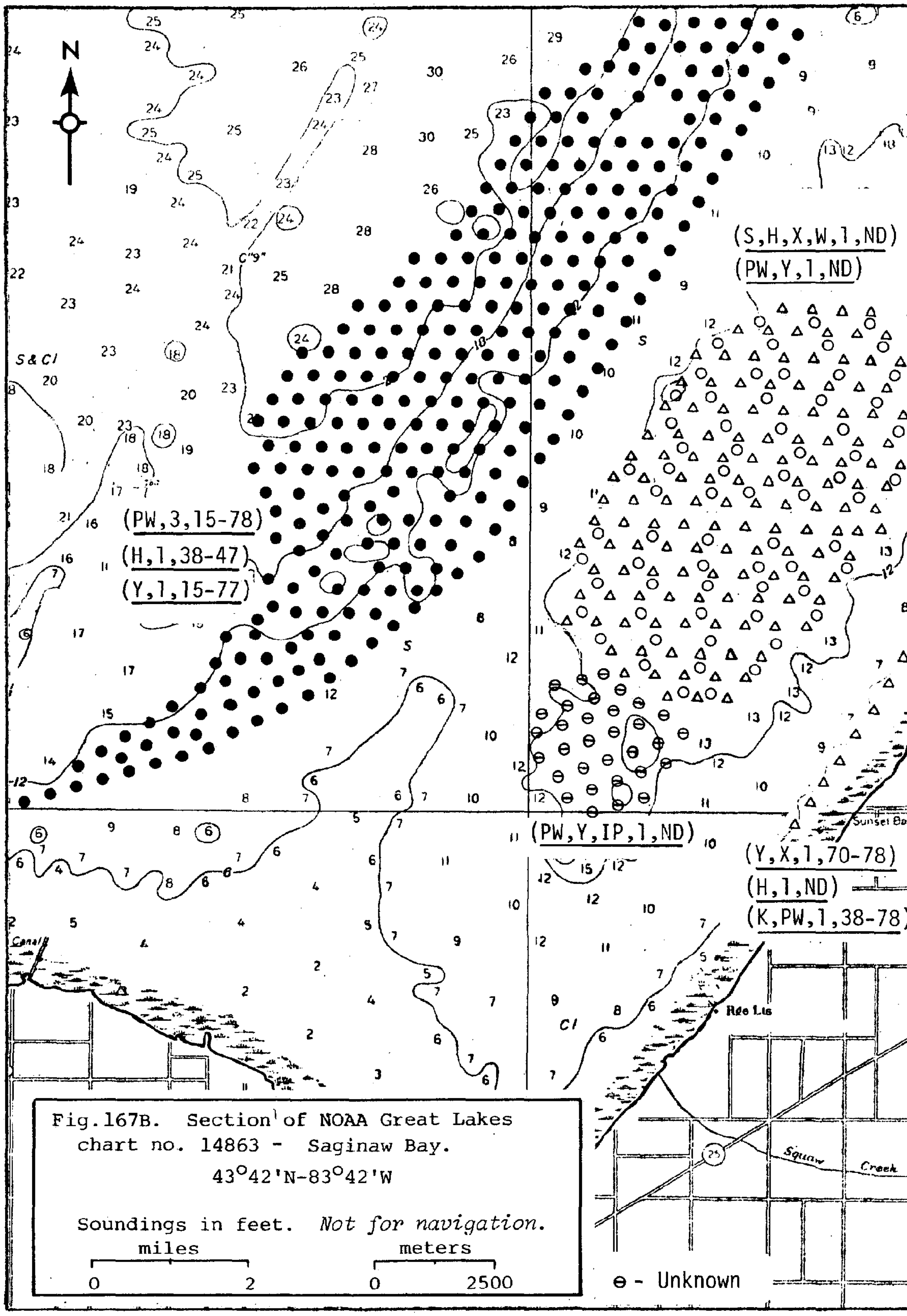



Fig.167B. Section[1] of NOAA Great Lakes chart no. 14863 - Saginaw Bay. 43°42'N-83°42'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

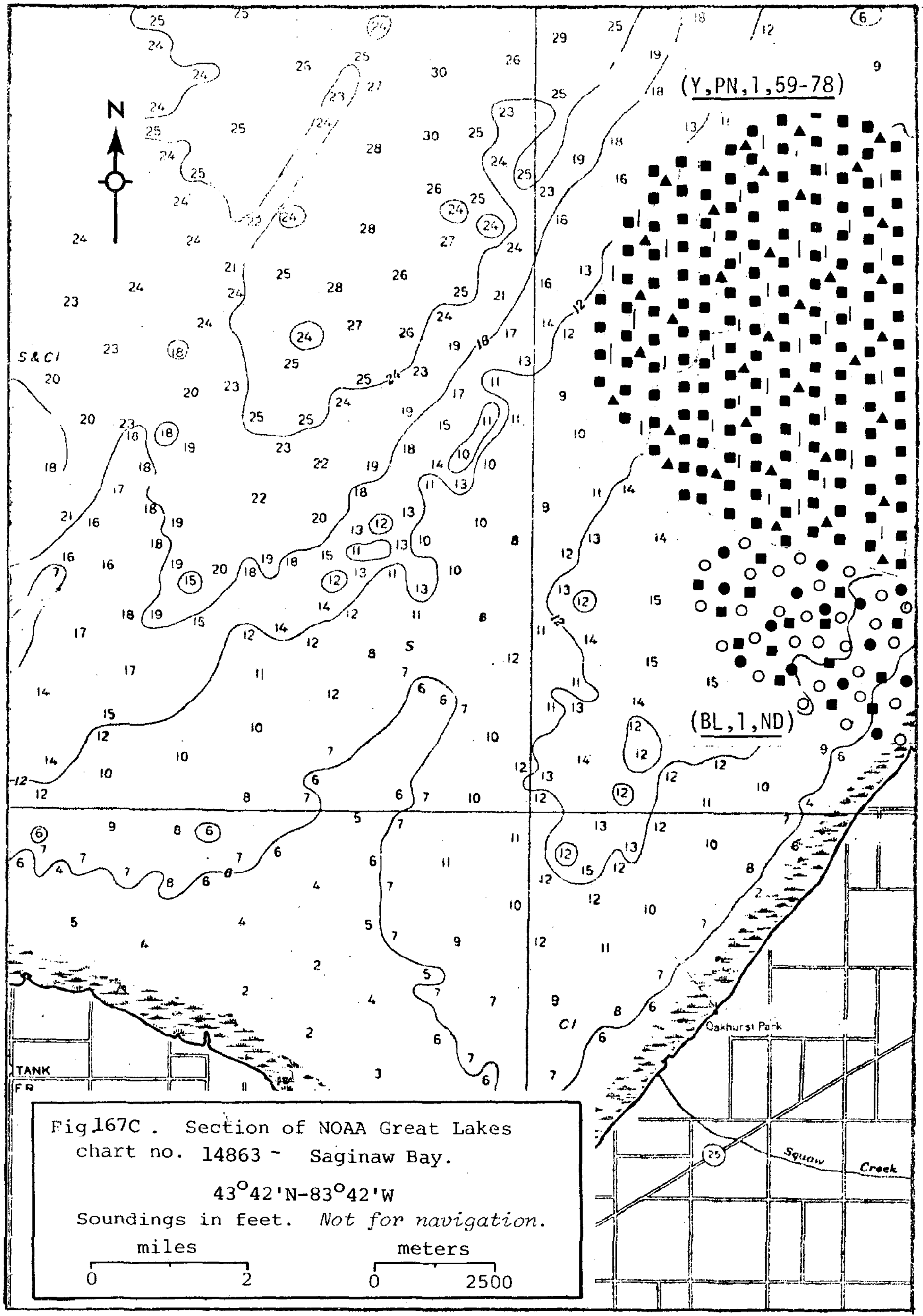



Fig 167C . Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

43°42'N-83°42'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

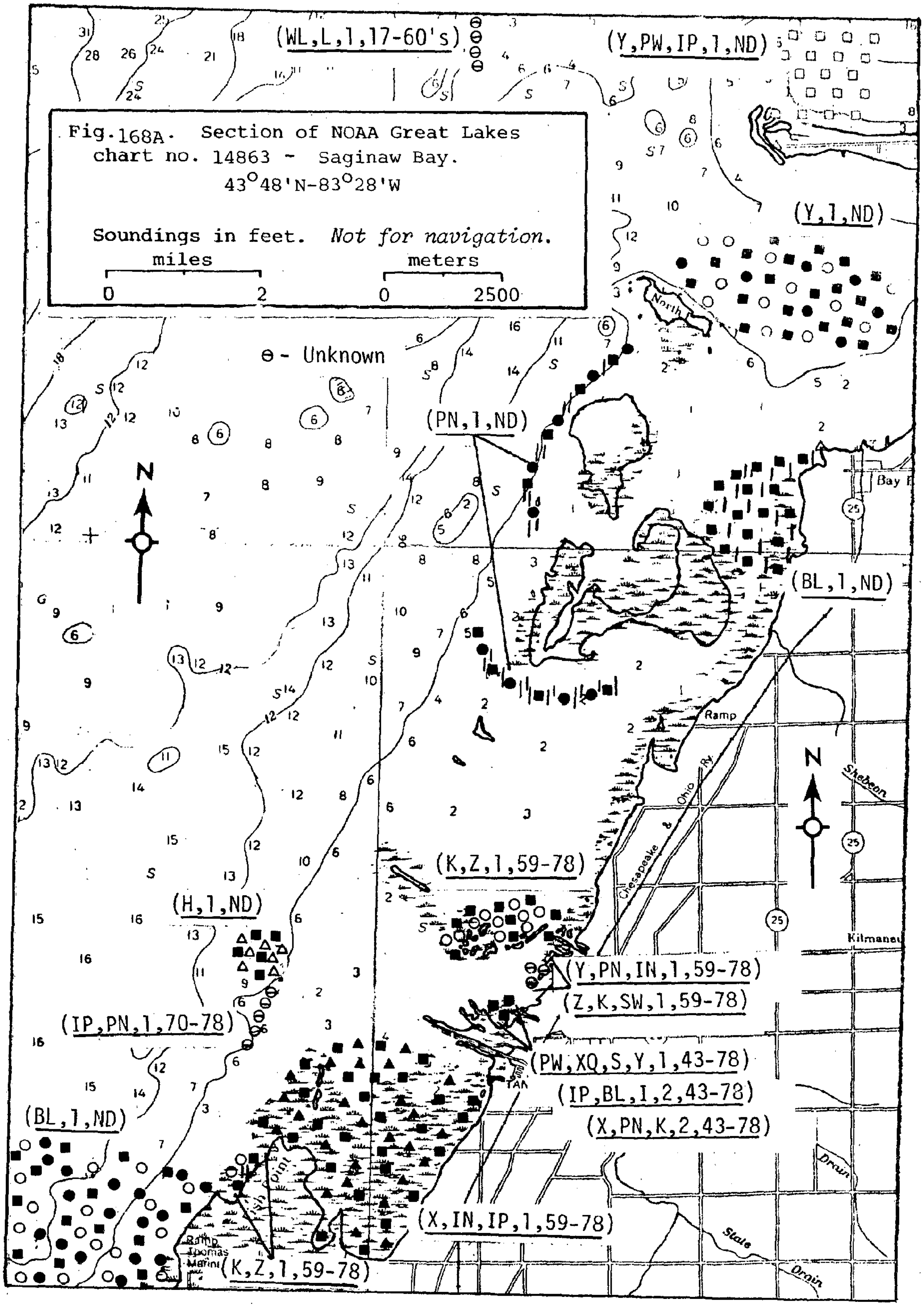


Fig. 168A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay. 43°48'N-83°28'W
Soundings in feet. *Not for navigation.*
miles
0
2
meters
0
2500
ϴ - Unknown
(WL,L,1,17-60's)
(Y,PW,IP,1,ND)
(Y,1,ND)
(PN,1,ND)
(BL,1,ND)
(K,Z,1,59-78)
(H,1,ND)
(Y,PN,IN,1,59-78)
(Z,K,SW,1,59-78)
(IP,PN,1,70-78)
(PW,XQ,S,Y,1,43-78)
(IP,BL,I,2,43-78)
(X,PN,K,2,43-78)
(BL,1,ND)
(X,IN,IP,1,59-78)
(K,Z,1,59-78)
N
N
Ramp
Chesapeake & Ohio Ry.
Bay
Kilmanet
Shebeon
Drain
State Drain
North
Ramp
Thomas
Marina

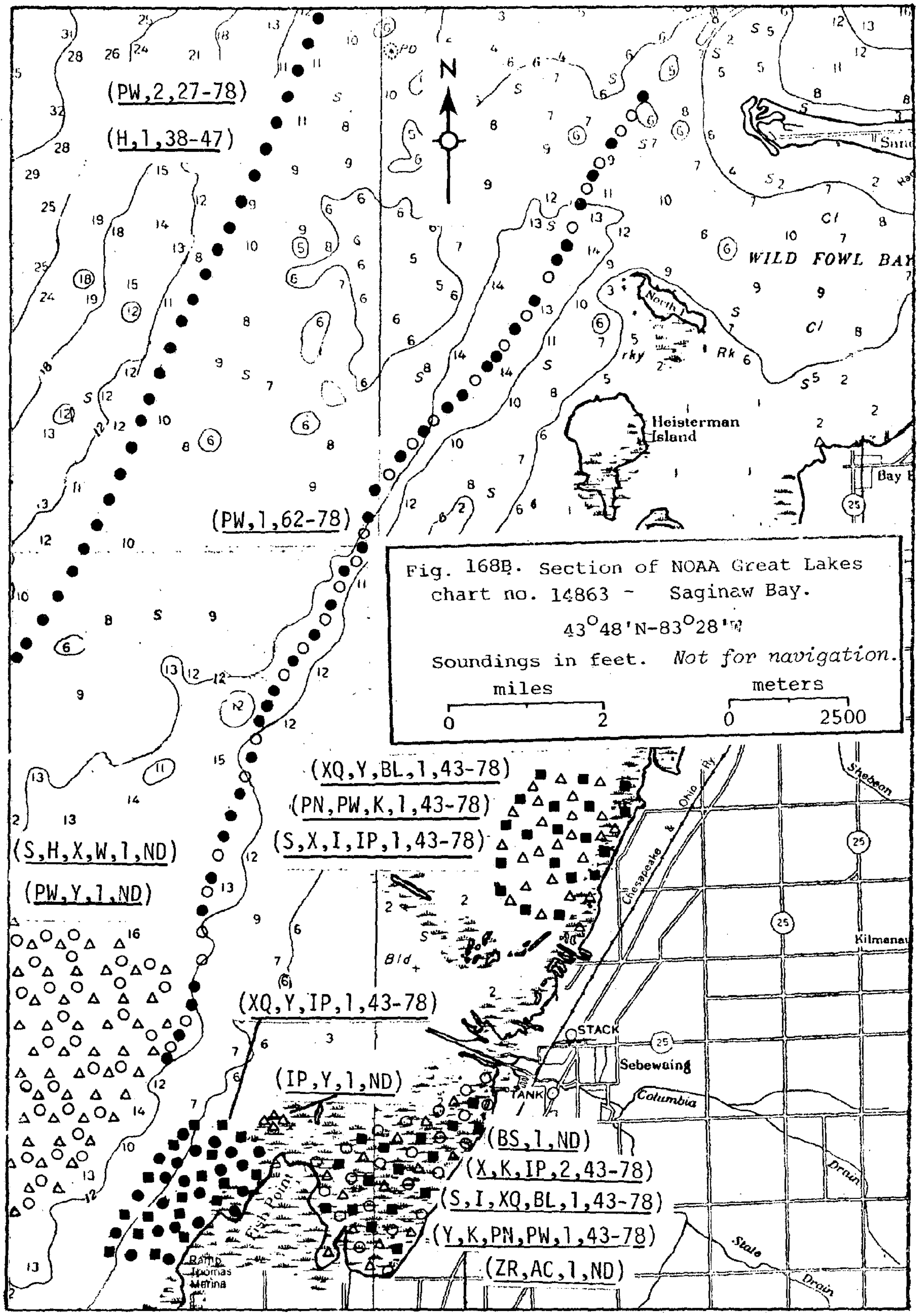



Fig. 168B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay. 43°48'N-83°28'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

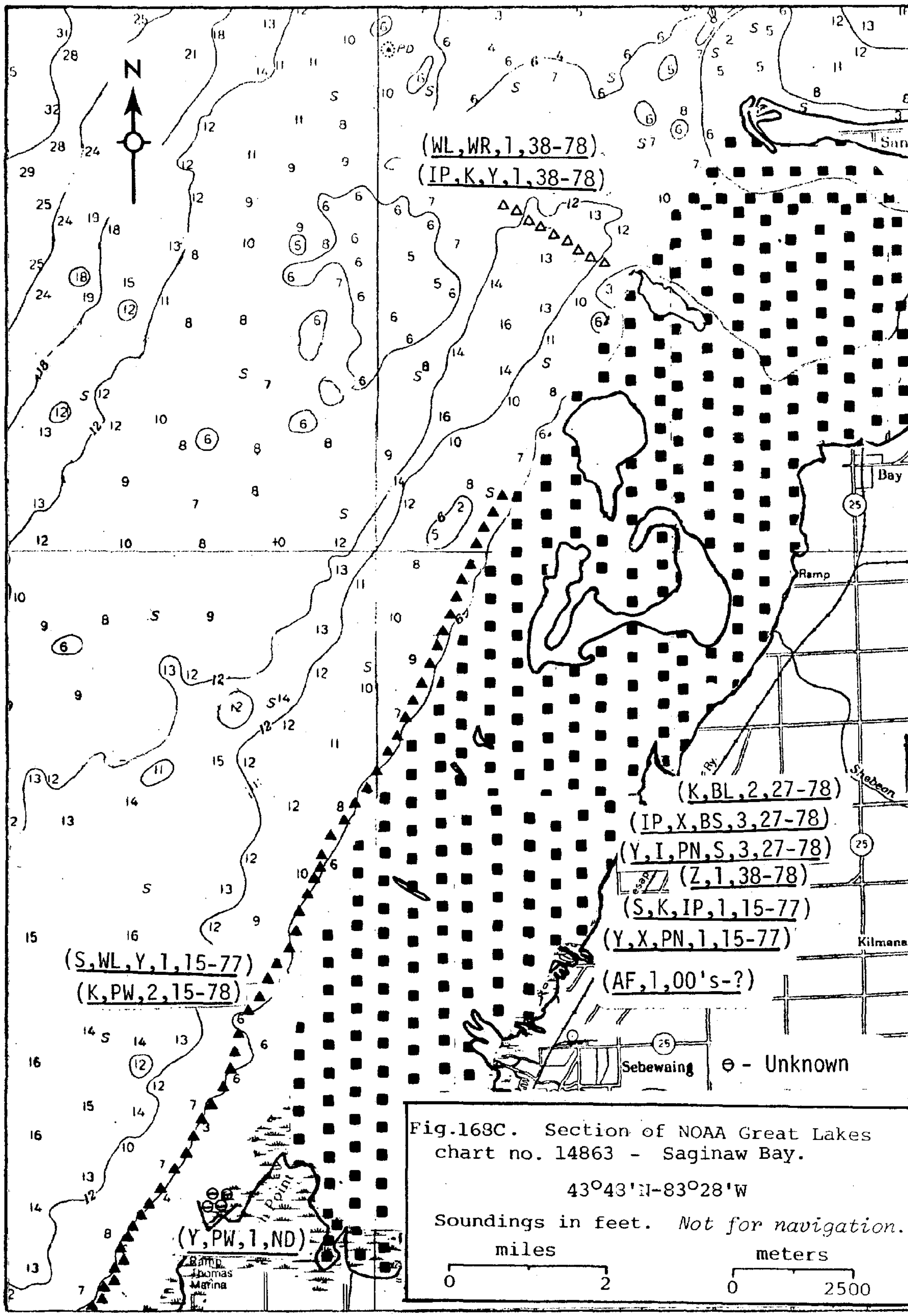



Fig.168C. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

43°43'N-83°28'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

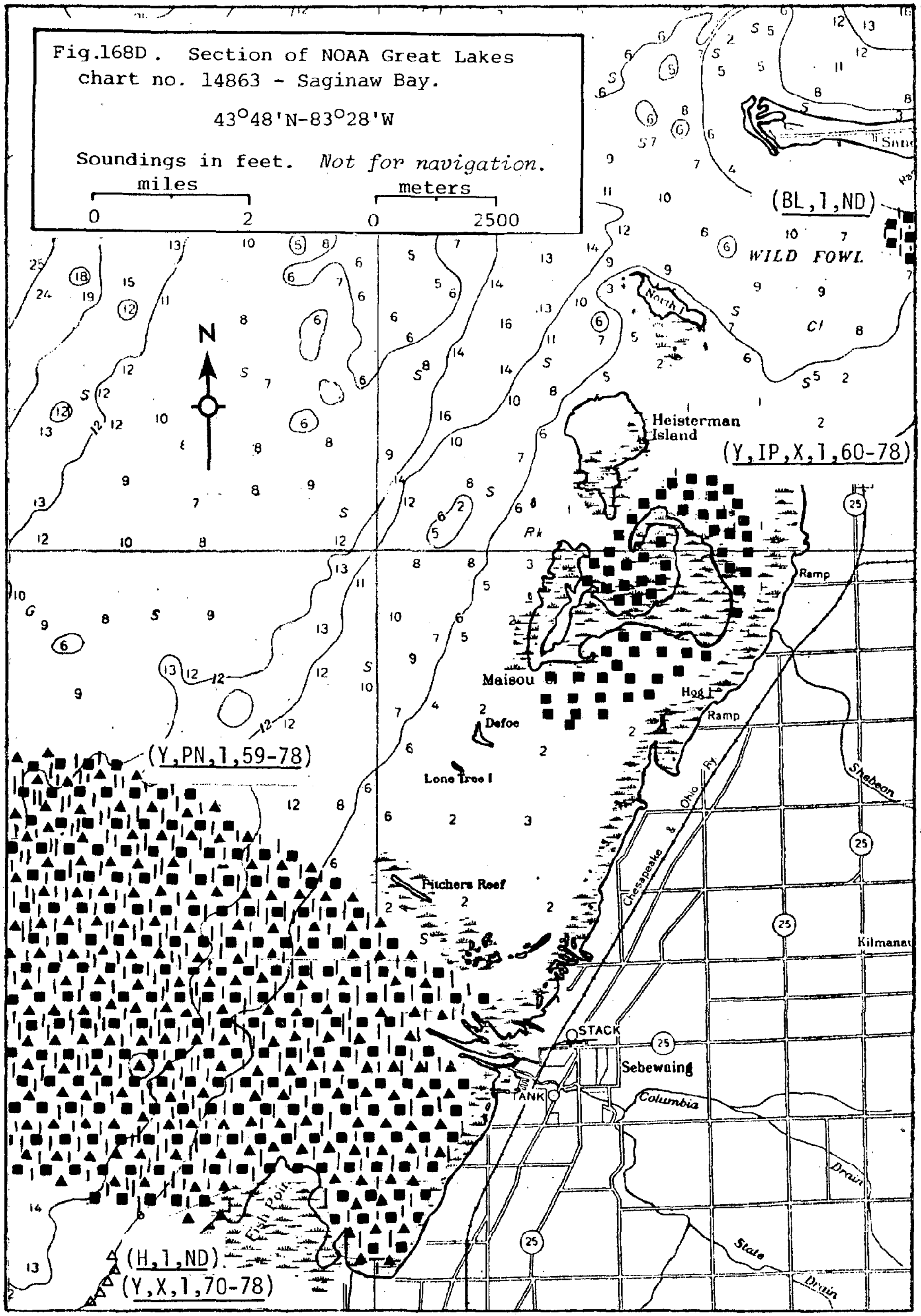



Fig.168D. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

43°48'N-83°28'W

Soundings in feet. *Not for navigation.*

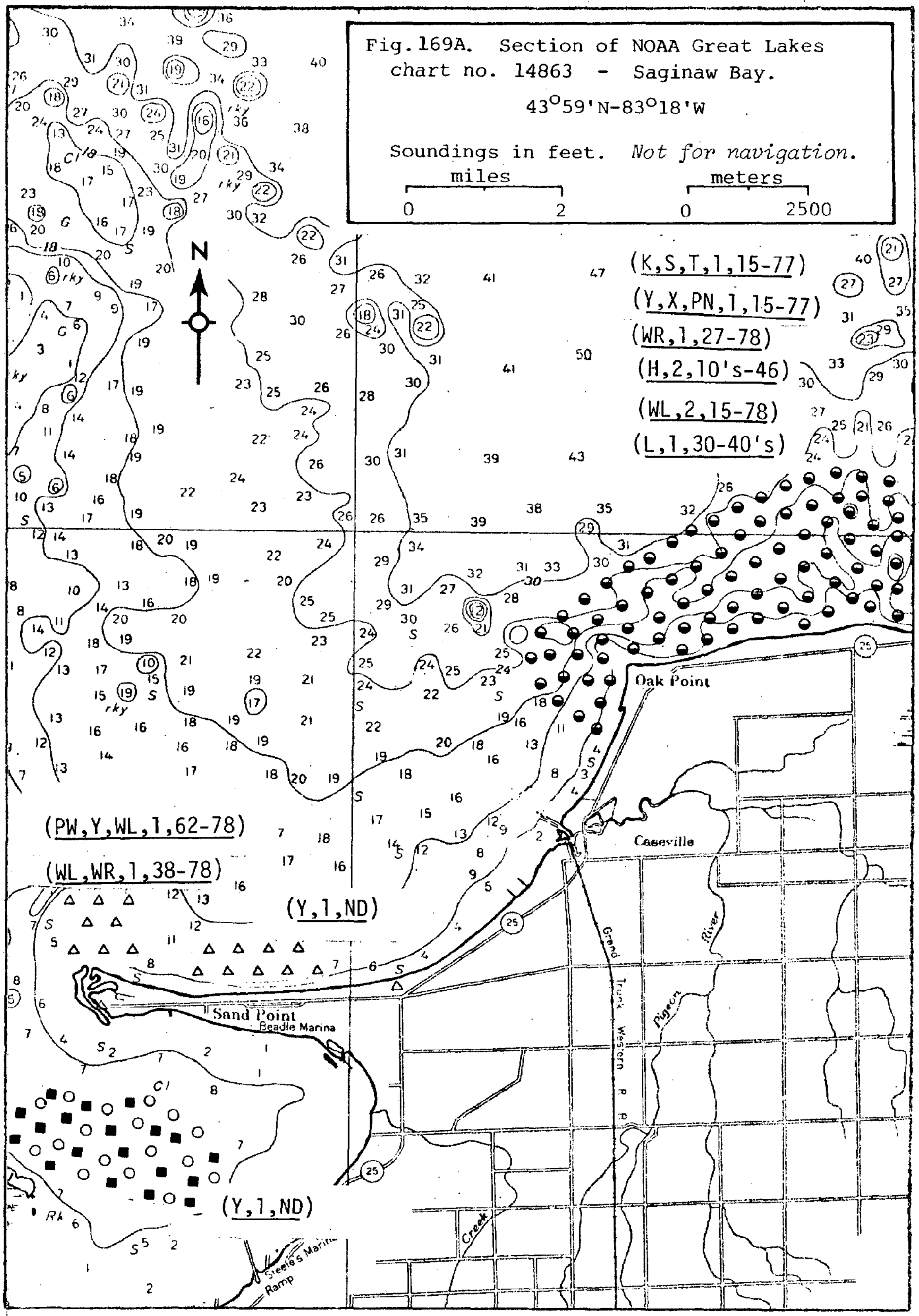



Fig. 169A. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
$43^{\circ}59'N-83^{\circ}18'W$

Soundings in feet. *Not for navigation.*

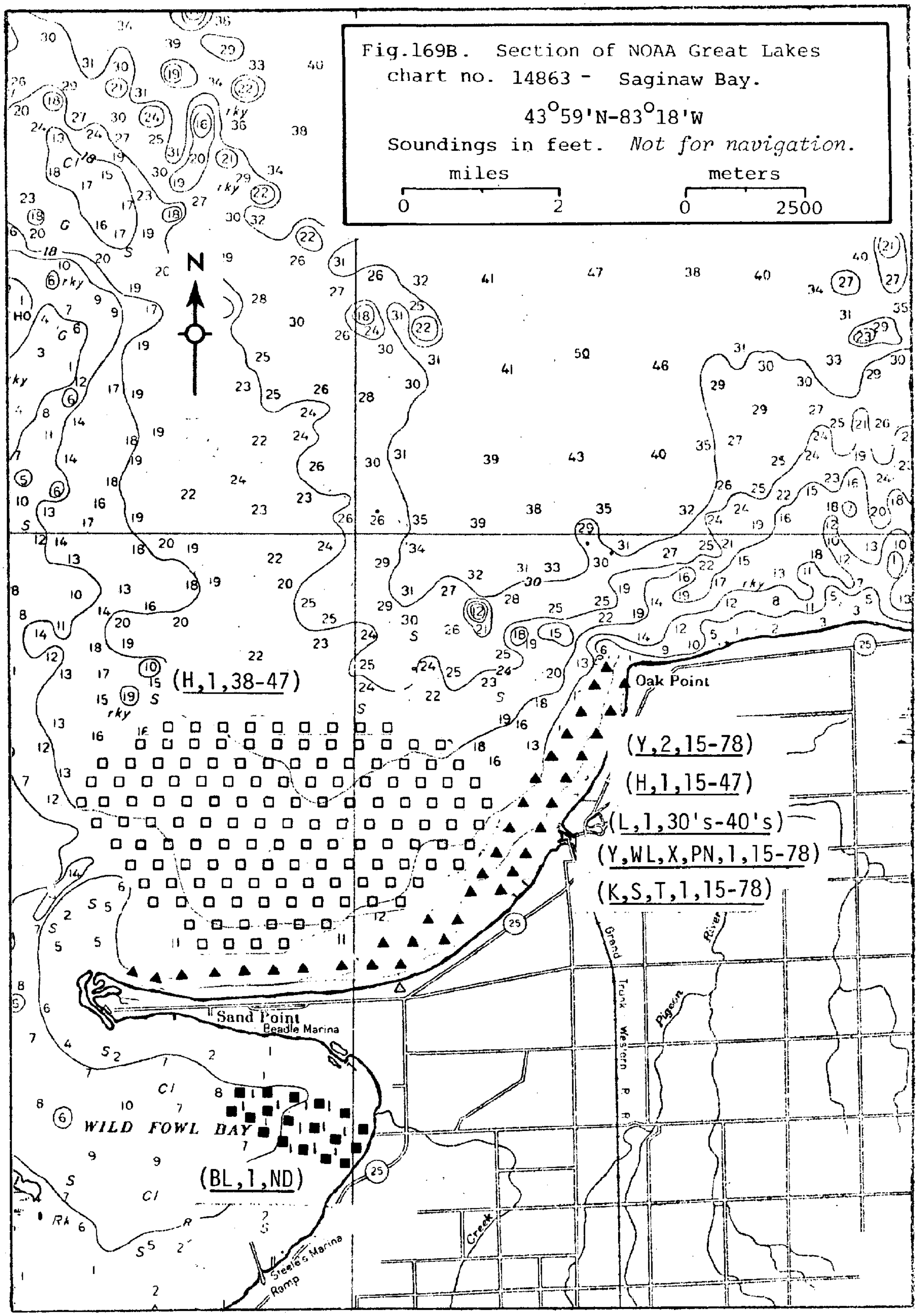
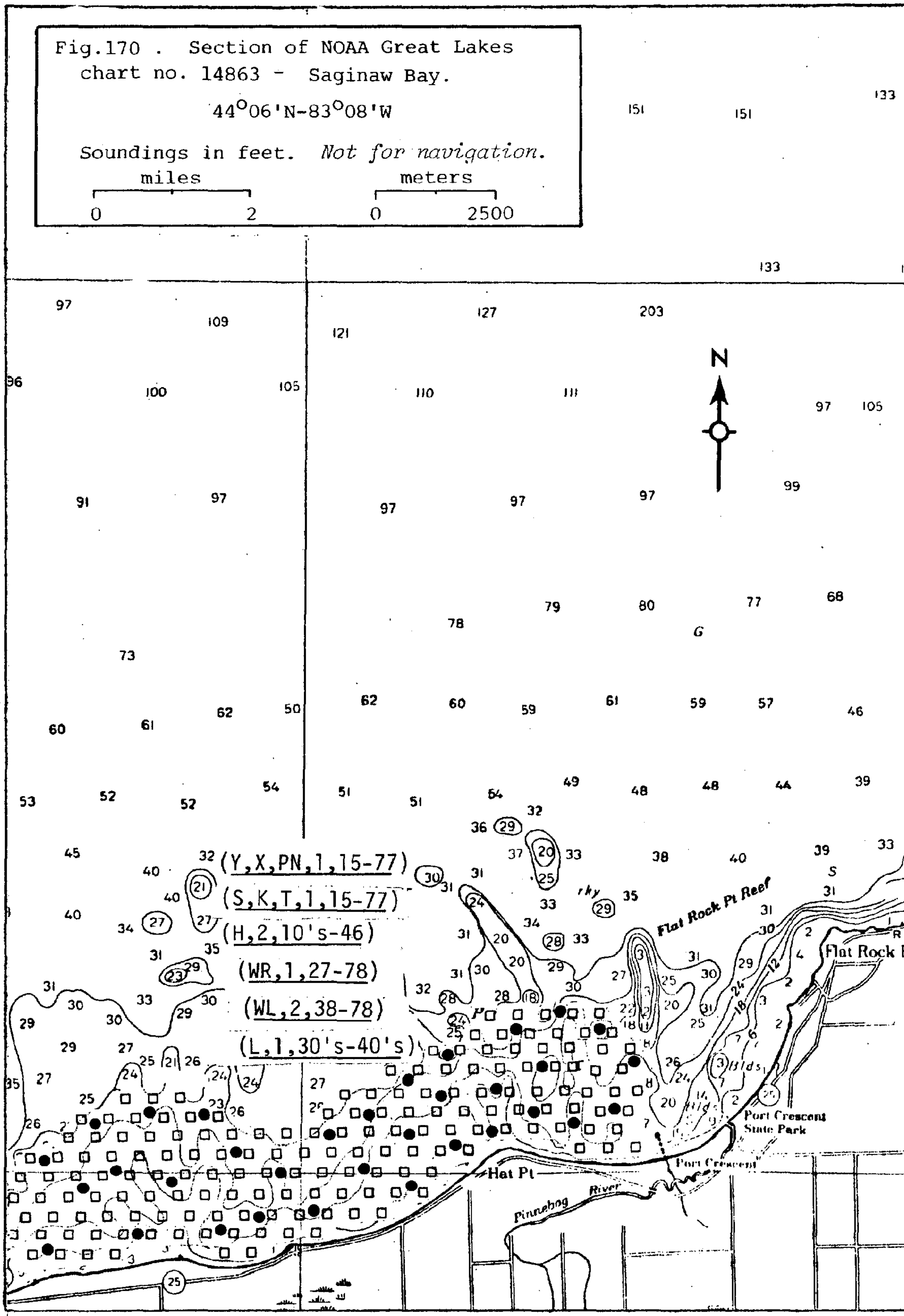



Fig.169B. Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.
43°59'N-83°18'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

Fig.170 . Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

44°06'N-83°08'W

Soundings in feet. *Not for navigation.*



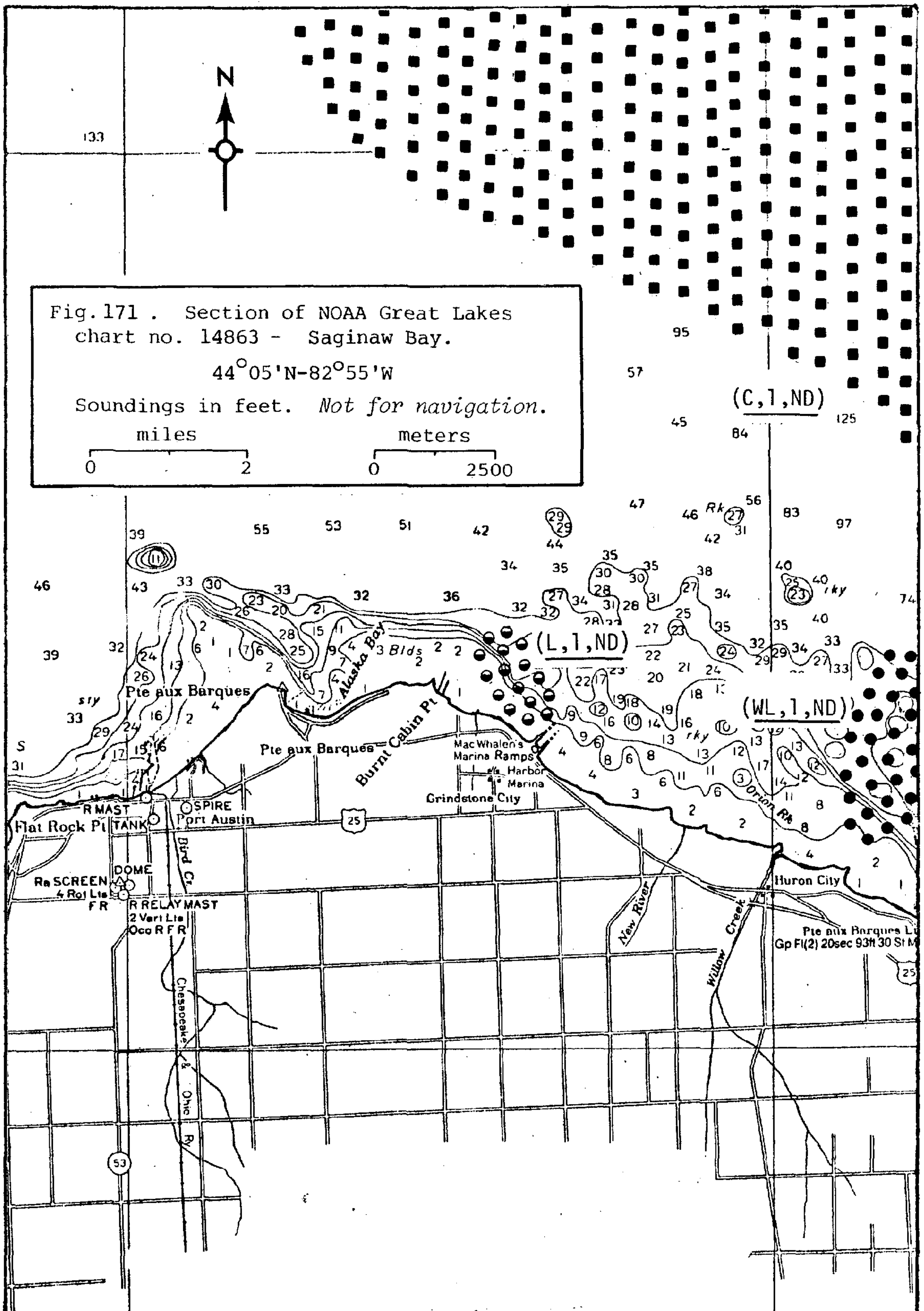



Fig. 171 . Section of NOAA Great Lakes chart no. 14863 - Saginaw Bay.

