1980

Elizabeth River Surface Circulation Atlas

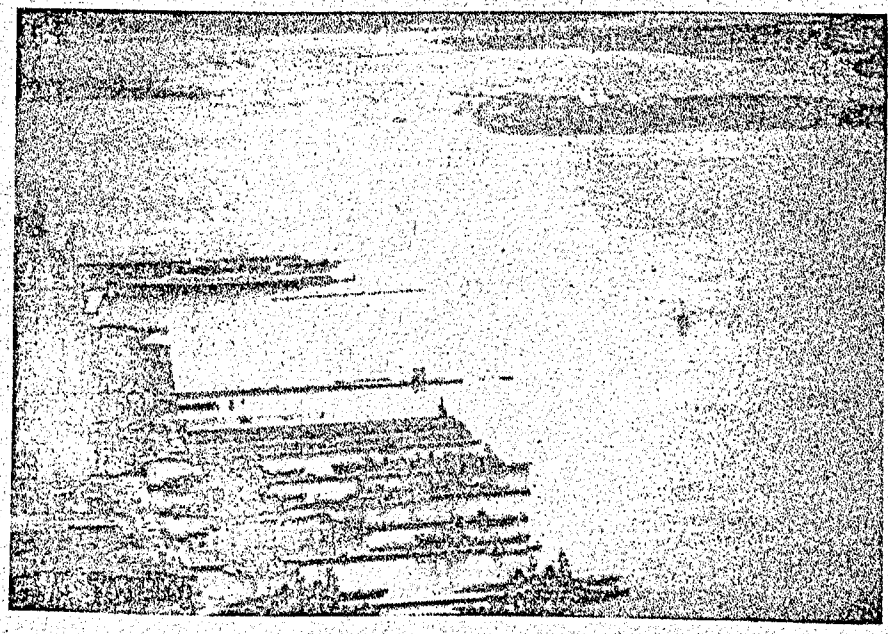
John C. Munday Jr.
Virginia Institute of Marine Science

Hayden H. Gordon
Virginia Institute of Marine Science

Charles J. Alston
Virginia Institute of Marine Science

ELIZABETH RIVER

SURFACE CIRCULATION ATLAS



Remote Sensing Center
Virginia Institute of Marine Science
School of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

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ELIZABETH RIVER SURFACE CIRCULATION ATLAS

FOREWORD

This Atlas of surface circulation in the Elizabeth River, Hampton Roads, Virginia, was produced from field data obtained by remote sensing of dye-emitting surface drogues. The maps show surface Lagrangian trajectories under various combinations of wind and tide. The Atlas was designed for use by planners and managers charged with decision-making and regulation in the Hampton Roads port region.

A limited number of copies was produced in 1977; after minor revisions, this edition is now published for wider distribution. Additional Atlas leaves may be produced in the future as studies permit.

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Description

The Elizabeth River Surface Circulation Atlas is a compendium of maps which detail the surface circulation throughout the main branch of the Elizabeth River, in the port of Hampton Roads, Virginia. Data for the Atlas maps were obtained directly from field experiments using Remote Sensing and dye-emitting low-windage surface drogues. The maps show surface Lagrangian trajectories under various combinations of wind and tide. The Atlas is not intended to duplicate NOAA tidal current tables, but rather to supplement the tables with empirical trajectory data at increased spatial resolution. Knowledge of surface currents under different tide and wind conditions enables a user to predict the movement of floating debris, such as oil spills, within the Elizabeth River Basin.

The Atlas is based on the fact that motion of surface water is a product of tidal flow and local winds, and is repeatable under similar conditions. The user obtains readily-available local wind and predicted tidal data, and finds within the Atlas the maps referring to the same conditions. With the trajectories on the maps, the user may move along a trajectory forward in time to find possible future positions, or backward to identify possible earlier positions.

The Atlas was designed to be used by planners and managers charged with decision-making and regulation in the Hampton Roads port region. Within this region, the Elizabeth River Basin was chosen for development of a circulation atlas, because of the Basin's large volume of ship traffic, industrial and waste treatment plants, oil and coal handling facilities, and military and civilian port activities. Immediate applications include: prediction of oil slick movement, to permit containment of a spill before serious environmental damage occurs; 'hindsight' prediction, to identify a possible source for a spill; and sewage and industrial outfall siting, with consideration for all the various wind and tide combinations.

The Atlas is arranged in leaves to allow future revisions in response to specific user needs. Future generations of the Atlas will include data from new field studies, filling in data gaps in the Condition Matrix.

One possible modification would be the addition of a grid coordinate system superimposed on the Atlas maps for orientation. As the data base becomes more complete, circulation information could be referenced to individual grid squares for tide and wind combinations, extending the usefulness of the Atlas to all locations in the Basin. A second possibility is to include circulation anomalies such as foam lines and convergence zones on the maps. These, of course, significantly modify the surface circulation by trapping and concentrating surface material under certain tidal phases. A third possibility is the addition of maps showing subsurface trajectories. Such data can be obtained using Remote Sensing techniques developed by Munday, Welch, and Gordon (1980, Ports 80 Conference, ASCE, p. 417-428).

Revisions will be contingent upon user experience with the Atlas and upon future needs. Due to the flexibility of the Atlas design, accommodations to user needs could be undertaken with a minimum of expense, effort, and time. New current data can be obtained and incorporated easily because the Atlas is prepared using semi-automated photogrammetric and computer plotting techniques.

Instructions

The surface circulation maps are keyed to wind data from the National Weather Service Office at Norfolk Regional Airport, and to NOAA Tide Tables for predicted high and low water at Sewells Point (Hampton Roads). The following steps are taken to locate the proper map:

1. Using the NOAA Tide Tables, find the times of predicted low and high tide at Sewells Point (Hampton Roads) which bracket the time of interest,

2. Call the National Weather Service Office in Norfolk (853-0553) and request the current and previous (2 to 3 hours) wind velocities,

3. Using the Condition Matrix, locate one of the sixteen bins appropriate for the tide phase and wind direction from Steps 1 and 2. Within the bin locate the wind speed rectangle corresponding to the actual speed from Step 2, and

