

KAUA'I COASTAL RESOURCE ATLAS



US Army Corps
of Engineers
Pacific Ocean Division

KAUA'I COASTAL RESOURCE ATLAS

**Prepared for the
US Army Corps of Engineers
Pacific Ocean Division
Contract No. DACW 84-83-Q-0032**

**by
Manoa Mapworks
Honolulu, Hawaii**

October 1983



To accompany the Kaua'i Island Coastal Resource Inventory (KICRI) prepared by AECOS, Inc., September 1982

Introduction

The Kaua'i Coastal Resource Atlas was prepared for the US Army Corps of Engineers, Pacific Ocean Division under contract #DACW 84-83-Q-010032. It is the companion volume to the Kaua'i Island Coastal Resource Inventory (KICRI; Contract #DACW 84-82-C-0016), a report on the same topic prepared for the Corps of Engineers by AECOS, Inc. in September, 1982.

Data for the atlas were developed by Corps of Engineers and AECOS in 1981. Field surveys conducted by Corps personnel developed the classification of bottom types, substrate types, and biological characteristics identified in the atlas. The atlas project was managed by Margaret E. Elliott, Corps of Engineers, who coordinated the development of the data base, design, compilation, map editing and publication. Margie Swafford provided technical assistance in the preparation of the volume.

Black and white aerial photographs taken for the Corps of Engineers by Tryck, Nyman and Hayes in 1975 form the basis of the map plates in the atlas. The atlas was designed and produced by Jane J. Eckelman and Everett A. Wingert of Manoa Mapworks, Honolulu. Funding for the atlas was provided under the Authority of Section 22 of the Water Resources Development Act of 1974 (PL 93-251), as amended (Planning Assistance to the States).

Field Methods

Most of the field data were obtained during two weeks of marine biological surveys conducted by James E. Maragos and Robert Moncrief (US Army Corps of Engineers, Pacific Ocean Division, Honolulu) during July–August, 1981. These surveys were qualitative but extensive in nature. The ecological surveys consisted of a series of SCUBA and boat-assisted observations, with notes taken on species present and their relative abundances. The notes were recorded on waterproof slates, and underwater photographs were also taken. Specimens of difficult or unknown species were collected or described for later evaluation and assignment. Limited time did not permit quantitative transect-type studies, and the emphasis was placed on covering more area using the more rapid qualitative methods described above.

Maragos concentrated on collecting information on corals, algae, other conspicuous invertebrates, water quality, and geology. Moncrief concentrated on collecting information on fish populations, particularly those species of recreational and food value. Both Maragos and Moncrief also identified existing or potential human uses or values of resources during their field surveys.

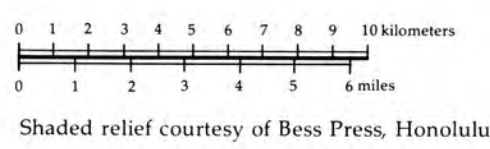
Additional use information was provided by Jeremy Harris, University of Hawaii Seagrass Extension Agent for Kaua'i during interviews

conducted by Captain Gerald Smith of the Corps of Engineers in July 1981. Consultants Paul Bartram and John Clark also provided use information. Finally, information on resources and their uses and values was obtained from previous published and unpublished literature. A complete coastal bibliography for Kaua'i is included at the end of the KICRI narrative report.

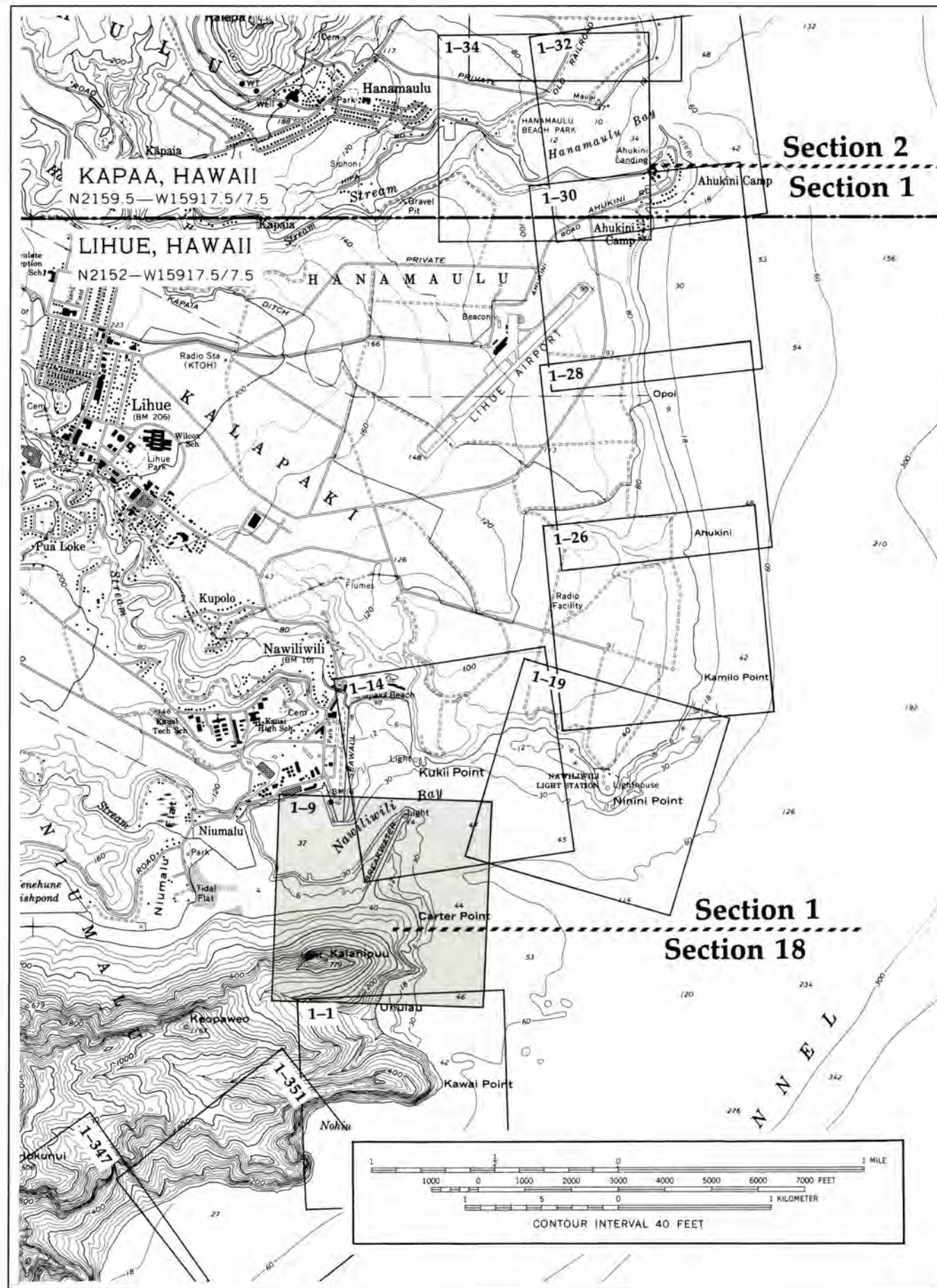
Mapping Methods

The atlas' facing page layout is made of two different views of each study area—an aerial photographic image at a scale of approximately 1:6000, and a reduced section of a US Geological Survey topographic map. The thematic data; coastal use, bottom types, shoreline types, special characteristics, and cultural detail were plotted on the photographic images to make it possible to discern real differences within and beyond the data classification system. The topographic sheet sections display coverage plots of the study and adjoining photographs to provide a referencing system for the photographic images. In addition, the index map includes aspects of topographic and hydrographic detail (height, slope, coordinates, bathymetric contours) not recorded by the camera. This combination of mapping formats was chosen for this project because it provides the value of the increased cultural and physical detail of the photographic image, which unfortunately dates quickly, and sets that detail against a framework of standardized symbolization.

In some cases photographic image designations will not match the image, e.g. the new airport runway construction near Līhu'e. Color photographs taken by the Corps in 1981 and by Air Survey Hawaii for the Corps in December 1982 were interpreted as the maps were being prepared to insure that current designations of land detail were used. One caution on use of the aerial images should be noted. Because of variation in aircraft flying height and slight tilt due to turbulence, the scale printed with the images is an average, and the scale of individual photographs will exhibit slight variations from this average. There is also some detail displacement due to perspective variation resulting from the differing topographic height of land features. Information provided in the atlas should not be used for purposes of navigation.



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Aerial Photograph Based Classification System

OFFSHORE

s - Sediment.

- sc - Sand bottom, including channels, in water depths less than 10 meters (especially common offshore from beaches).
- sd - Sand bottom, deeper than 10 meters (some possibility of error, such as white reflecting rock in deep water, not checked by dives).

Special types.

- co - Areas of greater than 50% live coral cover (spot checked for verification).
- br - Beachrock (offshore).

r - Rock.

- rs - Mostly sand bottom but with some rocky features; rock bottom covered by a veneer of sand.
- rbs - Hard bottom, but with conspicuous sediment up to 50% coverage.
- rb - "Other" hard bottom types (a catch-all for dark areas, not reefal or sedimentary; normally basalt with a thin veneer of marine life).
- rbb - Seaward extensions of talus boulder beaches, with definable rocks or boulders.
- rbc - Seaward extensions of cobble beaches (rocks smaller than boulders).

rc - Reef complex.

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- rcp - Consolidated smooth limestone pavement.
- rcg - Consolidated reef with well defined groove-and-spur system.
- rsg - Sand predominates in the depressions of conspicuous groove-and-spur system.
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Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

-  Pole-and-line fishing.
-  Gill-netting.
-  Throw-netting.
-  Spearfishing.
-  Torching.
-  Trapping.
-  Lobster.
-  Sea urchin (wana).
-  Octopus (he'e).
-  Surround netting.
-  Aquarium fish collecting.
-  Seaweed (limu).
-  Sport-diving.
-  Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

-  Crabbing (kona, 'a'ama, swimming crab).
-  Limpet (opihi).
-  Trolling, bottom-fishing.
-  Specialized fisheries (type indicated).