$44^{\circ}05'N-82^{\circ}55'W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

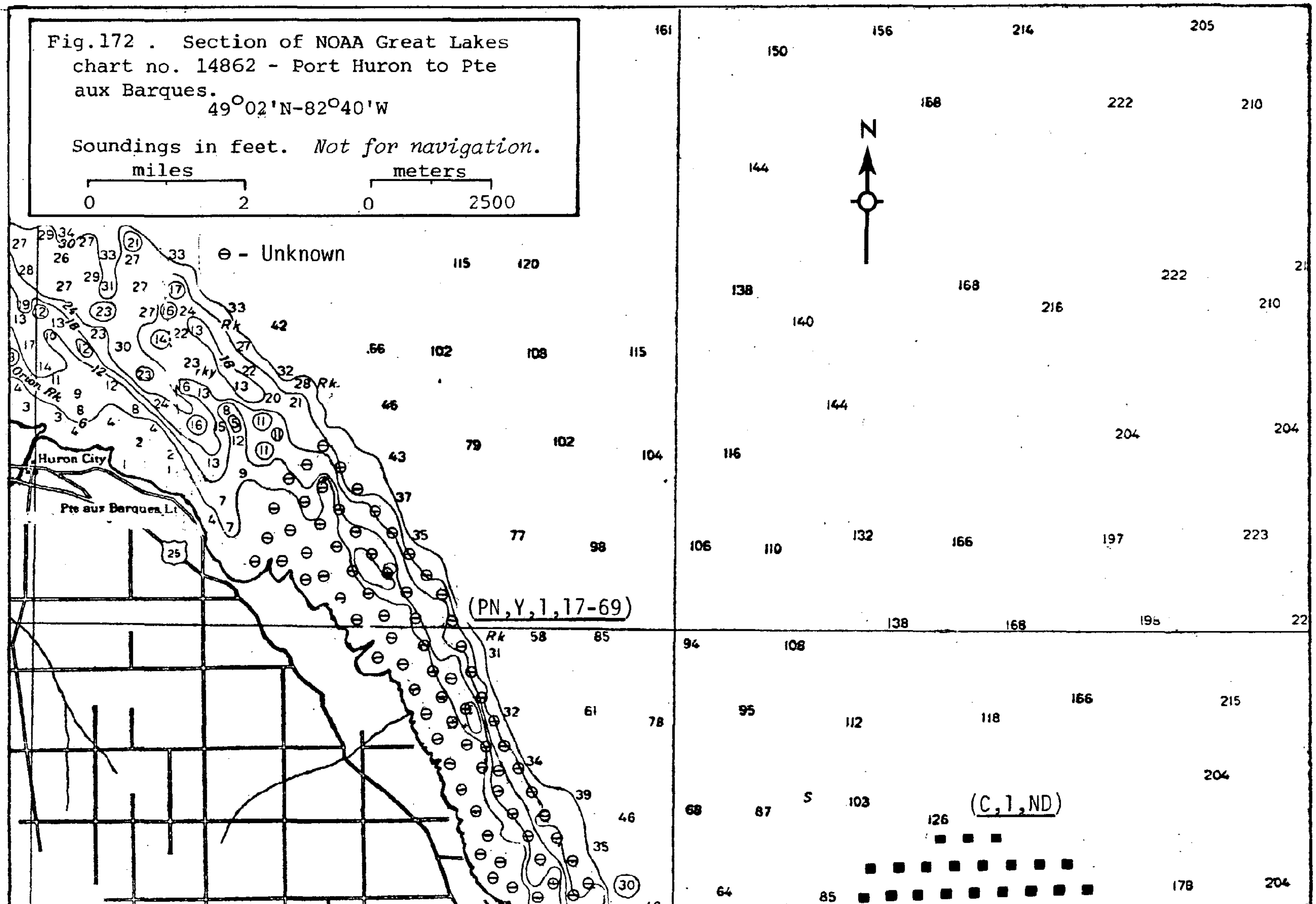



Fig.172 . Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
49°02'N-82°40'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

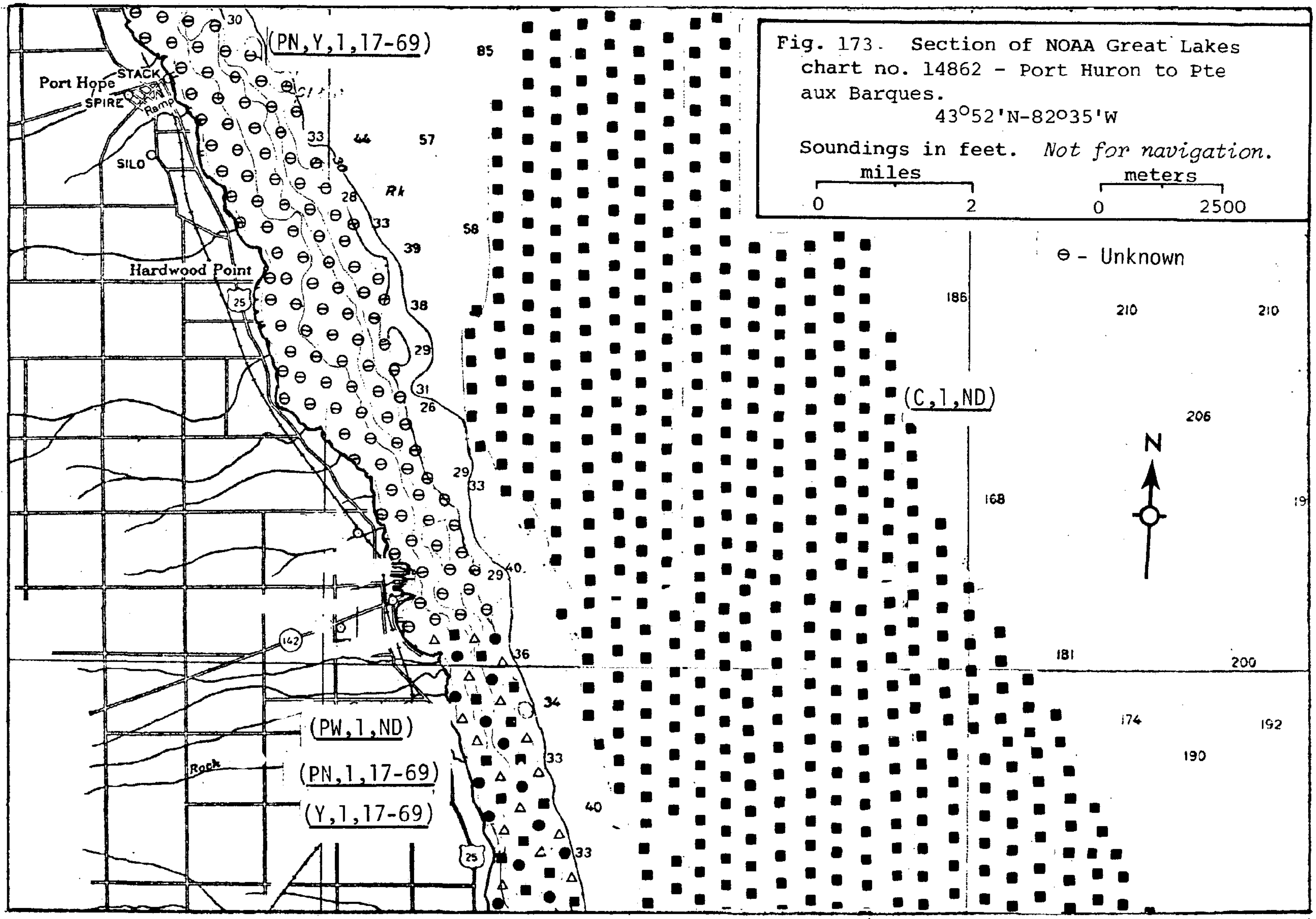



Fig. 173. Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°52'N-82°35'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

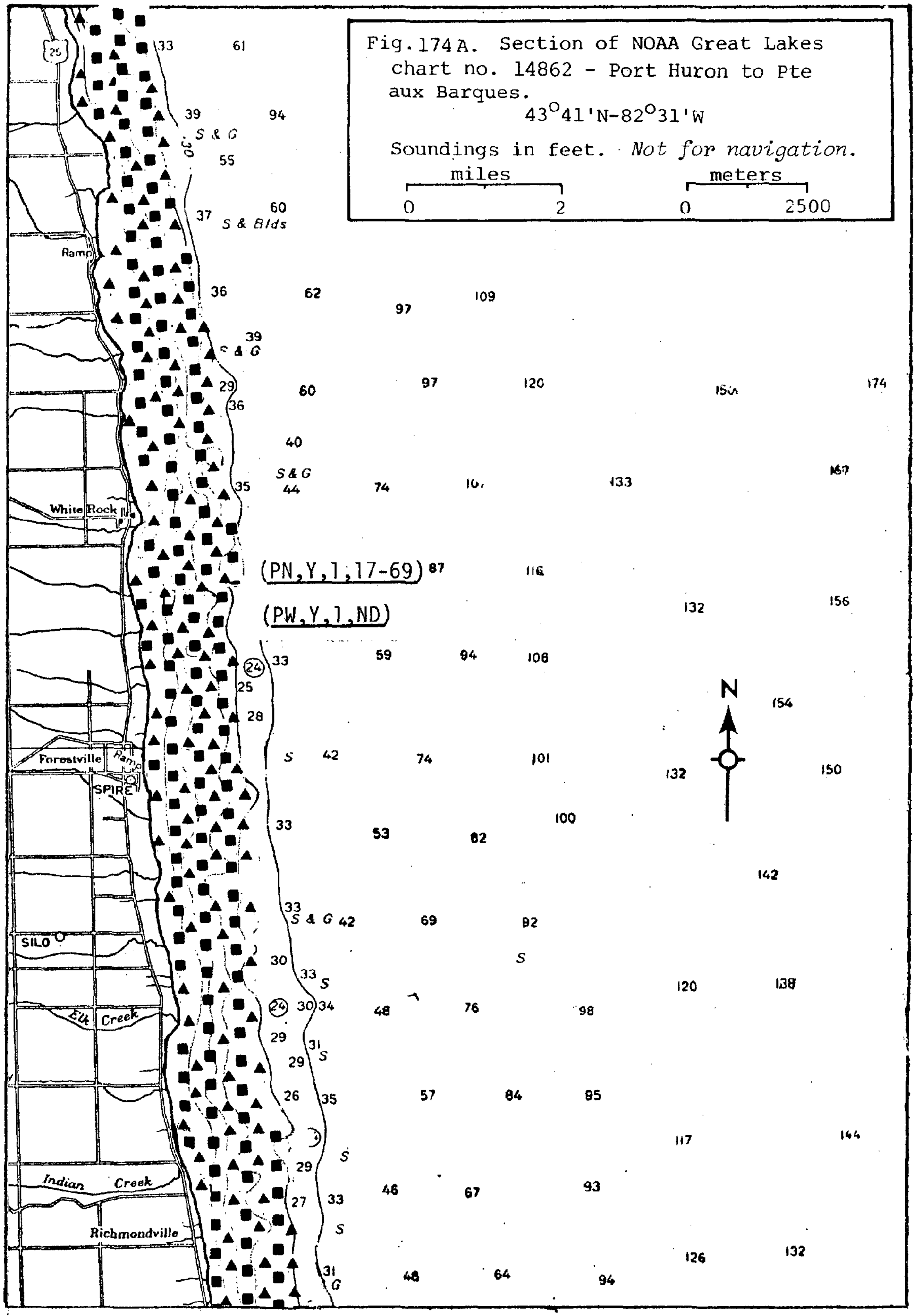



Fig. 174A. Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°41'N-82°31'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

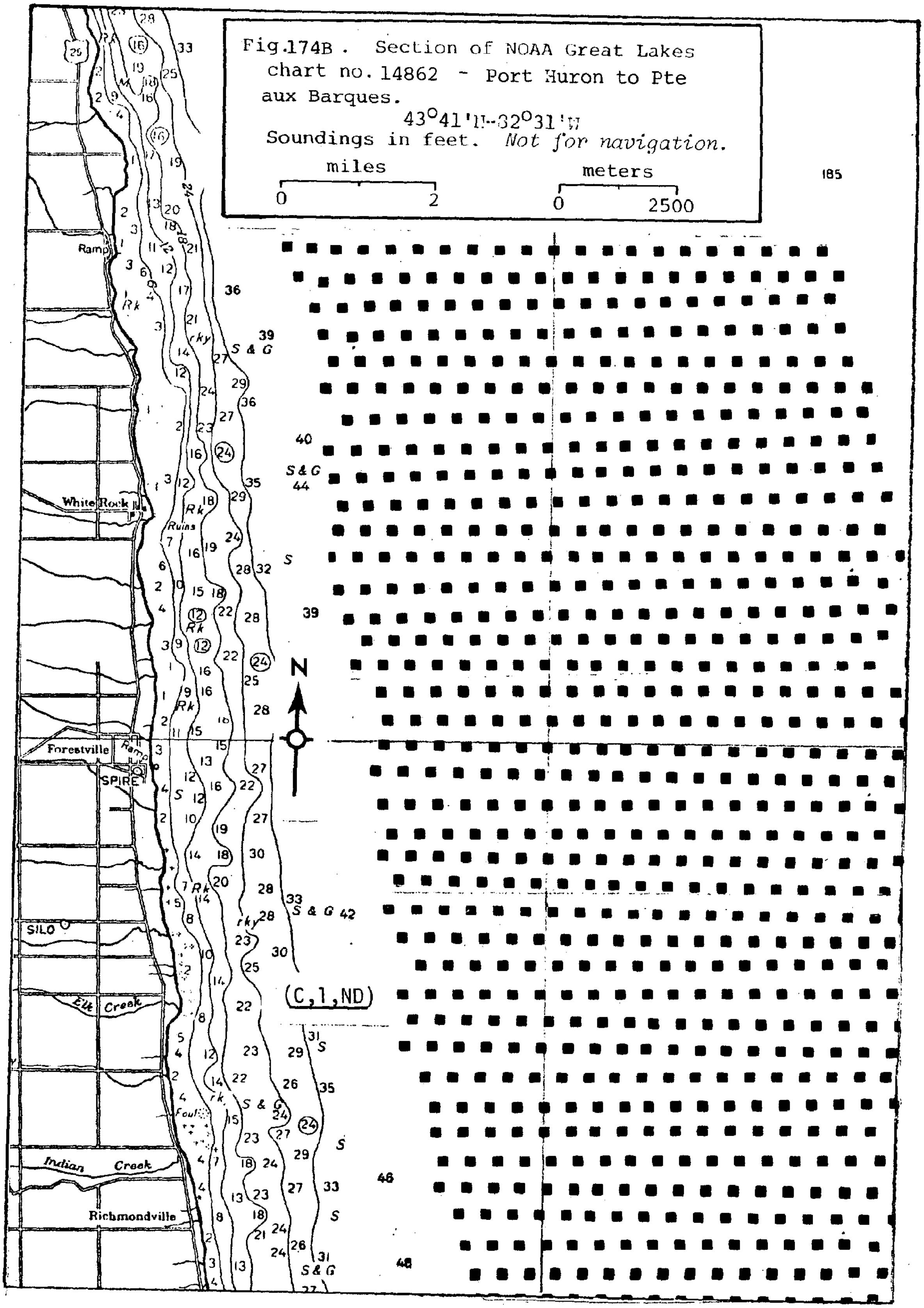



Fig.174B . Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°41'N-82°31'W
Soundings in feet. *Not for navigation.*

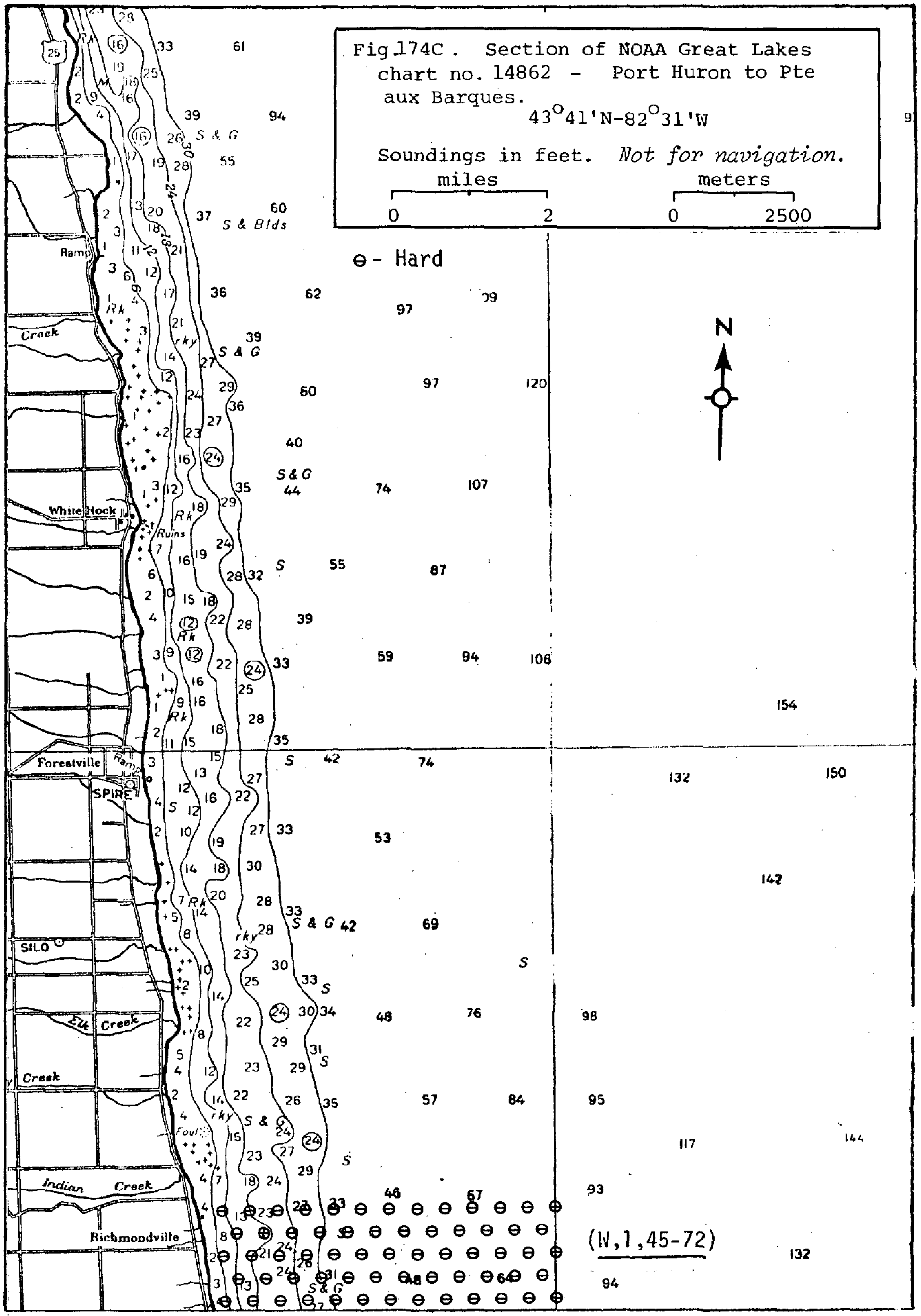



Fig 174C. Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°41'N-82°31'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

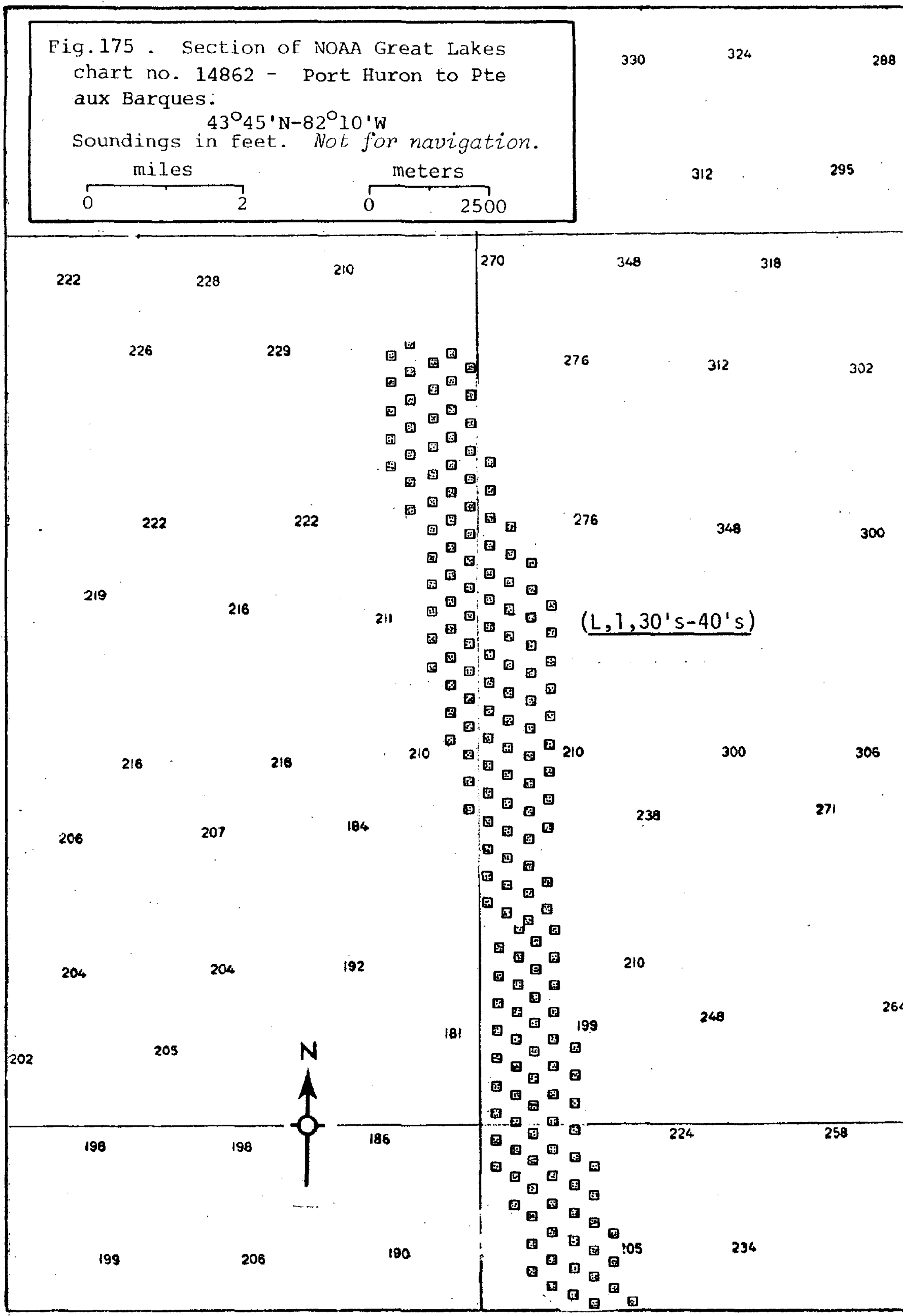



Fig.175 . Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°45'N-82°10'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

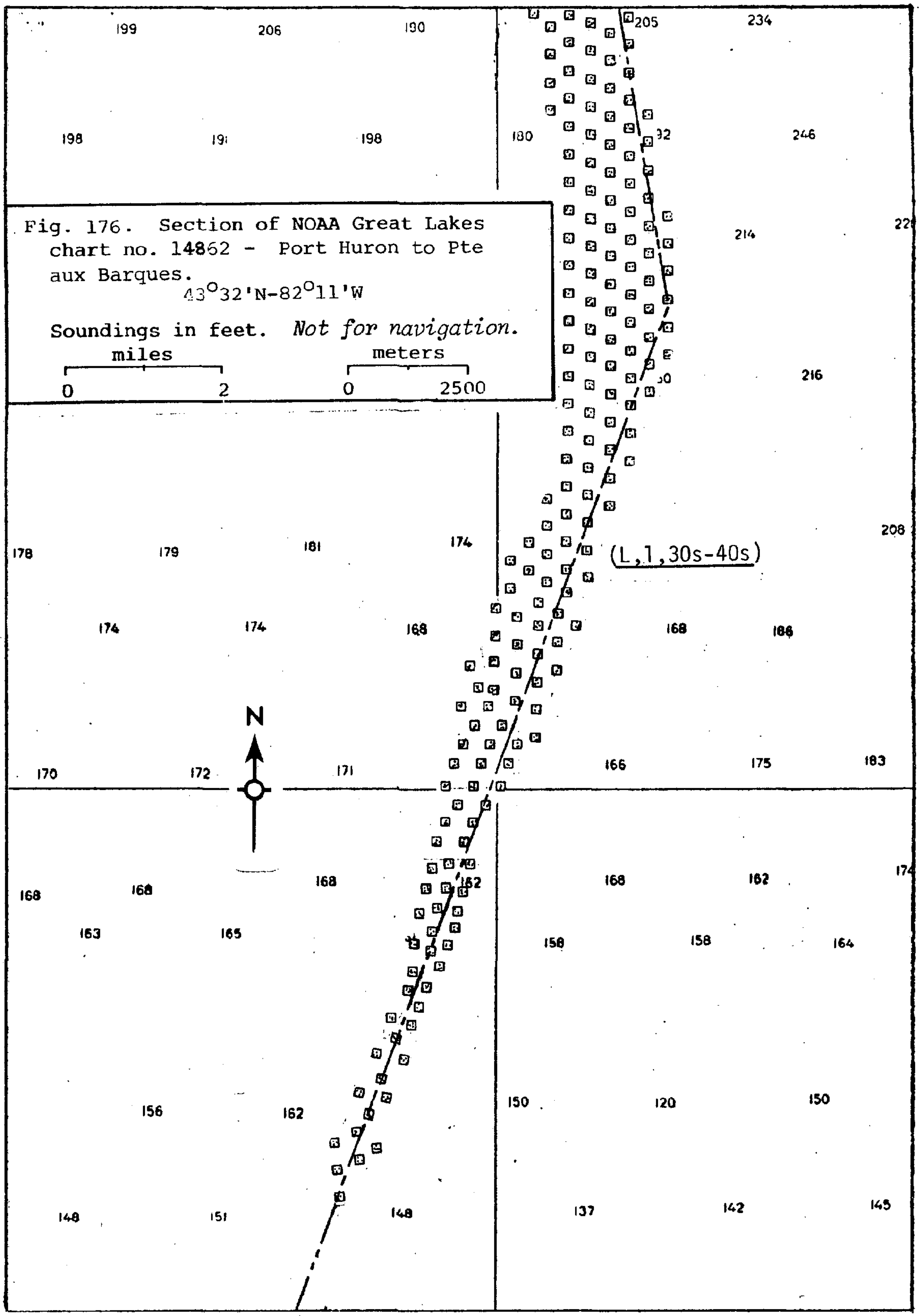



Fig. 176. Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°32'N-82°11'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

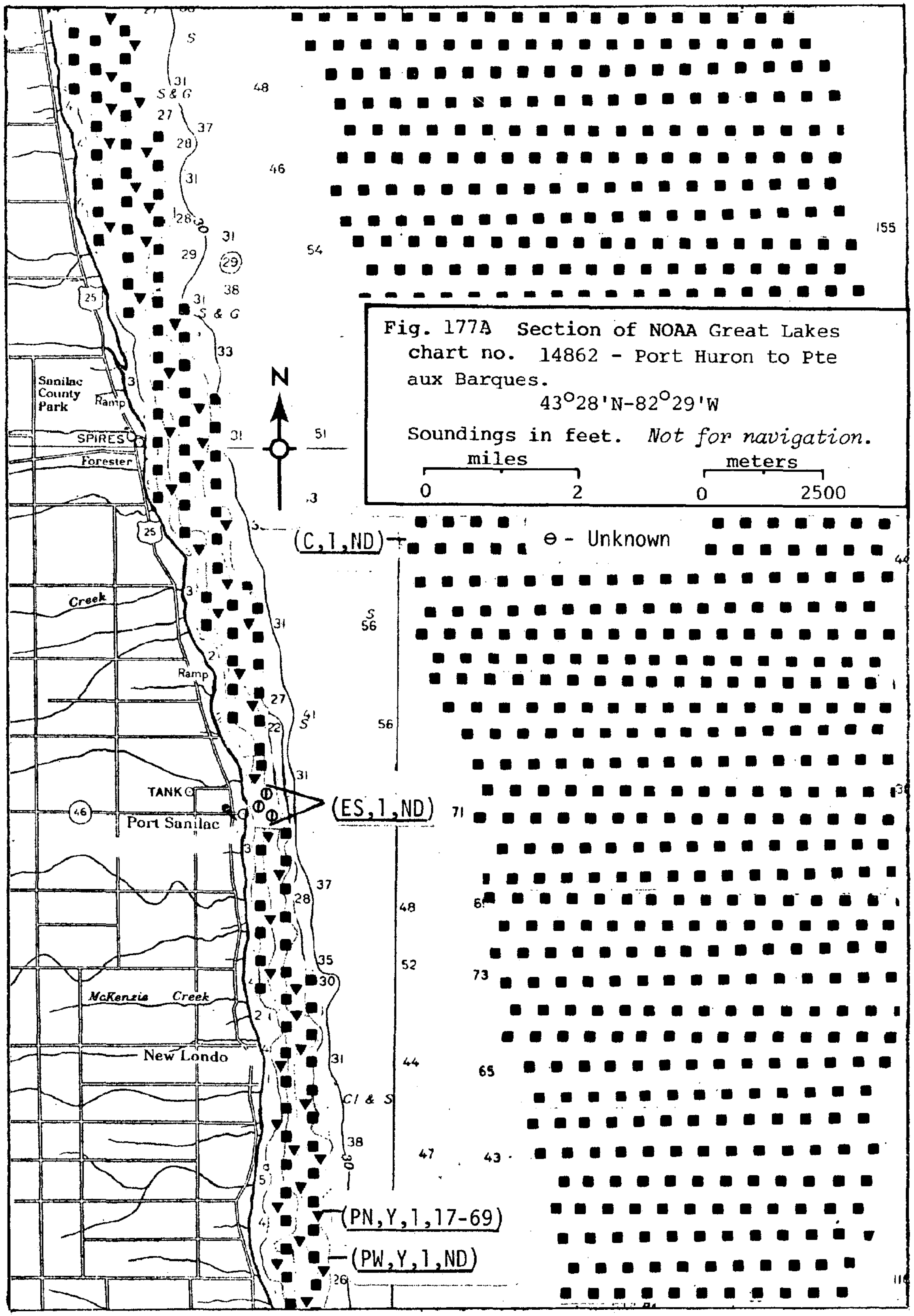



Fig. 177A Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°28'N-82°29'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

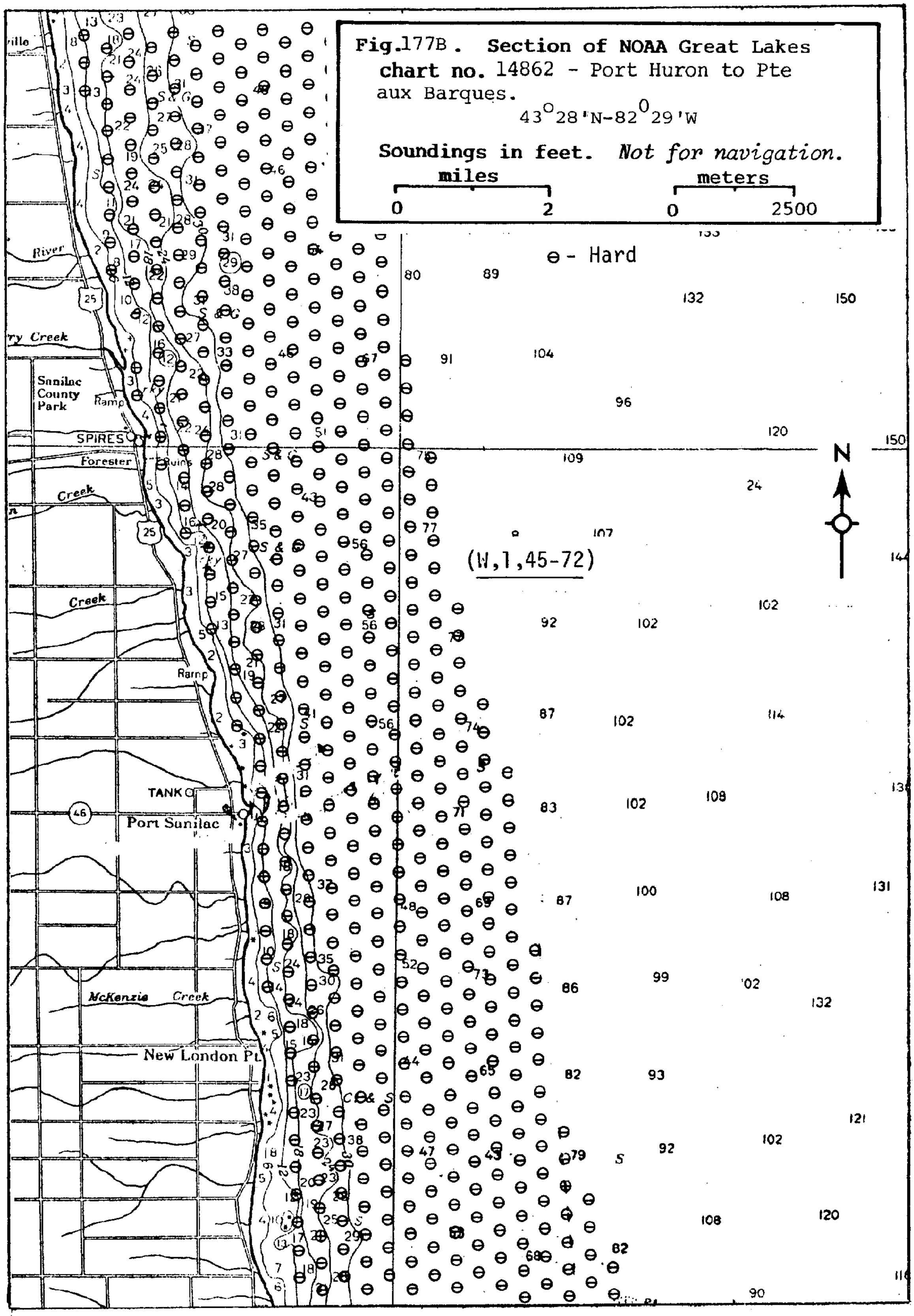



**Fig.**177B . **Section of NOAA Great Lakes chart no.** 14862 - Port Huron to Pte aux Barques.
$43^{\circ}28'$N-$82^{\circ}29'$W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