4. The number(s) indicate the map number(s) which contain the specific circulation data of interest.

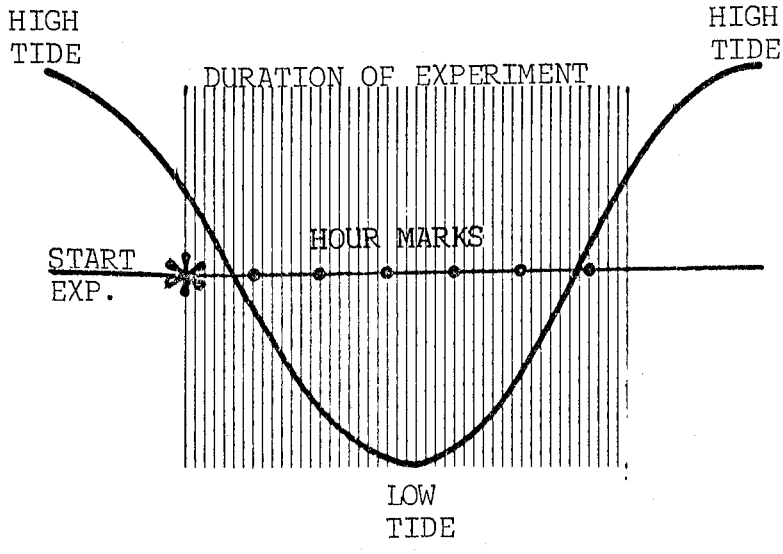
On each map are surface drogue positions plotted every 15 minutes, with the initial release position depicted by a * symbol. On the lower right corner is a tide curve (high tide above the horizontal line, low tide below) showing the span of the experiment within a tide cycle. Dots along the horizontal line indicate hours after drogue release. Wind speed and direction are illustrated on each map with an arrow referenced to the north arrow (0 to 5 knots, short arrow; 6 to 15 knots, medium arrow; greater than 15 knots, wind arrow same length as north arrow).

CONDITION MATRIX

TIDE PHASE	WIND SPEED (KTs)	NE	SE	SW	NW
H FALLING ↓	> 15			10	
	6—15				5,8
	0—5				
	> 15	2,3		4,7	5,6,8
	6—15				
	0—5				
L RISING ↓	> 15	2,3,11		9	6
	6—15				
	0—5				
	> 15	12		9	
	6—15				
	0—5				

WIND DIRECTION

Sample Tide Curve



Example (Hypothetical)

Suppose one wishes to know surface circulation west of Tanner Point in the Elizabeth River at 1200 on a particular day. By consulting the NOAA Tide Tables, time of high tide is found to be 0930 and low tide 1500. A call to the Norfolk Weather Bureau shows winds to be 200° at 10 gusting to 15 knots. Checking the Condition Matrix for a tide phase between high (H) and low (L), wind direction SW, and speed 6 to 15 knots reveals maps number 4 and 7 are appropriate. A brief review of the wind and tide information on both maps tends to favor map 4 which begins earlier in the tide cycle and has winds nearer 200°. Drogue tracks show a well-defined ebb flow.

ELIZABETH RIVER

Willoughby Bay

Sewells Pt.

Lafayette River

Tanner Pt.

Lambert Pt.