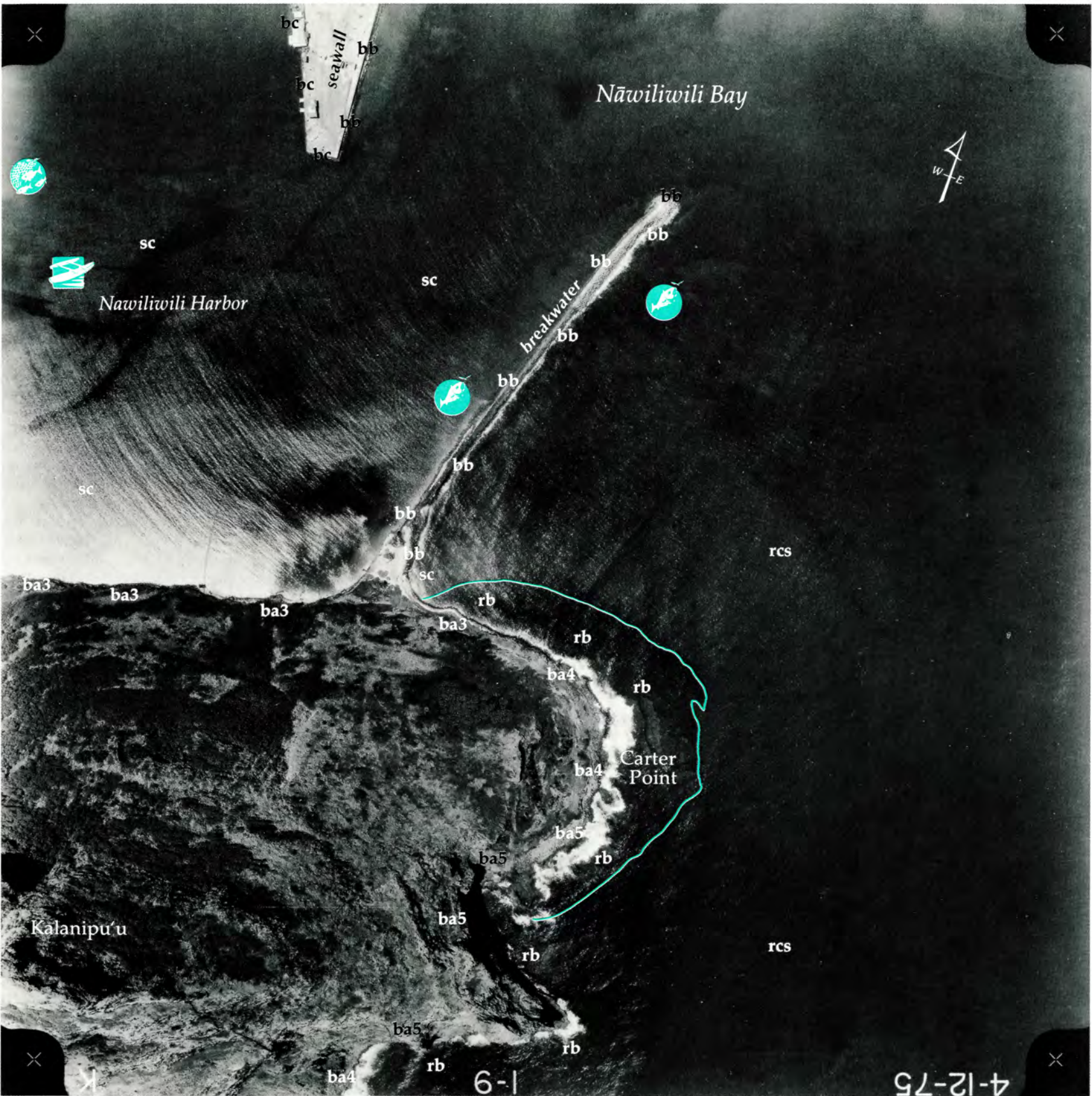
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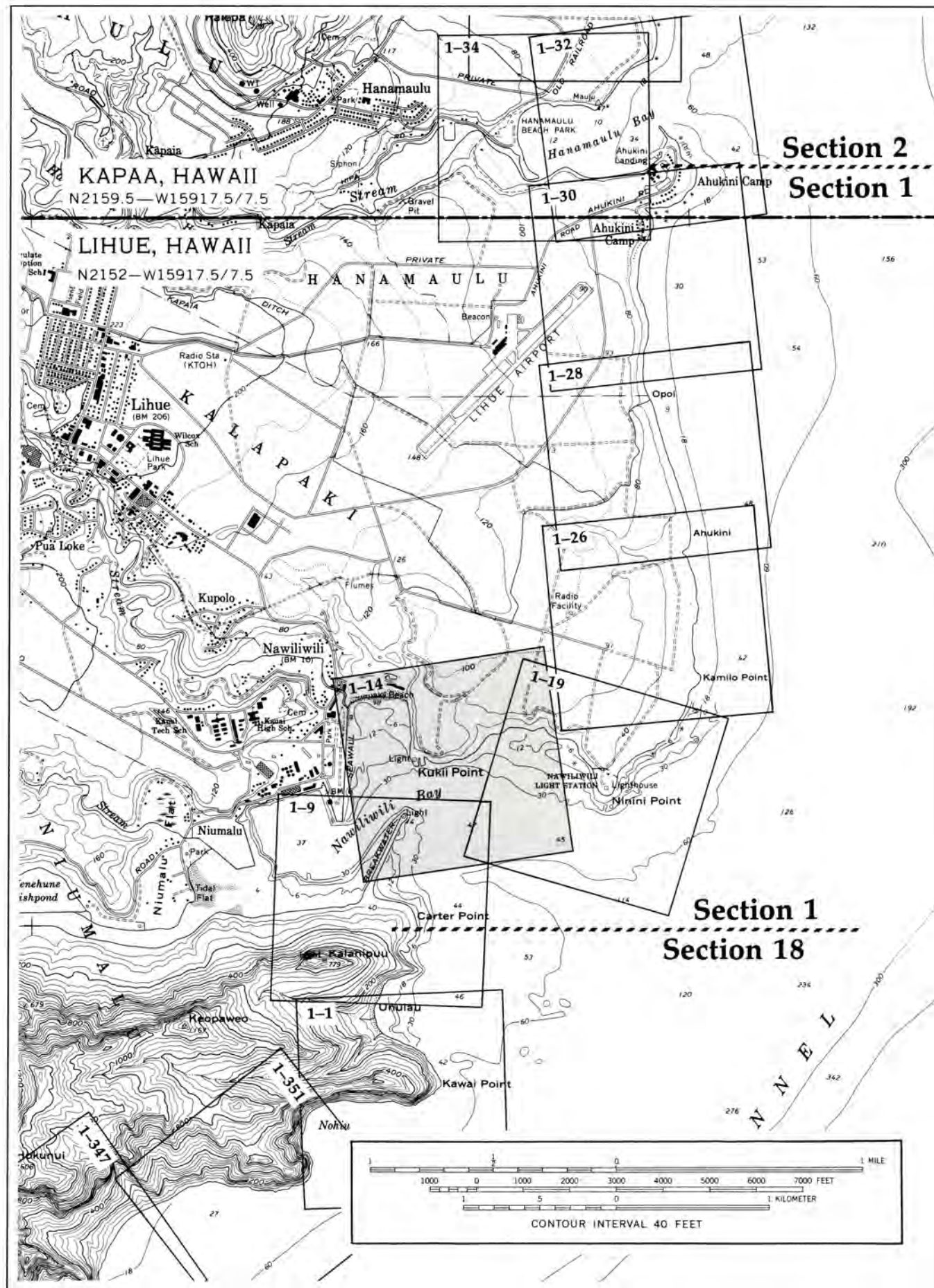
-  Board surfing.
-  Body surfing.
-  Canoe paddling.
-  Sailing.
-  Aquatic recreation (smallcraft sailing, wind-surfing).
-  Excursion boat.
-  Anchorage.

Study Sites

-  Shoreline (above water observations).
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- Spearfishing.
- Torching.
- Trapping.
- Lobster.
- Sea urchin (wana).
- Octopus (he'e).
- Surround netting.
- Aquarium fish collecting.
- Seaweed (limu).
- Sport-diving.
- Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