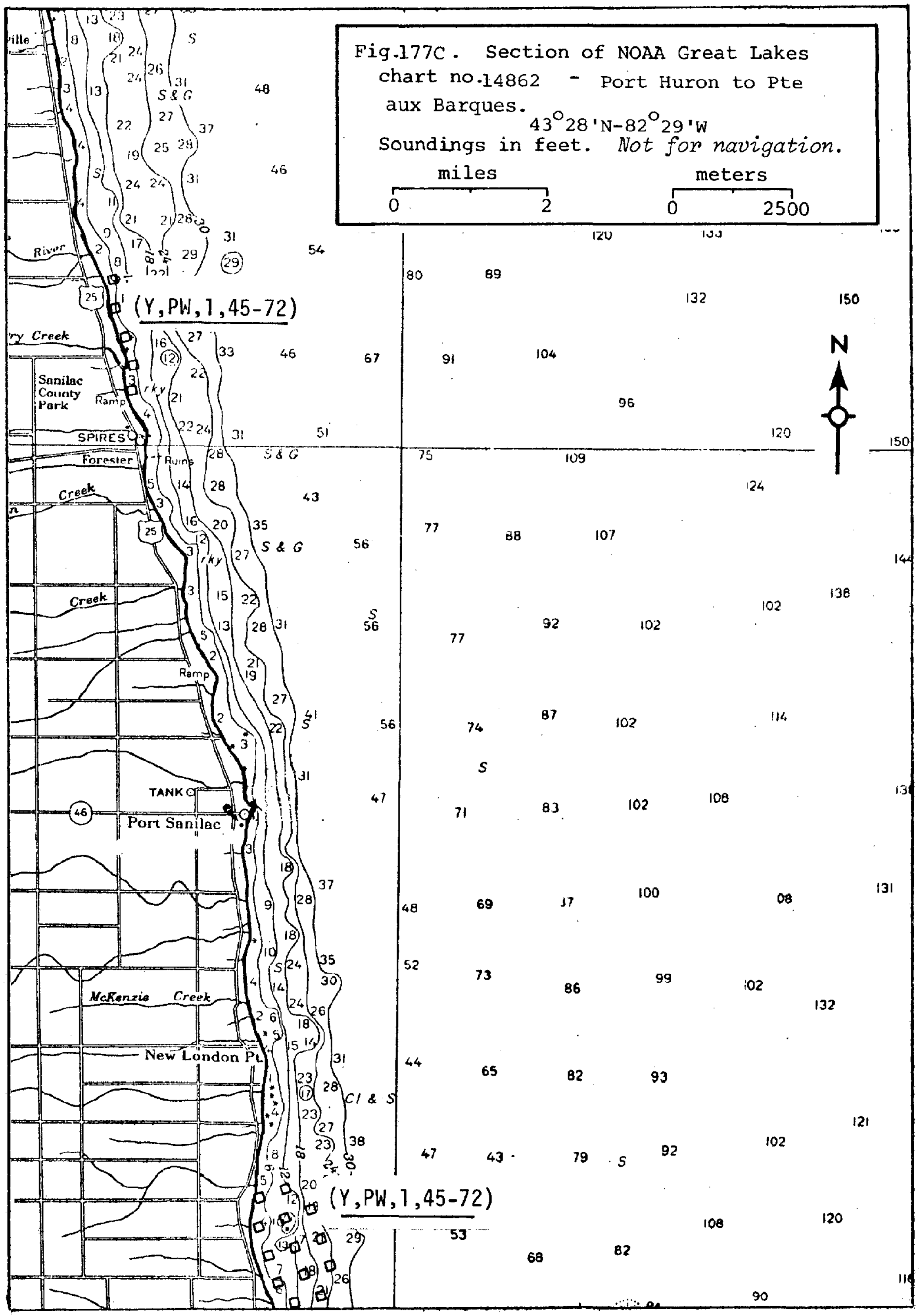



Fig.177C. Section of NOAA Great Lakes chart no.14862 - Port Huron to Pte aux Barques. 43°28'N-82°29'W
Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 2500

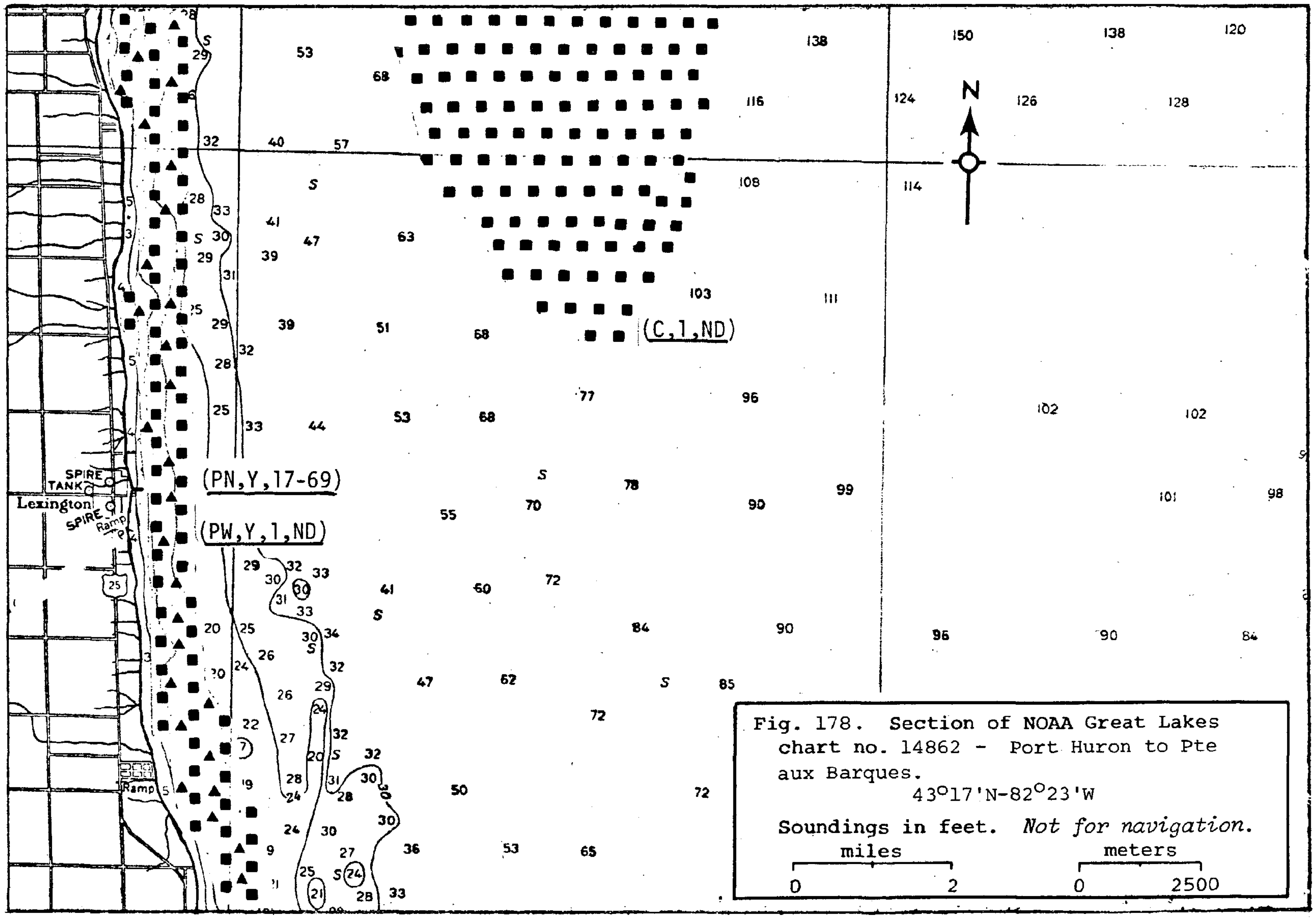



Fig. 178. Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°17'N-82°23'W

**Soundings in feet.** *Not for navigation.*

miles 0 2 meters 0 2500

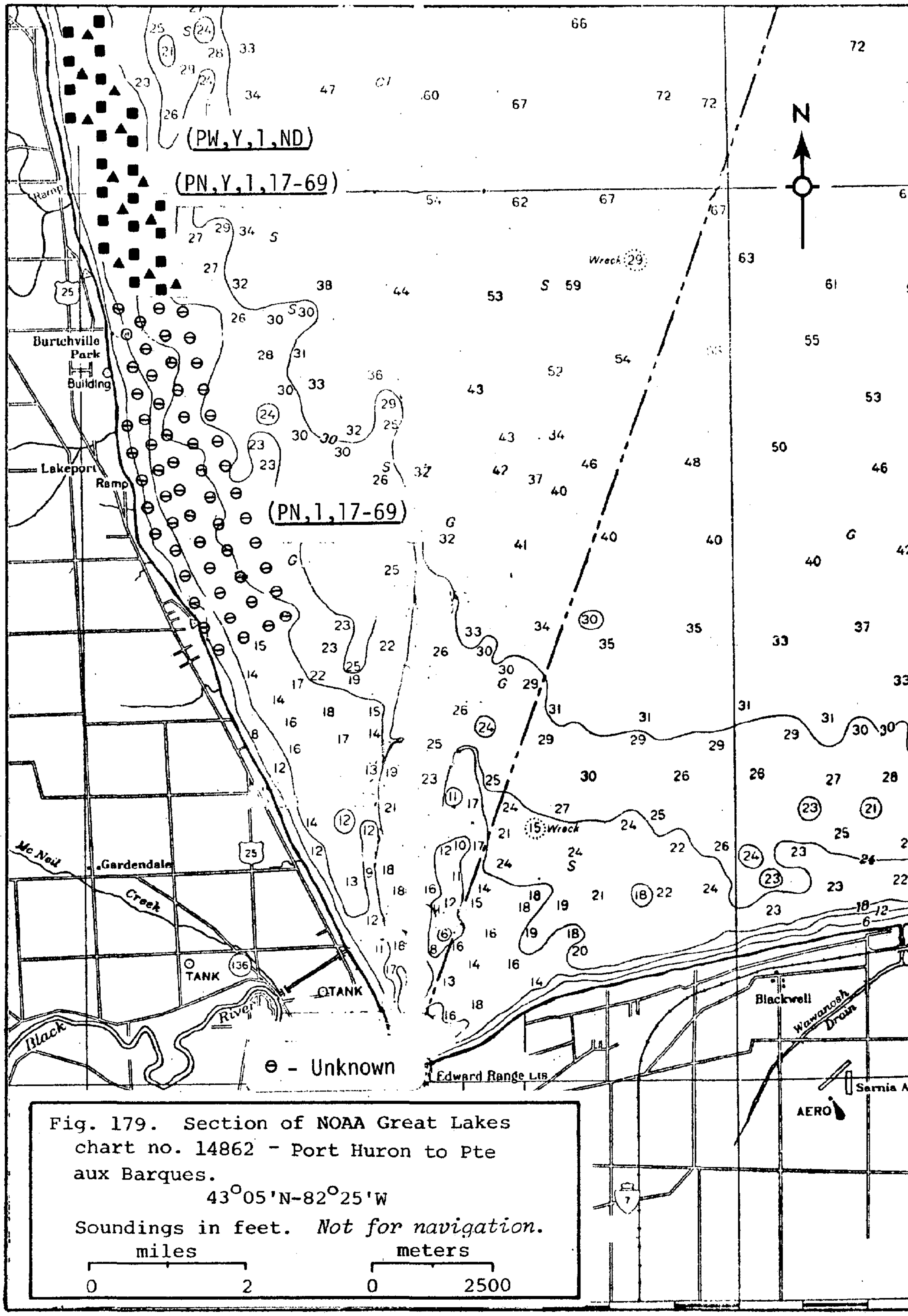



Fig. 179. Section of NOAA Great Lakes chart no. 14862 - Port Huron to Pte aux Barques.
43°05'N-82°25'W
Soundings in feet. *Not for navigation.*
miles 0 2 meters 0 2500

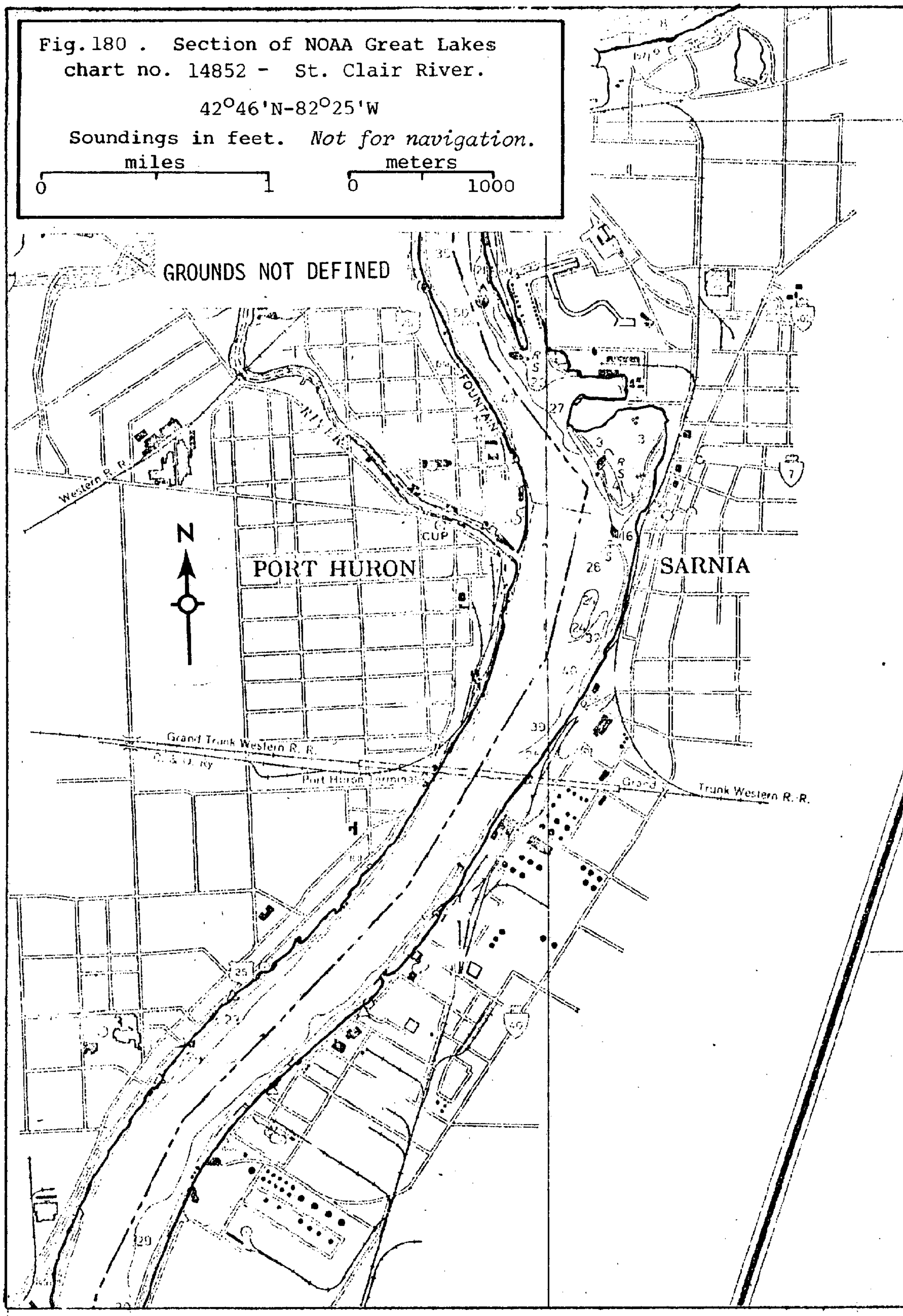



Fig. 180 . Section of NOAA Great Lakes chart no. 14852 - St. Clair River.

$42^{\circ}46'$N-$82^{\circ}25'$W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

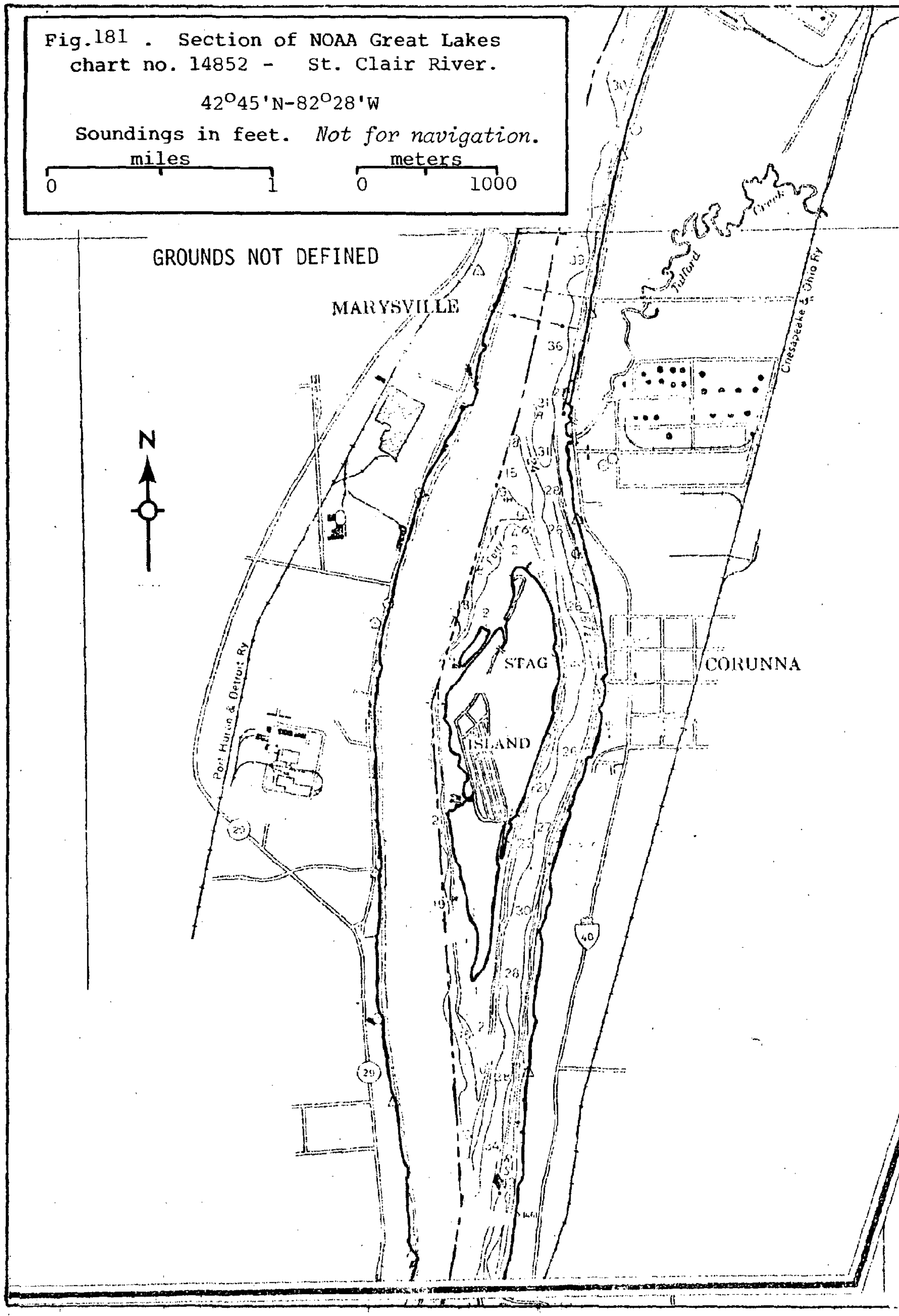



Fig.181 . Section of NOAA Great Lakes chart no. 14852 - St. Clair River.

42°45'N-82°28'W

Soundings in feet. *Not for navigation.*

Fig. 182. Section of NOAA Great Lakes chart no. 14852 - St. Clair River.

42°49'N-82°28'W

Soundings in feet. *Not for navigation.*

miles meters

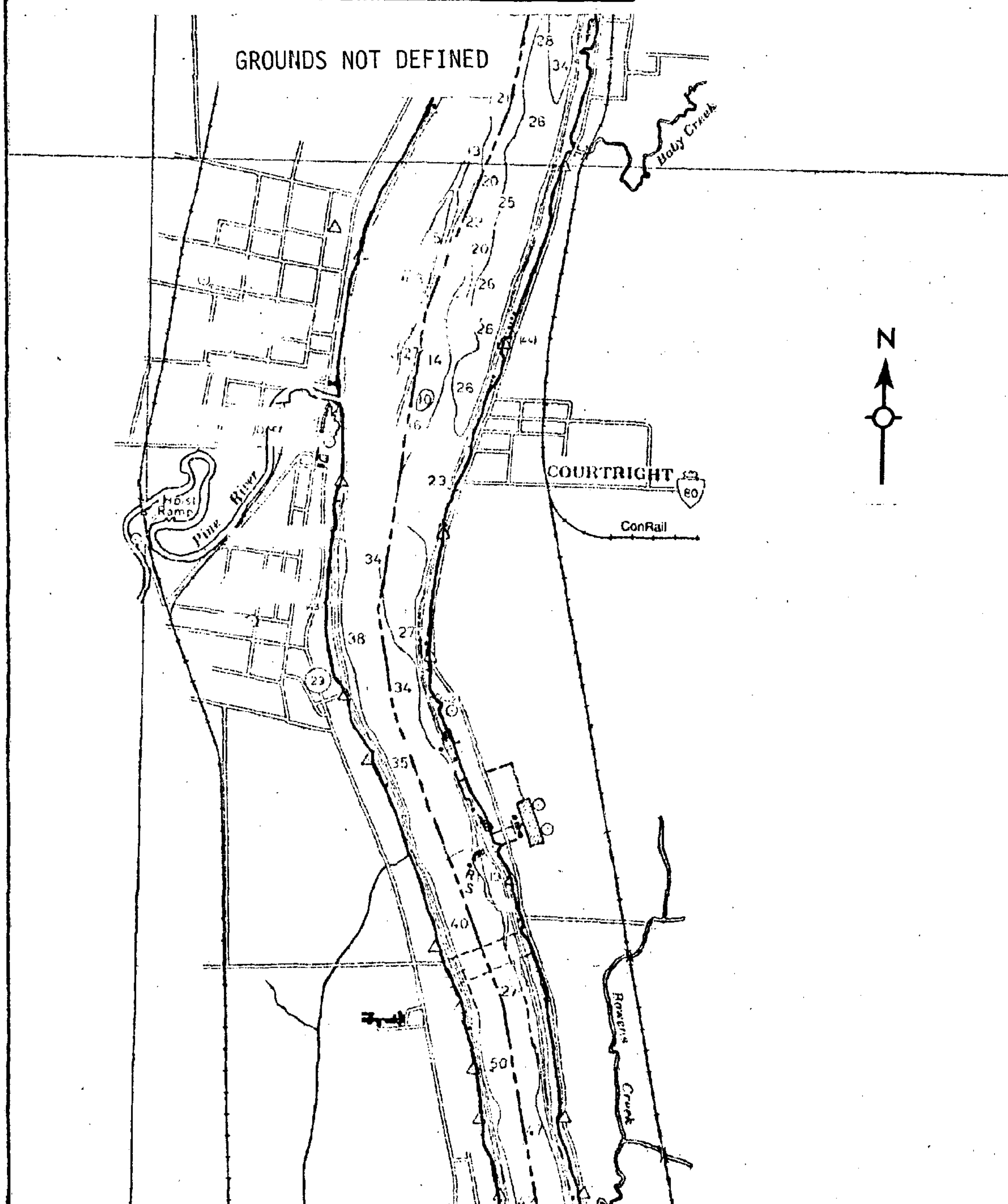


Fig. 183. Section of NOAA Great Lakes chart no. 14852 - St. Clair River.

42°44'N-82°29'W

Soundings in feet. *Not for navigation.*

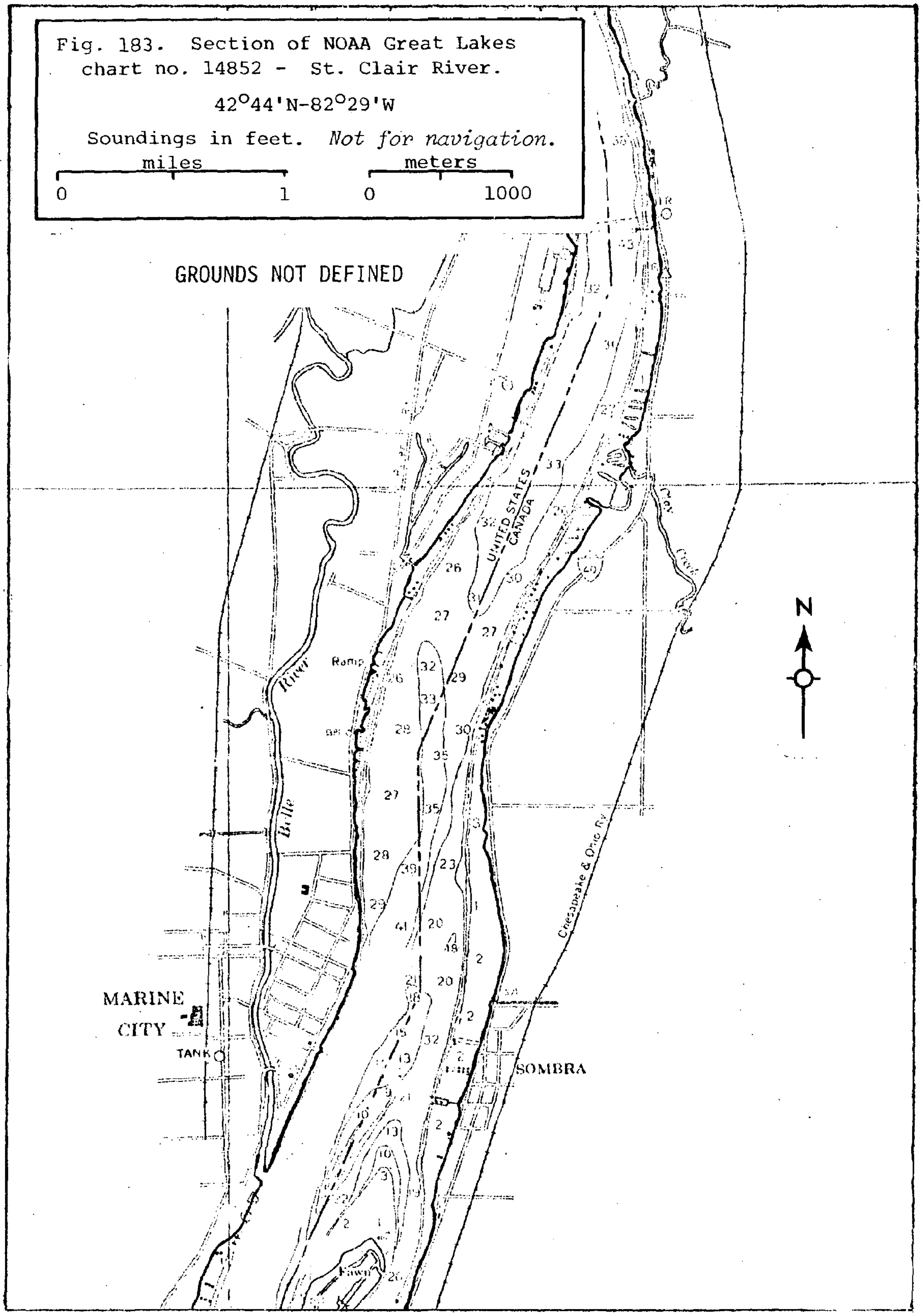
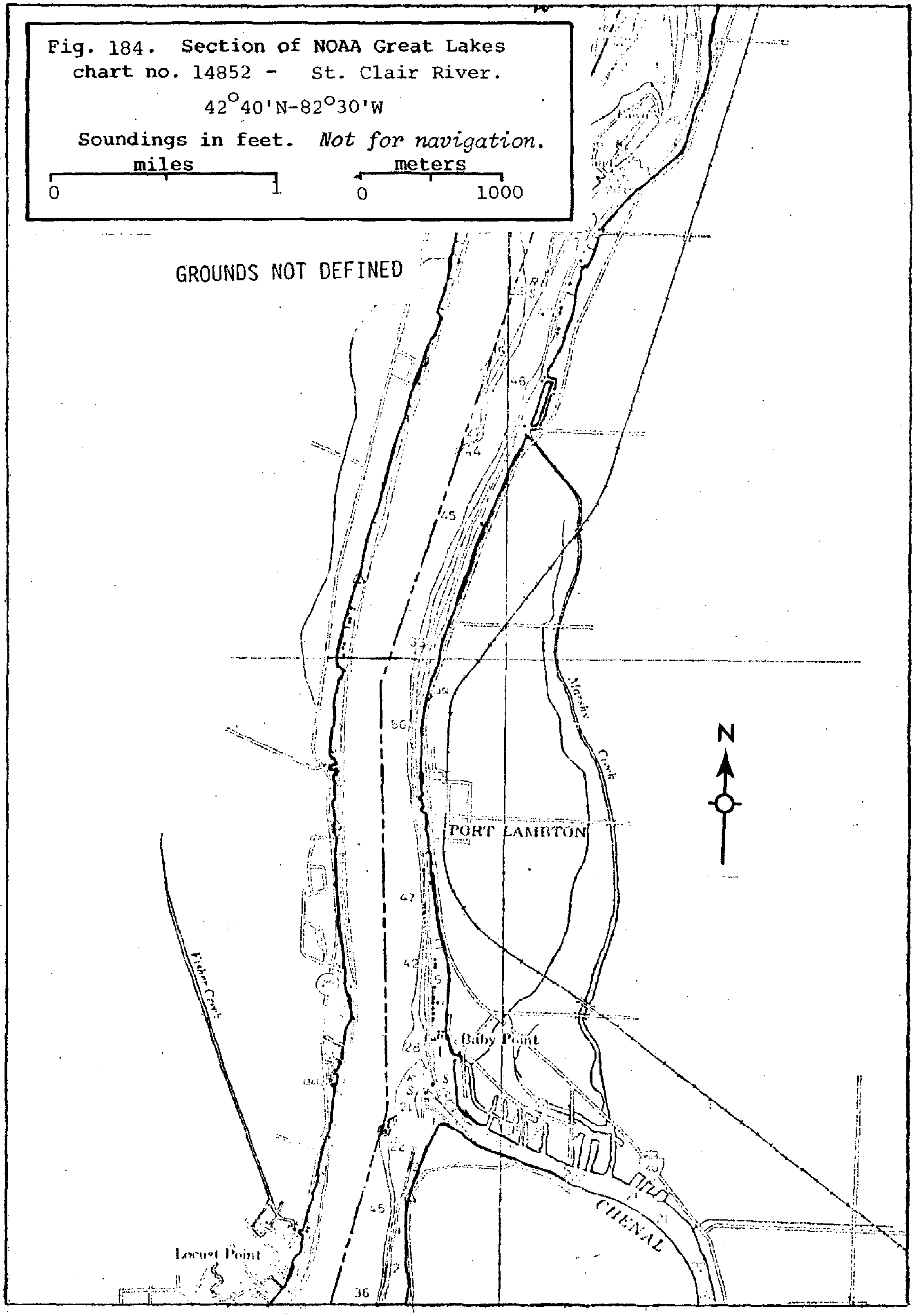


Fig. 184. Section of NOAA Great Lakes chart no. 14852 - St. Clair River.
42°40'N-82°30'W
Soundings in feet. *Not for navigation.*



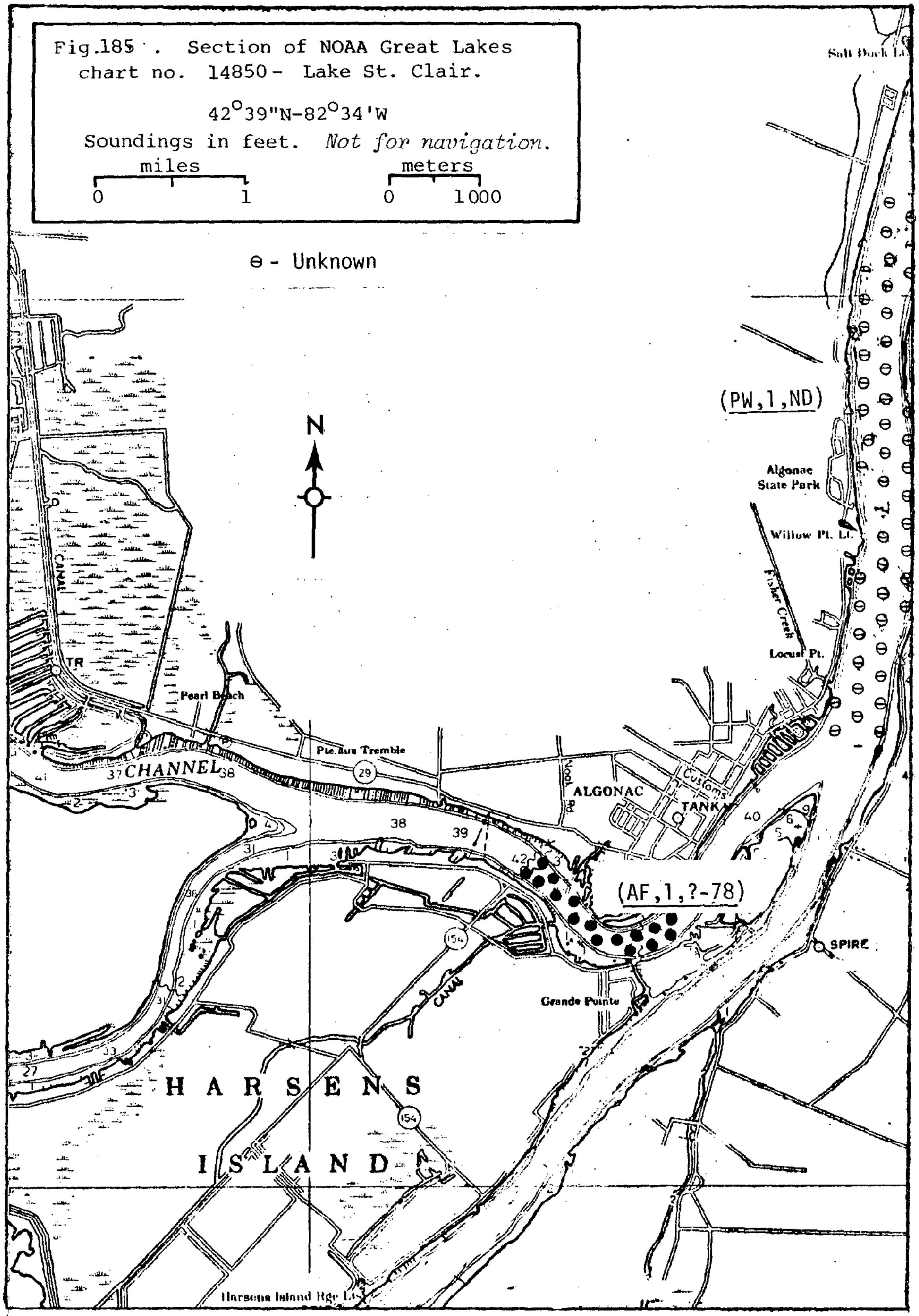


Fig.185 . Section of NOAA Great Lakes chart no. 14850- Lake St. Clair.
42°39"N-82°34'W
Soundings in feet. Not for navigation.
miles
0
1
meters
0
1000
ϴ - Unknown
N
(PW,1,ND)
Algonac State Park
Willow Pt. Lt.
Fisher Creek
Locust Pt.
Pearl Beach
Pte. Aux Tremble
CHANNEL
ALGONAC
Customs
TANK
(AF,1,?-78)
SPIRE
Grande Pointe
CANAL
HARSENS
ISLAND
Harsens Island Rge Lts
Salt Dock Lt