Port Norfolk

Craney Island

Craney Island Disposal Area

SCALE 1:24000

1 0 1 MILE

0 1000 2000 3000 4000 5000 7000 FEET

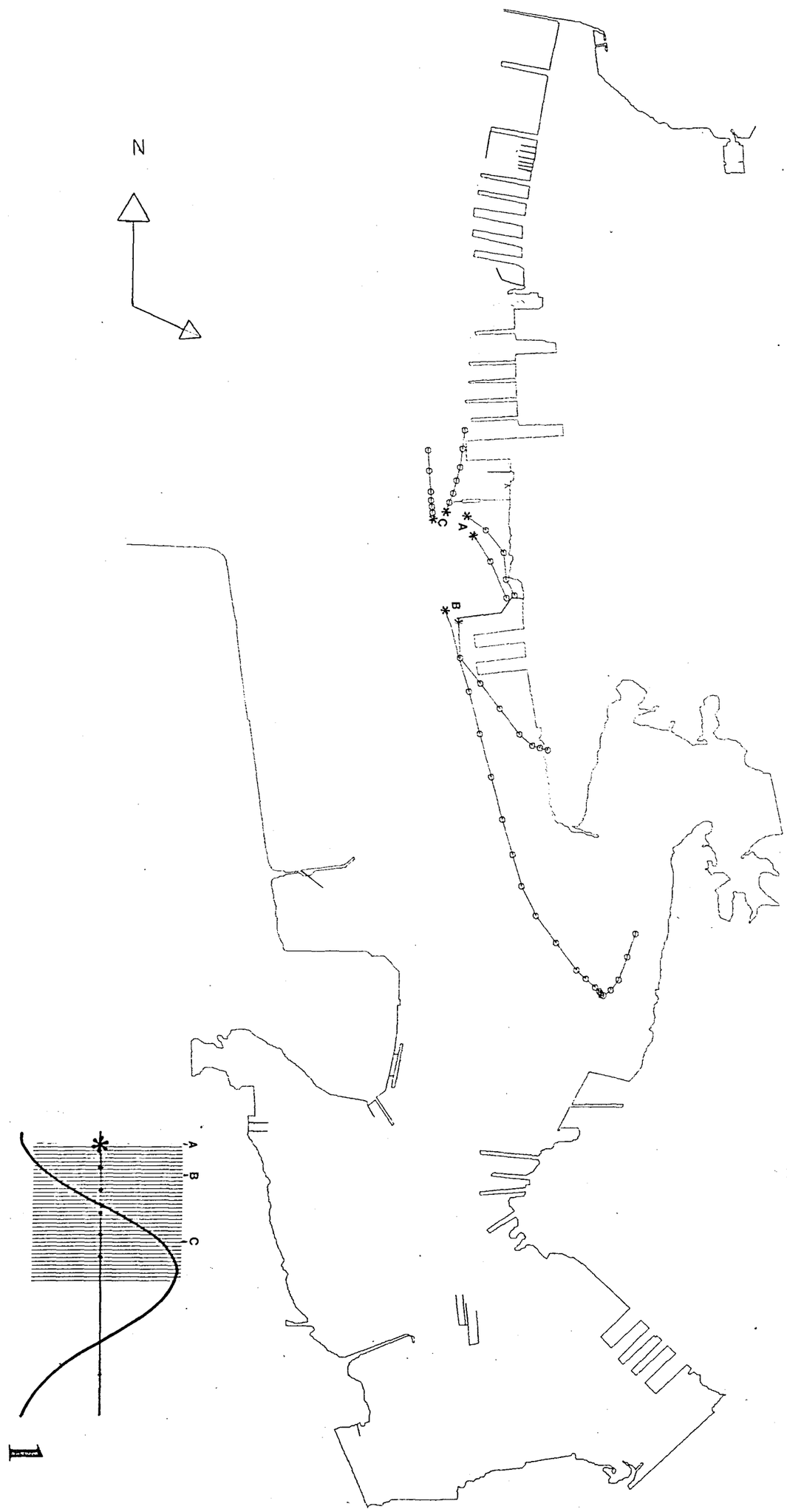
1 5 0 1 KILOMETER

HHGIPLTA-H.GORDON-MV11

ELIZABETH RIVER BASIN 423767 AM A

HHGIPLTA-H.GORDON-MV11

ELIZABETH RIVER BASIN 42376 AM R



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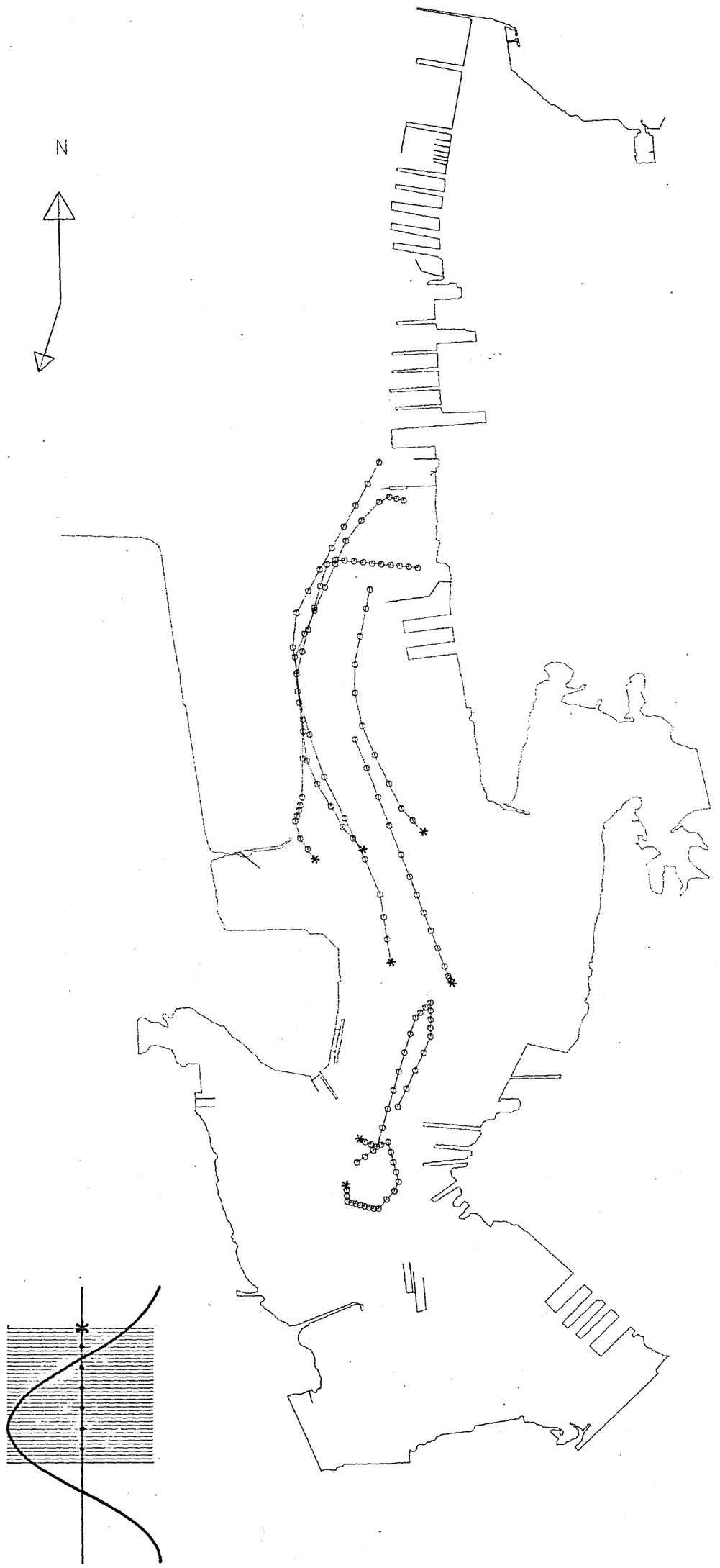

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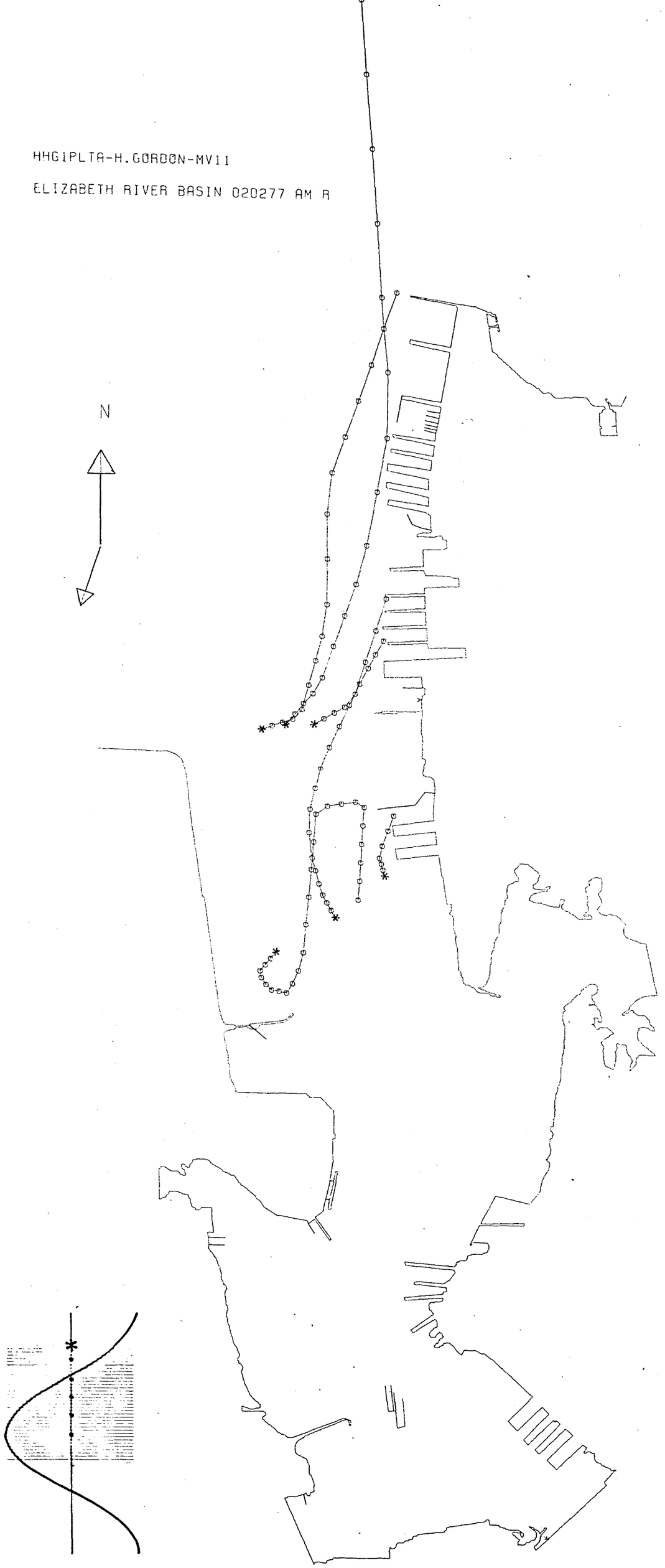