- Crabbing (kona, 'a'ama, swimming crab).
- Limpet (opihi).
- Trolling, bottom-fishing.
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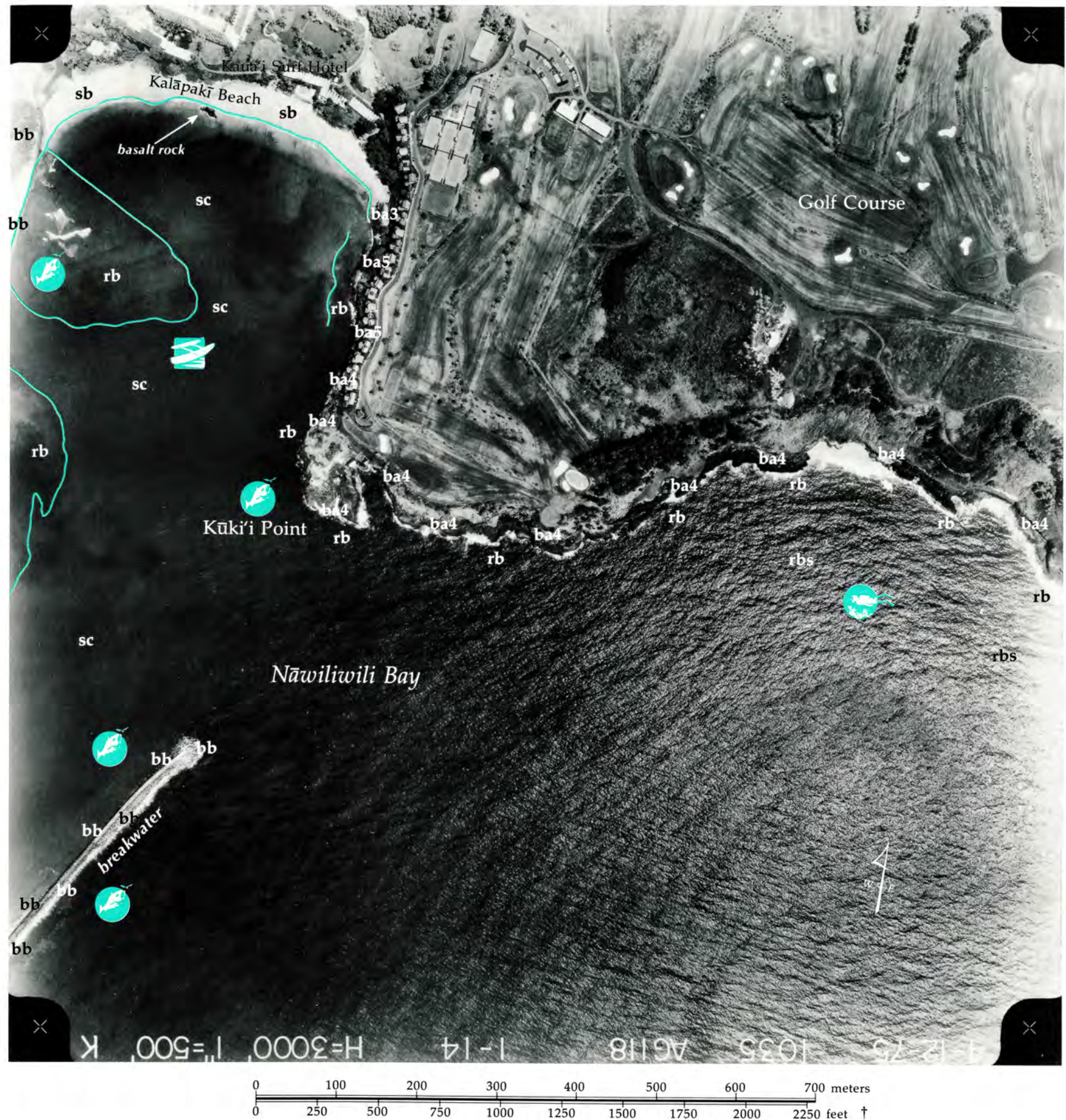
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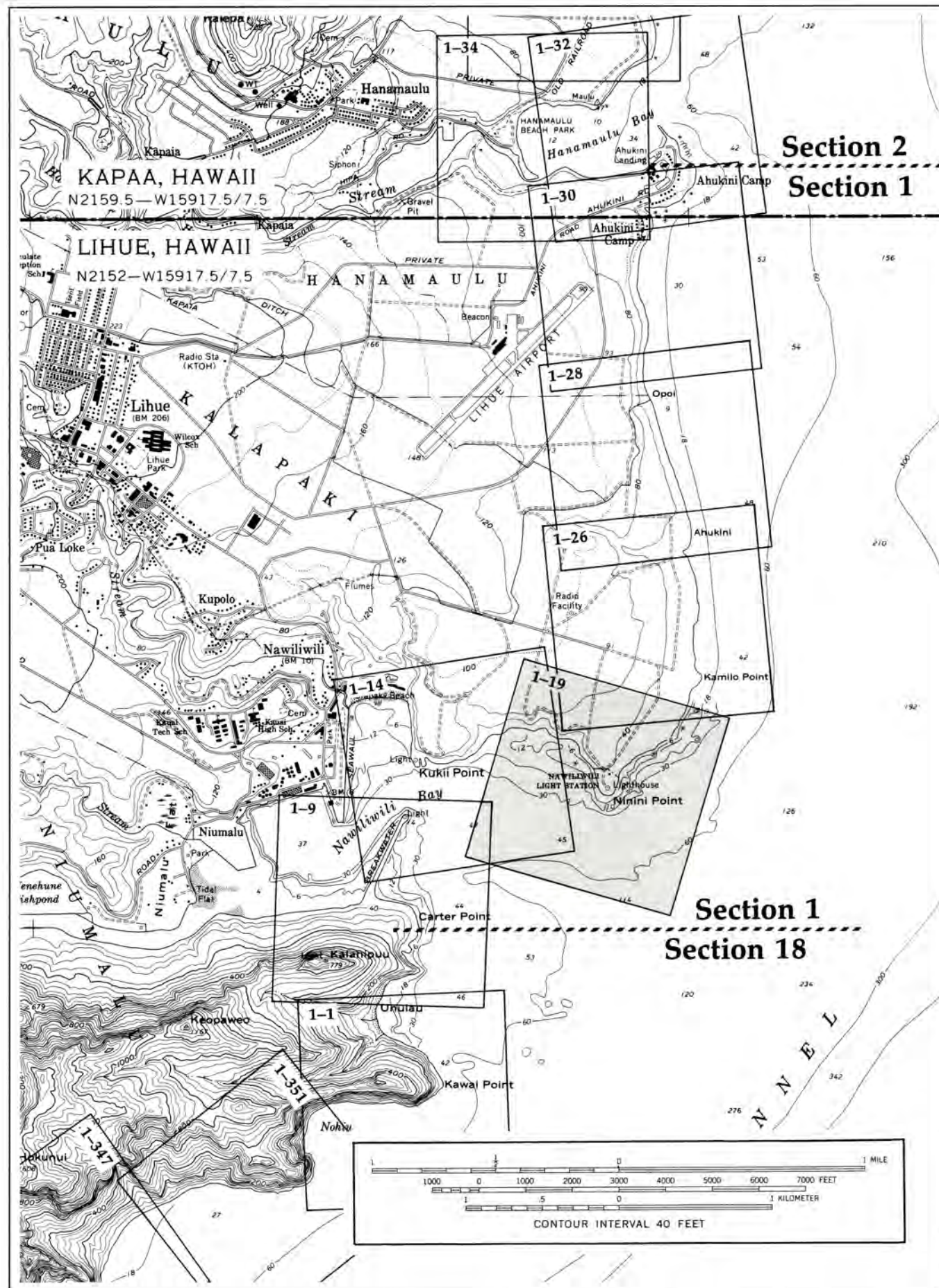
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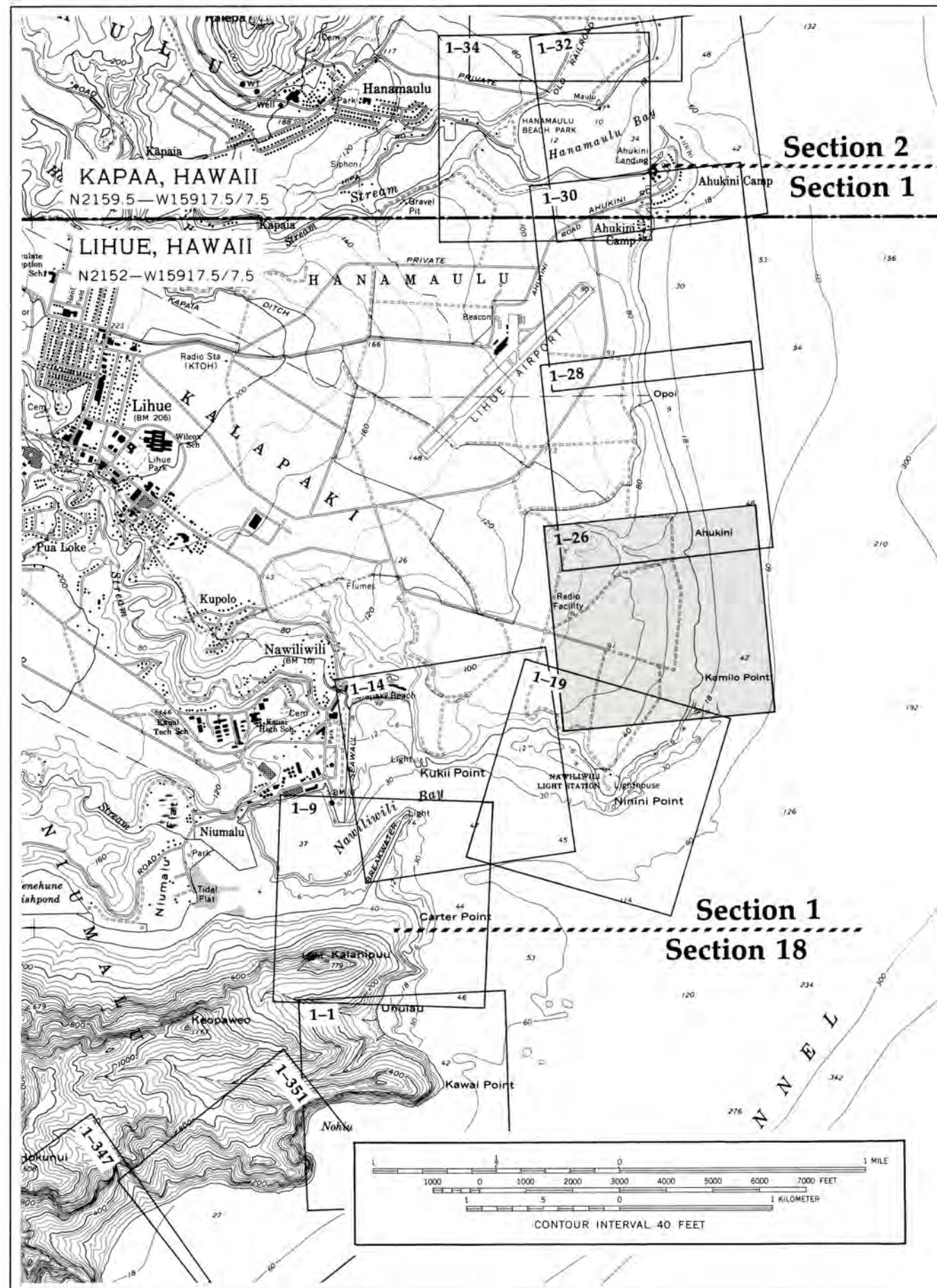