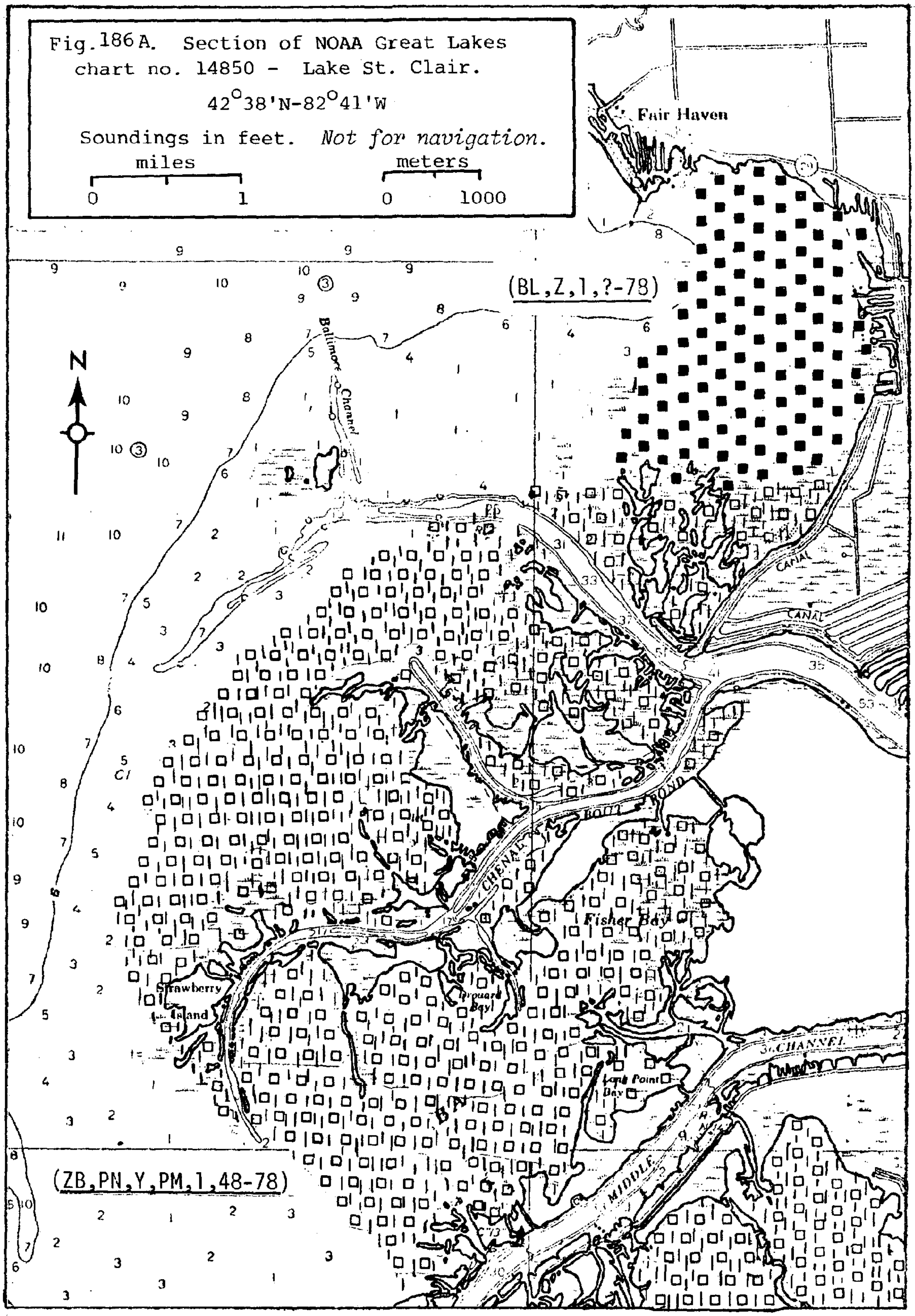



Fig. 186A. Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.
42°38'N-82°41'W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

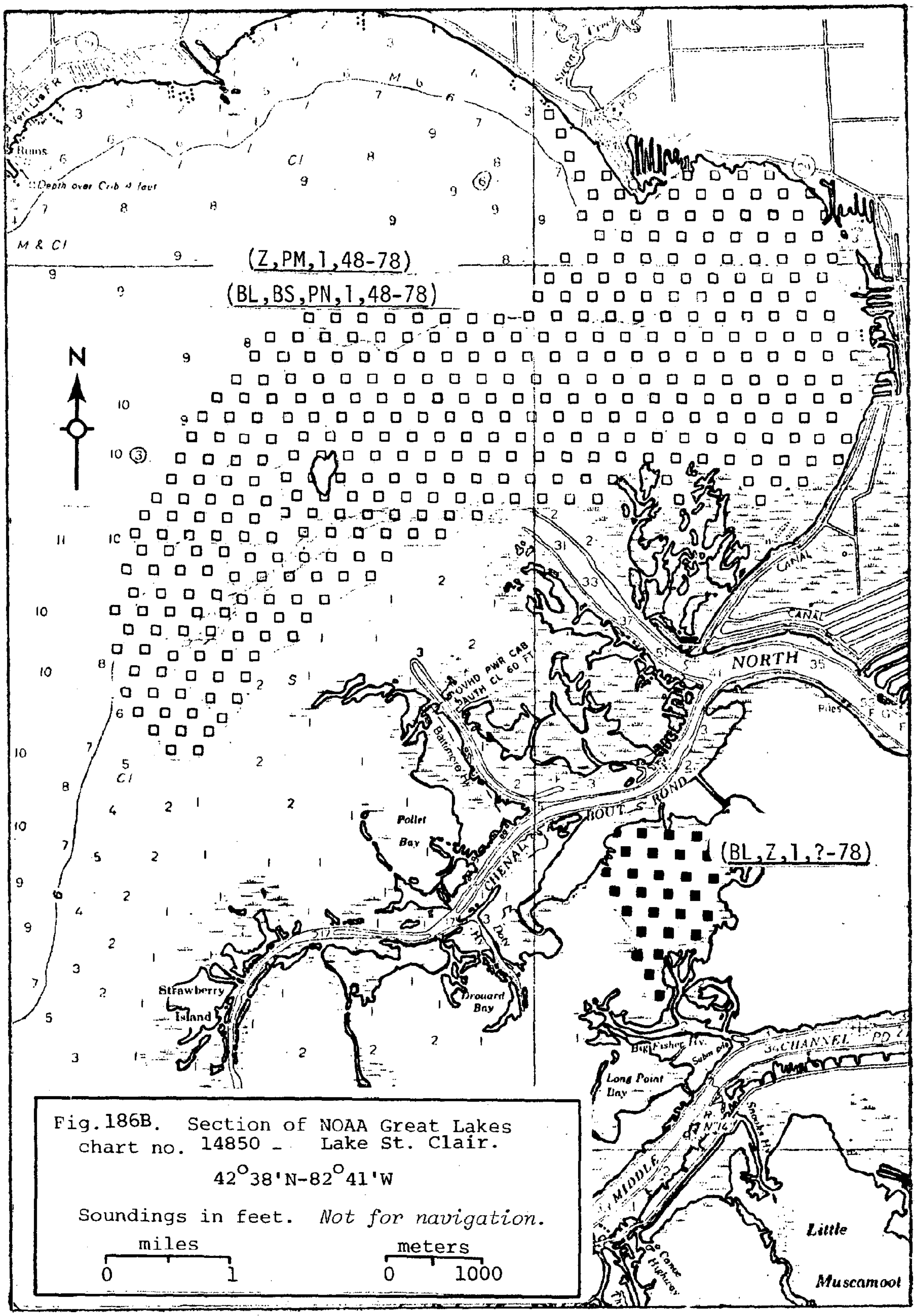



Fig. 186B. Section of NOAA Great Lakes chart no. 14850 – Lake St. Clair.

42°38'N-82°41'W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

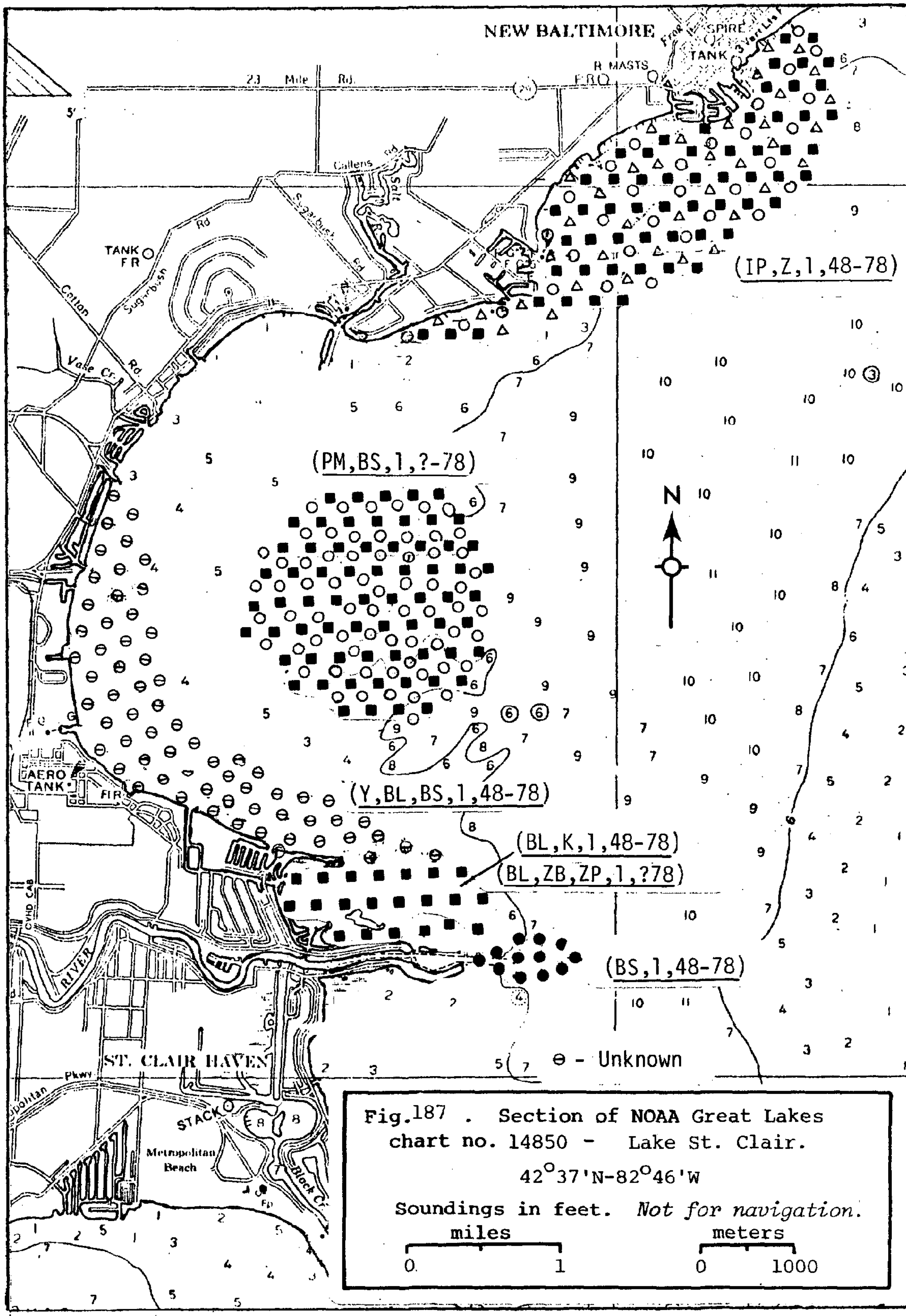



Fig.187 . Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.

$42^{\circ}37'$N-$82^{\circ}46'$W

Soundings in feet. *Not for navigation.*

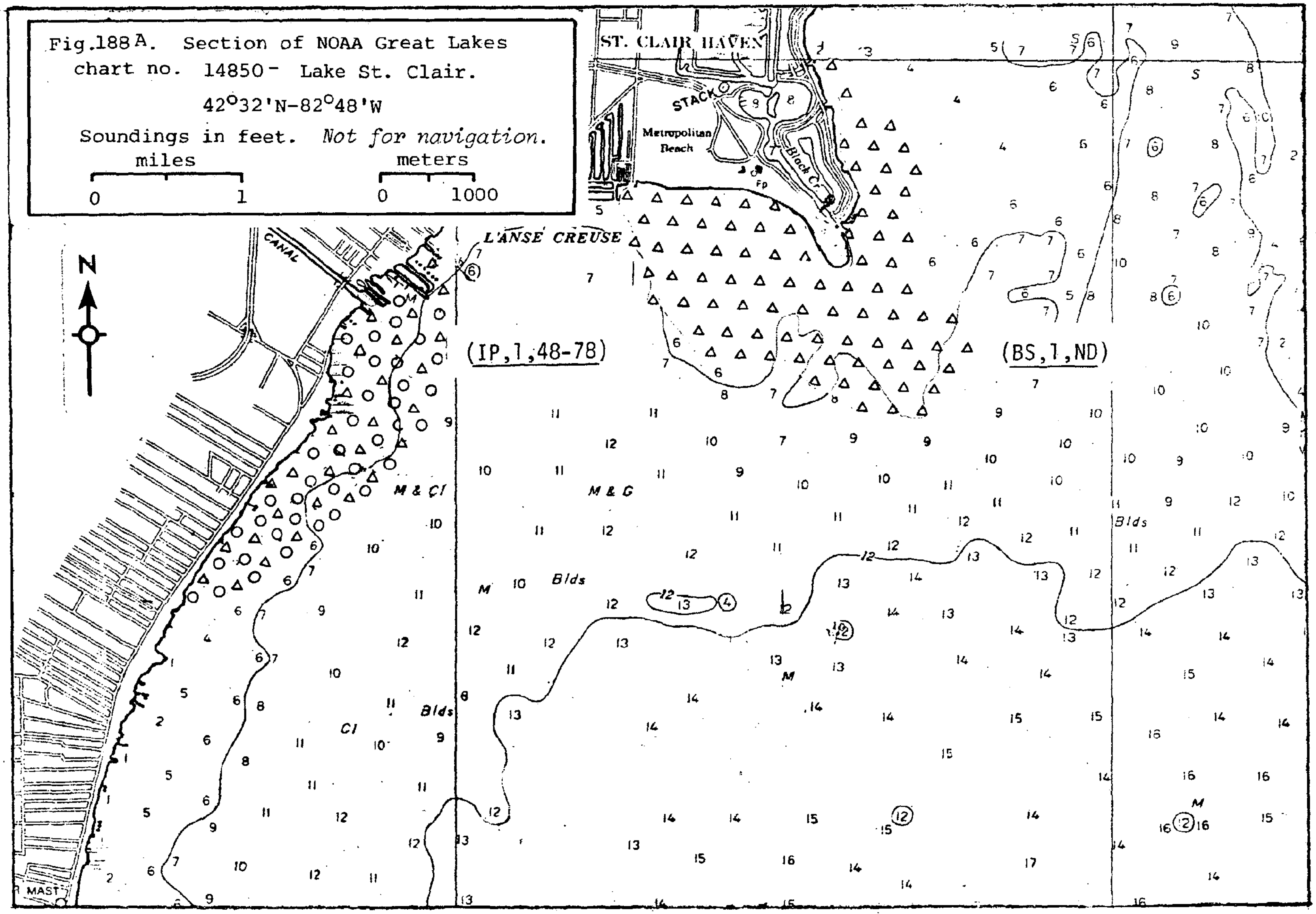



Fig.188A. Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.
42°32'N-82°48'W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

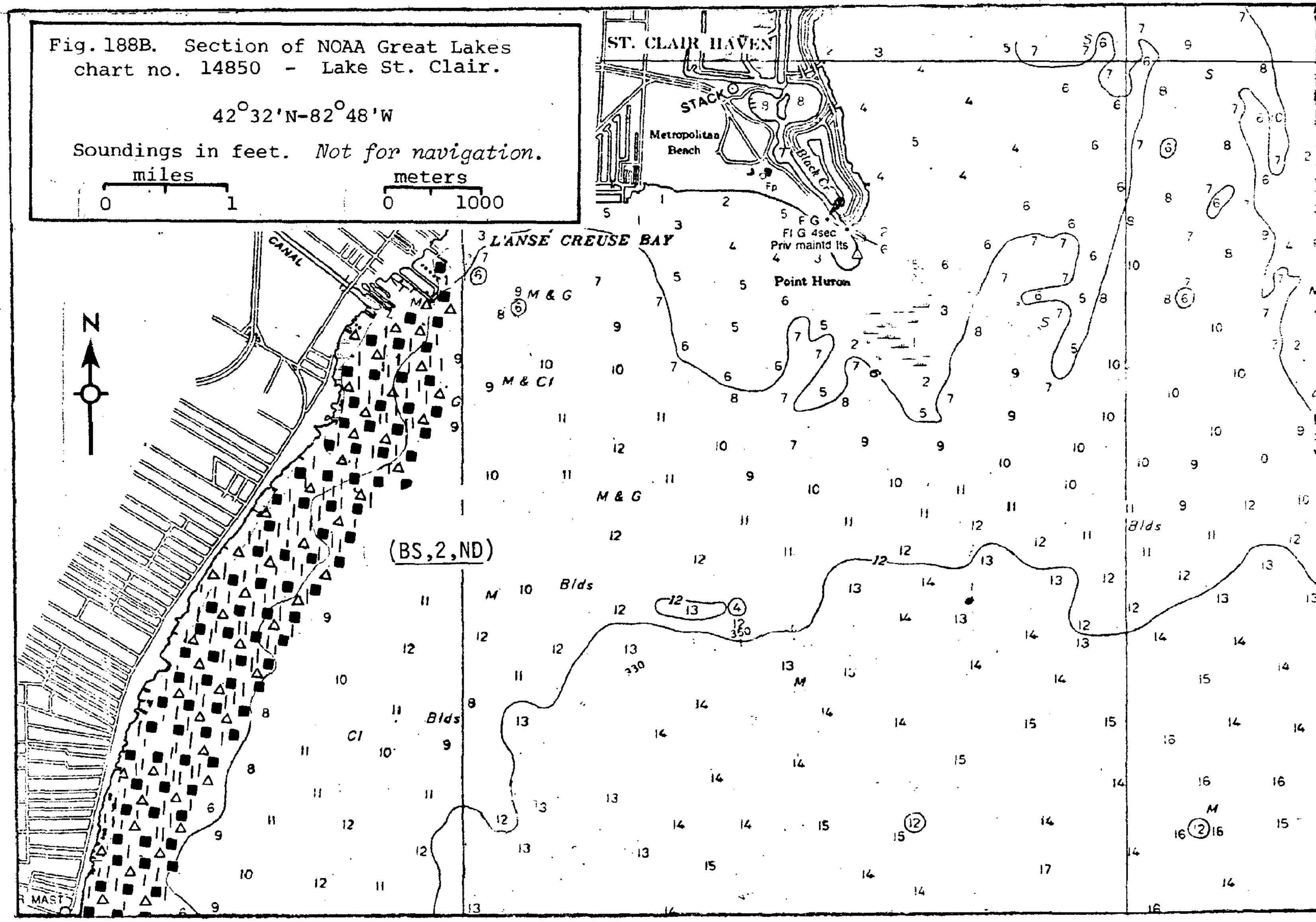



Fig. 188B. Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.

$42^{\circ}32'N-82^{\circ}48'W$

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

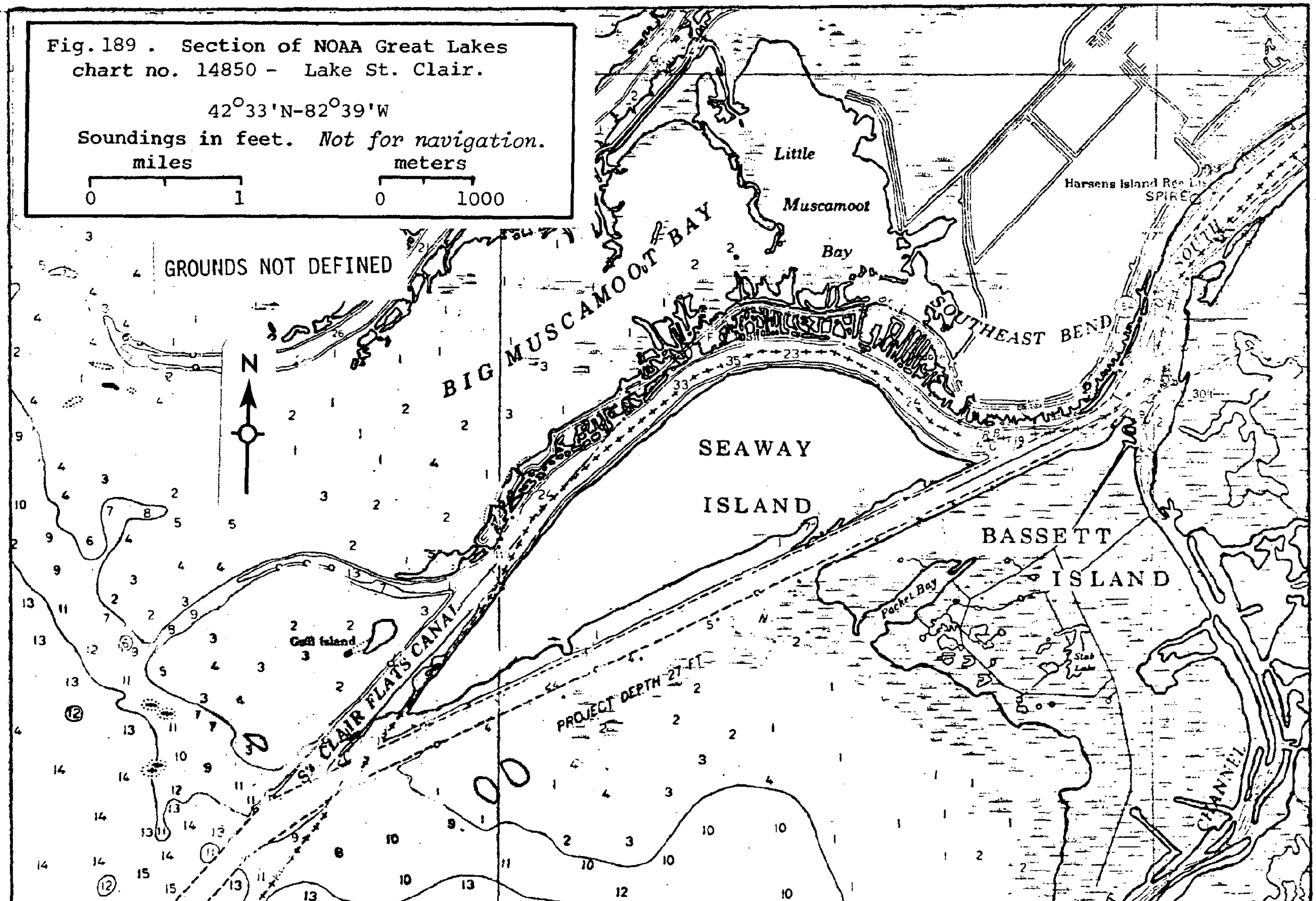



Fig. 189 . Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.

$42^{o}33'N-82^{o}39'W$

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

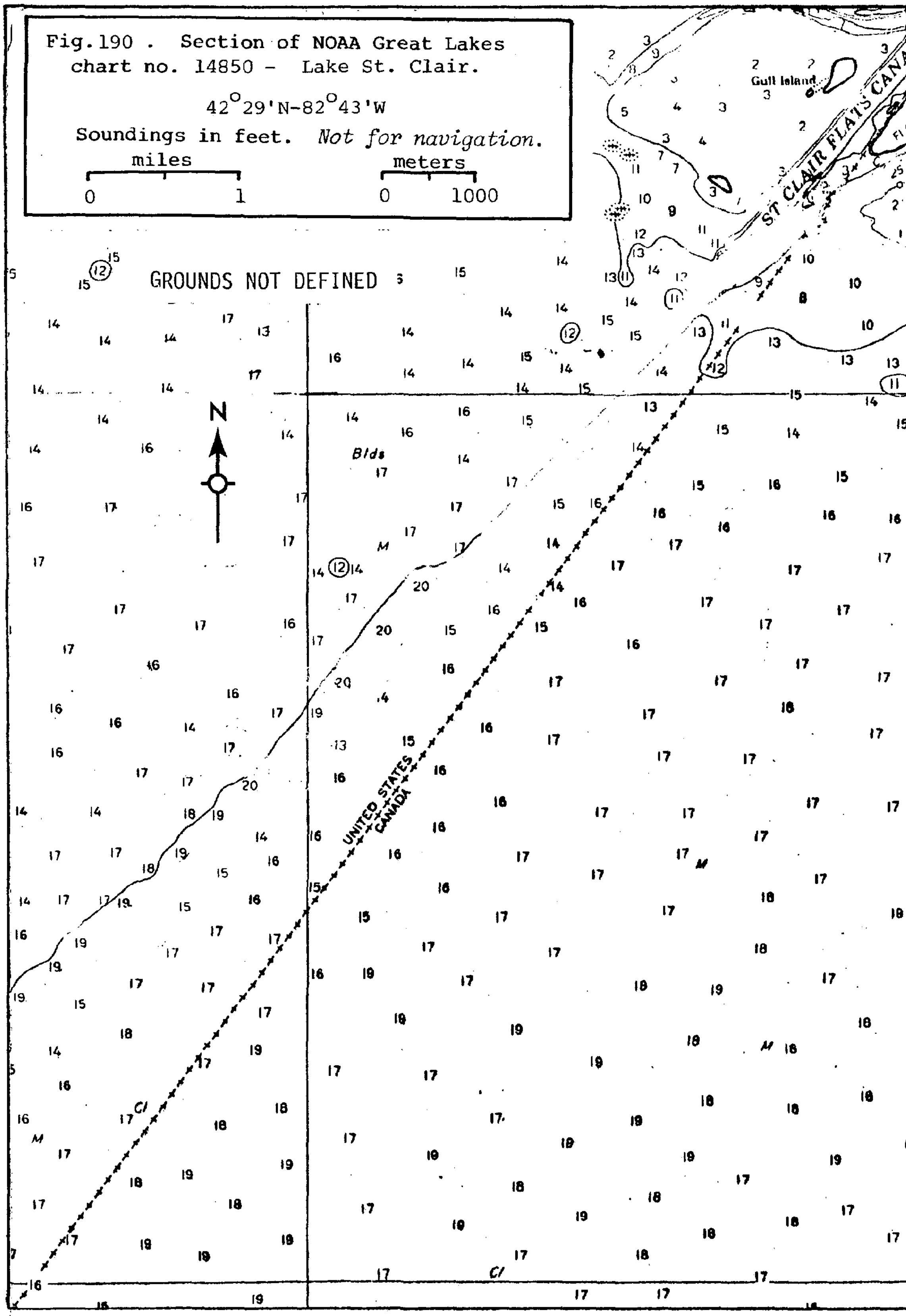



Fig. 190 . Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.

42°29'N-82°43'W

Soundings in feet. *Not for navigation.*

miles 0 1 meters 0 1000

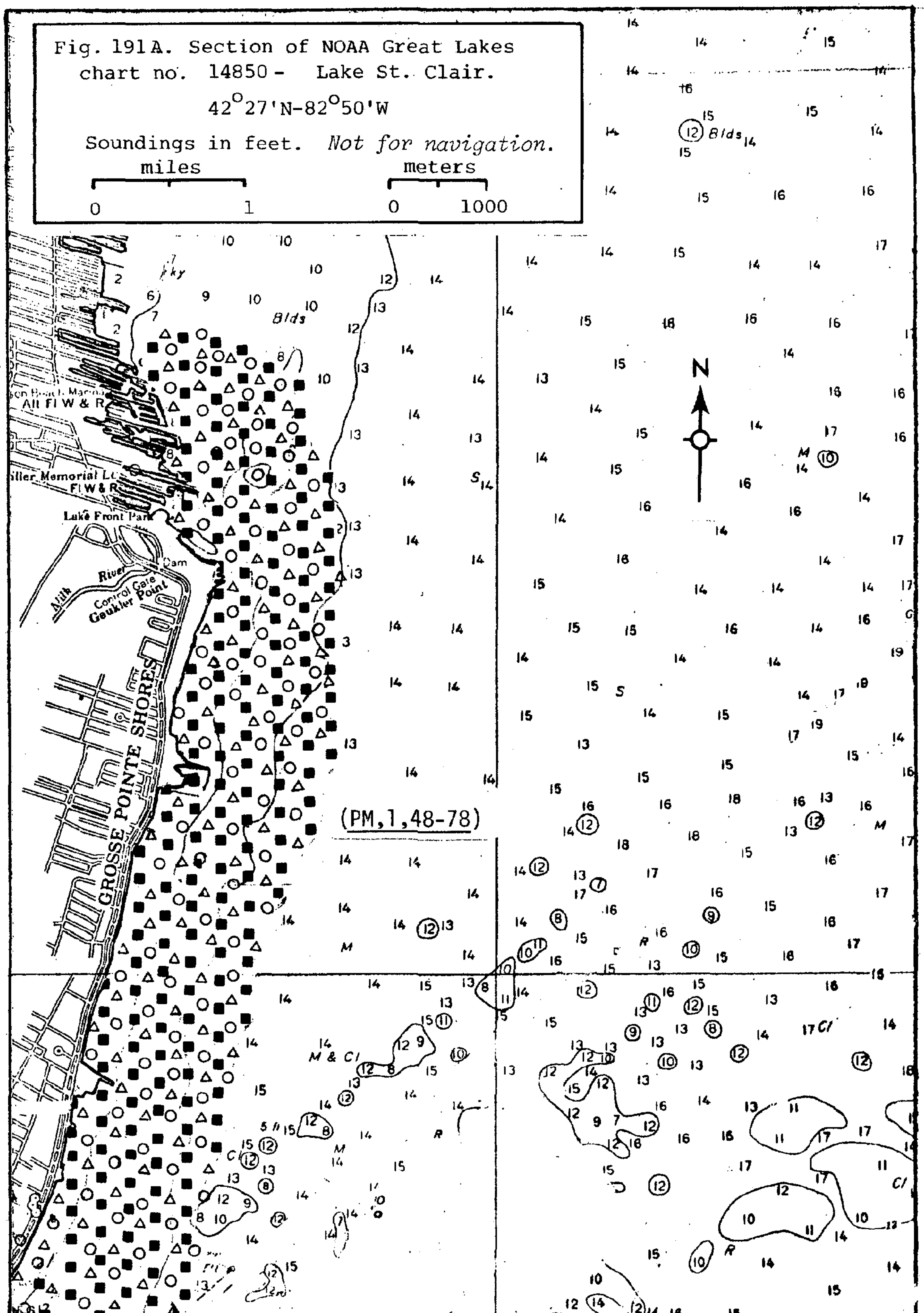


Fig. 191A. Section of NOAA Great Lakes
chart no. 14850 - Lake St. Clair.
42°27'N-82°50'W
Soundings in feet. *Not for navigation.*
miles
0 1
meters
0 1000
GROSSE POINTE SHORES
Lake Front Park
Milk River
Control Gate
Geukler Point
(PM,1,48-78)
N

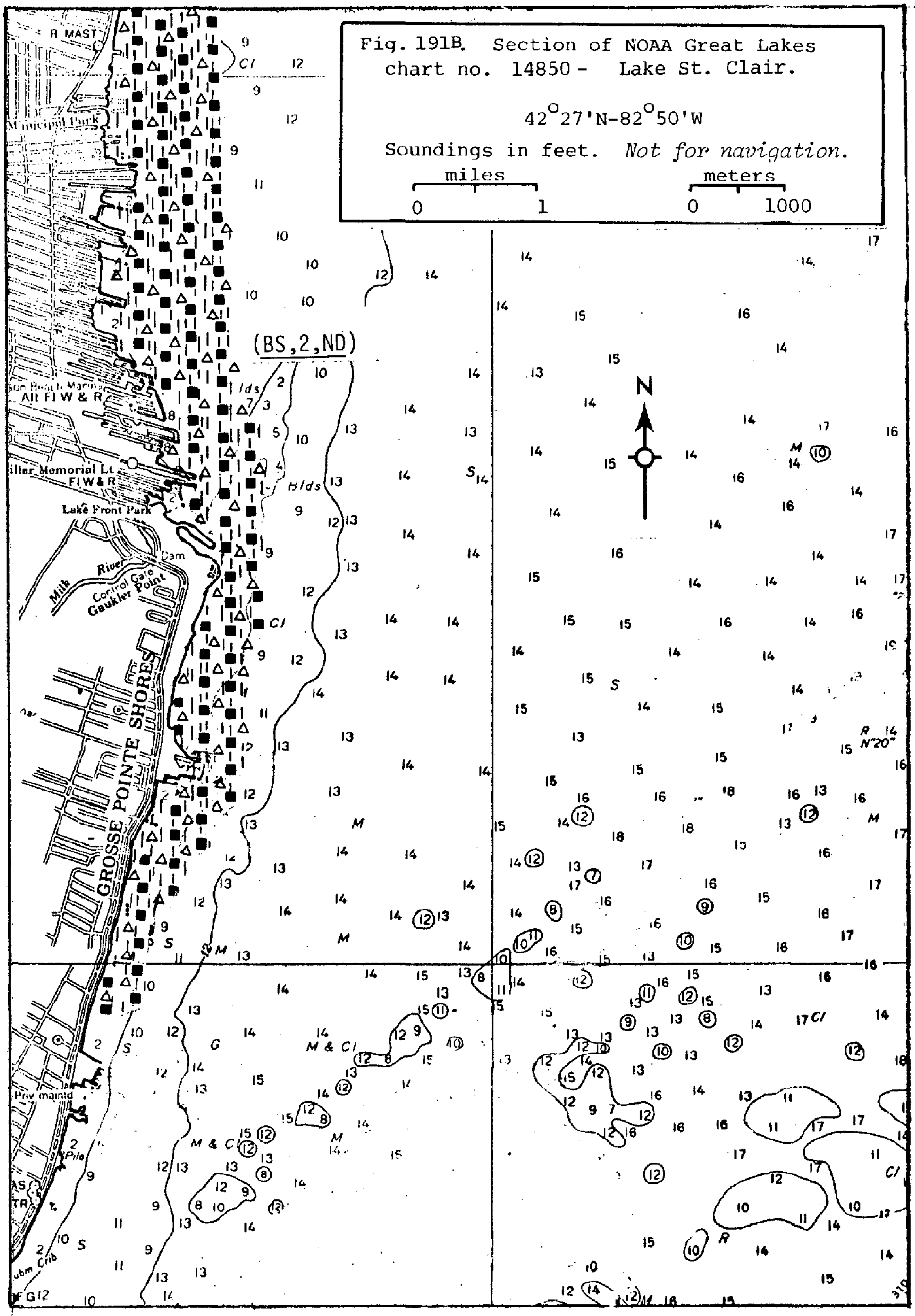


Fig. 191B. Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.
42°27'N-82°50'W
Soundings in feet. *Not for navigation.*
miles
0 1
meters
0 1000
(BS,2,ND)
N
GROSSE POINTE SHORES
Lake Front Park
Milk River
Gaukler Point
Control Gate
Dam
Municipal Park
Miller Memorial Lt
Priv maintd