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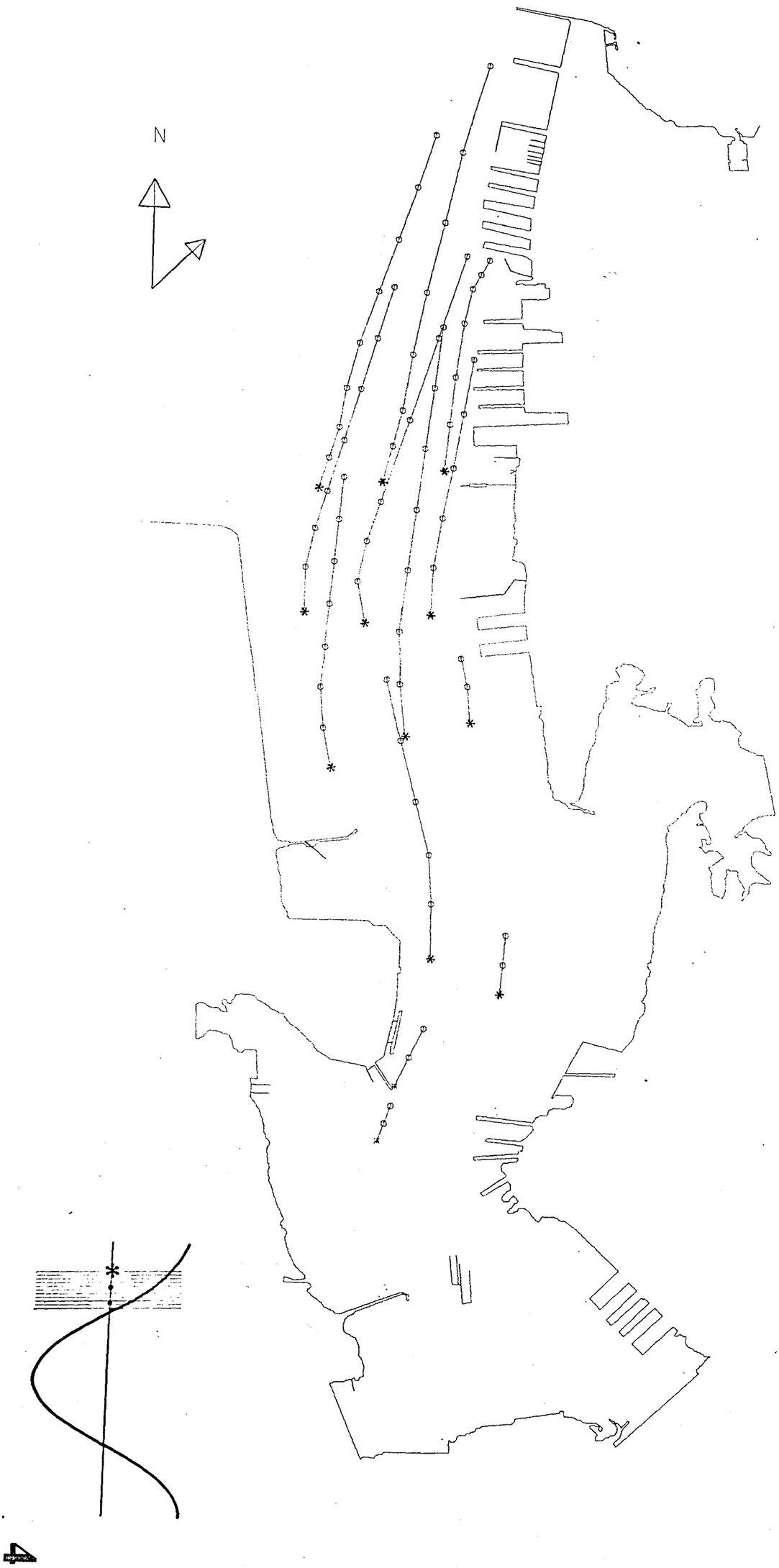