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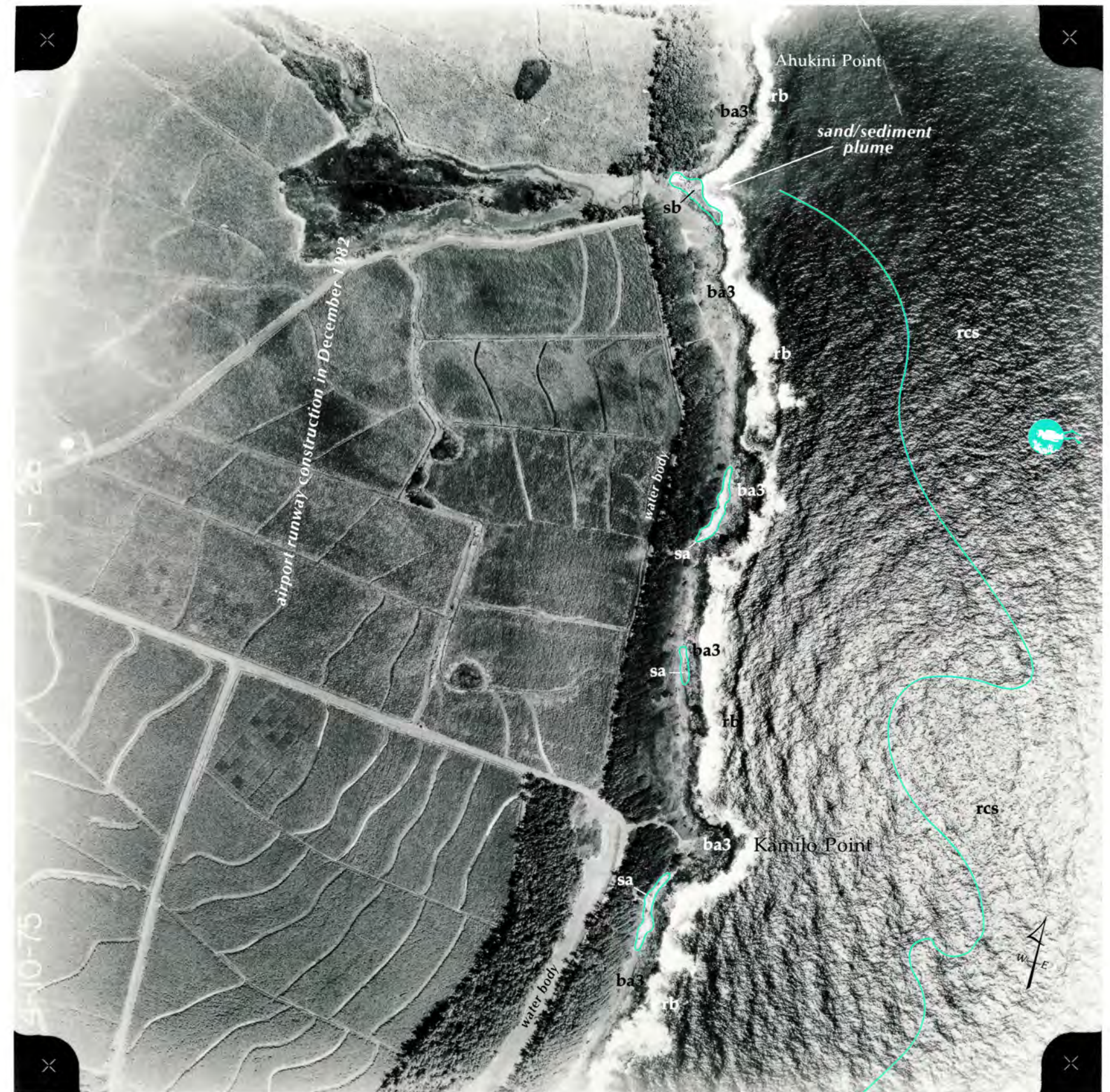
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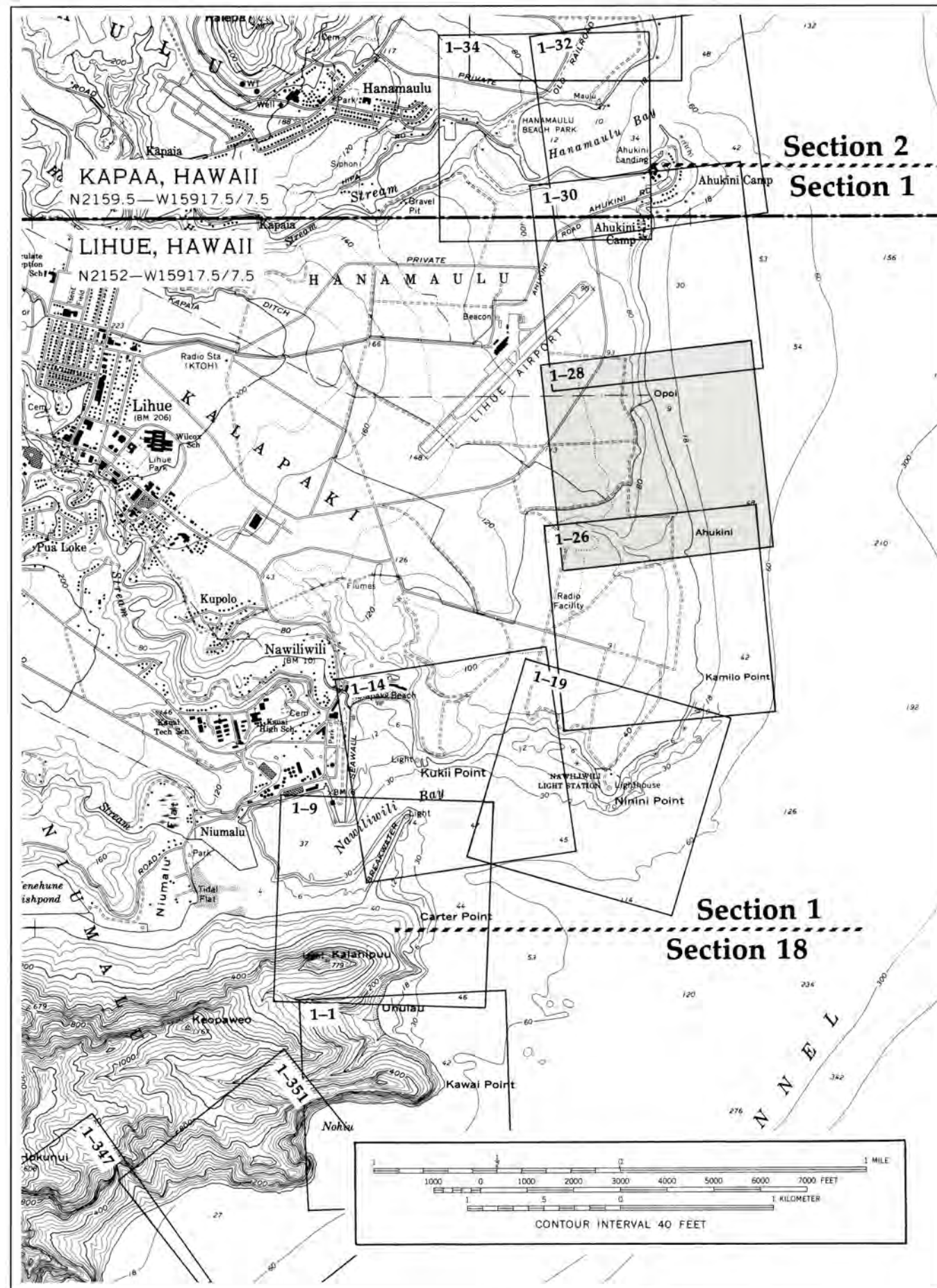
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0 100 200 300 400 500 600 700 meters
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Photograph 1-28: Section 1