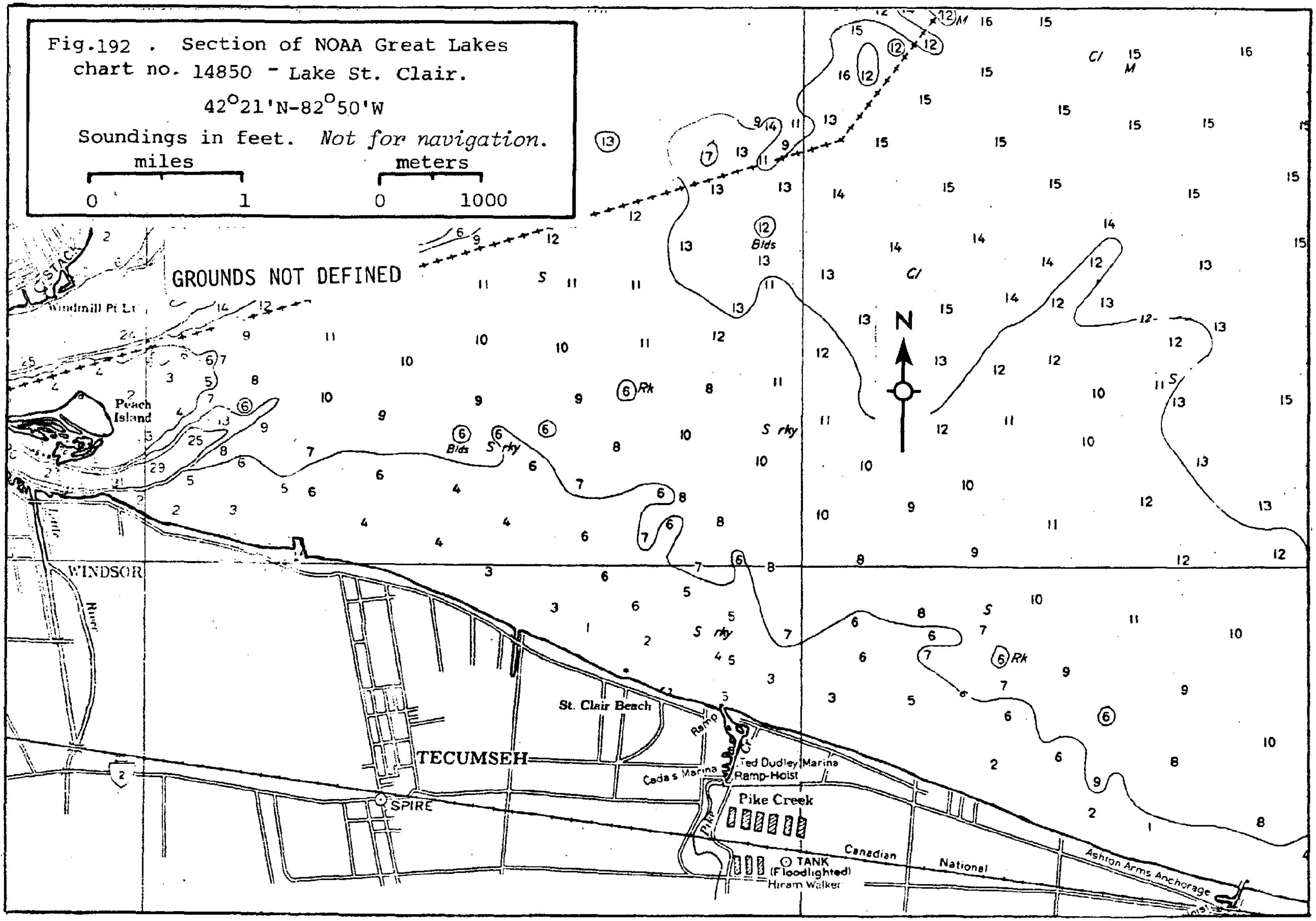



Fig.192 . Section of NOAA Great Lakes chart no. 14850 - Lake St. Clair.
42°21'N-82°50'W
Soundings in feet. *Not for navigation.*
miles 0 1 meters 0 1000

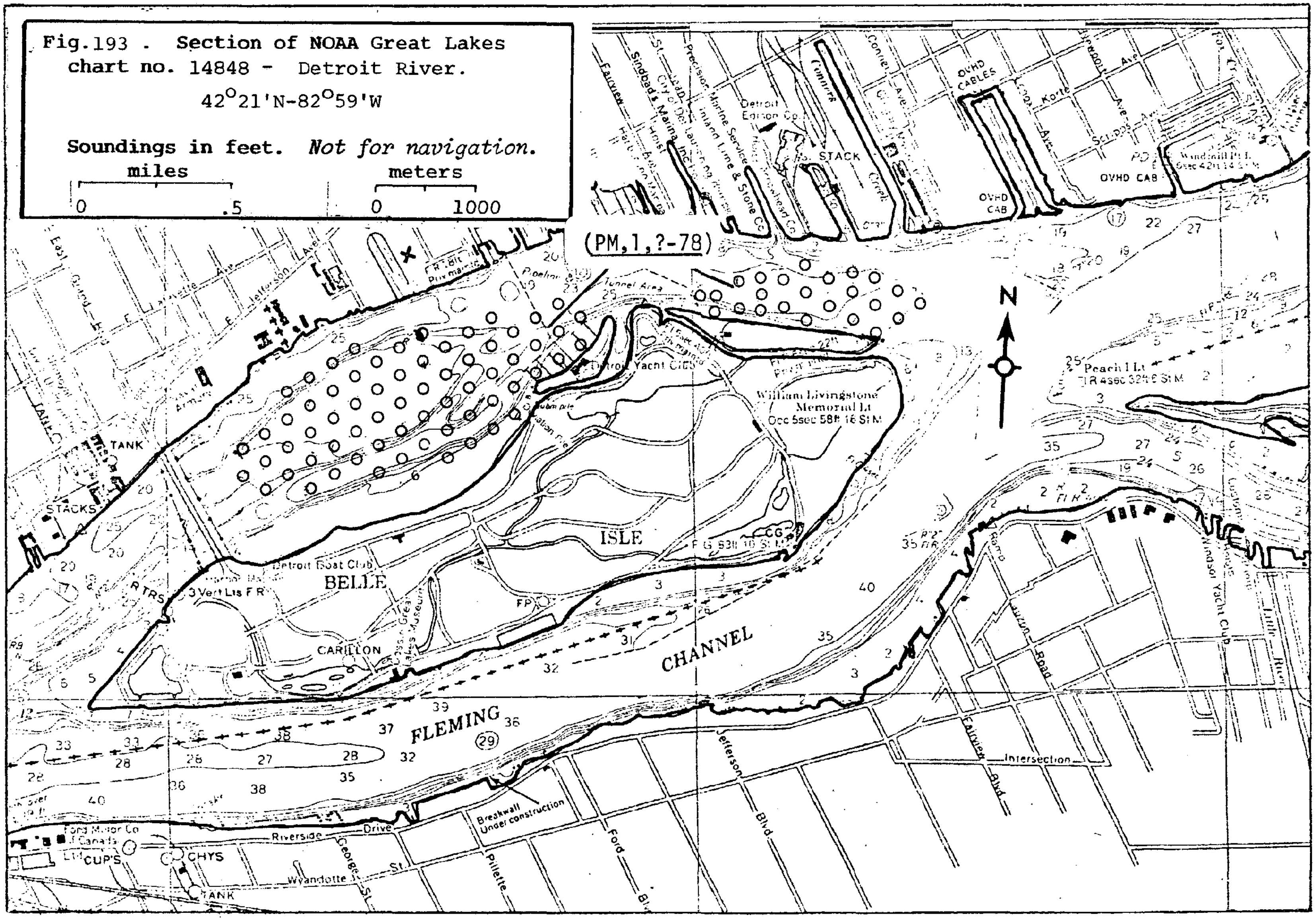



Fig.193 . Section of NOAA Great Lakes chart no. 14848 - Detroit River.
$42^{o}21'N-82^{o}59'W$

Soundings in feet. *Not for navigation.*

miles 0 .5 meters 0 1000

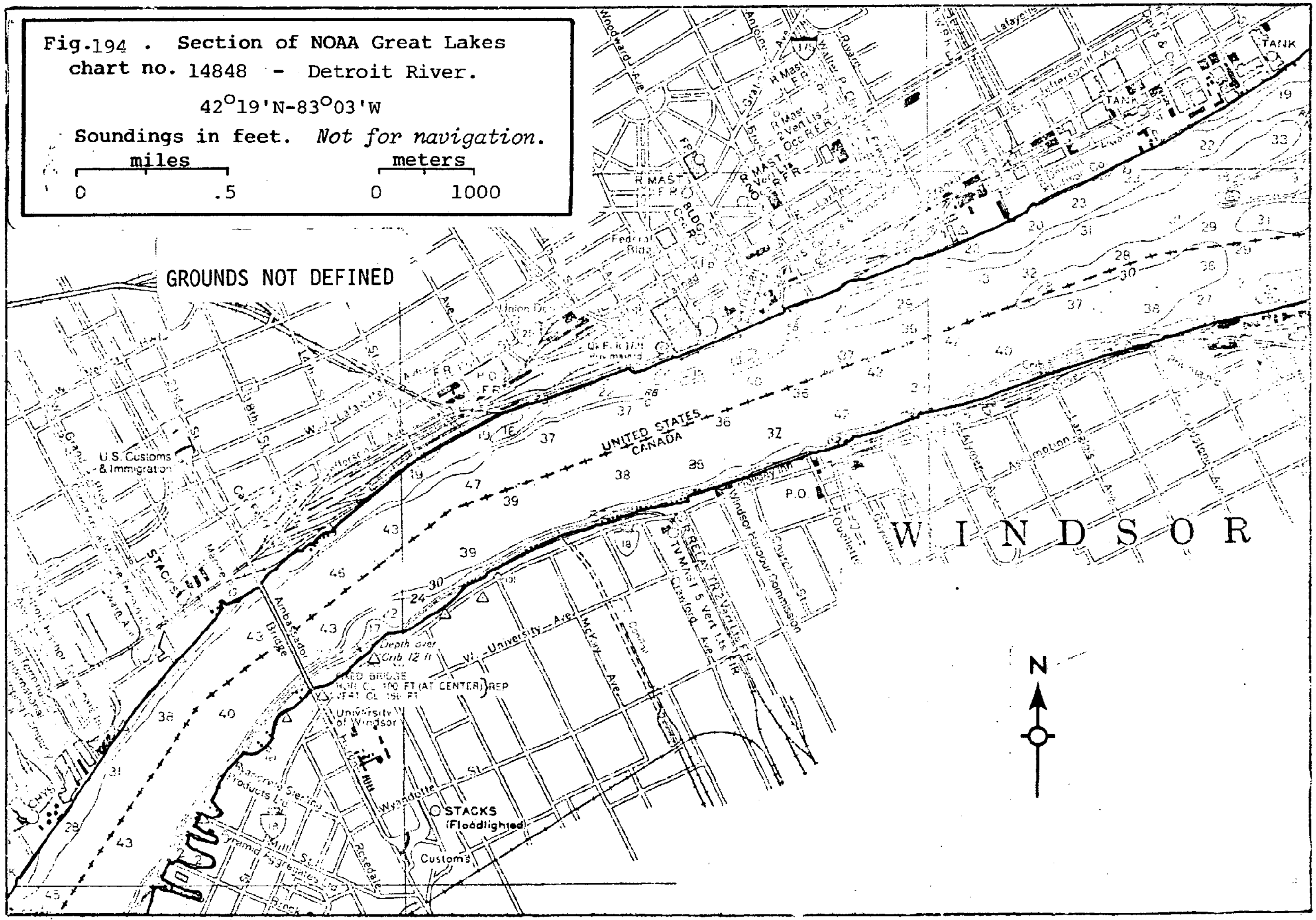
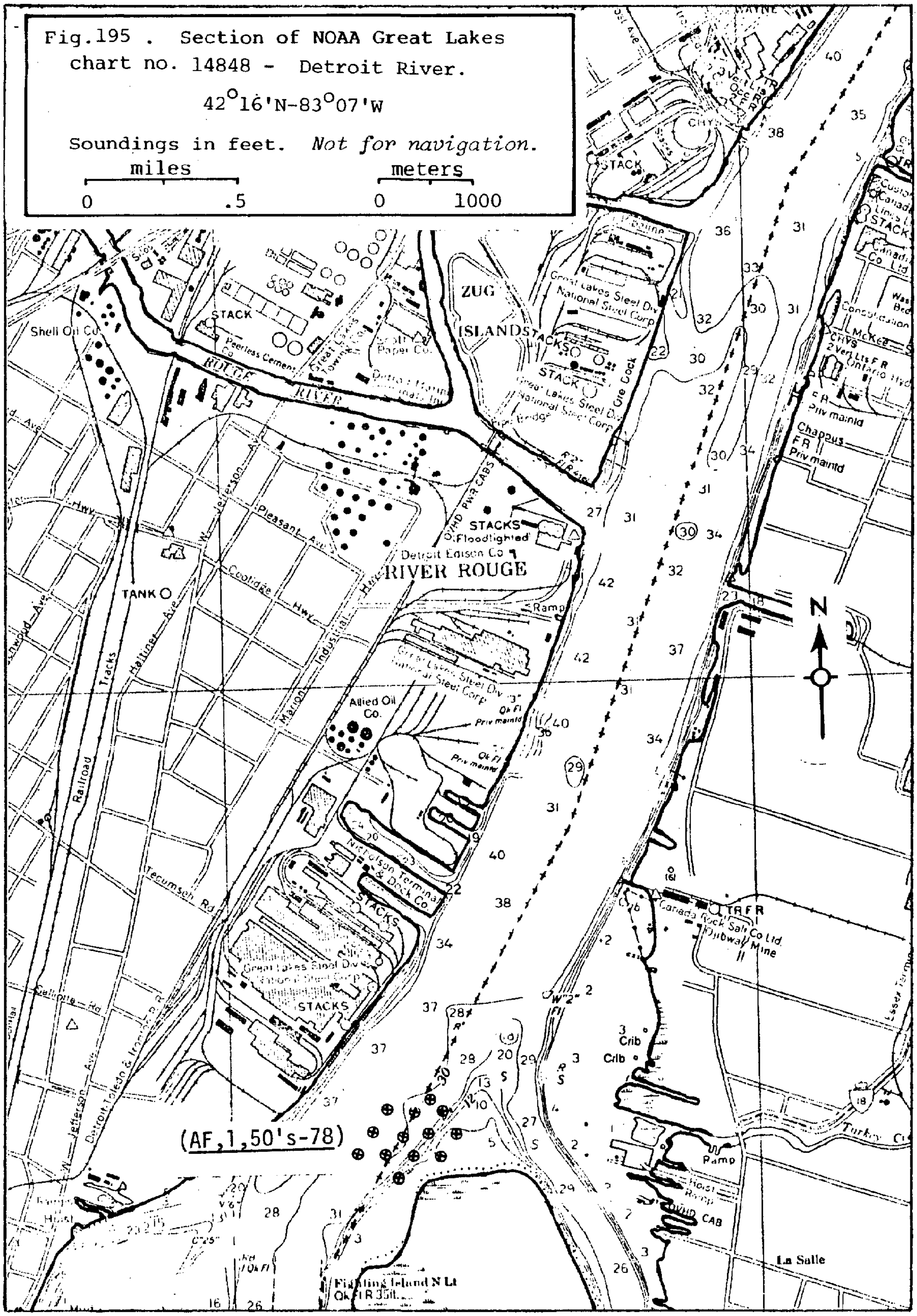



Fig. 194. Section of NOAA Great Lakes chart no. 14848 - Detroit River.
$42^{\circ}19'N-83^{\circ}03'W$
Soundings in feet. *Not for navigation.*
miles 0 .5
meters 0 1000

Fig.195 . Section of NOAA Great Lakes chart no. 14848 - Detroit River.
$42^{\circ}16'N-83^{\circ}07'W$
Soundings in feet. *Not for navigation.*



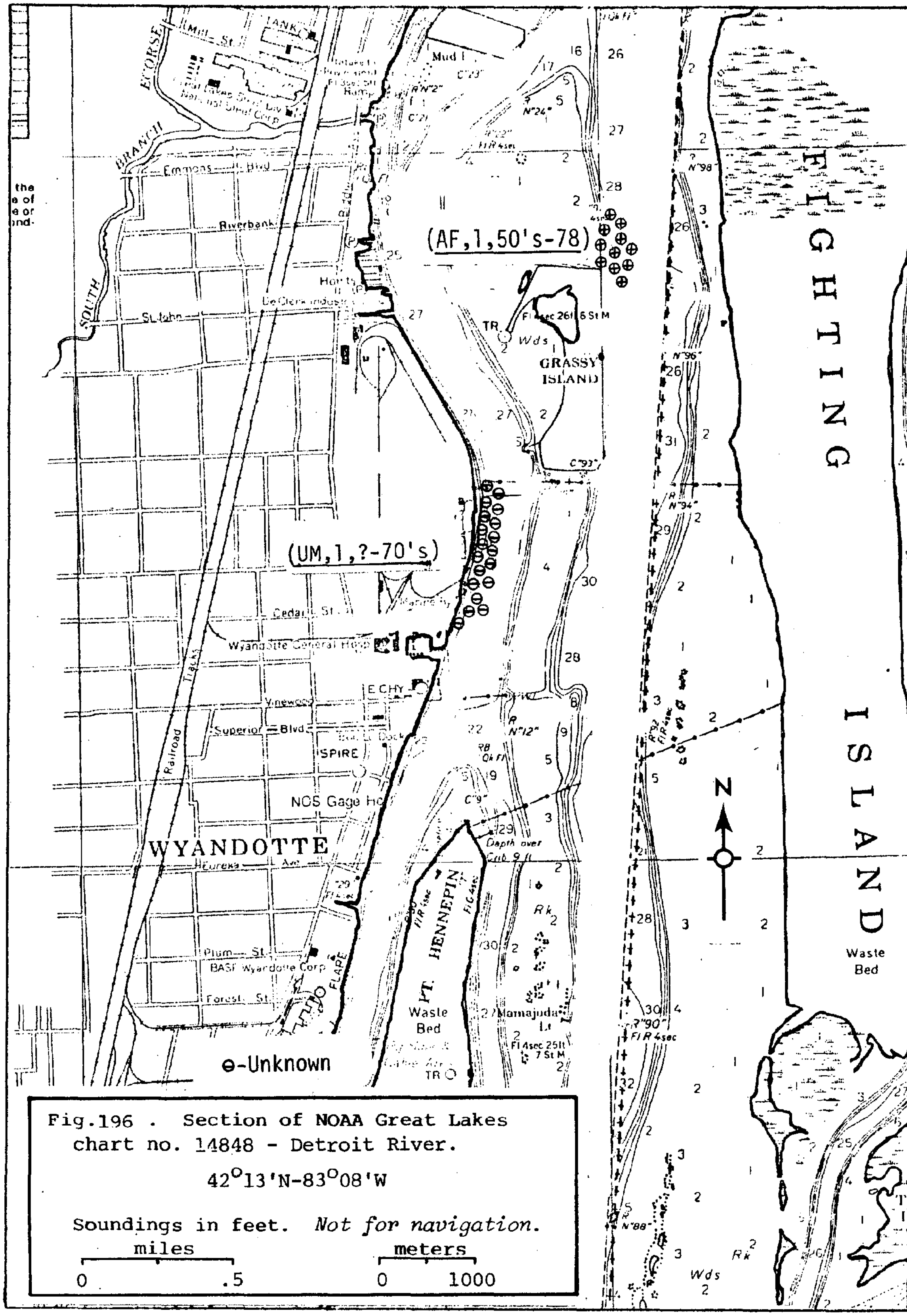



Fig.196 . Section of NOAA Great Lakes chart no. 14848 - Detroit River.

$42^{o}13'N-83^{o}08'W$

Soundings in feet. *Not for navigation.*

miles 0 .5

meters 0 1000

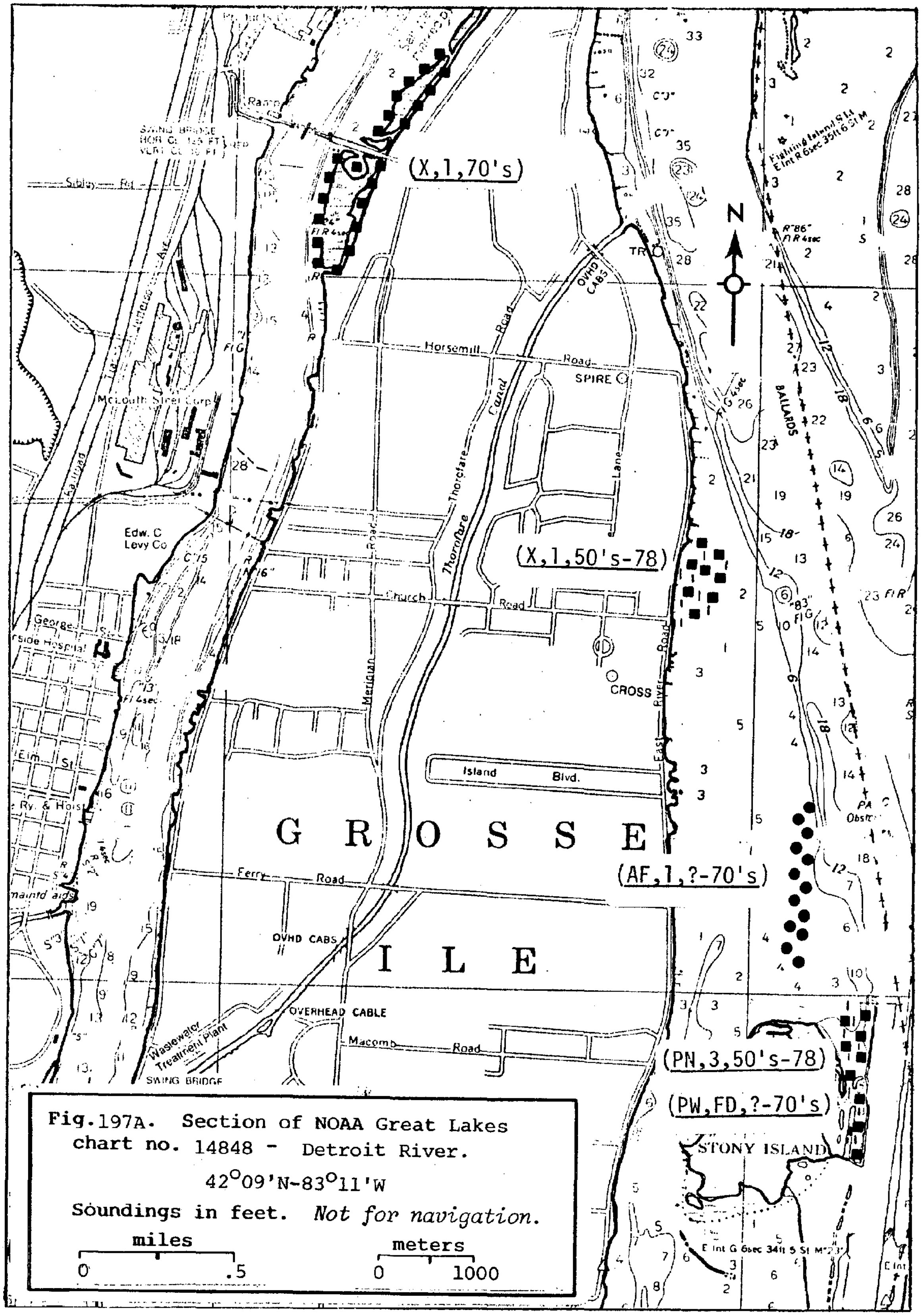



Fig.197A. Section of NOAA Great Lakes chart no. 14848 - Detroit River.

42°09'N-83°11'W

Soundings in feet. *Not for navigation.*

miles 0 .5    meters 0 1000

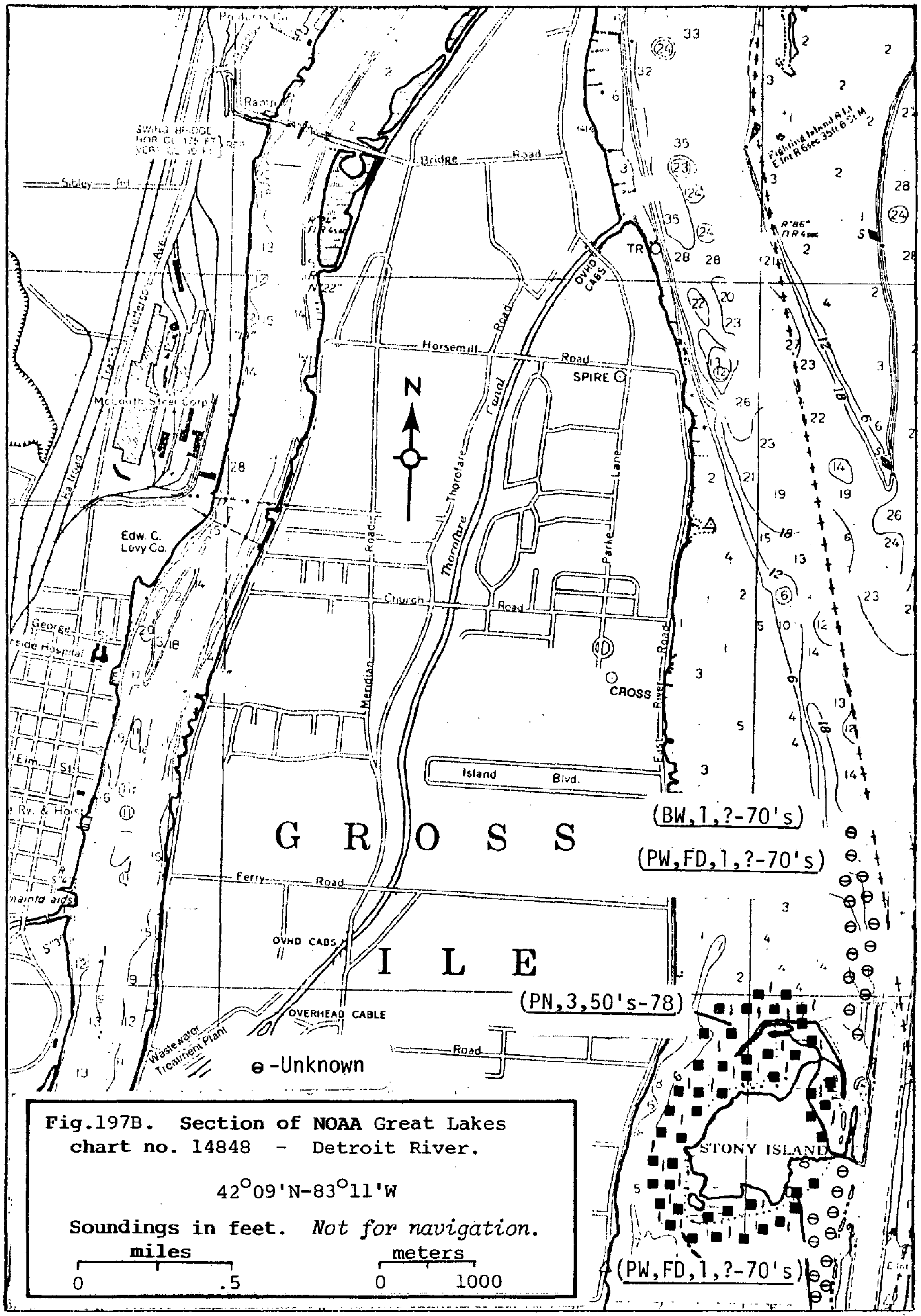



**Fig.197B. Section of NOAA Great Lakes chart no. 14848 - Detroit River.**

42°09'N-83°11'W

**Soundings in feet.** *Not for navigation.*

miles 0 .5 meters 0 1000

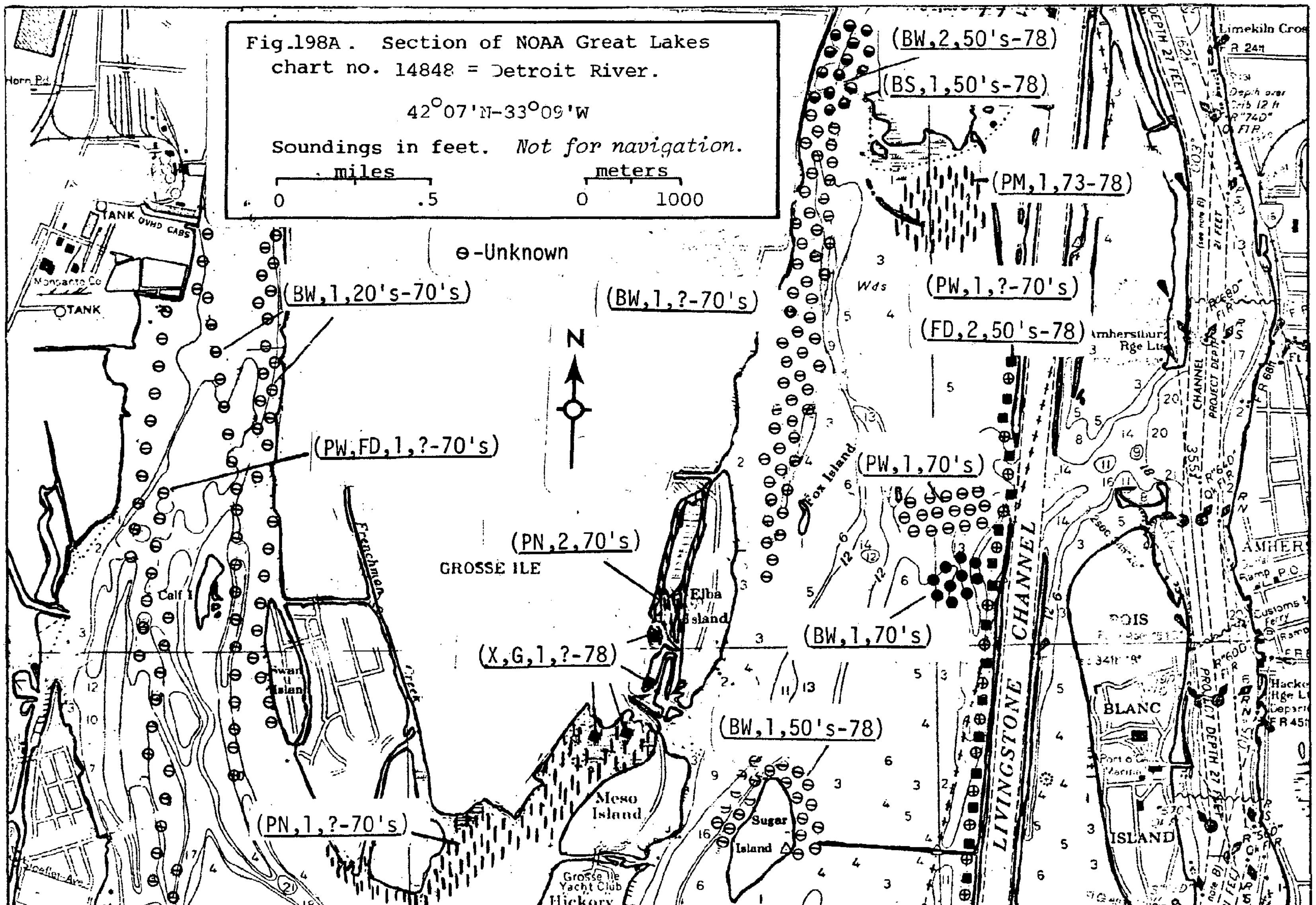



Fig.198A. Section of NOAA Great Lakes chart no. 14848 = Detroit River.

42°07'N-33°09'W

Soundings in feet. *Not for navigation.*

miles 0 .5 meters 0 1000

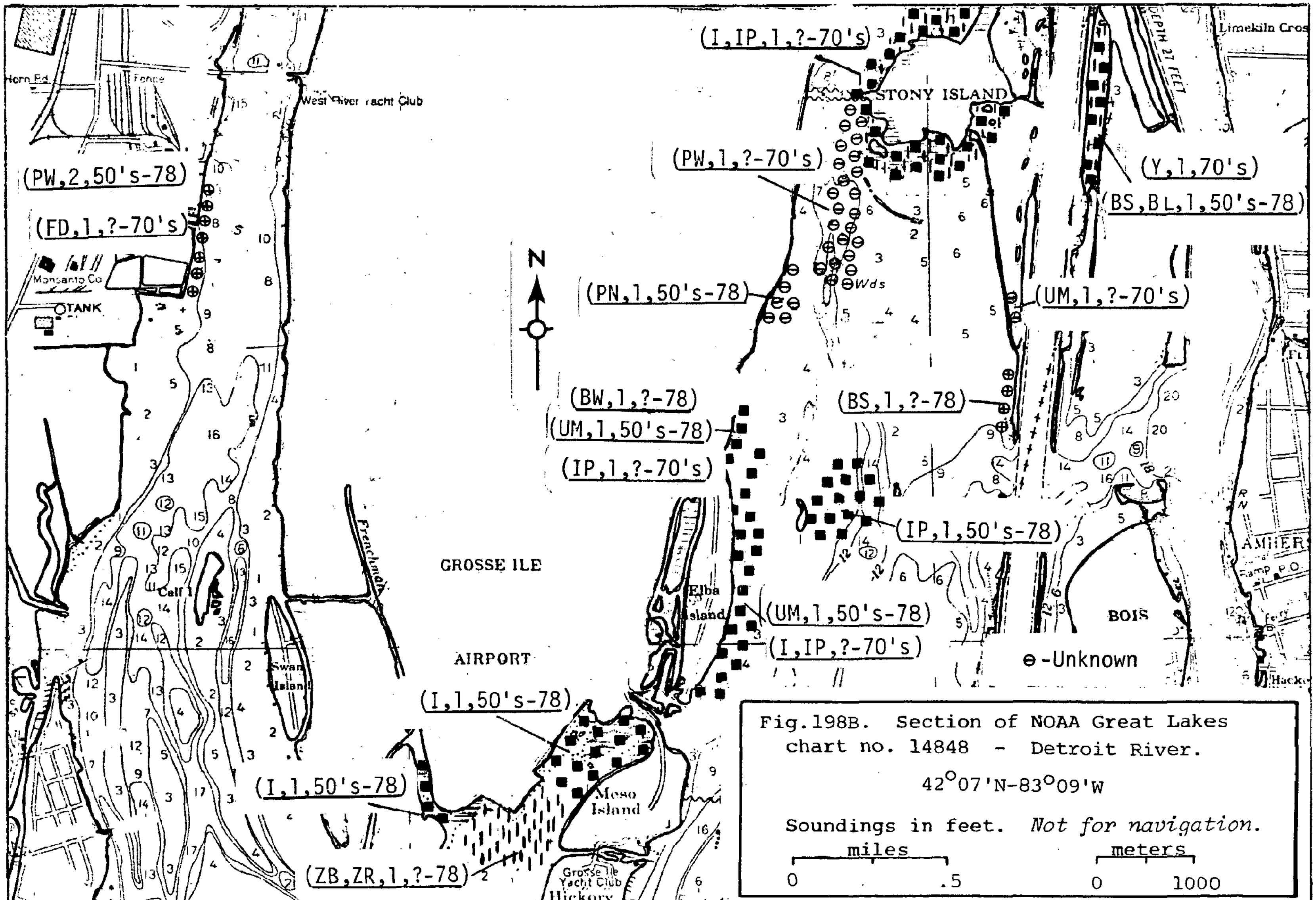


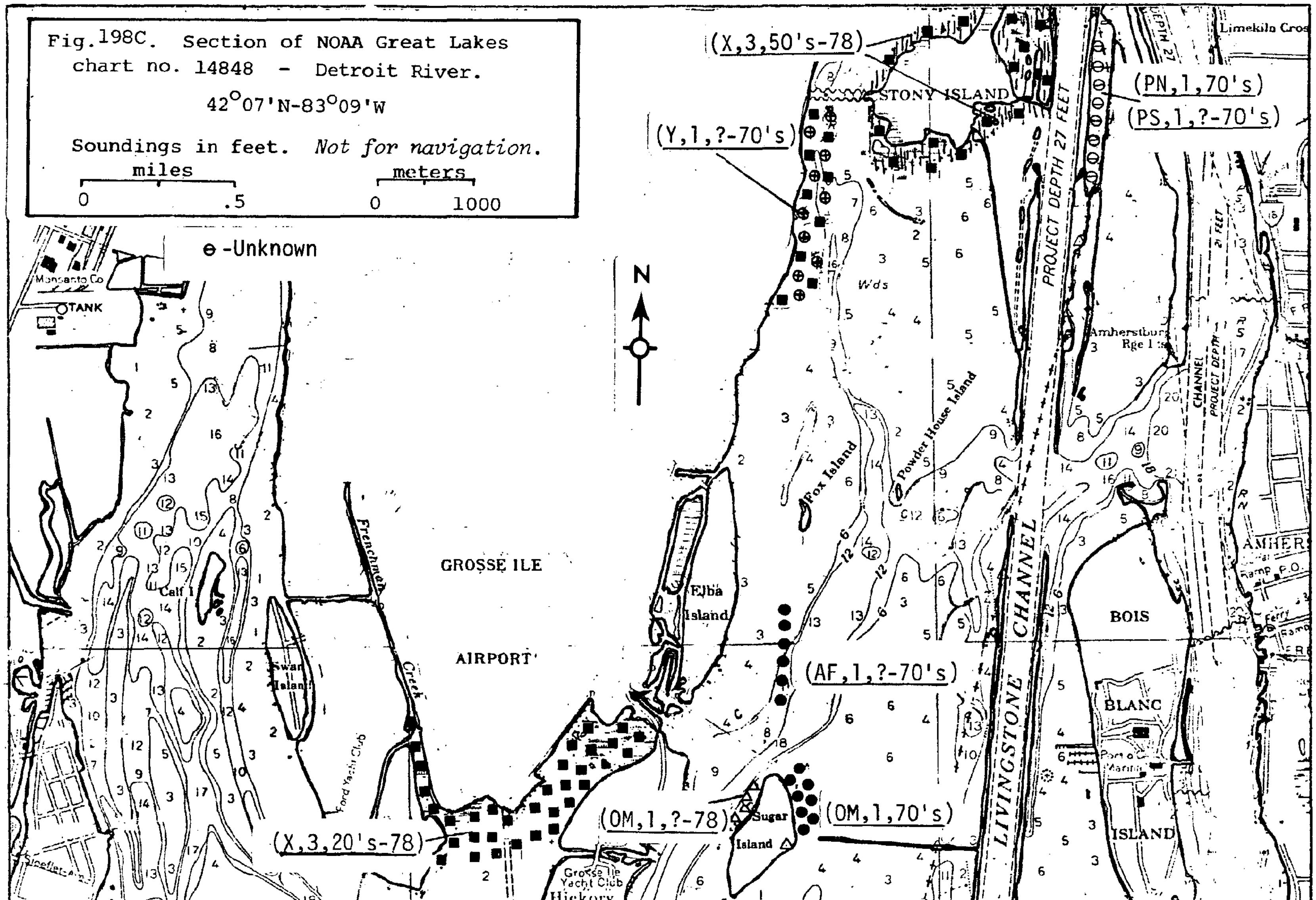

Fig.198B. Section of NOAA Great Lakes chart no. 14848 - Detroit River.