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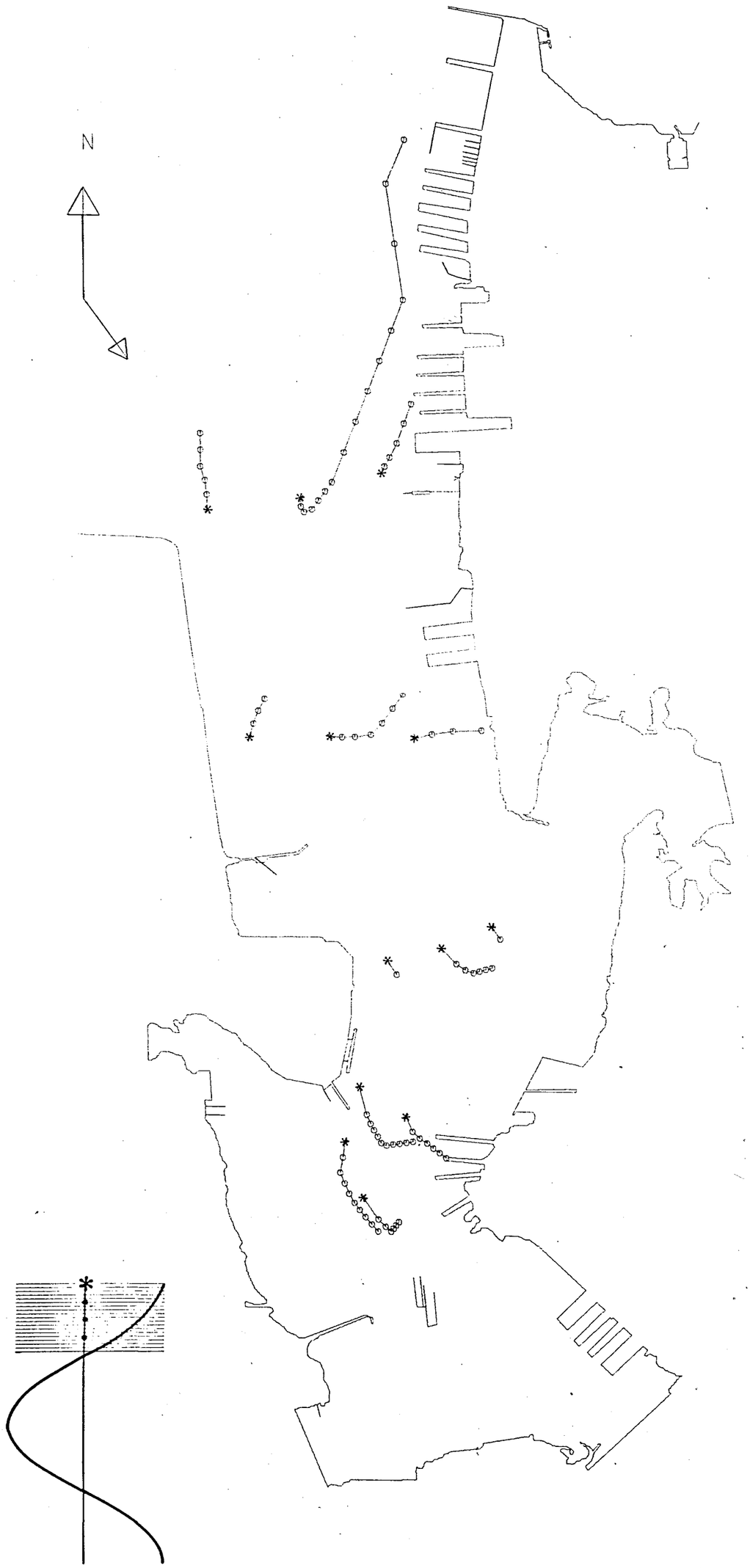

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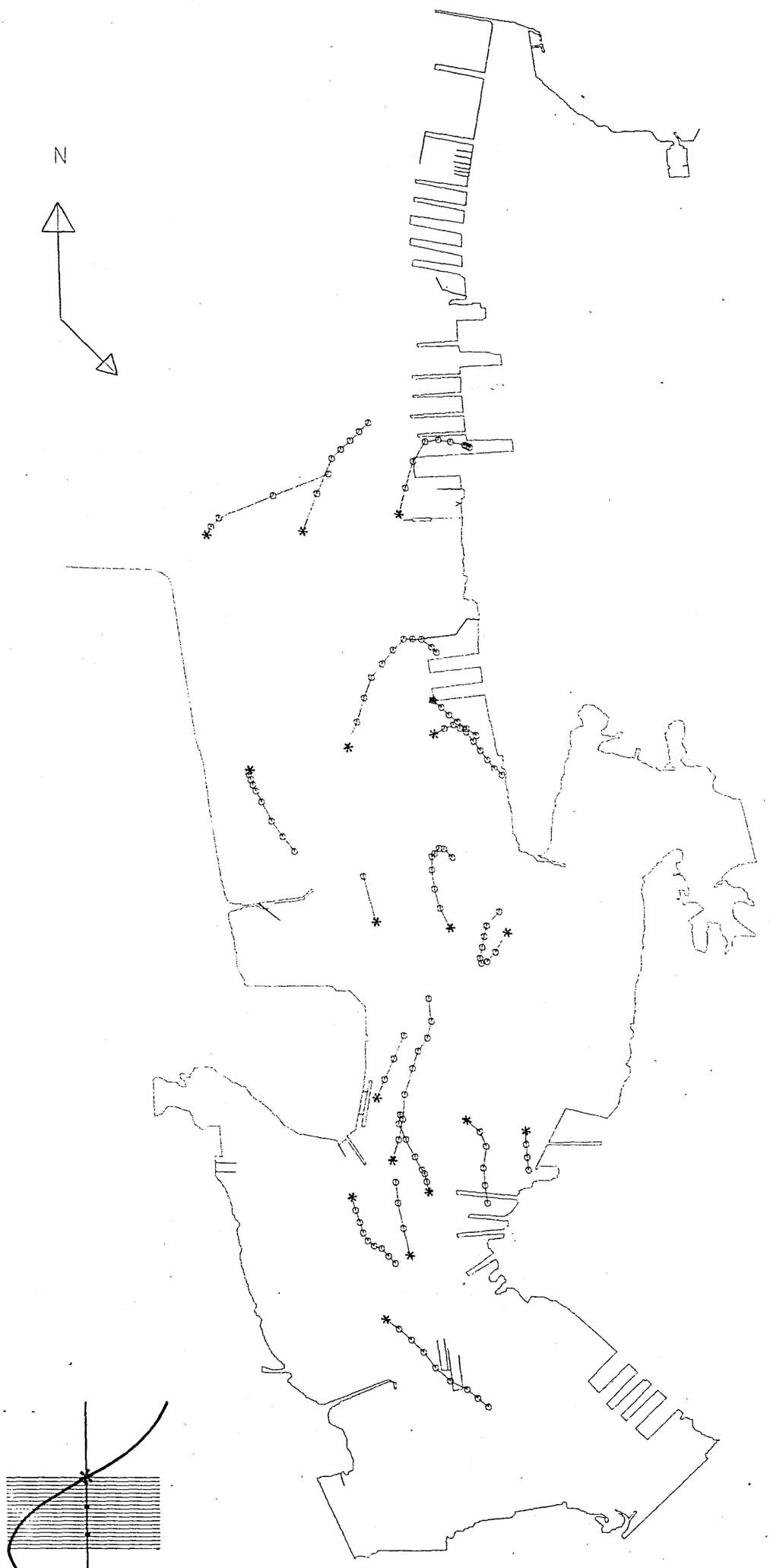