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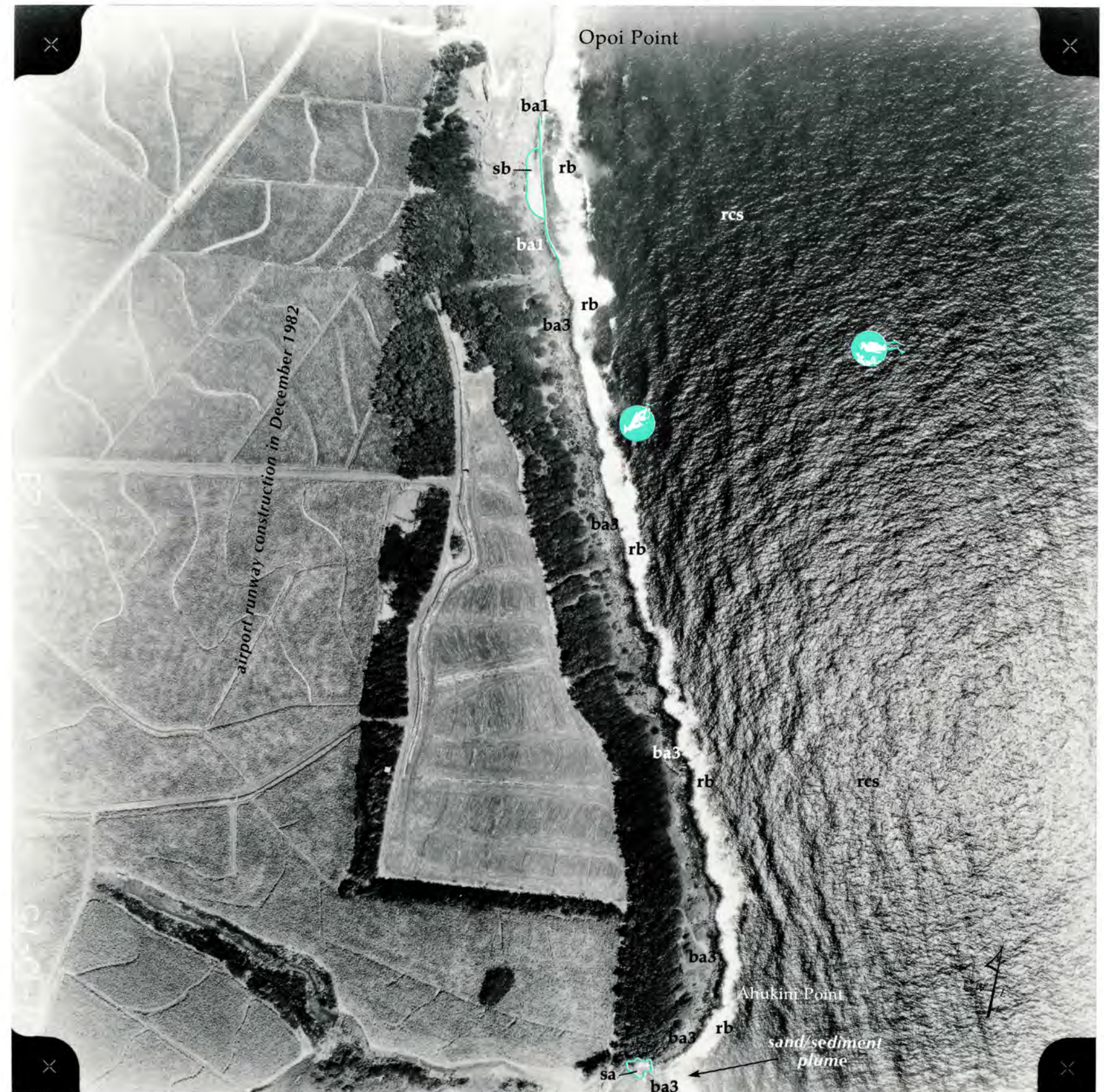
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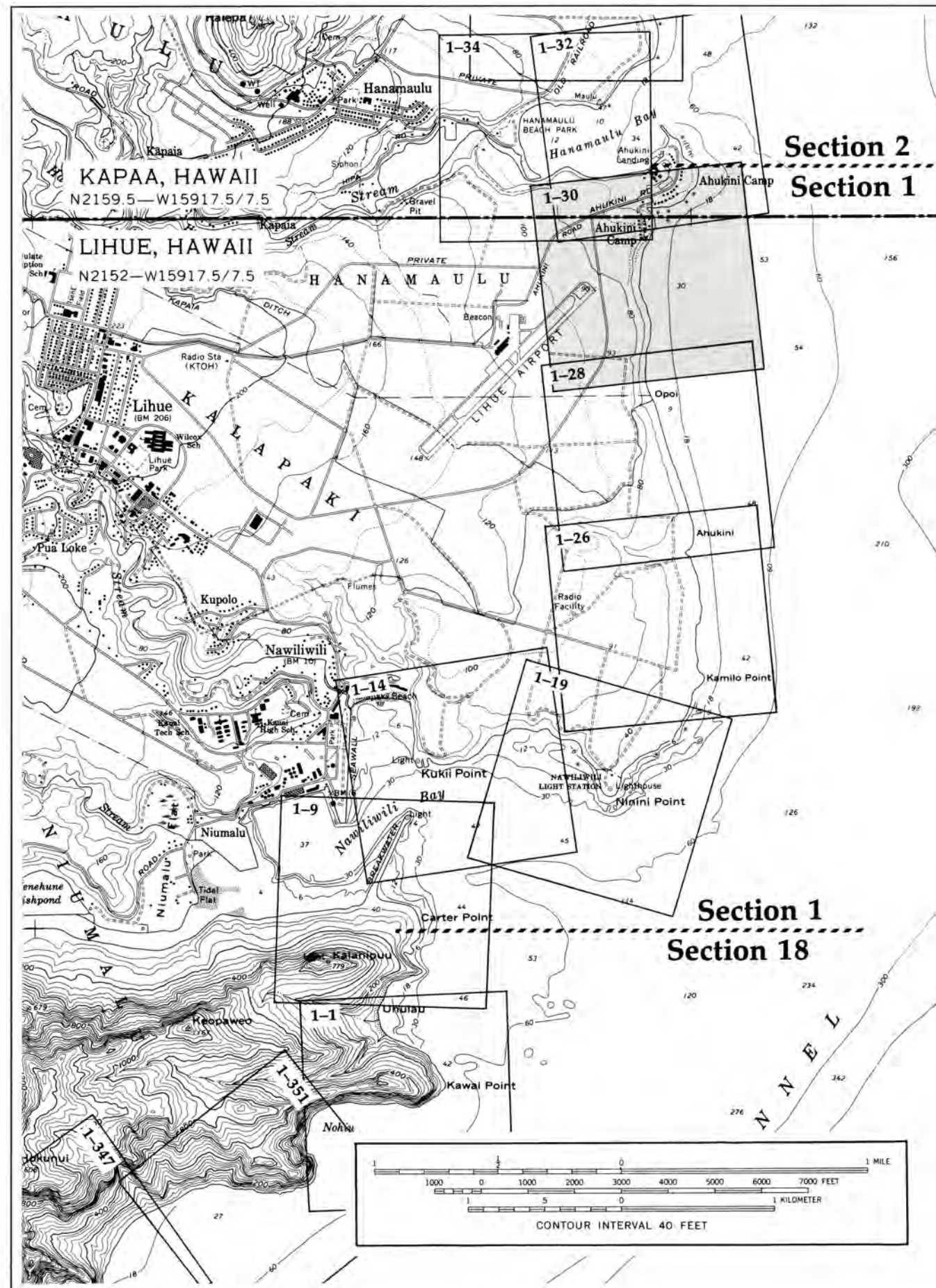
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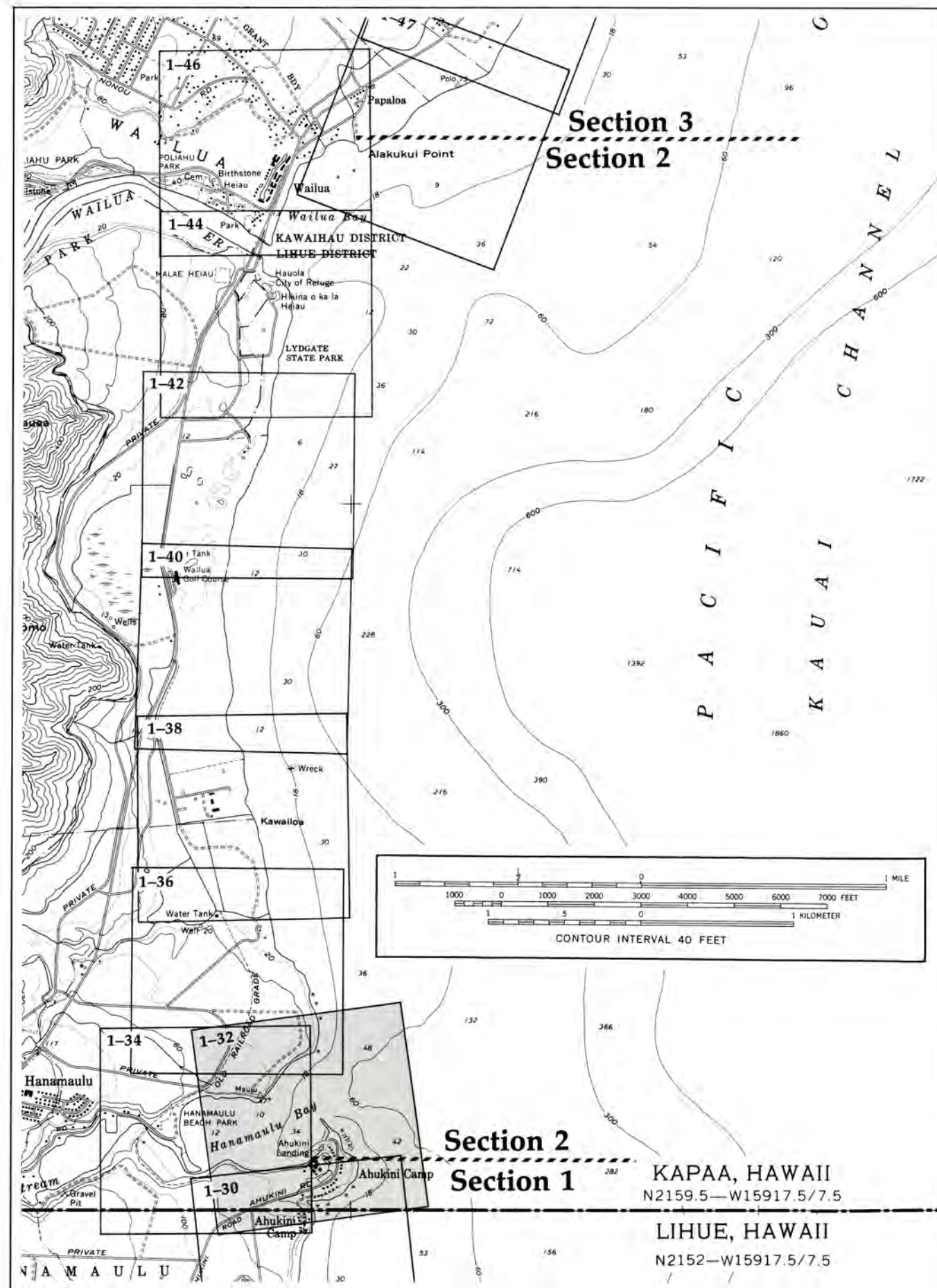
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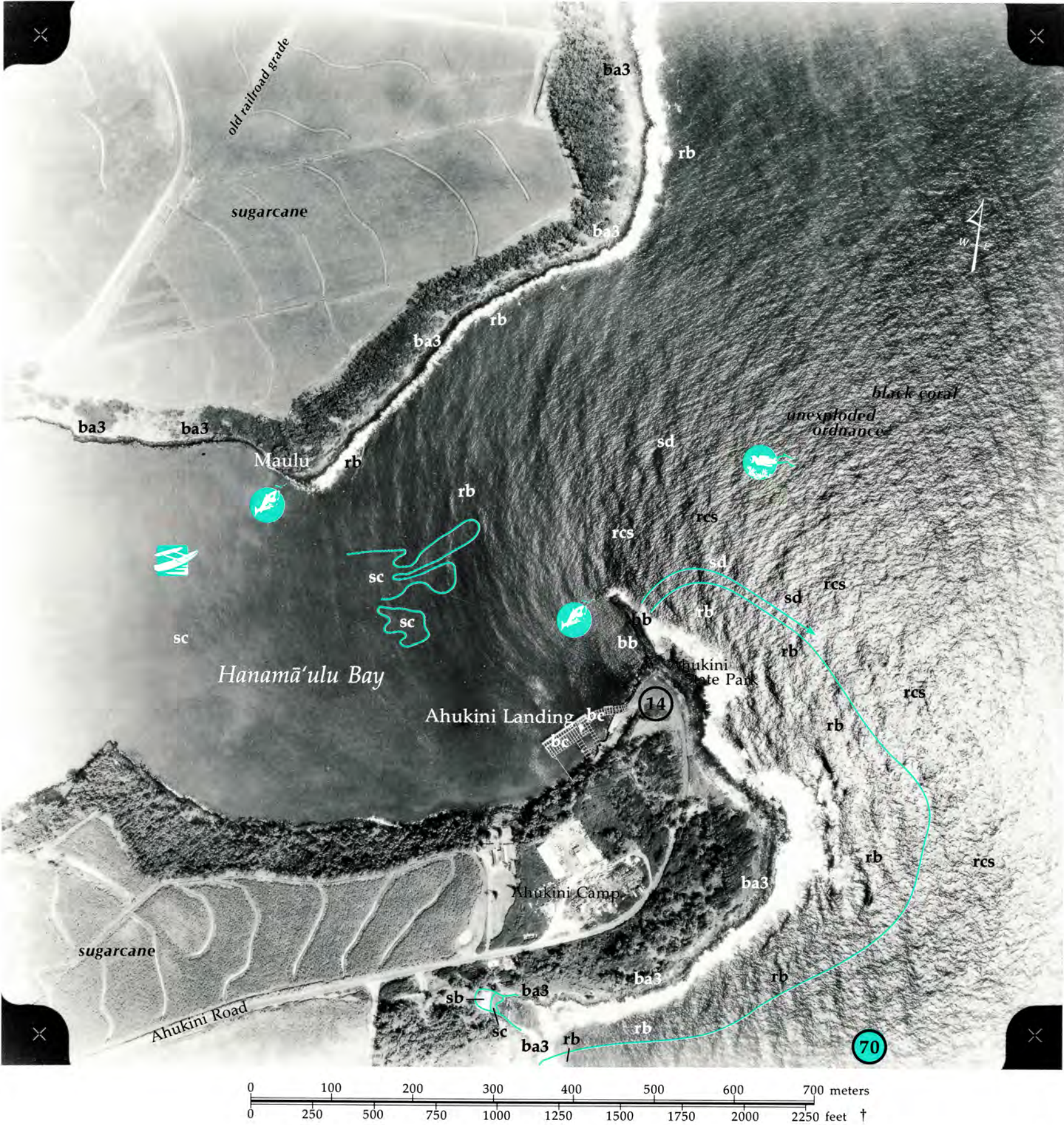