42°07'N-83°09'W

Soundings in feet. *Not for navigation.*

Fig. 198C. Section of NOAA Great Lakes chart no. 14848 - Detroit River.
42°07'N-83°09'W

Soundings in feet. *Not for navigation.*



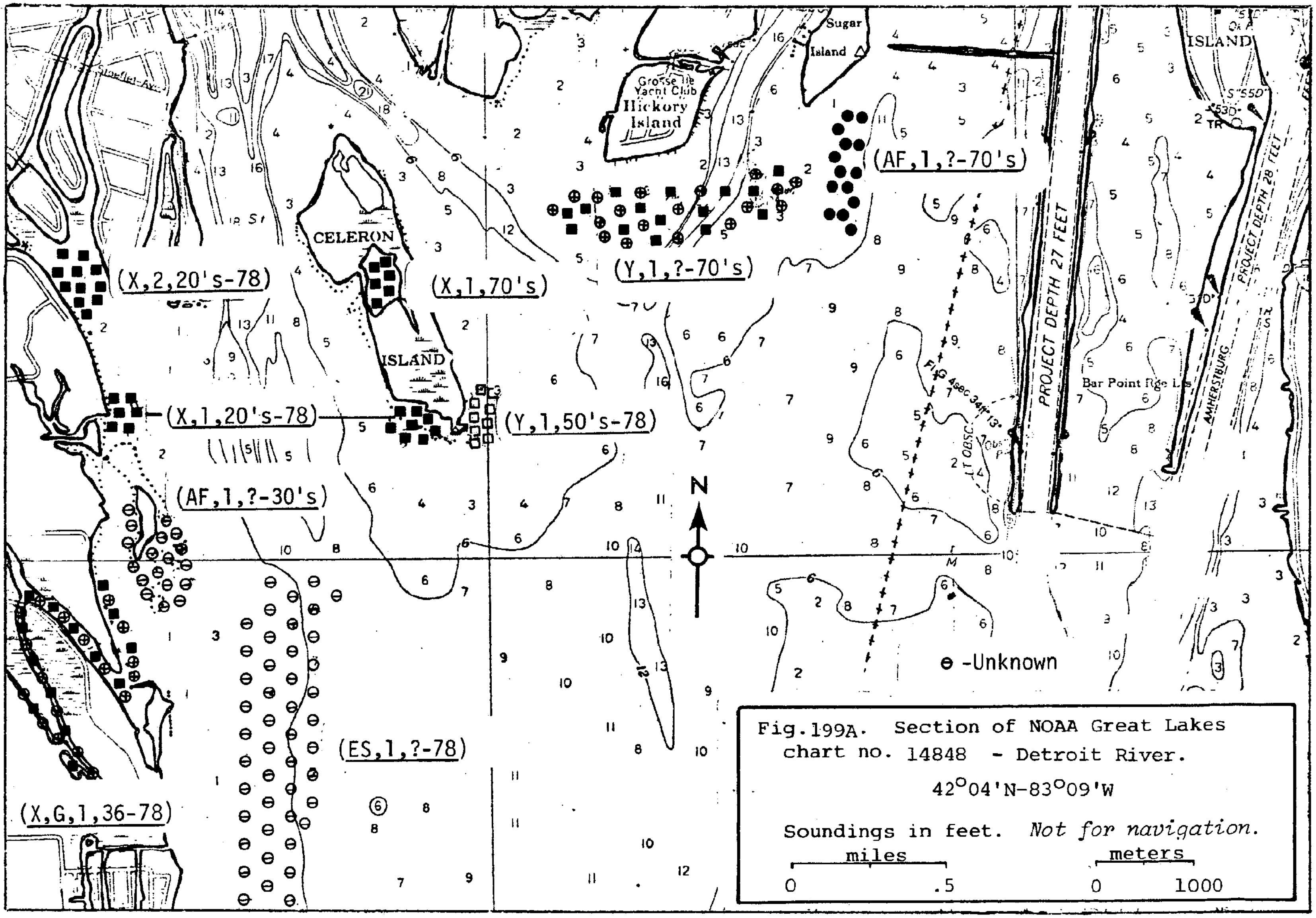



Fig.199A. Section of NOAA Great Lakes chart no. 14848 - Detroit River.

42°04'N-83°09'W

Soundings in feet. *Not for navigation.*

miles 0 .5

meters 0 1000

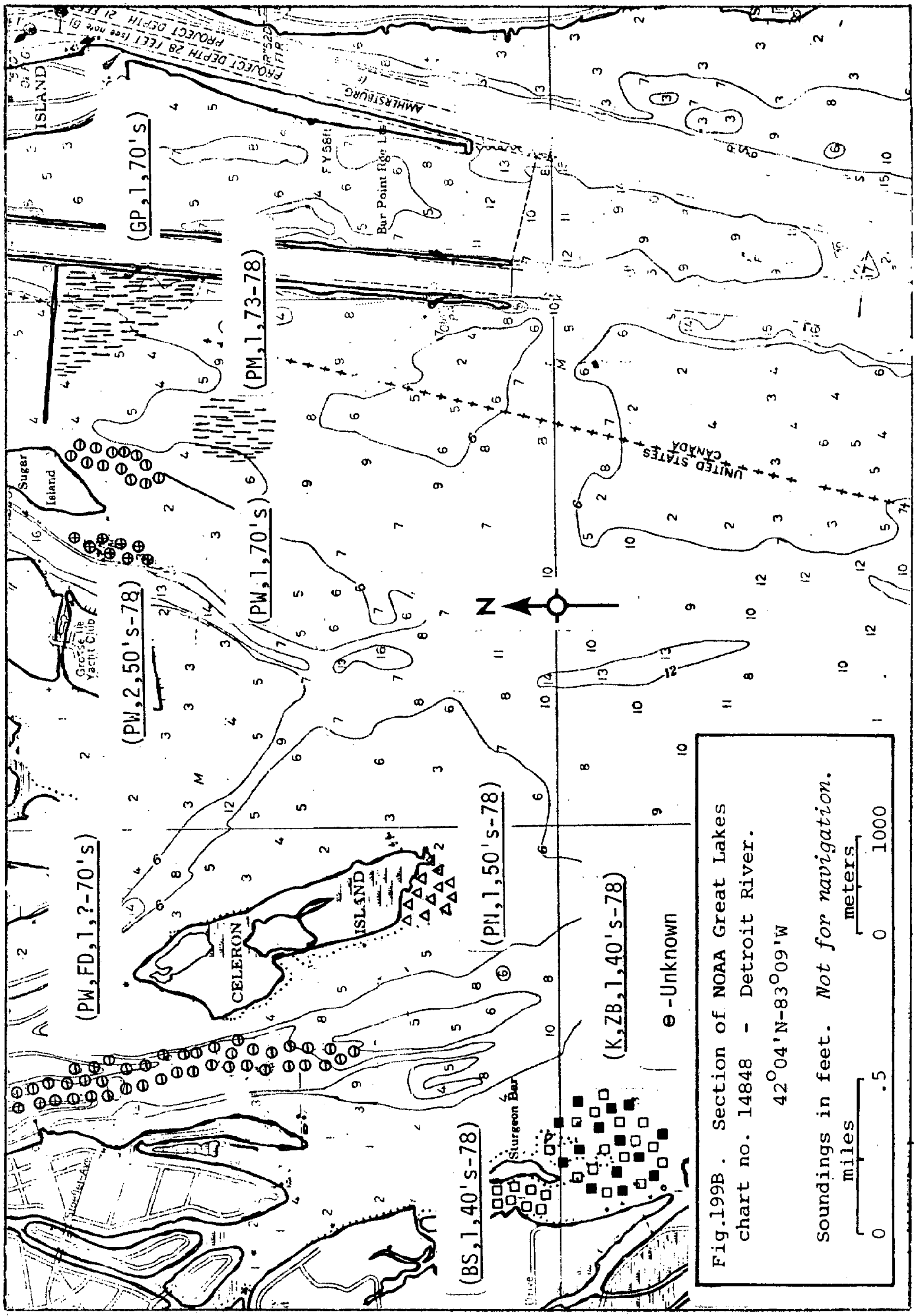



Fig.199B. Section of NOAA Great Lakes chart no. 14848 - Detroit River.
42°04'N-83°09'W

Soundings in feet. *Not for navigation.*

miles 0 .5
meters 0 1000

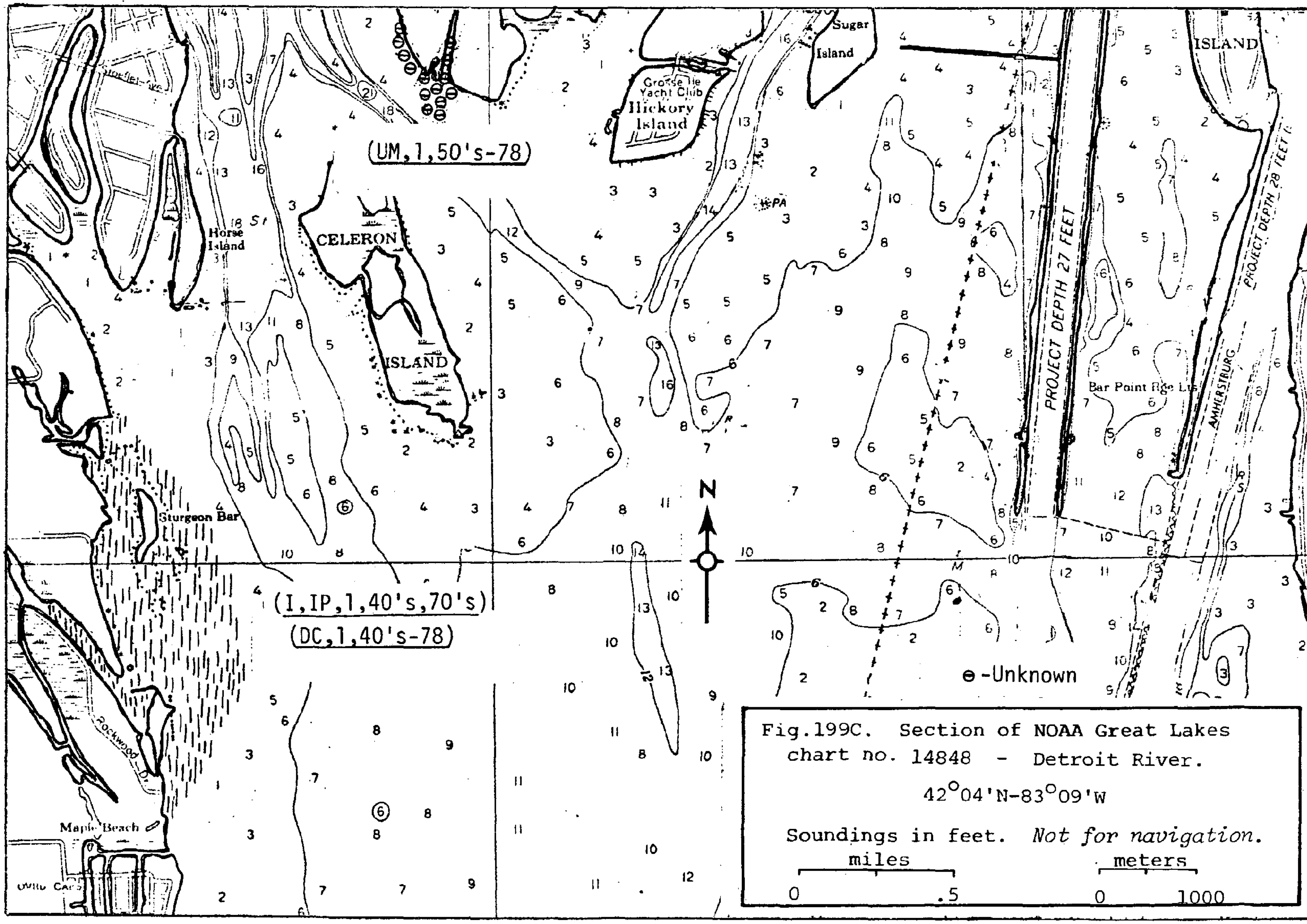



Fig.199C. Section of NOAA Great Lakes chart no. 14848 - Detroit River.

$42^{\circ}04'N-83^{\circ}09'W$

Soundings in feet. *Not for navigation.*

miles 0 .5 meters 0 1000

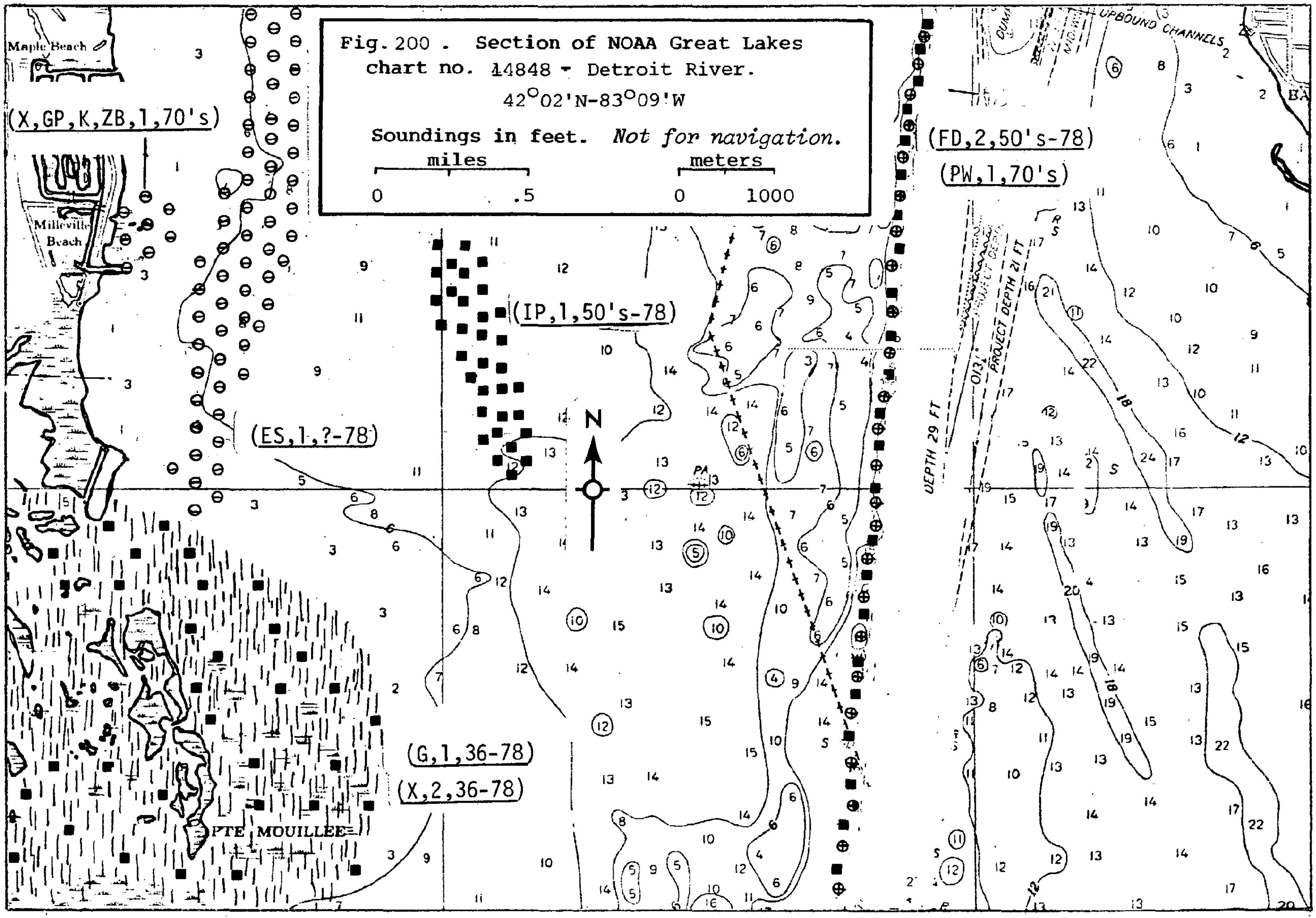



Fig. 200 . Section of NOAA Great Lakes chart no. 14848 - Detroit River. 42°02'N-83°09'W

Soundings in feet. *Not for navigation.*

miles 0 .5 meters 0 1000

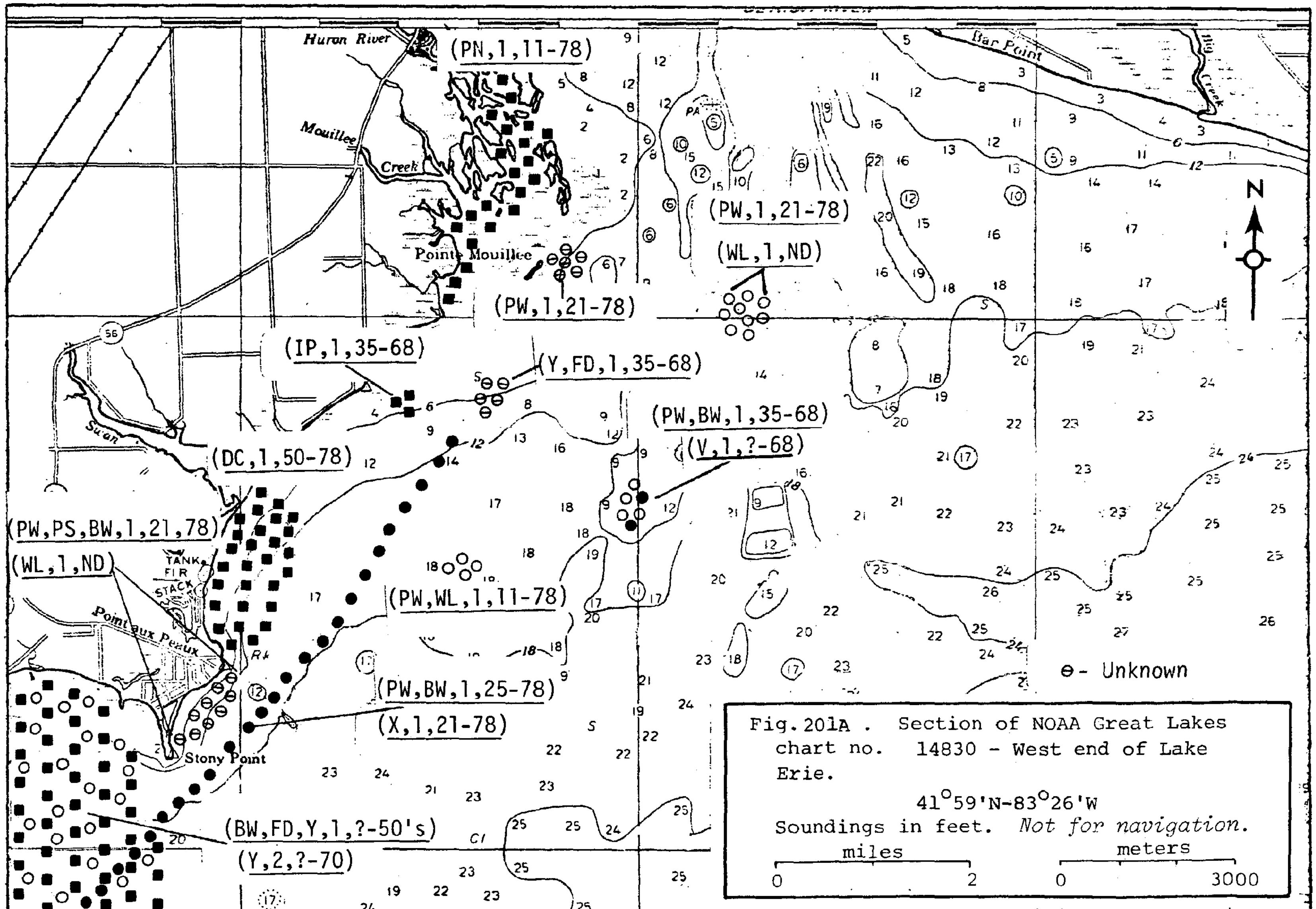



Fig. 201A . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie.

41°59'N-83°26'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

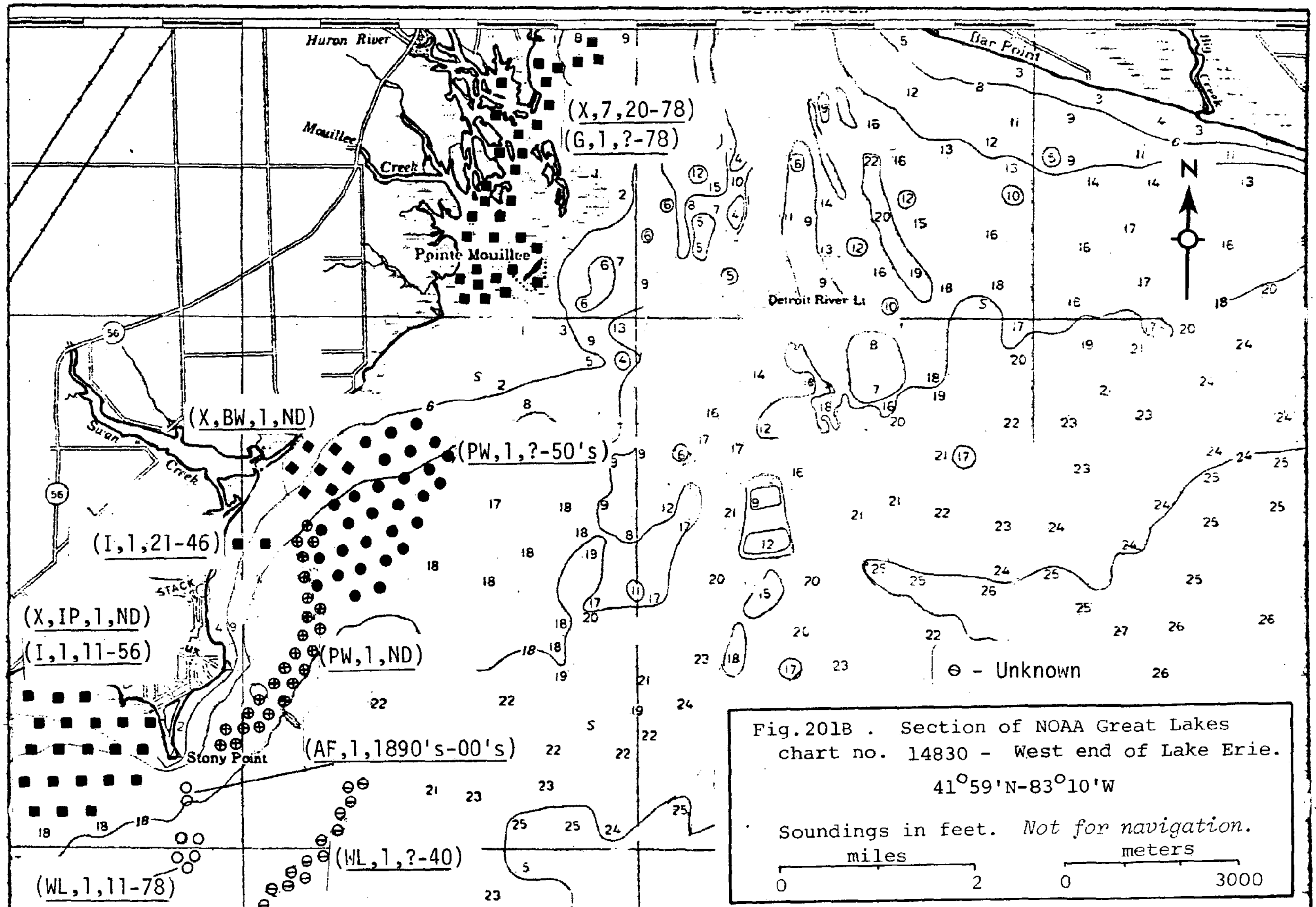



Fig.201B . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie. $41^{o}59'N-83^{o}10'W$

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

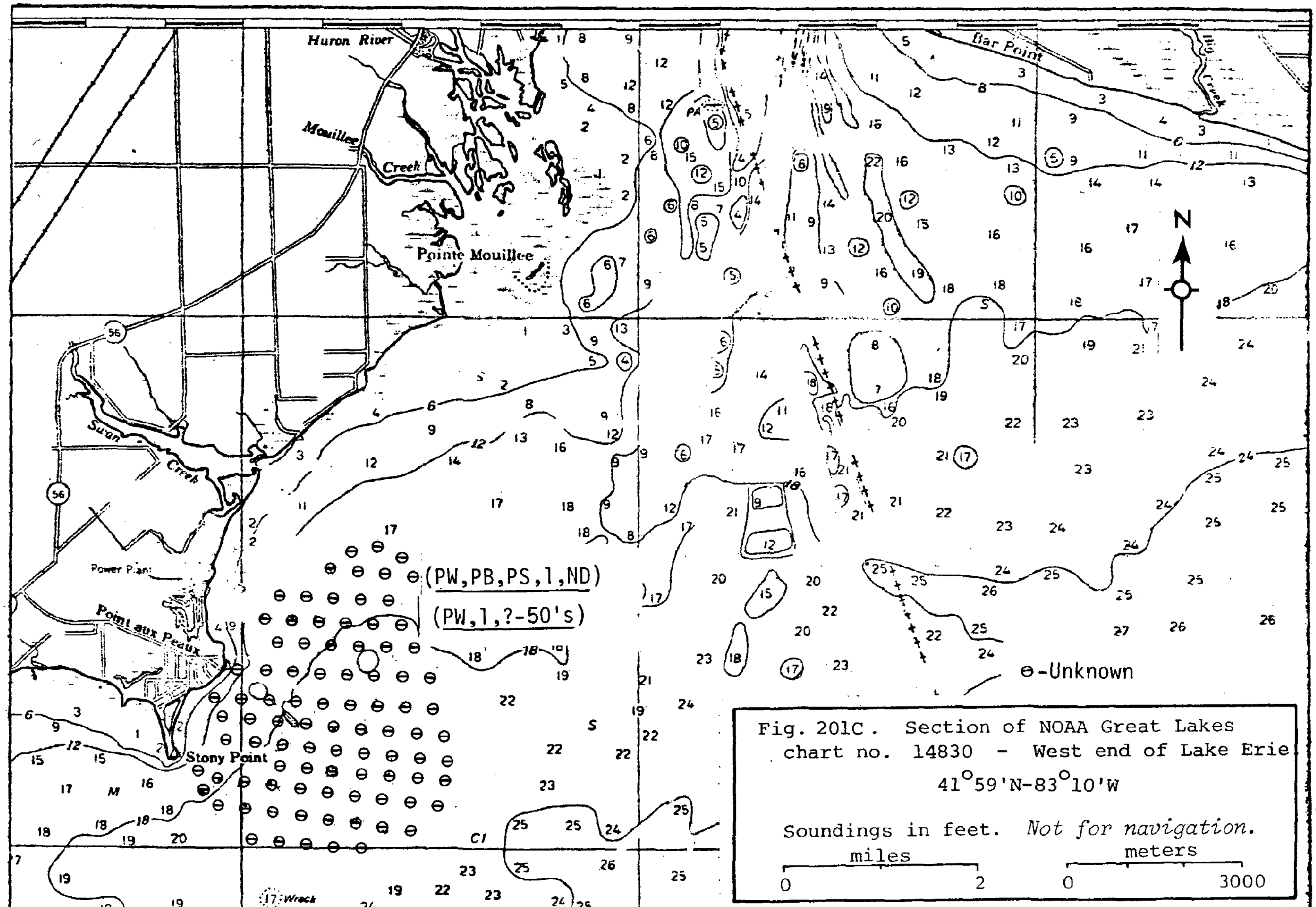



Fig. 201C. Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie
41°59'N-83°10'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

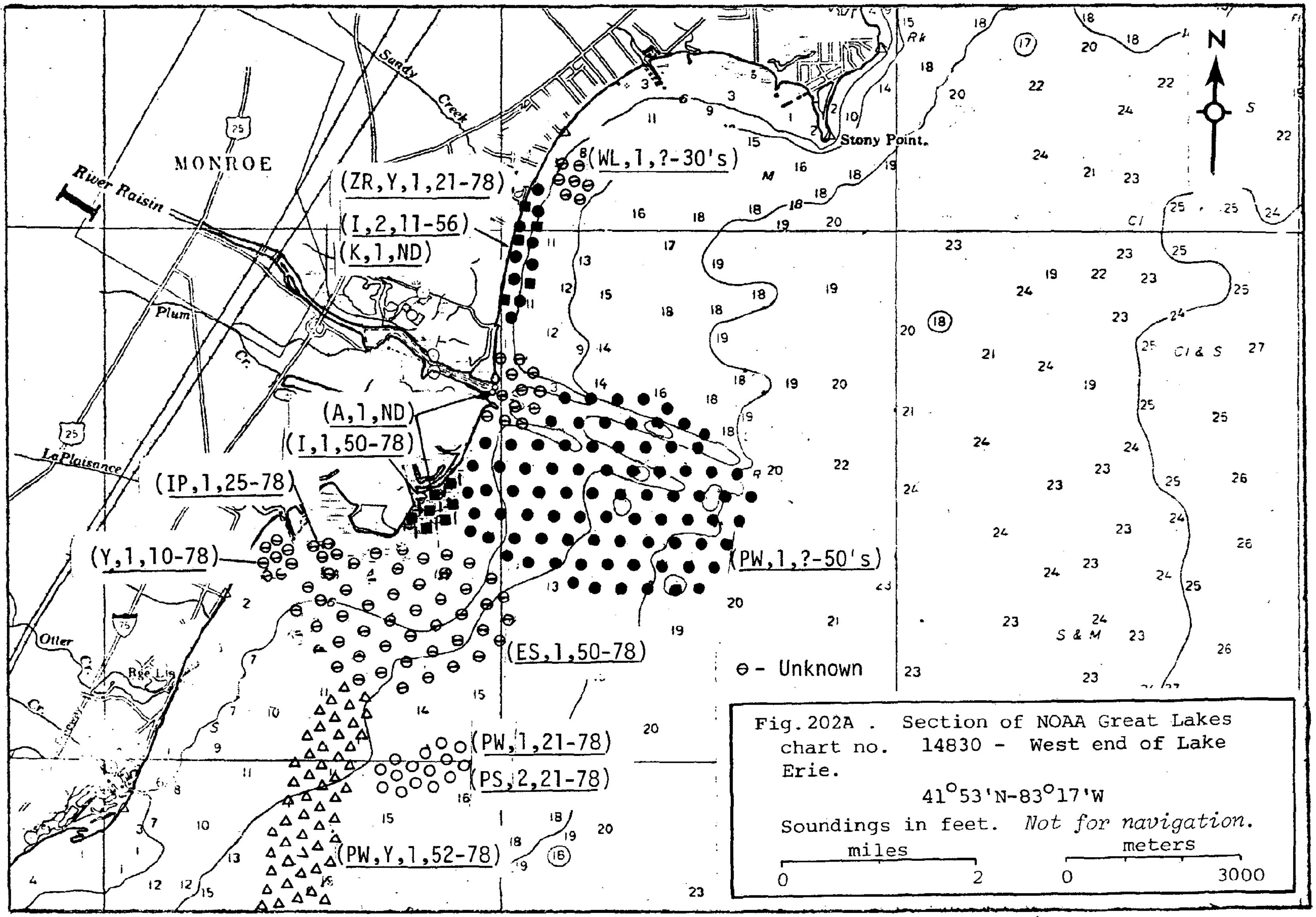



Fig. 202A . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie.

41°53'N-83°17'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

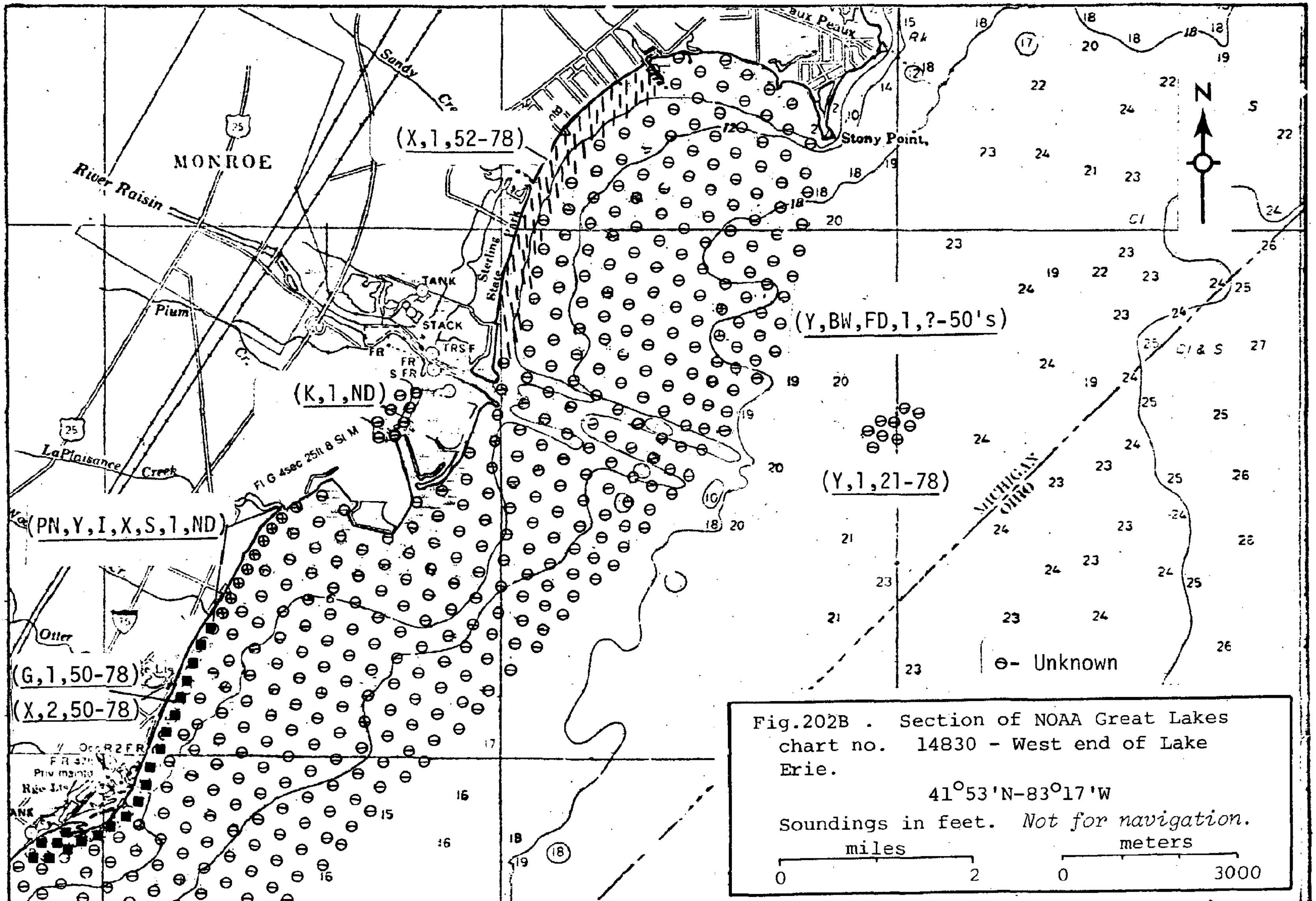



Fig.202B . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie.