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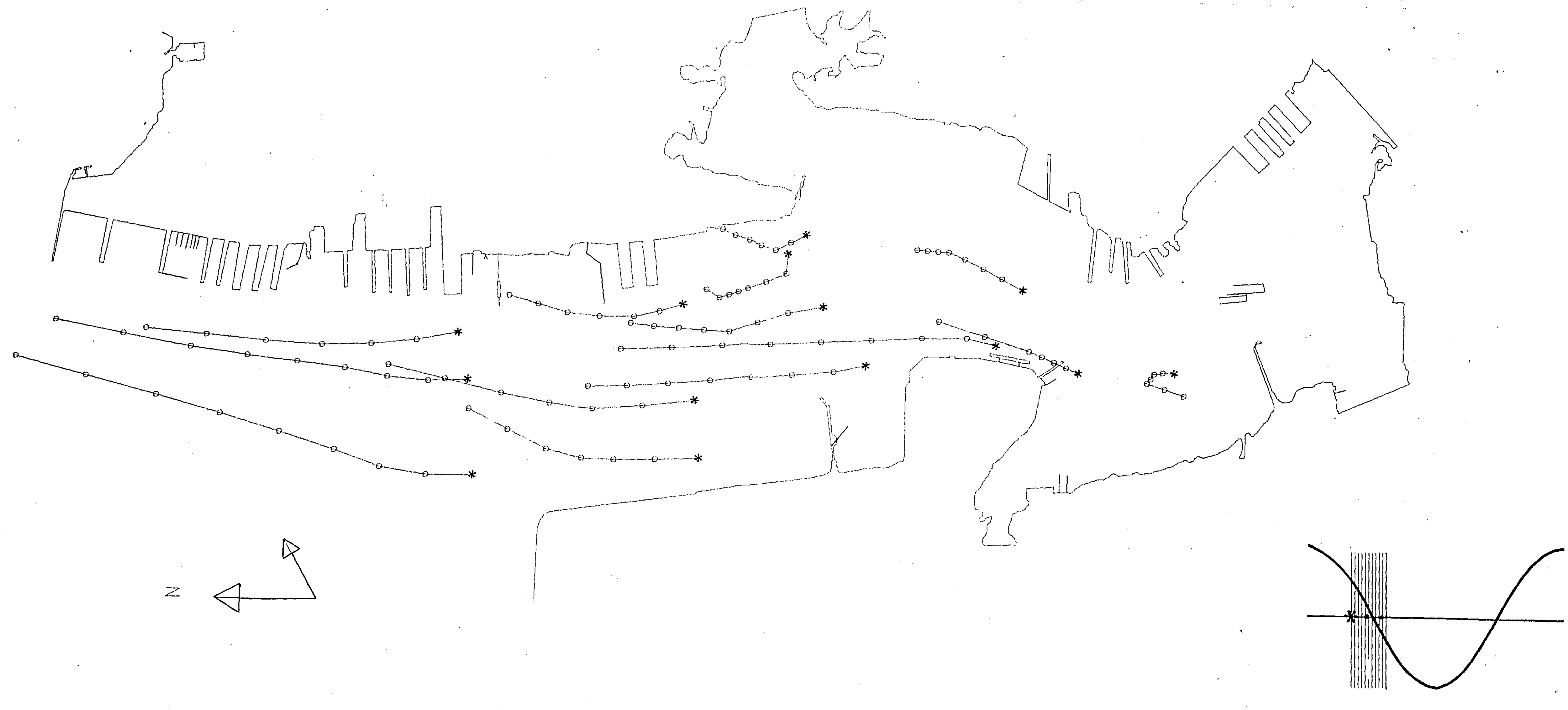

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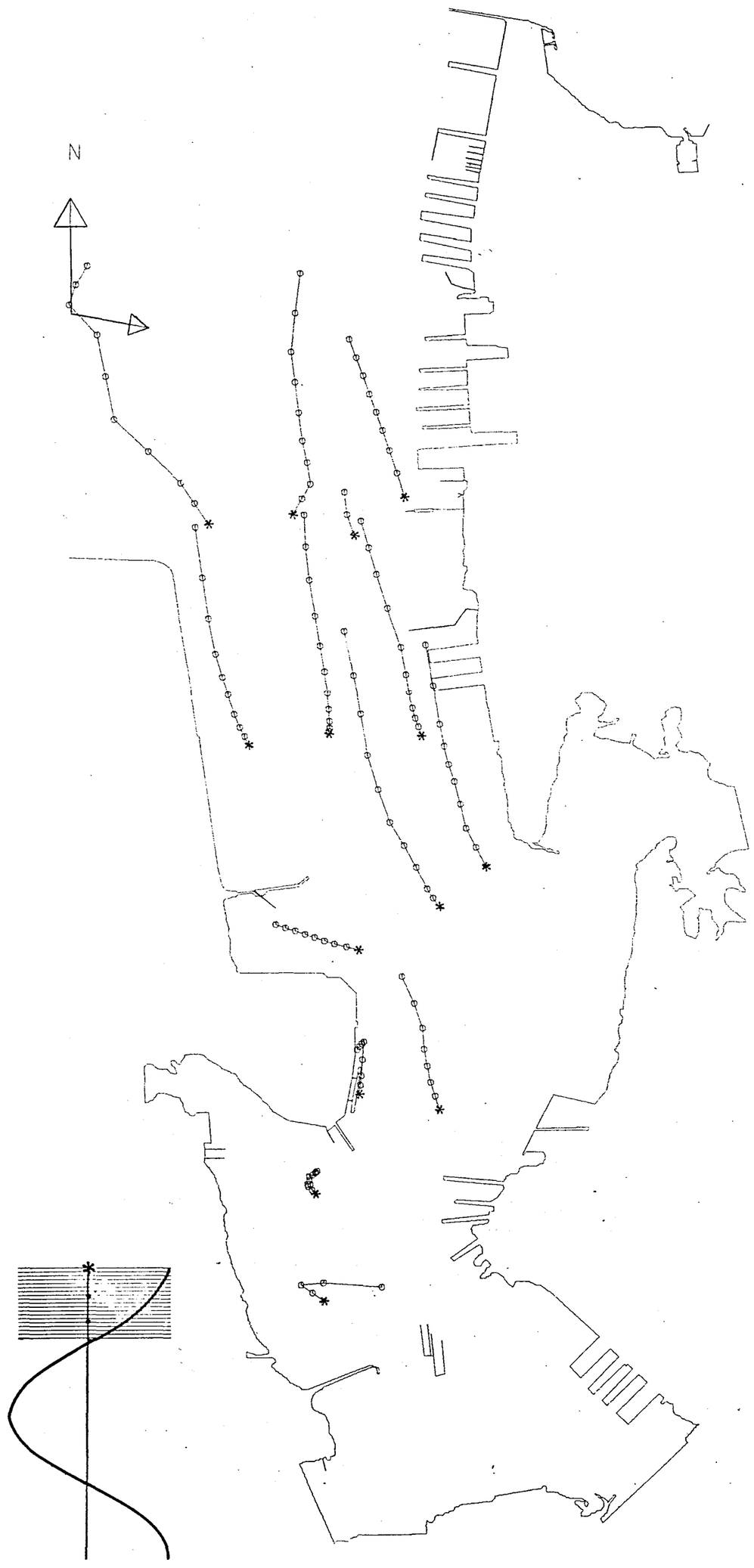