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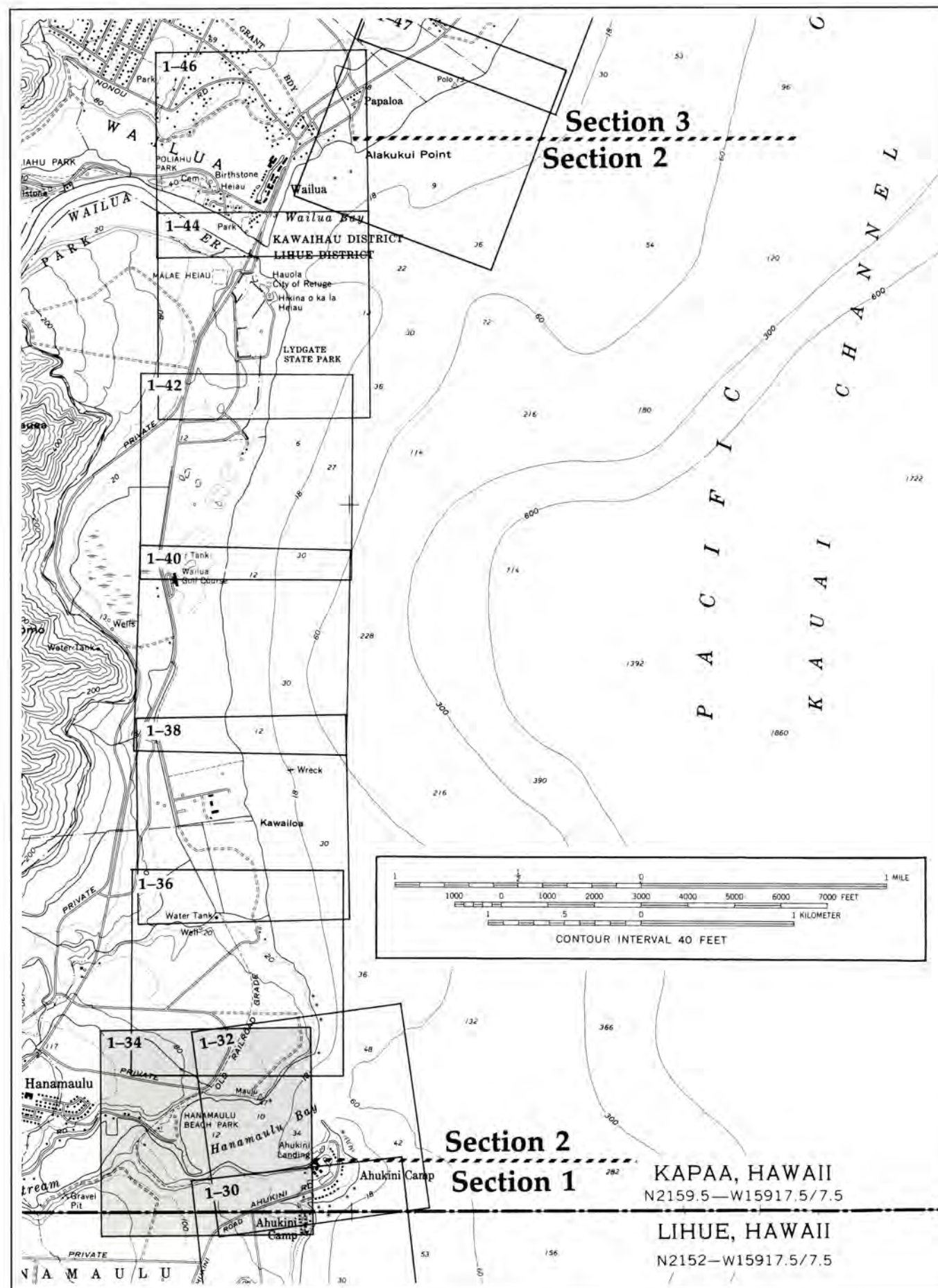
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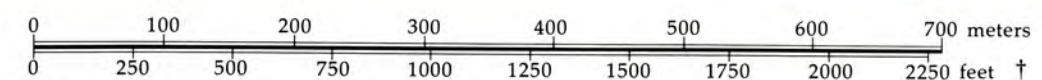
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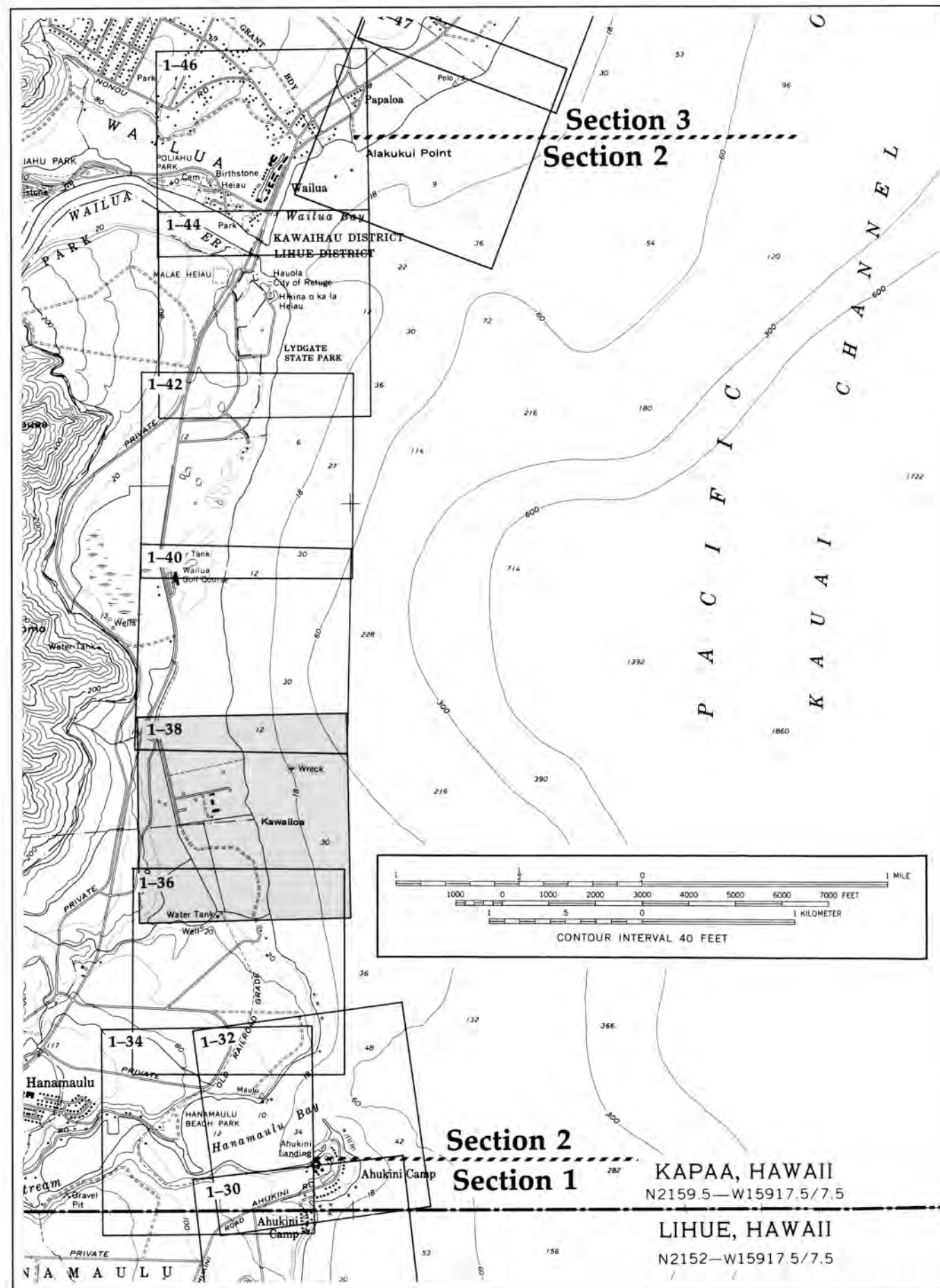
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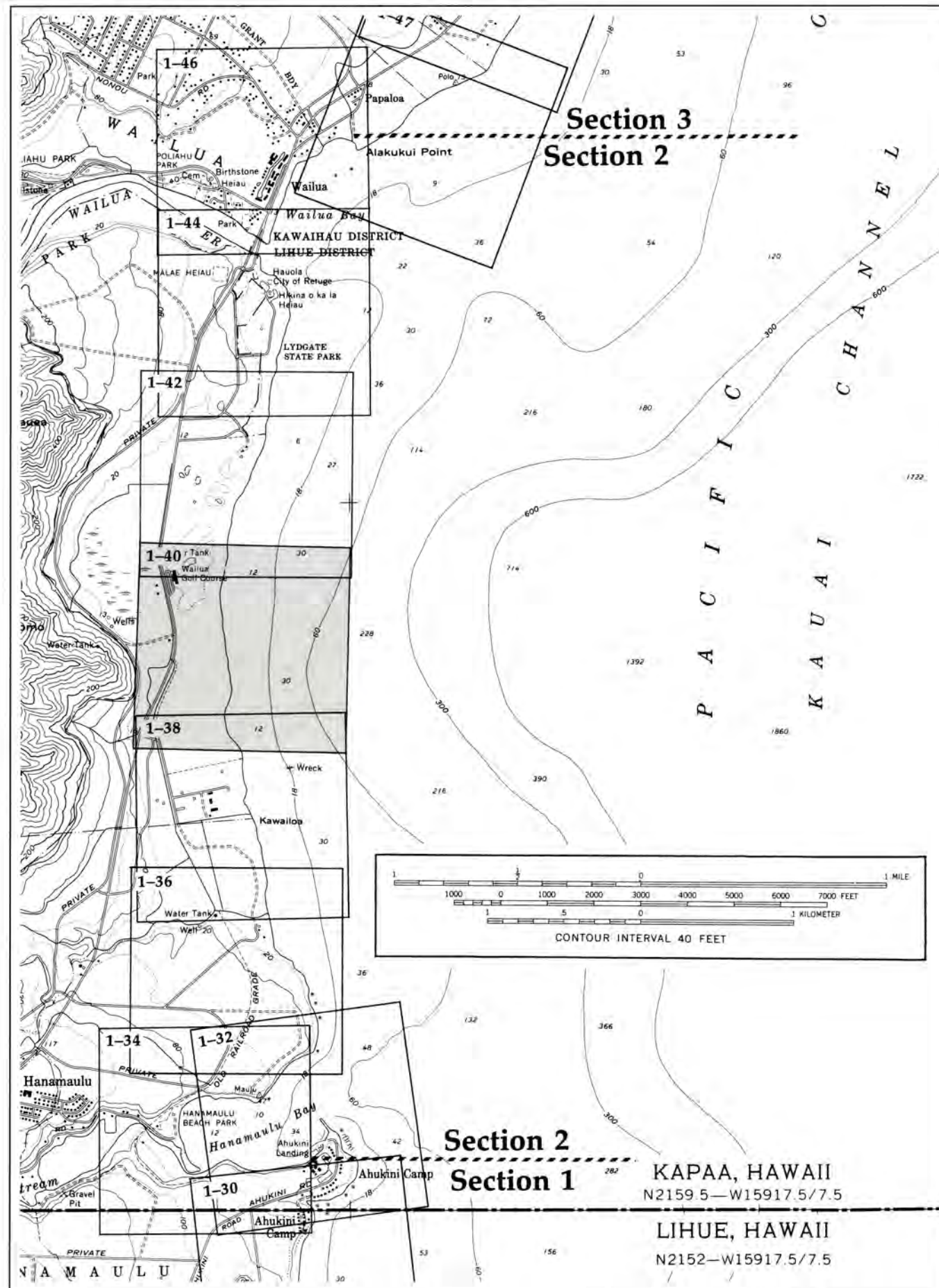