41°53'N-83°17'W

Soundings in feet. *Not for navigation.*

miles 0 2

meters 0 3000

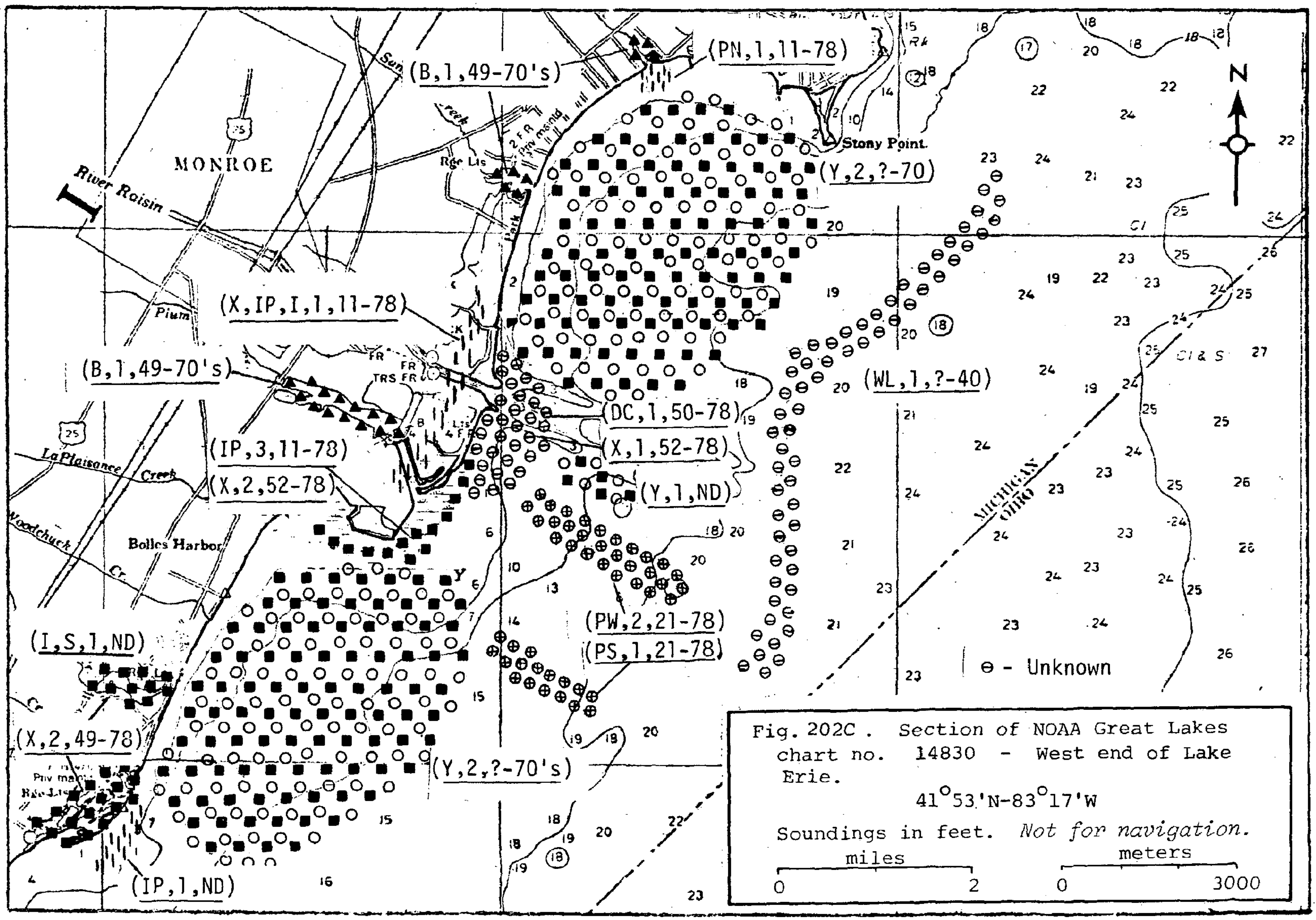



Fig. 202C . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie.

41°53'N-83°17'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

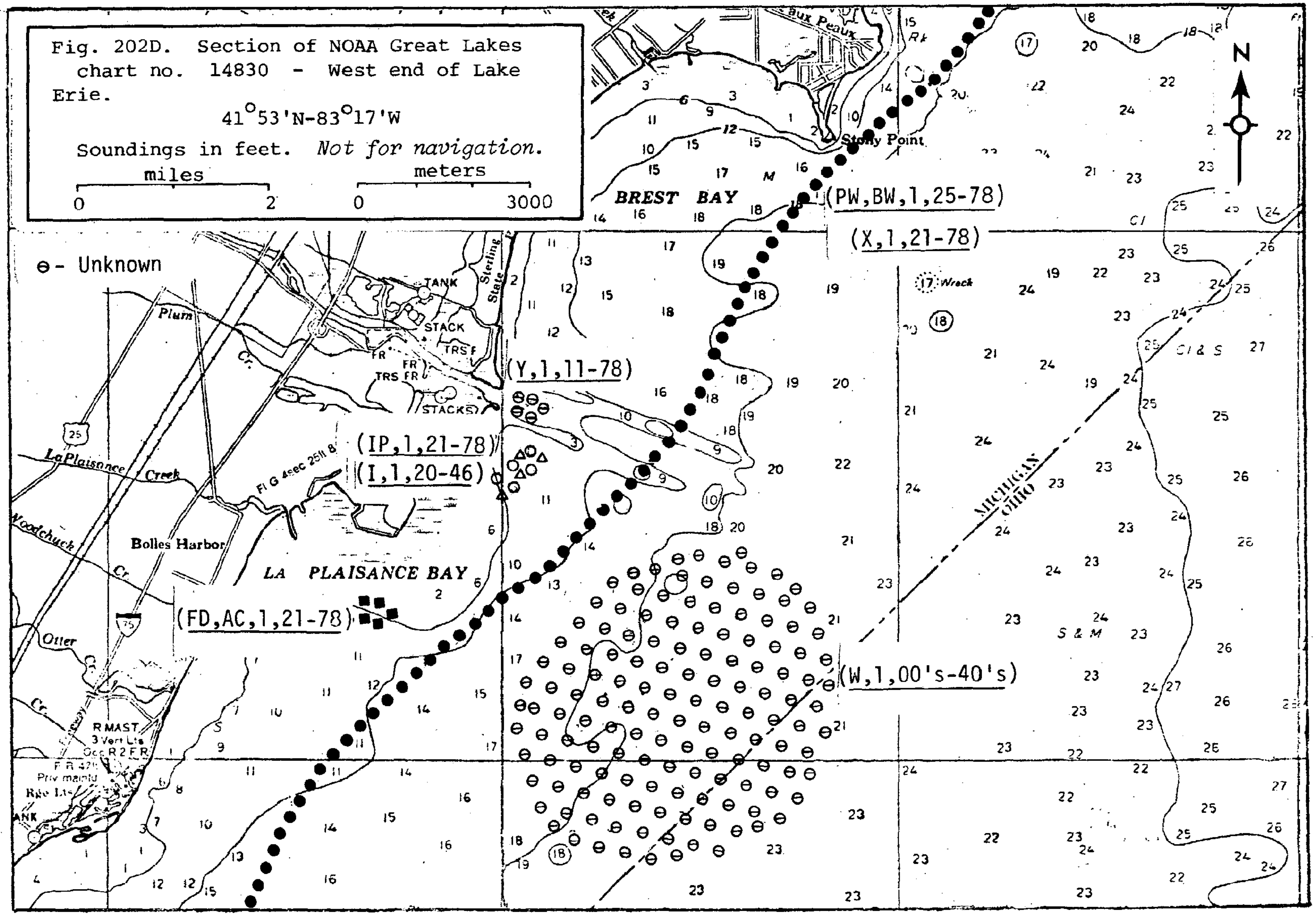



Fig. 202D. Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie.

41°53'N-83°17'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

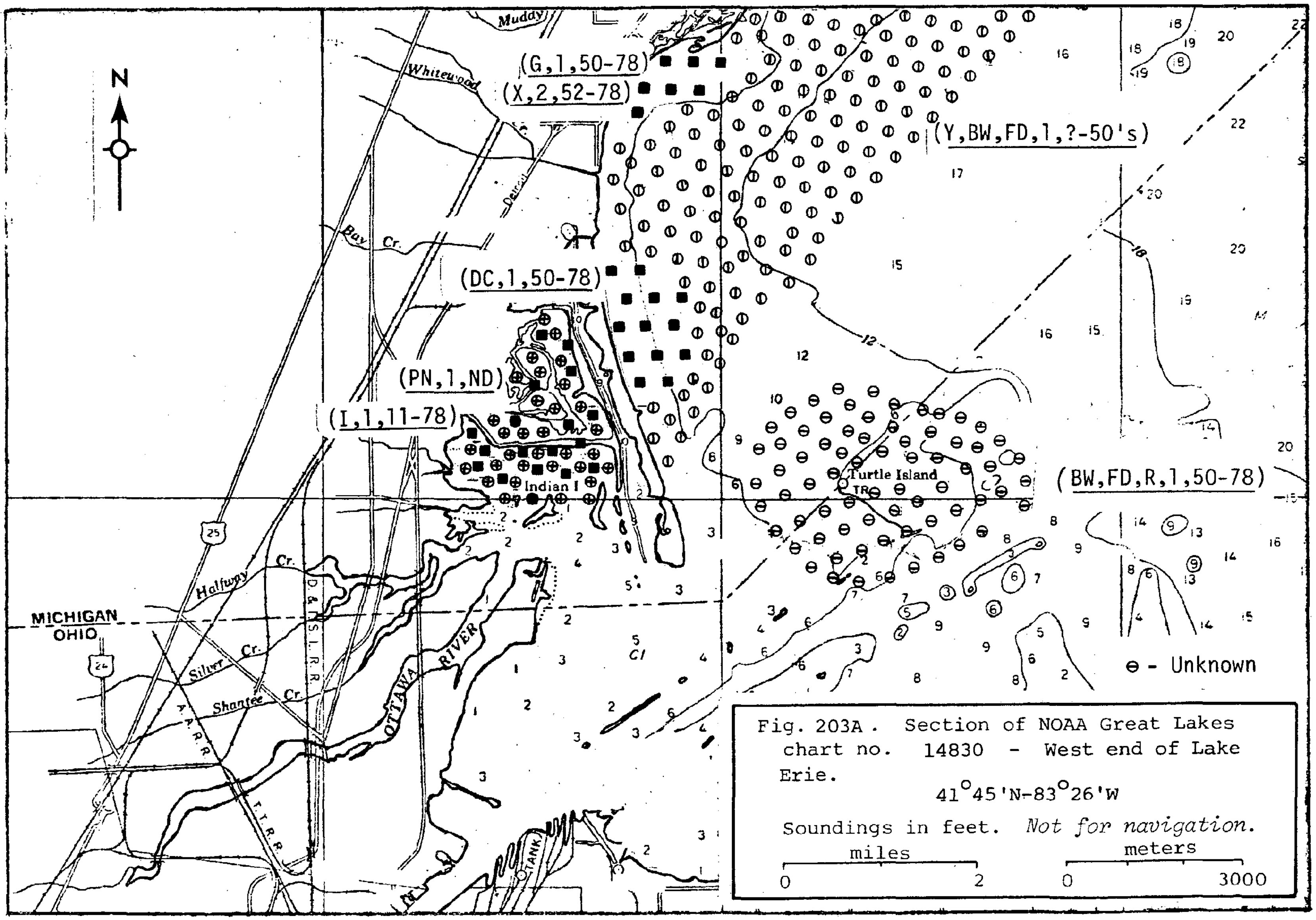



Fig. 203A . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie.

41°45'N-83°26'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

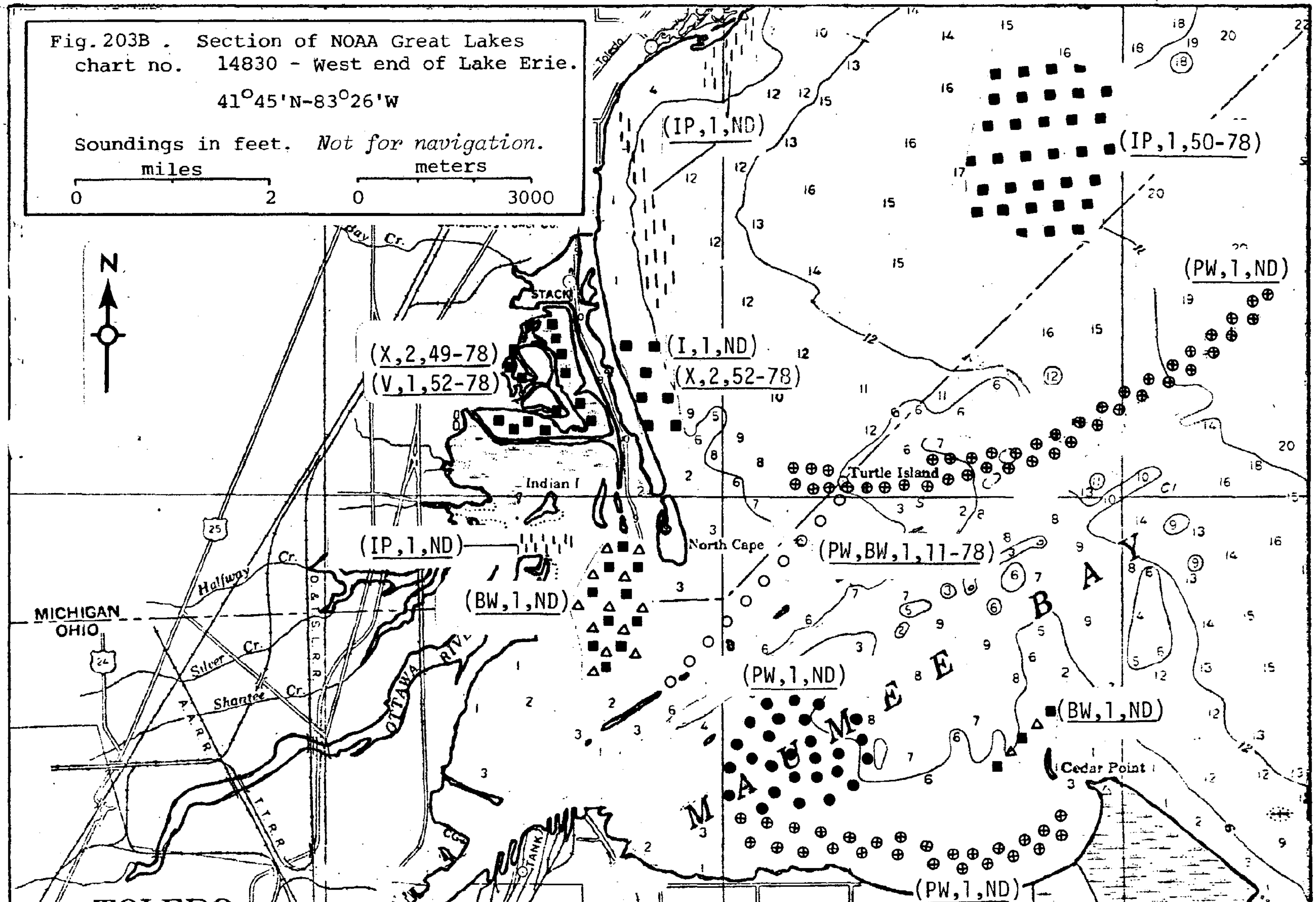



Fig. 203B . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie.

41°45'N-83°26'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

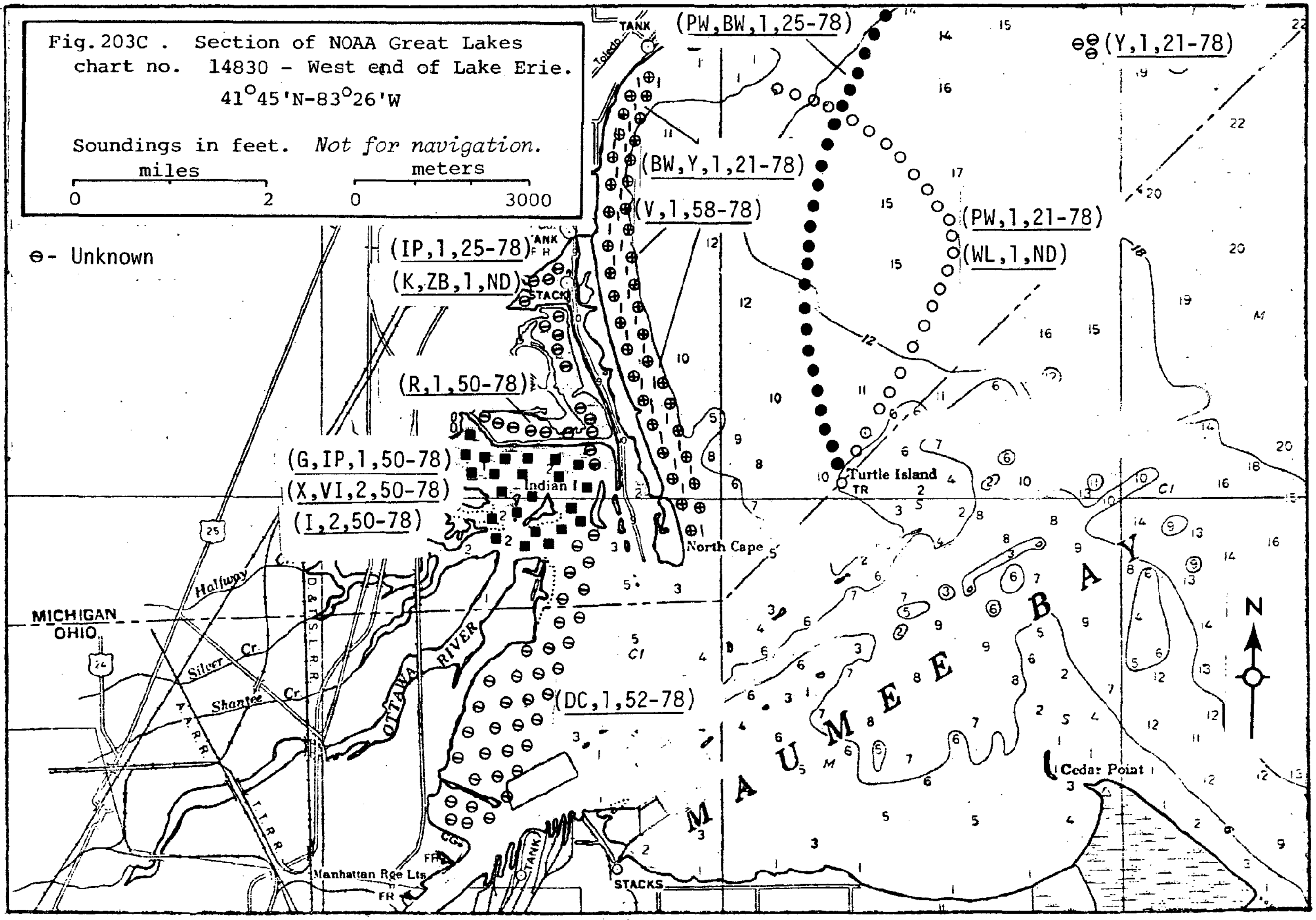



Fig. 203C . Section of NOAA Great Lakes chart no. 14830 - West end of Lake Erie. 41°45'N-83°26'W

Soundings in feet. *Not for navigation.*

miles 0 2 meters 0 3000

APPENDIX 4

LAKE HURON REDUCED SECTIONAL MAPS WITH

SPECIAL REFERENCE TO CHUB FISHING AREAS

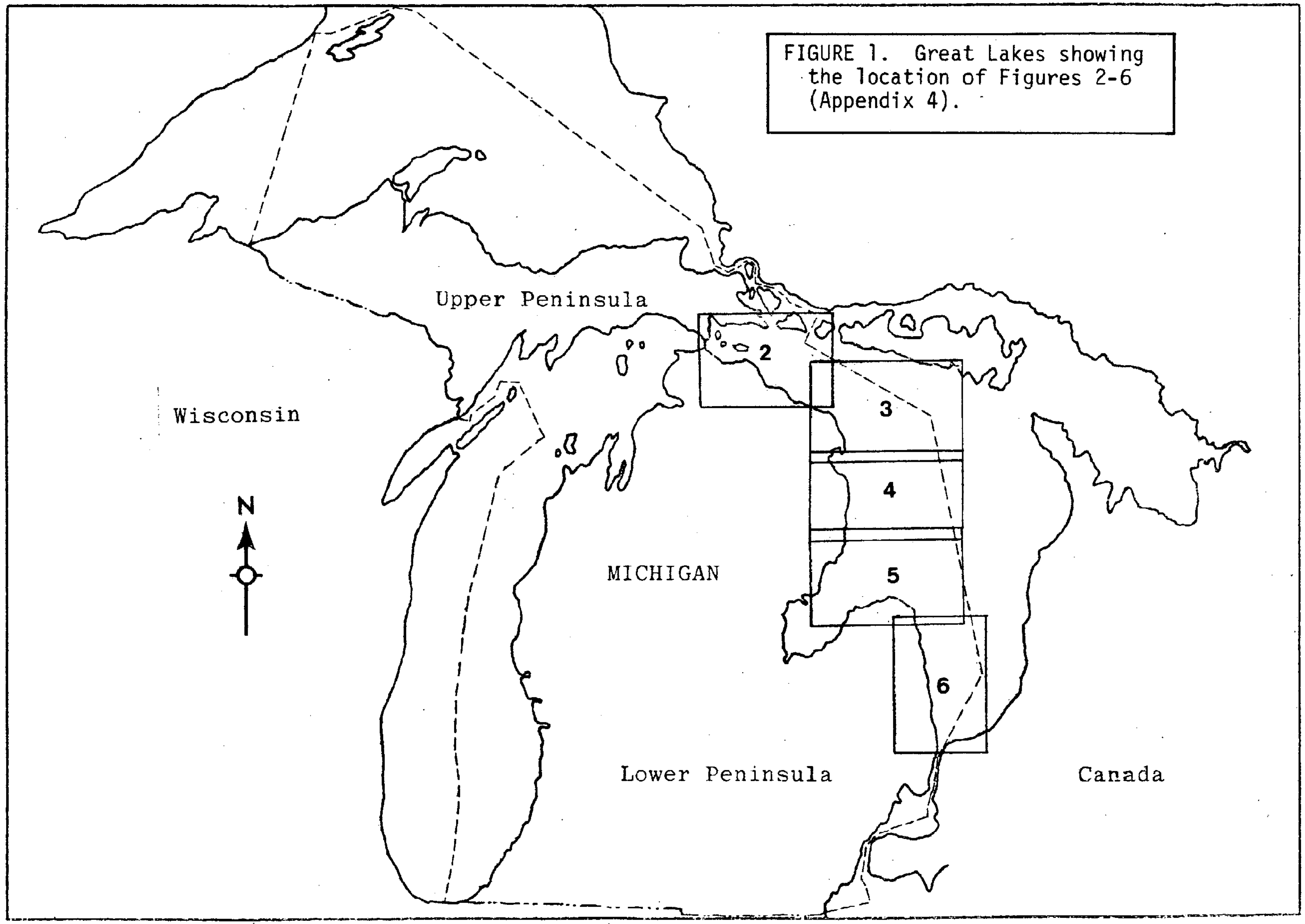



FIGURE 1. Great Lakes showing the location of Figures 2-6 (Appendix 4).

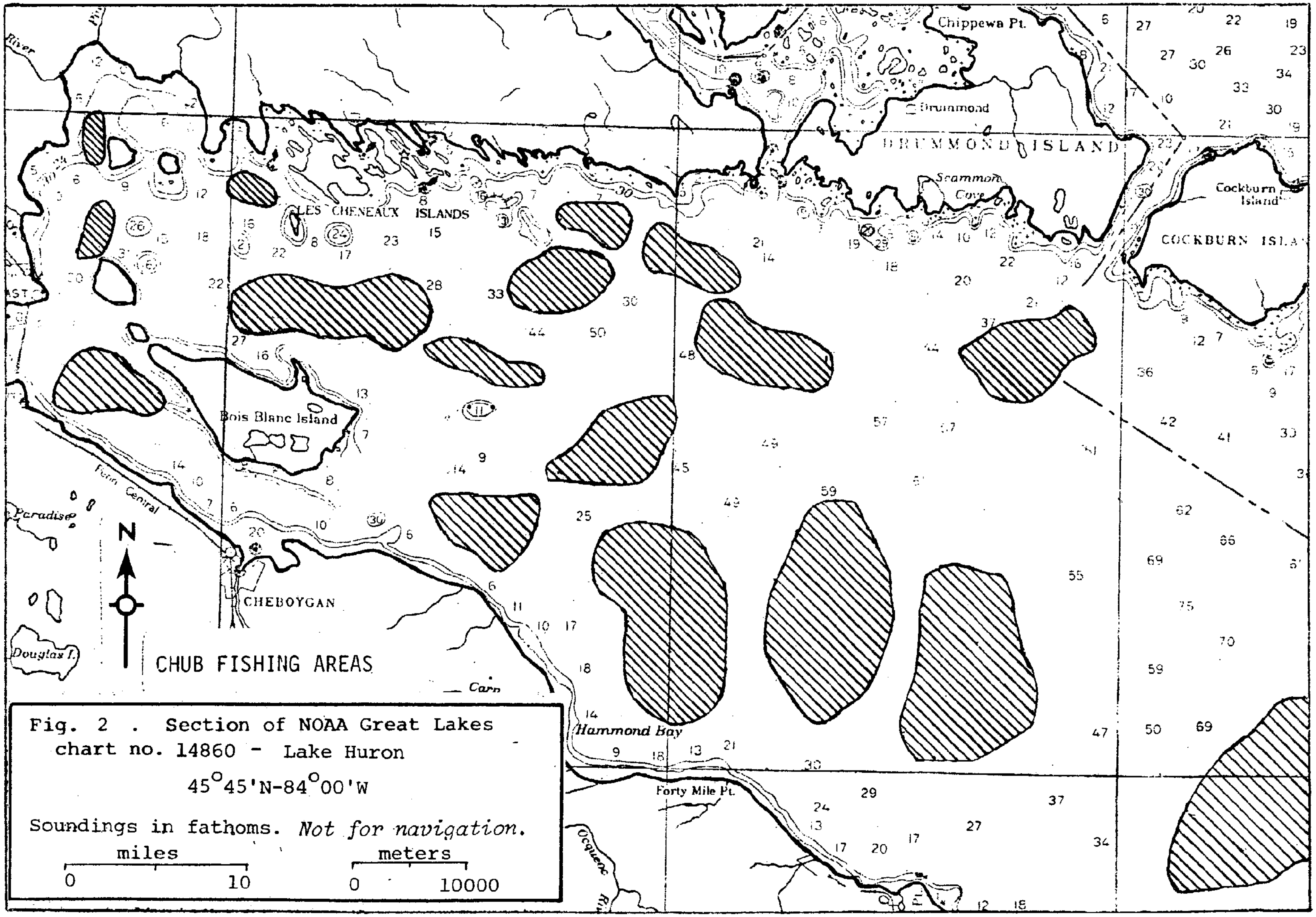



Fig. 2 . Section of NOAA Great Lakes chart no. 14860 - Lake Huron

45°45'N-84°00'W

Soundings in fathoms. *Not for navigation.*

miles 0 10 meters 0 10000

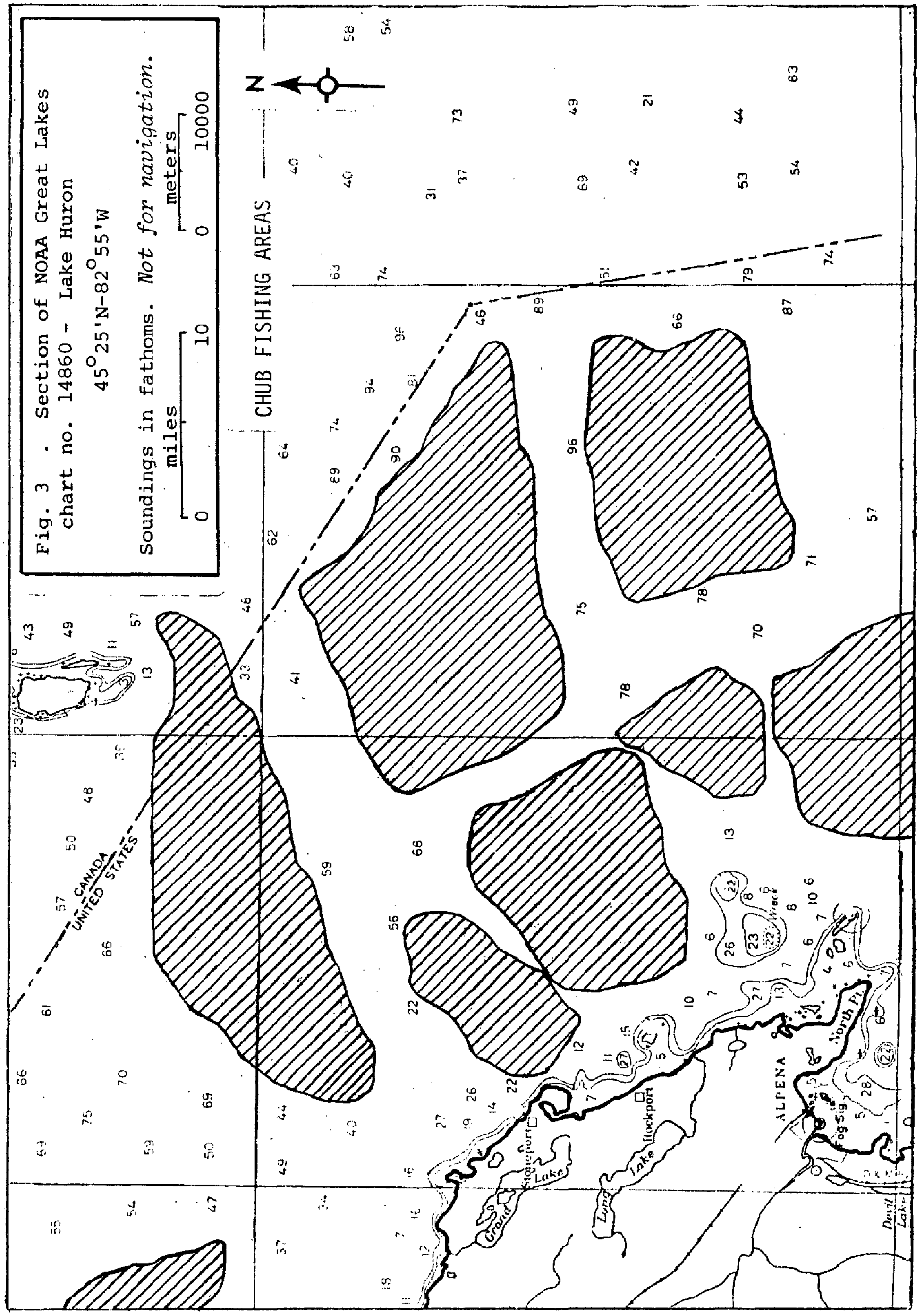



Fig. 3 . Section of NOAA Great Lakes chart no. 14860 - Lake Huron 45°25'N-82°55'W