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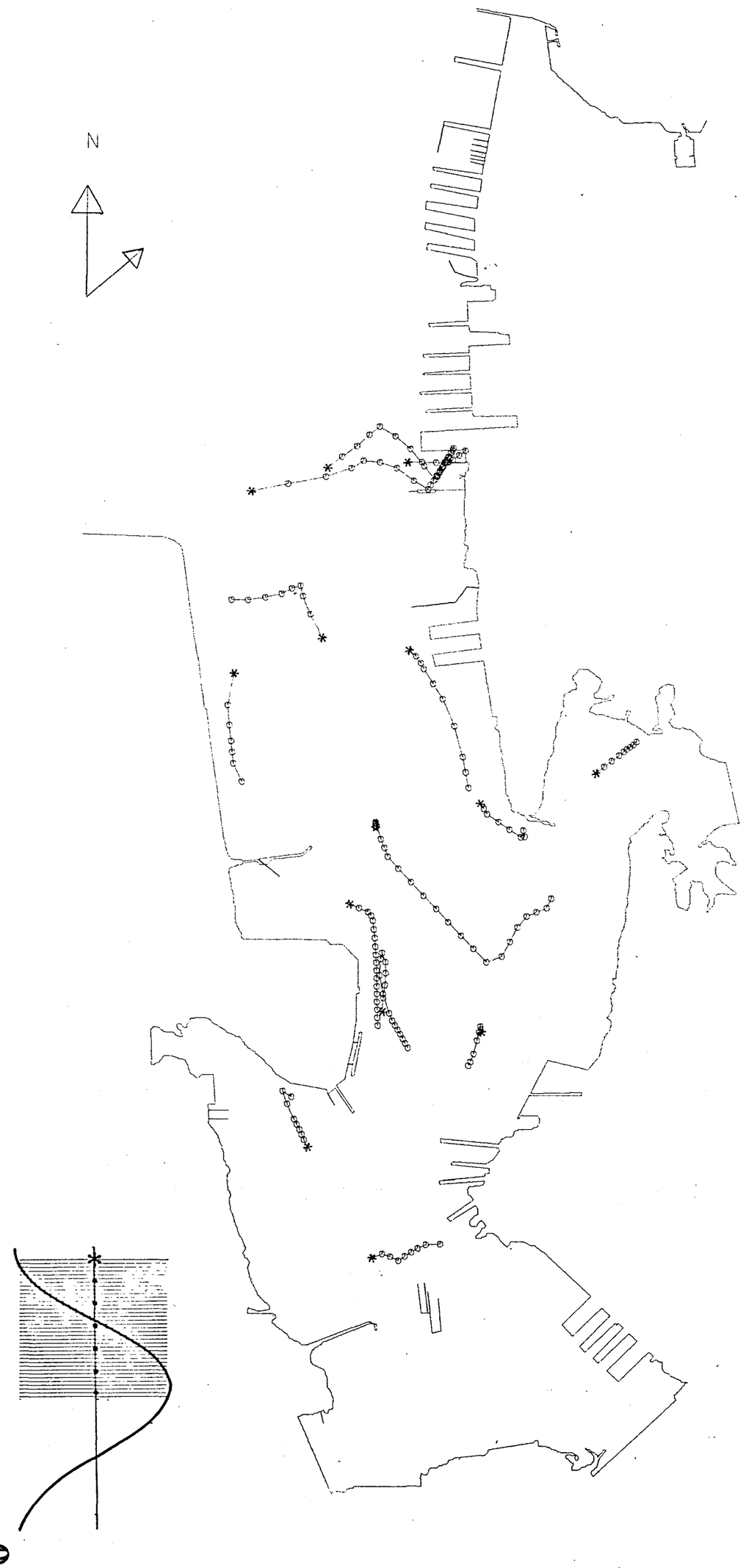