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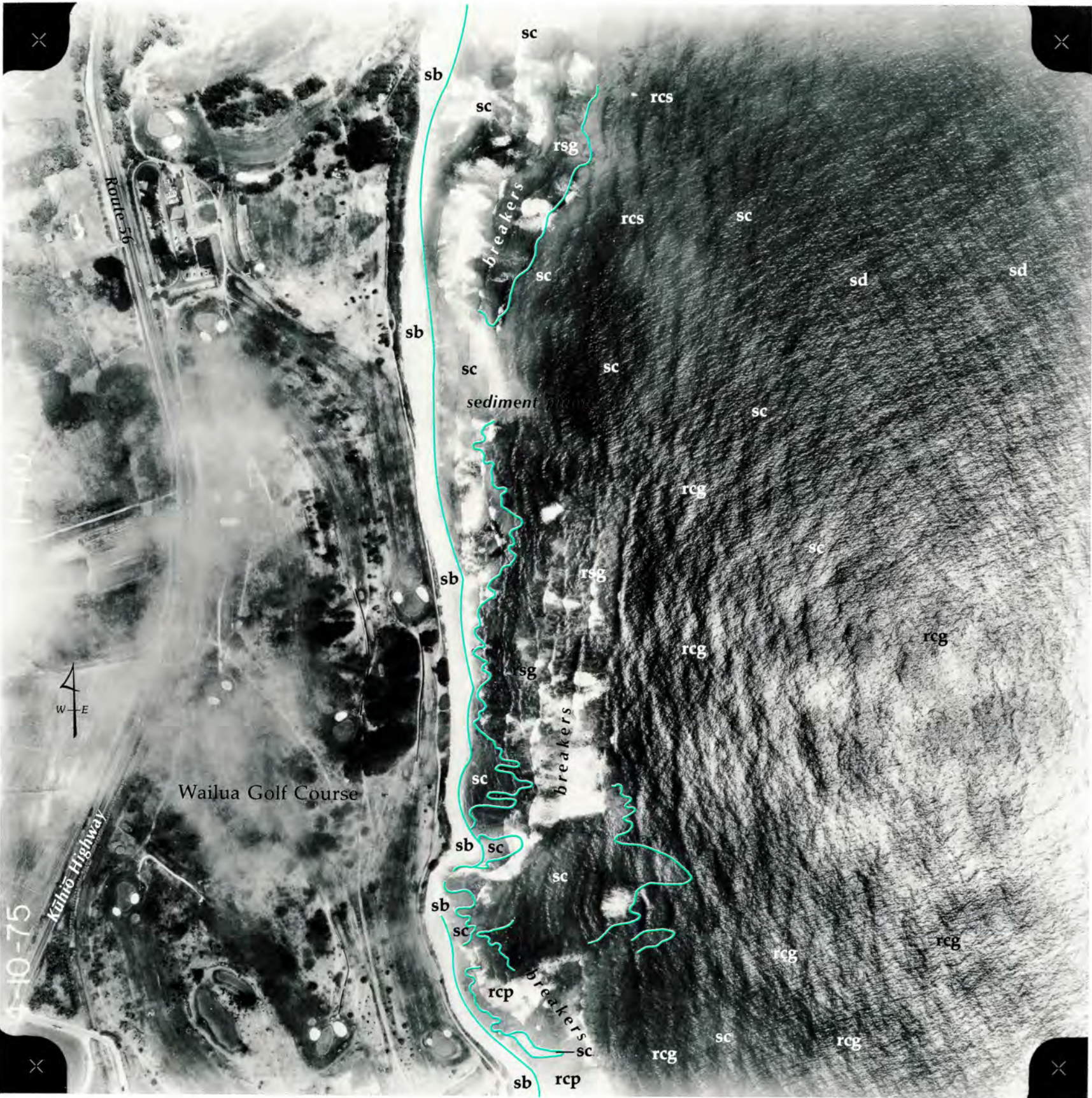
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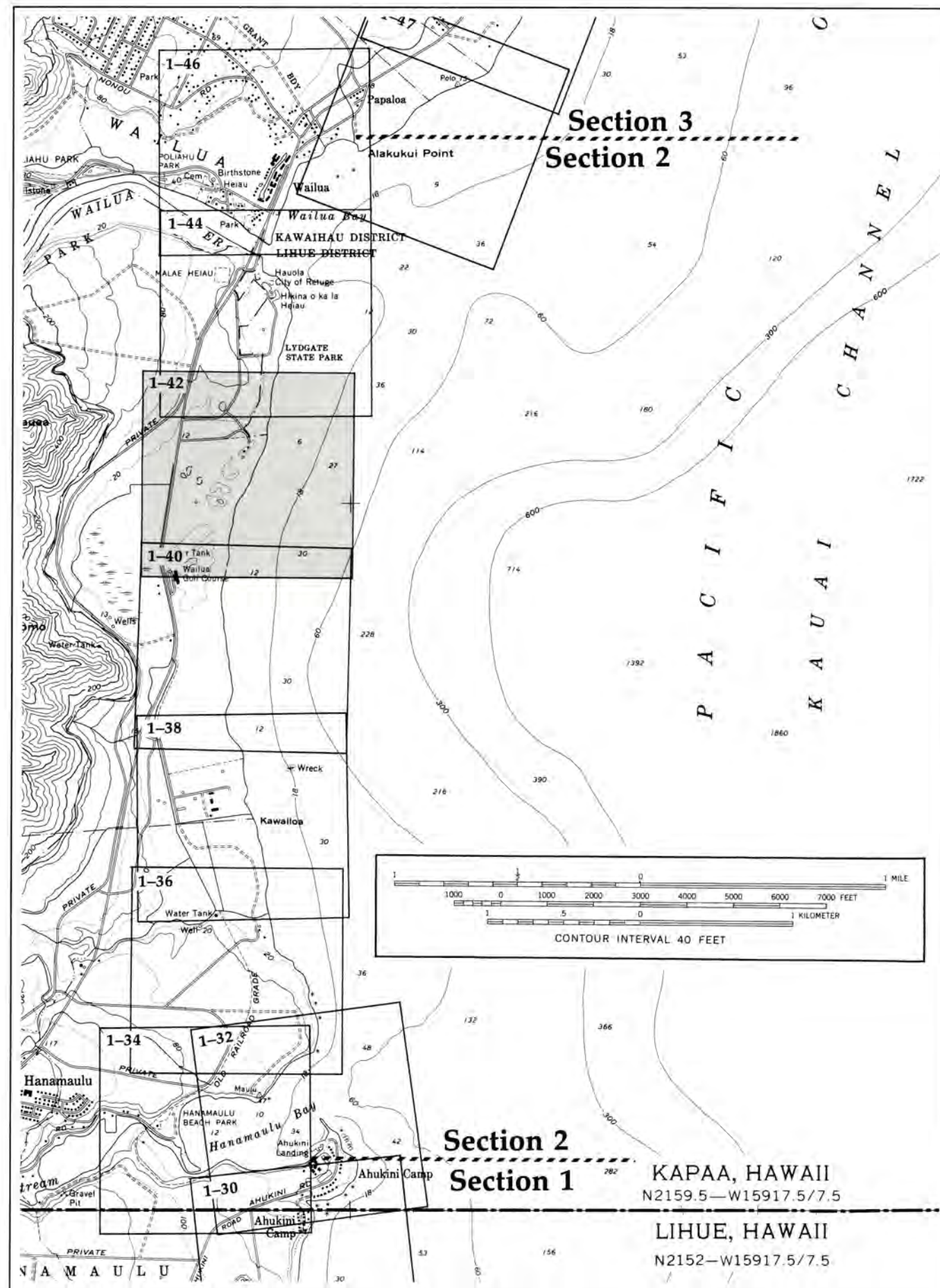
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- br - Beachrock (a specialized category normally formed at the shoreline).
- tp - Tidepools, where they are a prominent feature at the shoreline.