Soundings in fathoms. *Not for navigation.*

miles 0 10 meters 0 10000

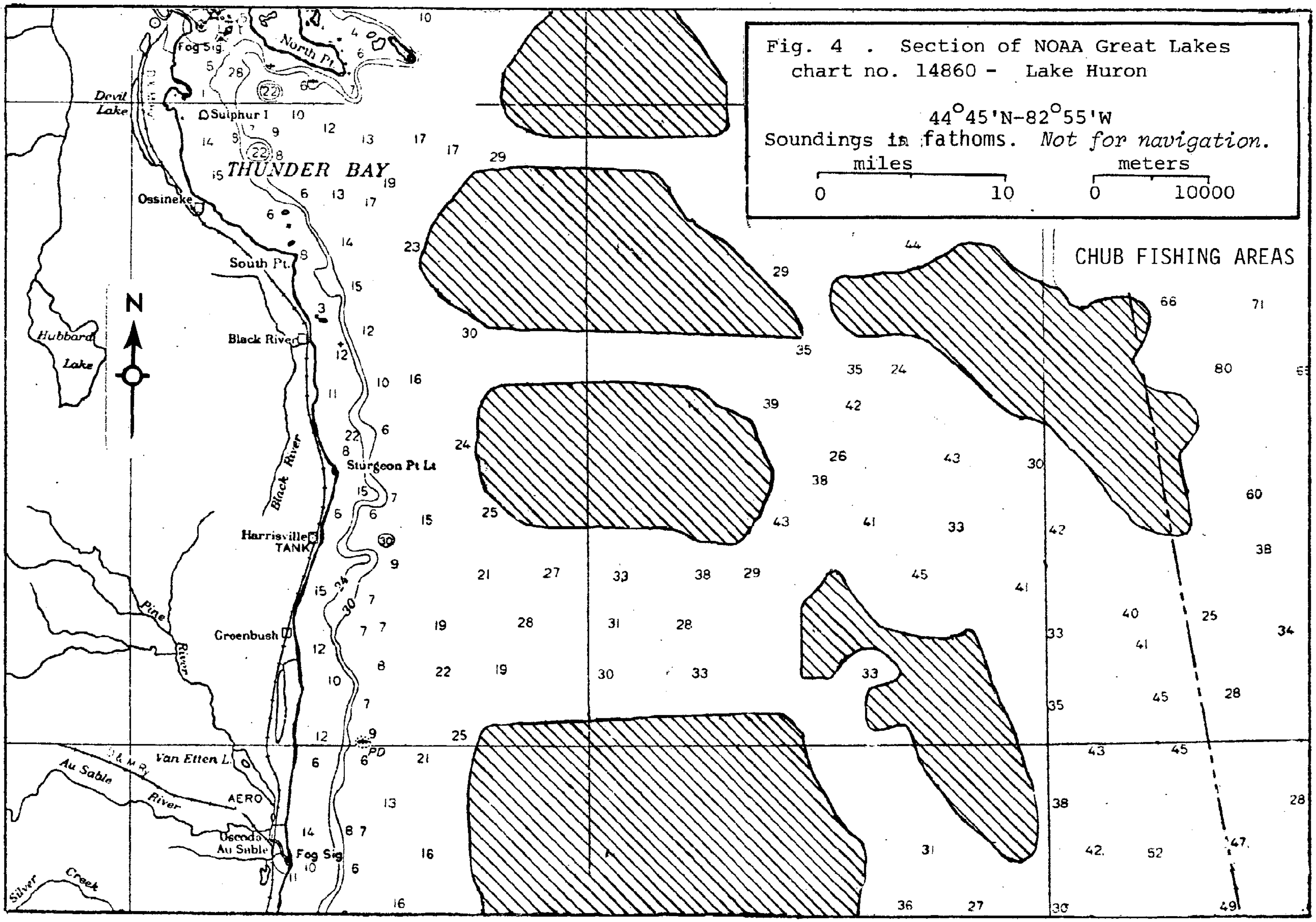



Fig. 4 . Section of NOAA Great Lakes chart no. 14860 - Lake Huron

44°45'N-82°55'W

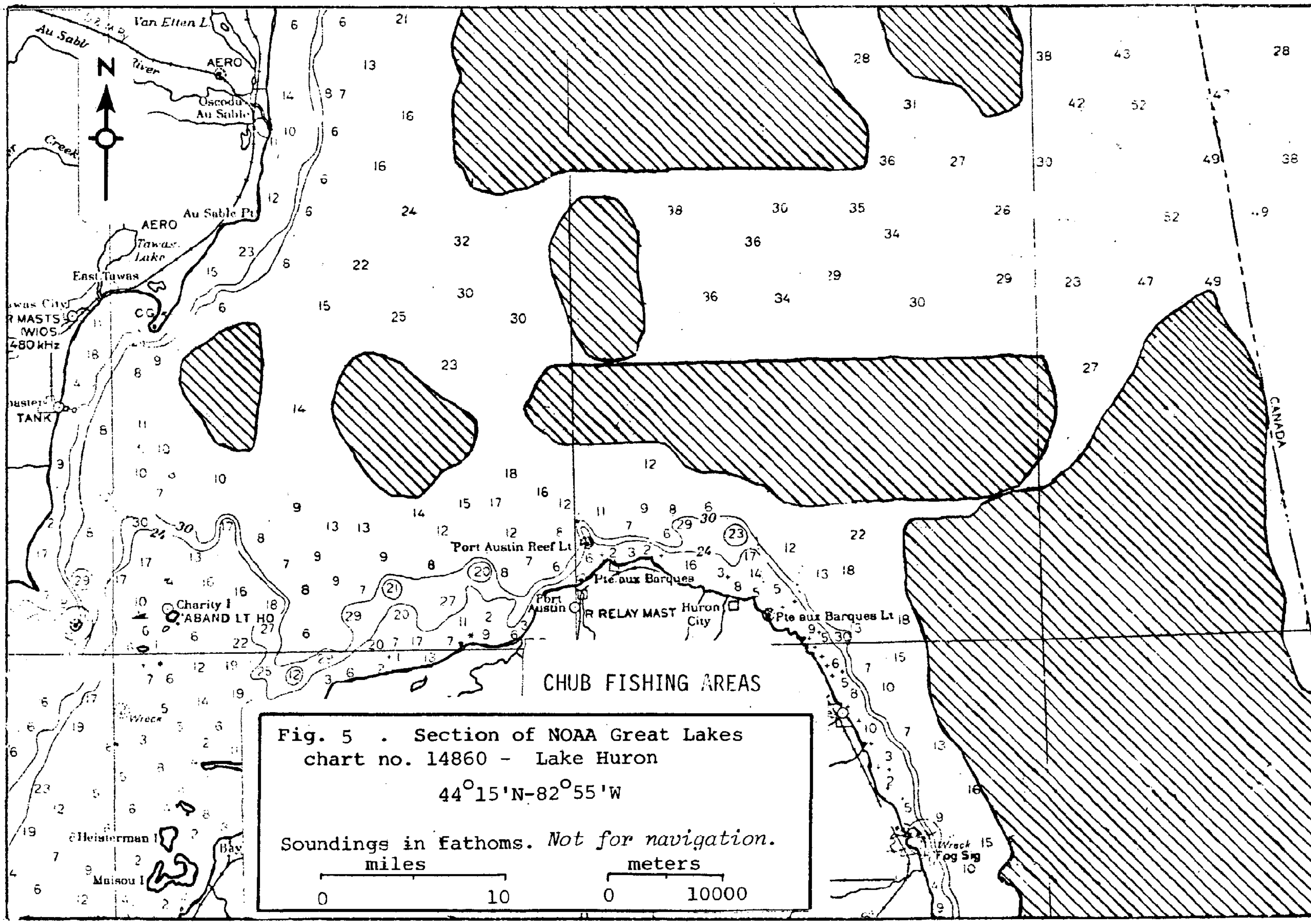



Fig. 5 . Section of NOAA Great Lakes chart no. 14860 - Lake Huron

44°15'N-82°55'W

Soundings in fathoms. *Not for navigation.*

miles 0 10 meters 0 10000

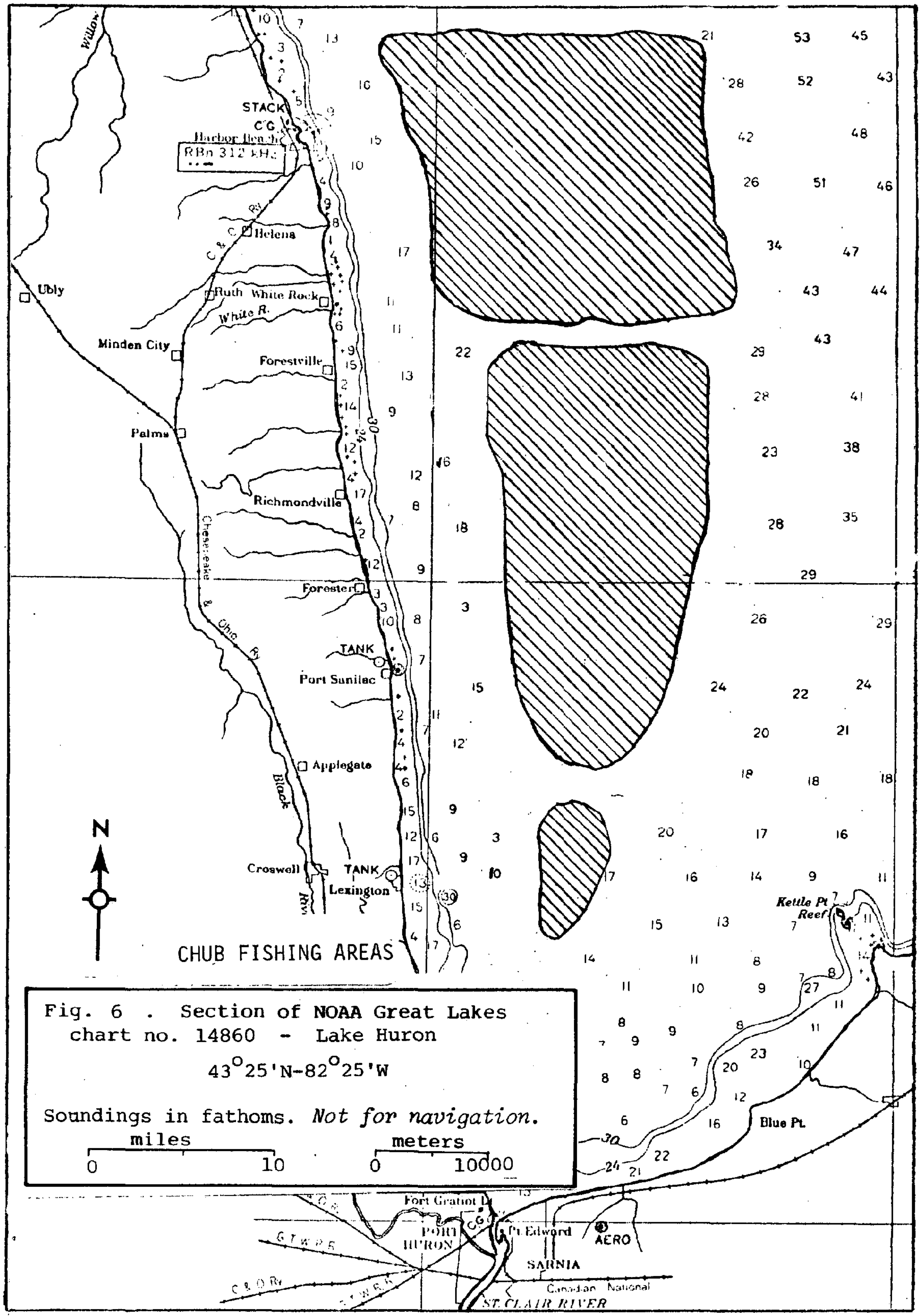



Fig. 6 . Section of NOAA Great Lakes chart no. 14860 - Lake Huron

$43^{\circ}25'$N-$82^{\circ}25'$W

Soundings in fathoms. *Not for navigation.*

miles 0 10 meters 0 10000

APPENDIX 5

LOCATIONS OF NEAR SHORE FISH SPAWNING GROUNDS REFERENCED

BY COUNTY, TOWNSHIP, RANGE, SECTION

AND NOAA CHART NUMBER

| GOGEBIC COUNTY | TOWNSHIP | RANGE | SECTIONS |
|---|---|---|---|
| Chart #14965 | T49N | R48W | 28,29,32,33 |
| | T50N | R46W | 25,35,36 |
| | T50N | R45W | 2,3,9,10,16,17,19,20 |
| ONTONAGON COUNTY | T51N | R44W | 13,23,24,26,27,33,34 |
| | T51N | R43W | 8,9,10,11,12,16,17,18 |
| | T51N | R42W | 7,8 |
| | T51N | R41W | 1,2,3,4,5,8 |
| | T51N | R40W | 5,6 |
| | T52N | R39W | 15,16 |
| | T53N | R38W | 9,16,17,20 |
| HOUGHTON COUNTY | | | |
| Chart #14964 | T55N | R35W | 9,10,16 |
| | T56N | R34W | 4,5,8,9,29,30 |
| | T57N | R34W | 32,33 |
| | T56N | R33W | 5,6,7 |
| | T52N | R33W | 27 |
| | T53N | R32W | 3,4,12,13,14,23 |
| | T55N | R31W | 21,22,28,29,31,32 |
| | T54N | R31W | 6,17,18 |
| KEWEENAW COUNTY | T58N | R32W | 23,24,27,28 |
| | T57N | R32W | 6 |
| | T53N | R32W | 19,20,30 |
| | T56N | R31W | 35,36 |
| | T56N | R30W | 20 |
| | T58N | R29W | 25,35,36 |
| | T57N | R29W | 2,3,11,12,13,14,15,21,22 |

APPENDIX 5 (Continued)

| KEWEENAW COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14964 | T58N | R28W | 25,26,27,28,29,30,34,35,36 |
| | T58N | R27W | 21,22,27,28,29,30 |
| | T59N | R26W | 15,16,17,18,19,20,21,22 |
| | T58N | R26W | 17,20,21,22 |
| BARAGA COUNTY | T52N | R33W | 34 |
| | T51N | R33W | 27,34 |
| | T50N | R33W | 4 |
| | T52N | R32W | 28,29,33,34 |
| | T51N | R32W | 4,5,8,18,24,25,32,35 |
| | T53N | R30W | 28,29 |
| MARQUETTE COUNTY | T52N | R29W | 1,2,3 |
| | T52N | R28W | 8,9,10,14,15,16,24 |
| | T52N | R27W | 19,27,28,33,34 |
| | T51N | R27W | 11,12 |
| | T51N | R26W | 7,15,18,19,20,22,23,29,32 |
| Chart #14963 | T50N | R26W | 4,5,8,9,14,15,22,23,25 |
| | T49N | R25W | 7,17,20,21,26,27,28,35 |
| | T49N | R24W | 24,25 |
| | T48N | R24W | 5,6,7,8,18,19,30,31,32 |
| | T48N | R23W | 3,4,5,6,10,11,12 |
| | T47N | R23W | 1,2,3,4,5,6,7,8 |
| ALGER COUNTY | T48N | R21W | 30,32 |
| | T48N | R22W | 23,24,25,26,27,33 |
| | T47N | R21W | 2,3,10,11,12,13,14 |
| | T48N | R20W | 21,22,27,28,36 |
| | T47N | R20W | 1,10,11,12,13 |
| | T48N | R19W | 25,31,36, |
| | T48N | R17W | 15,16,17,18,19 |
| | T47N | R19W | 6,7,8,17,18,24 |
| | T49N | R16W | 31,32 |
| | T49N | R15W | 1,2,3,12 |
| | T50N | R14W | 12,13,14,23,24 |
| | T49N | R14W | 1,2,3,4,7,8,9 |
| | T50N | R13W | 7,8,17,18,19,20 |

APPENDIX 5 (Continued)

| | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| LUCE COUNTY | | | |
| Chart #14962 | T50N | R12W | 30,31,32,33,34,35,36 |
| | T49N | R12W | 1,2 |
| | T50N | R11W | 31,32,33,34,35,36 |
| | T49N | R11W | 4,5,6 |
| | T49N | R10W | 1,2,3,4,5,6 |
| | T50N | R 9W | 23,24,25,26,27,28,31,32,33 |
| | T50N | R 8W | 1,2,3,4,5,7,8,9,10,11,16,17,18,19 |
| CHIPPEWA COUNTY | T50N | R 8W | 1 |
| | T51N | R 7W | 33,34,35 |
| | T50N | R 7W | 1,2,3,4,5,6 |
| | T51N | R 6W | 13,14 |
| | T50N | R 6W | 2,3,4,5,6 |
| | T48N | R 6W | 7,8,17,18,19,20,21,28,29,33 |
| | T51N | R 5W | 31,32,33 |
| | T50N | R 5W | 5,6,7 |
| | T48N | R 5W | 7,8,17,18,19,20,21,28,29,33 |
| | T51N | R 5W | 31,32,33 |
| | T50N | R 5W | 5,6,7 |
| | T48N | R 5W | 7,8,17,18,19,20,21,28,29,33 |
| | T47N | R 5W | 4,5,8,9,10,13,14,15,16 |
| | T47N | R 4W | 17 |
| | T47N | R 3W | 1,2,3,4,9,10,11,12 |
| Chart #14882 | T43N | R 6E | 19,20,30 |
| | T43N | R 5E | 36 |
| | T42N | R 6E | 3,4,5,8,9,10,15,16 |
| | T42N | R 5E | 11 |
| | T41N | R 5E | 12,14,15,23,24,25 |
| Chart #2295 | T41N | R 7E | 27,28 |
| | T41N | R 6E | 12,13 |
| | T42N | R 7E | 3,10,11,12 |
| MENOMINEE COUNTY | | | |
| Chart #14909 | T32N | R27W | 13,23,24,25,26,35,36 |
| | T31N | R26W | 5,6,7 |

APPENDIX 5 (Continued)

| MENOMINEE COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14909 (cont.) | T33N | R26W | 1,11,12,14,22,27,28,32,33 |
| | T35N | R25W | 1,12,23,24,25,26,34,35 |
| | T34N | R25W | 3,4,9,10,16,17,20,21,30,31,32 |
| | T35N | R24W | 7,19,20,29,30 |
| DELTA COUNTY | | | |
| Chart #14908 | T37N | R24W | 12,13,14,23,24 |
| | T38N | R23W | 27,28,29,31,32,33 |
| | T37N | R23W | 5,6,7,8 |
| | T40N | R22W | 1,2,3,10,12,13,14,15,23,26, 27,28,29,32,34,35 |
| | T39N | R22W | 2,3,5,8,10,11,14,15,22,26,35 |
| | T38N | R22W | 2,23,24,25 |
| | T40N | R21W | 6,7,29,30 |
| | T39N | R21W | 25,36 |
| | T38N | R21W | 1,2,3,4,7,8,9,10,13,14,16,17, 18,19,22,23,27,28,30,32,33 |
| | T40N | R20W | 14,15,16,21,23,24,26,27,28, 33,34,35 |
| | T39N | R20W | 4,8,9,13,14,17,18,19,22,23, 27,30 |
| | T38N | R20W | 7,8,13,25,26 |
| | T37N | R20W | 12,13 |
| | T40N | R19W | 1,11,12,14,15,22,23,27,28, 29,30,31,32,33,34,35 |
| | T39N | R19W | 4,5,7,8,9,10,11,13,14,15,32,33 |
| | T38N | R19W | 24,25,31 |
| | T37N | R19W | 12 |
| | T41N | R18W | 32,33 |
| | T40N | R18W | 4,5,6,9,16,20,21,29,30,31,32 |
| | T39N | R18W | 5,6,7,18,24,25,26,27,28,33,34 |
| | T38N | R18W | 9,19 |
| SCHOOLCRAFT COUNTY | T39N | R17W | 1,4,8,9,17,19,20 |
| | T41N | R16W | 13,14,22,23,26,27,28,32,33 |

| SCHOOLCRAFT COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14908 (Cont.) | T40N | R16W | 6,7,17,18,19 |
| | T41N | R15W | 7,11,12,18,19 |
| Chart #14911 | T41N | R13W | 22,25,26,27 |
| MACKINAC COUNTY | T41N | R12W | 4,5,8,9 |
| | T39N | R12W | 12,13 |
| | T38N | R12W | 5,6,7,8,35,36 |
| | T37N | R12W | 1,2,7,18,25 |
| | T42N | R11W | 25,36 |
| | T41N | R11W | 9,10,11,12,23,24,25,26 |
| | T40N | R11W | 25,26,35,36 |
| | T39N | R11W | 1,2,7,8 |
| | T37N | R11W | 14,24,30 |
| | T43N | R10W | 25,26,34,35 |
| | T42N | R10W | 3,4,9,10,13,14,16,17,18,19, 20,21,23,24,30 |
| | T40N | R10W | 7,8,14,15,16,17,18,19,20,21, |
| CHARLEVOIX COUNTY | T39N | R10W | 1,2,3,4,10,11,12,13,14,17,22, 23,24,25,26,27 |
| | T38N | R10W | 11,12,13,14,23,24 |
| | T37N | R10W | 1,12 |
| | T43N | R 9W | 22,25,26,27,28,29,30,32,33, 35,36 |
| | T42N | R 9W | 28,29,32,33 |
| | T41N | R 9W | 3,8,9,16,17,22 |
| | T40N | R 9W | 16,17,20,21,25,26,29,30,31, 32,33,35,36 |
| | T39N | R 9W | 2,3,5,6,7,8,9,10,11,12,13,14, 15,17,18,19,20,25,26 |
| | T38N | R 9W | 1 |
| | T43N | R 8W | 19,20,21,27,28,29,30 |
| | T42N | R 8W | 1,2,3,8,11,12,13,14,29,32,33, |
| | T40N | R 8W | 28,29,31,32,33 |
| | T39N | R 8W | 1,2,3,6,7,8,9,10,11,12,14,15, 16,17,19,20,21,22,23,29,30,31 |
| | T38N | R 8W | 6 |

| CHARLEVOIX COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14911 (cont.) | T42N | R 7W | 4,6,7,8,9,11,12,13,17,18,28, 29,32,33 |
| | T41N | R 7W | 3,4 |
| | T42N | R 6W | 18,19,20,21,22,25,26,27,28, 29,32,33 |
| | T42N | R 5W | 31 |
| Chart #14881 | T41N | R 5W | 5,6,8,9,16,21,22,25,26,27, 35,36 |
| | T40N | R 5W | 11,14,15,24 |
| | T41N | R 4W | 13 |
| | T42N | R 3W | 10,11,13,14,24 |
| | T41N | R 3W | 3,4,5,7,8,9,10,11,12,13,14, 18,19,20,29,30,31,32 |
| MACKINAC COUNTY | T40N | R 3W | 11,14,15,24 |
| | T42N | R 2W | 16,17,18,19,20,21,22,27,34, 35,36 |
| | T41N | R 2W | 1,2,3,7,8,10,11,16,17,18,20,21 |
| | T42N | R 1W | 26,27,28,29,30,31,32,33 |
| | T41N | R 1W | 1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15,16,21,22,23,24,27, 28,32,33 |
| | T42N | R 1E | 31,32,33,34,35,36 |
| | T41N | R 1E | 1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15,16,17,18,19 |
| | T41N | R 2E | 1,2,3,4,5,6,7,8,9,10,15,16, 17,18,20,21 |
| EMMET COUNTY | | | |
| Chart #14911 | T39N | R 7W | 1,2,11,12,14,15,16,17,18,19, 20,21,22,23 |
| | T39N | R 6W | 1,3,4,6,7,13,14,15,16,17,18 19,20,21,22,23,24,25,26 |
| | T39N | R 5W | 19,20,21,29,30,31,32 |
| | T38N | R 7W | 23,26 |
| | T38N | R 6W | 5,6,7,12,13,14,18,23,26,27,34 |

| EMMET COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14911 (Cont.) | T38N | R 5W | 5,6,7,8,18 |
| | T37N | R 7W | 10,13,24,26 |
| | T37N | R 6W | 5,6,7 |
| | T36N | R 7W | 25,26 |
| | T36N | R 6W | 30,31 |
| CHARLEVOIX COUNTY | T34N | R 9W | 11,12,13,14,30,31 |
| | T34N | R 8W | 13,14,20,21,23,27,28 |
| | T33N | R 9W | 1,2,11,14,27,34 |
| ANTRIM COUNTY | | | |
| Chart #14913 | T32N | R 9W | 14,23,27,28,33,34 |
| | T31N | R 9W | 11,14 |
| | T30N | R 9W | 6,7,17,18,19,20,29,32 |
| | T29N | R 9W | 5,6,7,18,19 |
| GRAND TRAVERSE COUNTY | T29N | R11W | 12,13,23,25,26,34,35 |
| | T28N | R11W | 2,3,10 |
| | T28N | R10W | 27,34 |
| | T30N | R10W | 10,11,14,15,16,22,23,24,27,28 |
| | T29N | R10W | 1,8,12,13,17,18,20,21,23,25, 29,31,32,35 |
| LEELANAU COUNTY | T33N | R11W | 24,25 |
| | T31N | R11W | 12,13,24,25,35,36 |
| | T30N | R11W | 2,11,15,21,23,26,35 |
| | T29N | R11W | 2,11,15,21,22,28 |
| | T28N | R11W | 27,33,34 |
| | T33N | R10W | 19,30 |
| | T32N | R10W | 3,5,6,8,17,19,30 |
| | T31N | R10W | 6,7,14,15,21,22,28,31,32,34 |
| Chart #14912 | T32N | R15W | 4,9,17,21,24,25,28,29,32,36 |
| | T31N | R15W | 1,12,25,26,27,28,29,32,35,36 |
| | T30N | R15W | 3,5,6,7,8,9,10,11,12,13,14,23, 24,25,26,27,35,36 |
| | T29N | R15W | 1,19,29,30,31,32 |

| | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| LEELANAU COUNTY | | | |
| Chart #14912 (Cont.) | T28N | R15W | 1,2,11,12,13,14,23,24 |
| | T32N | R14W | 17,18,19,20,21,22,27,34 |
| | T31N | R14W | 3,7,10,15,17,18,19,20,22,23, 26,27,28,29,32,33,34 |
| | T30N | R14W | 3,4,5,6,7,20,21,25,28,29,30, 31,32,36 |
| | T29N | R14W | 5,6,7,11,14 |
| | T29N | R13W | 2,3 |
| | T35N | R13W | 8,10,11,12,13,14,17,18,19,20, 23,24,29,30,31,32,33 |
| | T34N | R13W | 3,4,5,8,9,10,14,15,16,21,23, 26,27,28,33,34 |
| | T31N | R13W | 9,15,16,17,20,21,28,29,32,33 |
| | T30N | R13W | 24,25,26,29,30,31,32,35,36 |
| | T31N | R12W | 27,28,33,34 |
| | T30N | R12W | 4,5,6,8,9,17,19,20,29,30,31 |
| BENZIE COUNTY | | | |
| Chart #14907 | T26N | R16W | 28,35 |
| | T26N | R16W | 33,34 |
| | T27N | R15W | 17,18,19,20,21,22 |
| MANISTEE COUNTY | T22N | R17W | 24,25,26,35,36 |
| | T21N | R17W | 10,15,21,22,28,32,33 |
| | T24N | R16W | 3,4,9,10,16,17,20,21,28,29, 32,33 |
| | T23N | R16W | 4,5,29,32 |
| MASON COUNTY | T19N | R20W | 6,7,18,19,29,30,31,32 |
| | T19N | R19W | 1,12,13,24 |
| | T20N | R18W | 1,11,12,13,14,22,23,27,28,31, 32,33 |
| | T18N | R18W | 4,5,8,9,16,17,20,21,22,27,28, 29,33,34 |
| | T17N | R18W | 3,4,9,10,15,16,22,23,26,27,34, 35 |

APPENDIX 5 (Continued)

| OCEANA COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14907 (cont.) | T15N | R19W | 13,23,24,25,26,35 |
| | T14N | R19W | 2,3,11,13,14,23,24,25,26,36 |
| | T16N | R18W | 2,3,10,11,15,21,22,27,28,32,33 |
| | T15N | R18W | 4,5,6,7,8 |
| Chart #14906 | T14N | R19W | 36 |
| | T14N | R18W | 31 |
| | T13N | R18W | 6,7,8,17,18,20,21,28,29,33 |
| OTTAWA COUNTY | T 8N | R17W | 17,19,20,21,27,28,29,30,31,32, 33,34,35,36 |
| | T12N | R16W | 4,5,9,10,15,16,21,22,27,28,34, 35 |
| | T11N | R16W | 2,3,10,11,13,14,23,24,25,26,36 |
| | T10N | R16W | 1,2,12 |
| | T 8N | R16W | 7,18,19,30,31 |
| | T 6N | R16W | 4,5,6,7,8,9,16,17,18,19,20,21, 28,29,30,31,32,33 |
| | T 5N | R16W | 4,5,6,7,8,9,16,17,18,19,20,21, 28,29,30,31,32,33 |
| | T11N | R15W | 31 |
| | T10N | R15W | 6,7,17,18,19,20,29,30,31,32,33 |
| | T 9N | R15W | 3,4,9,10,14,15,22,23,25,26,35,36 |
| | T 2N | R19W | 1,2,3,10,11,12,13,14,24 |
| | T 1N | R18W | 1,2,3,4,5,8,9,10,11,12,13,14,15, 16,22,23,24,25,26,36 |
| | T 3N | R18W | 11 |
| | T 3N | R17W | 1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22,23,24,25, 26,27,28,29,30,31,32,33,34,35,36 |
| | T 1N | R17W | 1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22,23,24,25, 26,27,28,29,30,31,32,33,34,35 |
| | T 4N | R16W | 4,5,6,7,8,17,18,19,20,29,30,31, 32 |
| | T 3N | R16W | 5,6,7,8,17,18,19,30,31,32 |

APPENDIX 5 (Continued)

| | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| VAN BUREN COUNTY | | | |
| Chart #14905 | T 2S | R18W | 12,13,23,24,25,26,34,35,36, |
| | T 1S | R17W | 8,9,16,17,20,21,28,29,31,32 |
| BERRIEN COUNTY | T 8S | R22W | 2,3,9,10,11,12,13,14,23,24 |
| | T 7S | R22W | 25,26,34,35,36 |
| | T 6S | R22W | 1,2,3,4,10,11,12,13,14,24 |
| | T 5S | R22W | 1,2,3,9,10,11,12,13,14,15, 16,21,22,23,24,25,26,27,33, 34,35,36 |
| | T 4S | R22W | 1,2,3,10,11,12,13,14,15,21, 22,23,24,25,26,27,34,35,36 |
| | T 8S | R21W | 3,4,5,7,8,9,17,18 |
| | T 6S | R21W | 1,2,3,4,5,6,7,8,9,10,11,15, 16,17,18,19,20,21 |
| | T 5S | R21W | 1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15,16,17,18,19,20,21,22, 23,24,25,26,27,28,29,30,31,32, 33,34,35,36 |
| | T 4S | R21W | 1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18,19,20,21,22,23, 24,25,26,27,28,29,30,31,32,33, 34,35,36 |
| | T 7S | R20W | 3,4,5,7,8,9,17,18,19 |
| | T 6S | R20W | 13,14,15,22,23,26,27,33,34,35 |
| | T 5S | R19W | 4,5,6,8,9 |
| | T 4S | R19W | 1,2,10,11,12,14,15,16,21,22 |
| | T 3S | R18W | 2,3,4,9,10,15,16,17,20,21,23, 27,28,29,30,31,32,33,34 |
| CHIPPEWA COUNTY | | | |
| Chart #14882 | T41N | R 7E | 19 |
| | T41N | R 6E | 19,20,21,22,23,24 |
| | T41N | R 5E | 13,14,16,17,20,21,22,23,24 |
| Chart #14881 | T41N | R 3E | 6,7,8,9,10,11,12,13,14,15 |
| | T41N | R 4E | 7,8,9,10,11,12,13,14,15,16,18 |

| CHEBOYGAN COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14881 (cont.) | T39N | R 3W | 8,9,22 |
| | T40N | R 1W | 35,36 |
| | T39N | R 1W | 1,2,3,4,5,6,7,8,9,10,11,12,13, 14,18,19,23,24,25,26,30,31,35, 36 |
| | T38N | R 1W | 21,22,23,24,25,27,28 |
| | T38N | R 1E | 19,20,21,22,23,25,26,27 |
| | T39N | R 2E | 5,6,7,8 |
| | T38N | R 2E | 30,31,32 |
| PRESQUE ISLE COUNTY | T37N | R 2E | 3,4,10,11,13,14,22,24,25,36 |
| | T37N | R 3E | 19,30,31 |
| | T36N | R 3E | 6,7,8,13,14,15,16,17,18,21,22, 23,24 |
| Chart #14864 | T35N | R 5E | 15 |
| | T35N | R 6E | 16,21,22,27,28 |
| | T34N | R 7E | 1,2,9,10,11 |
| | T34N | R 8E | 6,7,8,16,17,18 |
| | T33N | R 9E | 7,8,18,31 |
| ALPENA COUNTY | T30N | R 8E | 10,11,13,15,24,25 |
| | T29N | R 8E | 1 |
| | T32N | R 9E | 3,4,6,8,9,10,23 |
| | T31N | R 9E | 12,13,23,26,27,29,30,31,32, 33,34 |
| | T30N | R 9E | 1,2,3,12 |
| | T29N | R 9E | 10,15,25,36 |
| | T31N | R10E | 4,7,8,18,19,27,28,32,32,33, 34 |
| | T30N | R10E | 3,6,7,8,18 |
| ALCONA COUNTY | T27N | R 9E | 1,12,13,24 |
| | T26N | R 9E | 12,13,23,24,25,26,35,36 |
| | T25N | R 9E | 2 |
| | T28N | R10E | 20,21,22,24,25,26,27,28,29,32, 33,34,35 |

APPENDIX 5 (Continued)

| ALCONA COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14864 (Cont.) | T27N | R10E | 1,2,6,7,10,11,12,19,20,29, 30,31 |
| | T26N | R10E | 6,7 |
| | T25N | R10E | 3,4,9.11,12,13,14,16,21,28, 29,32 |
| | T27N | R11E | 6,7 |
| IOSCO COUNTY | | | |
| Chart #14863 | T21N | R 7E | 1,11,12,13,14,23,24,25,26, 35,36 |
| | T22N | R 8E | 13,24,25,26,27,28,29,30,31, 32,33,34,35 |
| | T21N | R 8E | 2,3,4 |
| | T23N | R 9E | 2,3,10,11,14,15,22,23,24,25,26, 27,34,35,36 |
| | T22N | R 9E | 1,2,3,4,5,7,8,9,10,11,12,17,18 |
| | T24N | R10E | 5,8,17,20,30,31 |
| | T23N | R10E | 6,7,18 |
| ARENAC COUNTY | T18N | R 5E | 1,2,10,11,14,15,16,21,22,27,28, 29,32,33 |
| | T18N | R 6E | 1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18,19,21,22,23,24, 25,27,34,35,36 |
| | T20N | R 7E | 25,36 |
| | T19N | R 7E | 1,2,11,12,13,14,15,16,17,19,20, 30,31 |
| | T18N | R 7E | 5,6,7,8,13,16,17,18,19,20,21, 23,24,25,26,27,28,29,31,32,33, 34,35,36 |
| | T20N | R 8E | 4,5,6,7,8,9,16,17,18,19,20,21, 28,29,30,31,32,33 |
| | T19N | R 8E | 4,5,6,7,8,9,13,14,16,17,18,19, 20,21,23,24,25,26,28,29,30,31, 32,33,34,35,36 |

APPENDIX 5 (Continued)

| ARENAC COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14863 (cont.) | T19N | R 9E | 13,14,15,16,17,18,19,20,21, 22,23,24,25,26,27,28,29,32, 33,34,35,36 |
| BAY COUNTY | T16N | R 4E | 13,24,25,26,35,36 |
| | T15N | R 4E | 1,12,13 |
| | T17N | R 5E | 5,6,7,8,17,18,19,20,21,28,29, 30,31,32,33 |
| | T16N | R 5E | 4,5,6,7,8,9,16,17,18,19,20, 21,28,29,30,31,32,33 |
| | T15N | R 5E | 4,5,6,7,8,9,16,17,18,19,20, 21,27,28,29,33,34 |
| | T14N | R 5E | 2,3 |
| | T17N | R 6E | 1,2,3,10,11,12,13,14,15,22,23, 24,25,26,27 |
| | T15N | R 6E | 13,23,24,25,26,27,33,34,35,36 |
| | T14N | R 6E | 1,2,3,4,5,6,7,8,9,10,11,12 |
| TUSCOLA COUNTY | T15N | R 7E | 1,11,12,13,14,15,16,20,21,22, 23,24,25,26,27,28,29,30,31,32 |
| | T14N | R 7E | 6 |
| | T16N | R 8E | 25,26,27,28,29,30,31,32,33,34, 35,36 |
| | T15N | R 8E | 1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18,19,20,30 |
| HURON COUNTY | T16N | R 8E | 3,9,12,13,14,16,17,20,23,24,25, 26,29,34,35,36 |
| | T17N | R 9E | 1,2,5,10,11,12,13,14,15,16,17, 18,19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36 |
| | T16N | R 9E | 1,2,3,4,5,6,7,8,9,10,11,15,16, 17,18,19,20,21,29,30,31,32 |
| | T15N | R 9E | 6 |
| | T18N | R10E | 12,13,14,19,20,21,22,23,24,25, 26,27,28,29,30,31,32,33,34,35 |

| HURON COUNTY | TOWNSHIP | RANGE | SECTION |
|---|---|---|---|
| Chart #14863 (cont.) | T17N | R10E | 3,4,5,6,7,8,17,18,19,20,30, |
| | T18N | R11E | 1,7,8,9,10,11,12,13,14,15, 16,17,18 |
| Chart #14862 | T18N | R14E | 1,2,12 |
| | T18N | R15E | 6,7,8,16,17,18,20,21,27,28, 29,33,34,35 |
| | T17N | R15E | 2,3,10,11,13,14,15,23,24,25, 26,36 |
| | T16N | R15E | 1,12 |
| | T17N | R16E | 4,5,8,9,15,16,17,20,21,22,26, 27,28,30,31,33,34,35 |
| | T16N | R16E | 1,2,3,5,6,7,8,10,11,12,13,14, 15,17,18,19,20,22,27,29,30,31, 32,34,35,36 |
| | T15N | R16E | 4,5,8,9,16,17,20,21,28,29,32,33 |
| | T16N | R17E | 6,7,8,17,18,19,20,21,29,30,31 |
| SANILAC COUNTY | T14N | R16E | 1,2,4,5,8,9,11,12,13,14,16,17, 20,21,23,24,25,26,28,29,32,33, 35,36 |
| | T13N | R16E | 3,4,9,10,15,16,21,22,27,28,33,34 |
| | T12N | R16E | 2,3,10,11,14,15,23,24,25,26, 35,36 |
| | T11N | R16E | 1,2,11,12,13,14,23,24,25,26,35, 36 |
| | T14N | R17E | 6,7,8,17,18,19,29,30,31,32 |
| | T13N | R17E | 4,5,6,7,8,17,18,19,20,29,30, 31,32 |
| | T12N | R17E | 5,6,7,8,16,17,20,21,28,29,32,33 |
| | T10N | R17E | 2,3,4,5,6,7,8,9,10,11,14,15,16, 17,18,19,20,21,22,23,27,29,30, 31,32 |
| | T 9N | R17E | 5,6,7,8,17,18,19,20,29,32,33 |
| | T 8N | R17E | 4,5,8,9,16,17,20,21,28,29,33,34 |