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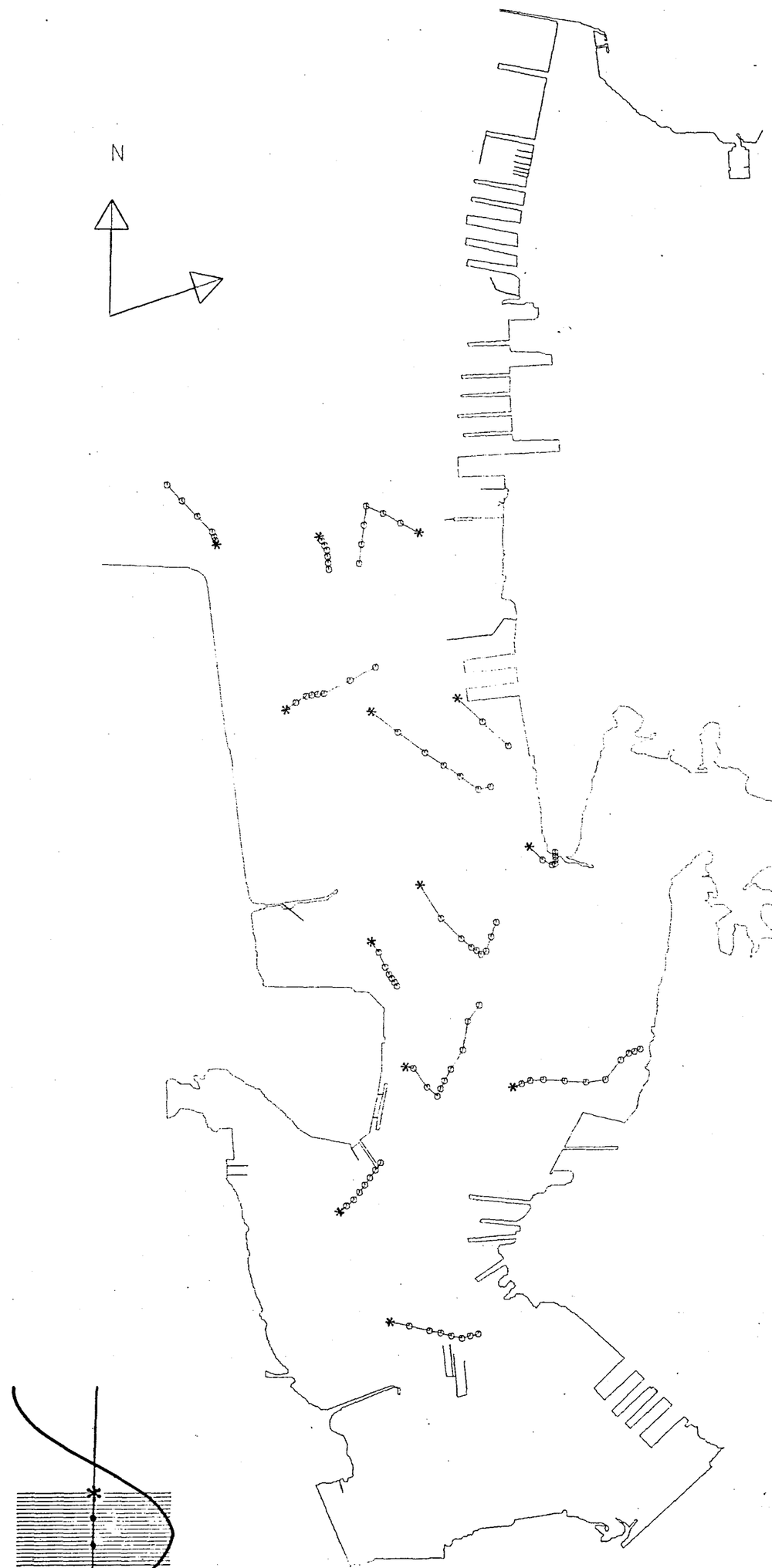

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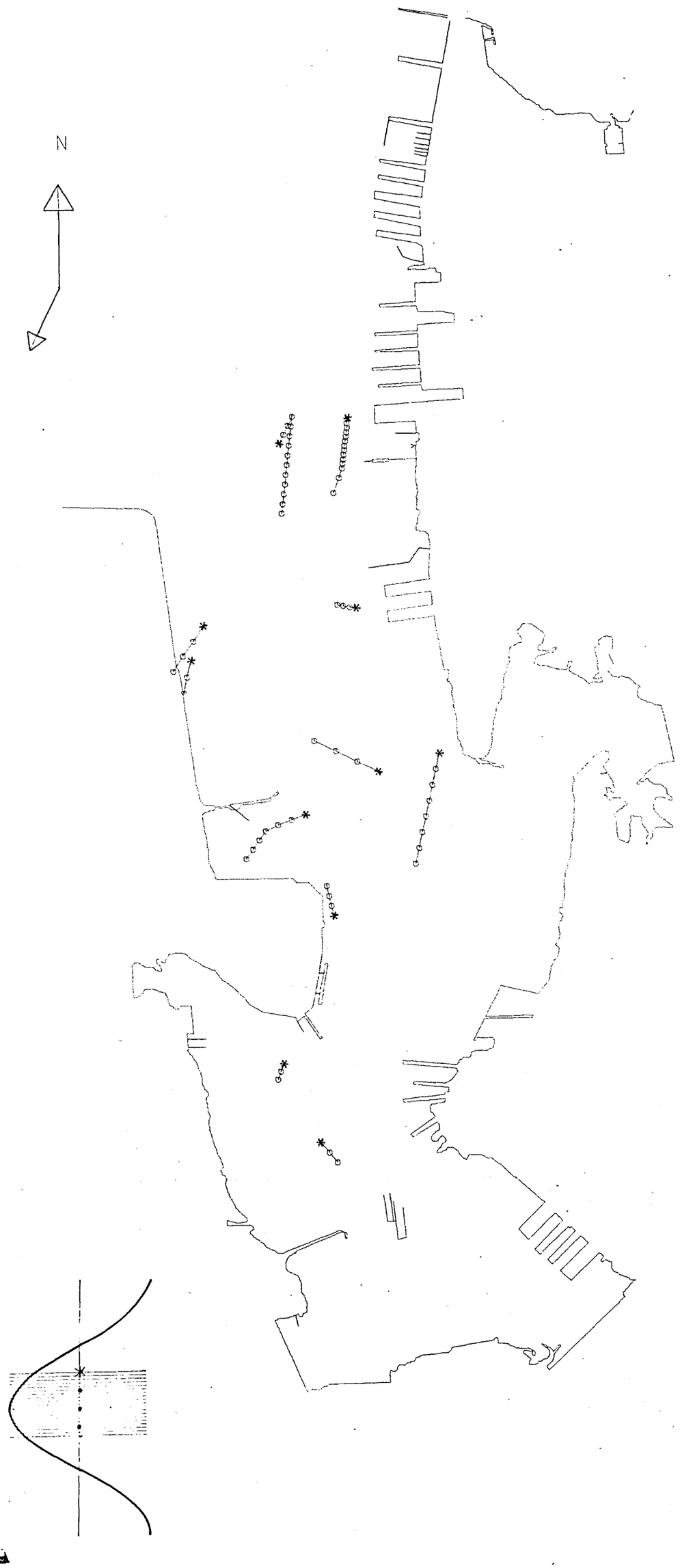

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