Offshore Bottom Type Summary

Categories	% Sand	% Rock
rbc, br, s, sb, sc, sd	100	—
rs	less than 50	more than 50
rbs, rcs, rsg	25 - 50	50 - 75
r, rc, co	less than 25	more than 75
rbb, rb, rcl, rcp, rcg	—	100

Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

-  Pole-and-line fishing.
-  Gill-netting.
-  Throw-netting.
-  Spearfishing.
-  Torching.
-  Trapping.
-  Lobster.
-  Sea urchin (wana).
-  Octopus (he'e).
-  Surround netting.
-  Aquarium fish collecting.
-  Seaweed (limu).
-  Sport-diving.
-  Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

-  Crabbing (kona, 'a'ama, swimming crab).
-  Limpet (opihi).
-  Trolling, bottom-fishing.
-  Specialized fisheries (type indicated).

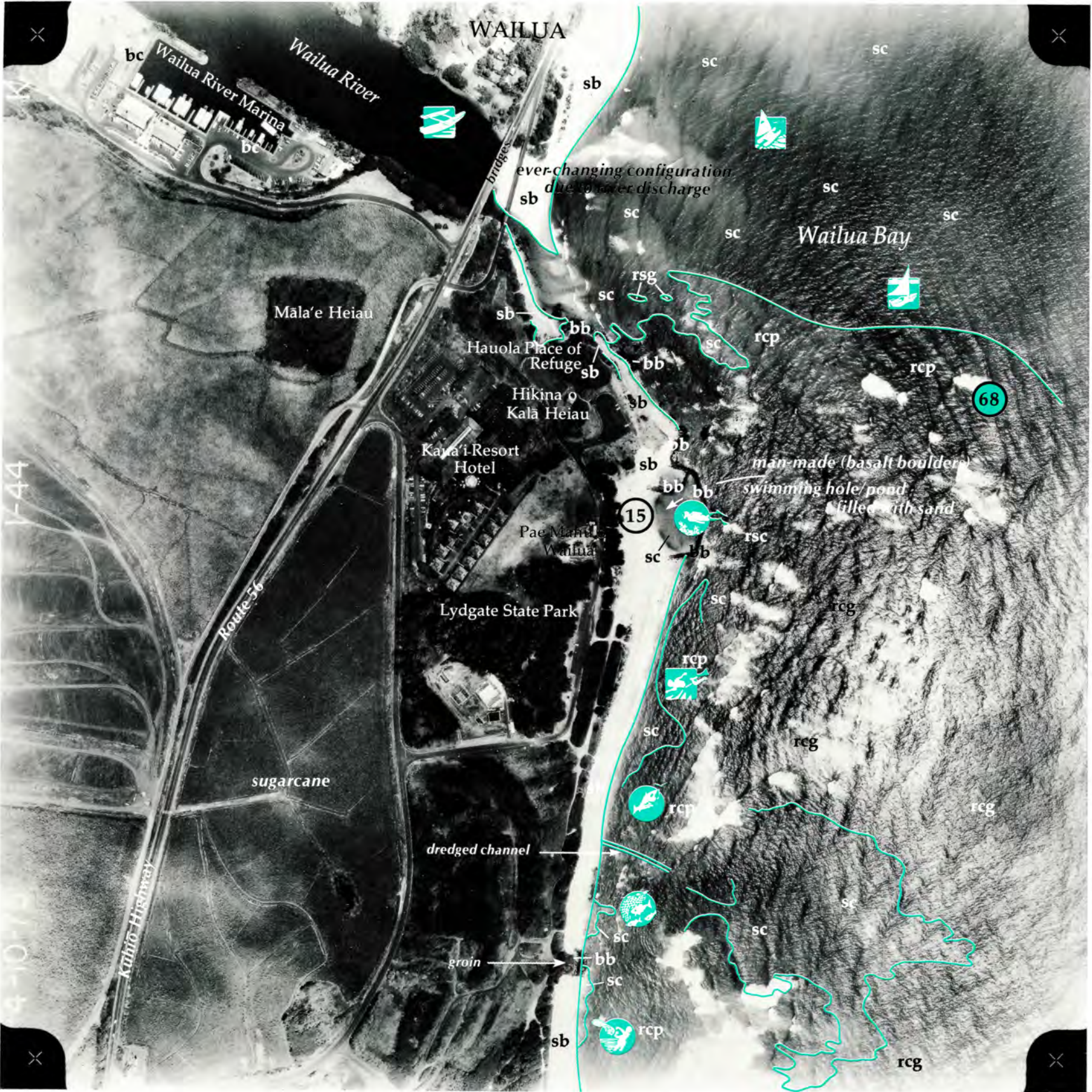
USES NOT RELATED TO BIOTA

-  Board surfing.
-  Body surfing.
-  Canoe paddling.
-  Sailing.
-  Aquatic recreation (smallcraft sailing, wind-surfing).
-  Excursion boat.
-  Anchorage.

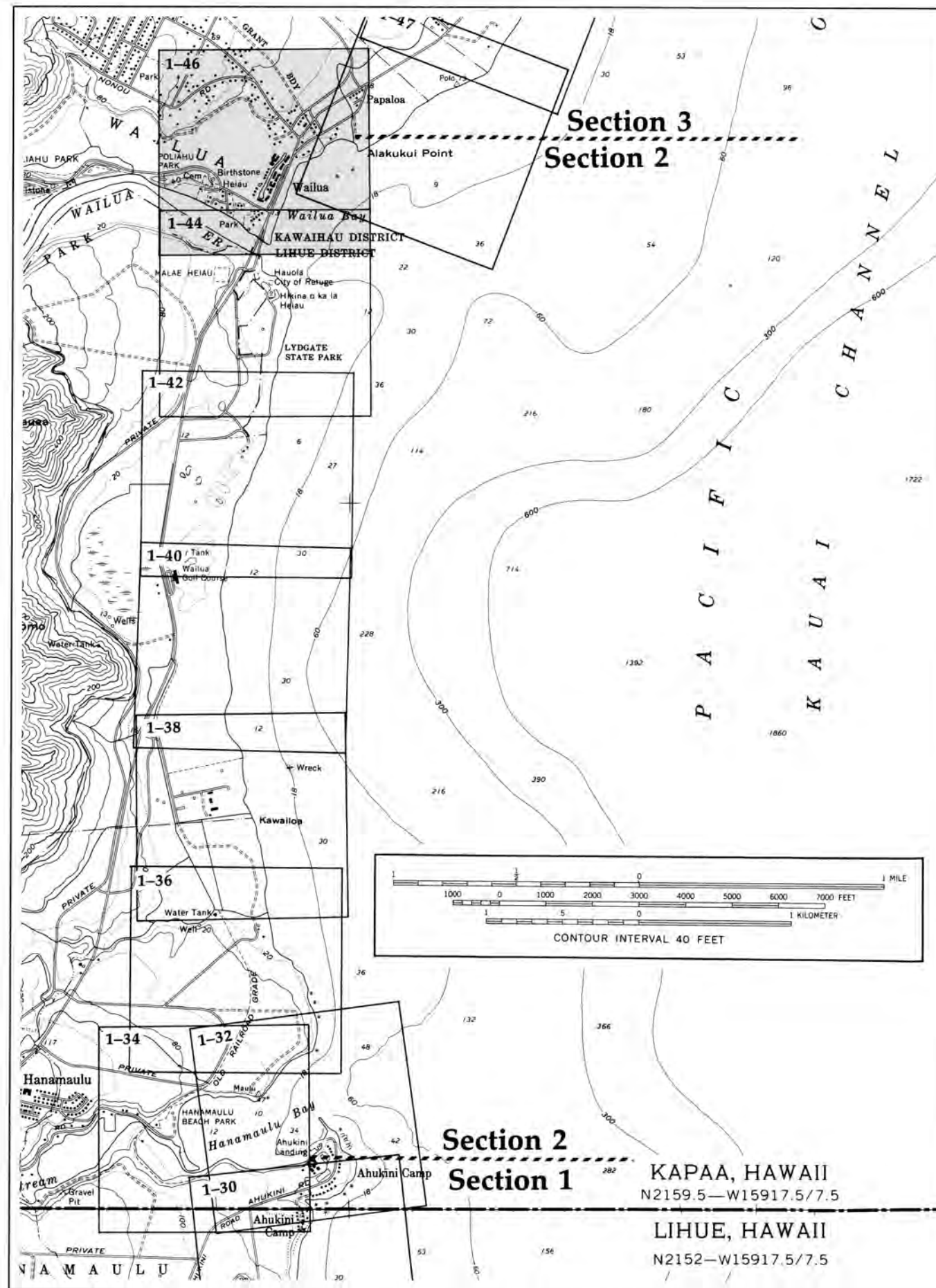
Study Sites

-  Shoreline (above water observations).
-  Inshore (inside reef edge).
-  Offshore (beyond reef edge).

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0 100 200 300 400 500 600 700 meters
 0 250 500 750 1000 1250 1500 1750 2000 2250 feet †



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Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

- Pole-and-line fishing.
- Gill-netting.
- Throw-netting.
- Spearfishing.
- Torching.
- Trapping.
- Lobster.
- Sea urchin (wana).
- Octopus (he'e).
- Surround netting.
- Aquarium fish collecting.
- Seaweed (limu).
- Sport-diving.
- Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

- Crabbing (kona, 'a'ama, swimming crab).
- Limpet (opihi).
- Trolling, bottom-fishing.
- Specialized fisheries (type indicated).

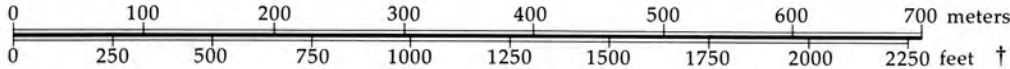
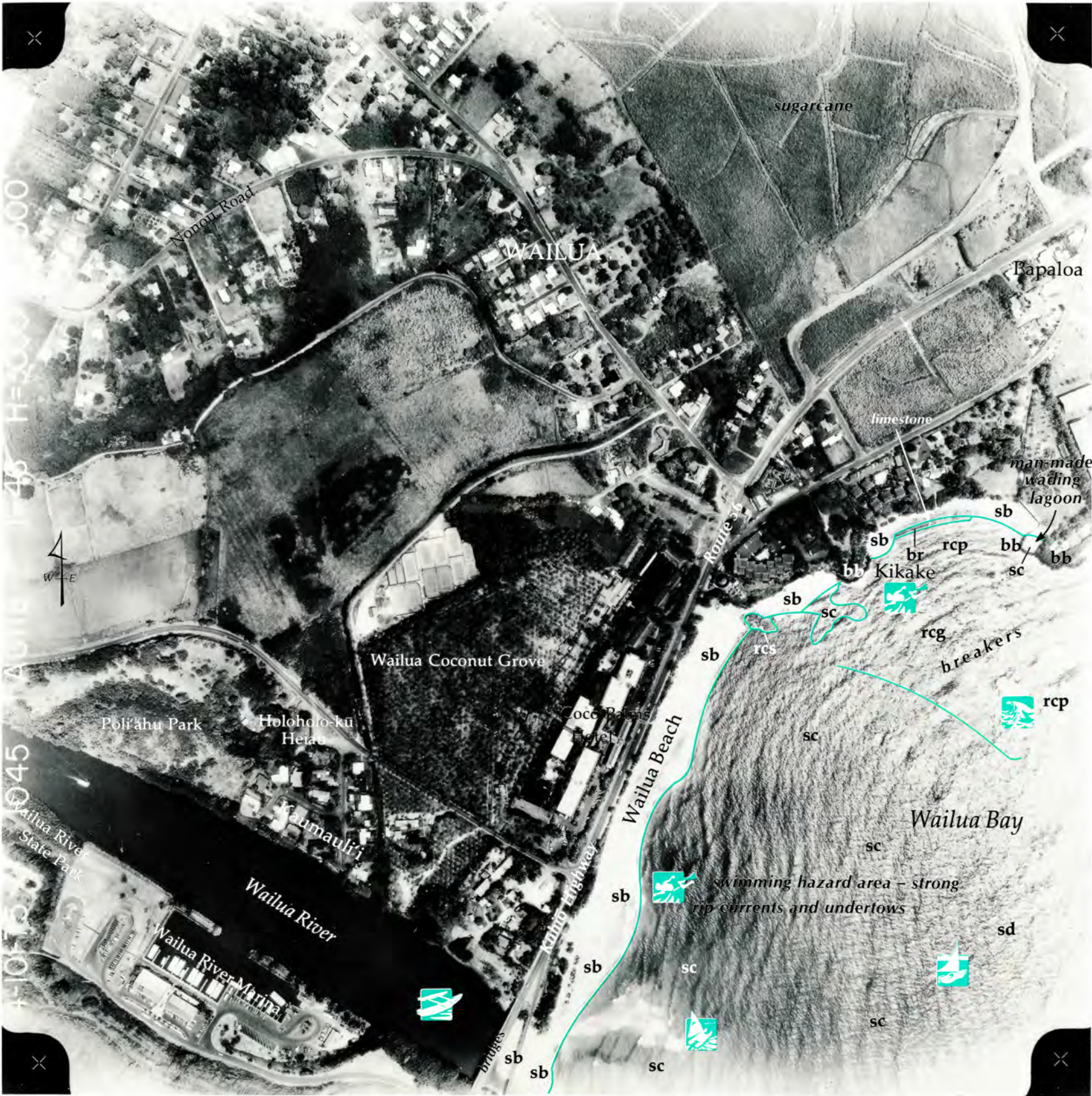
USES NOT RELATED TO BIOTA

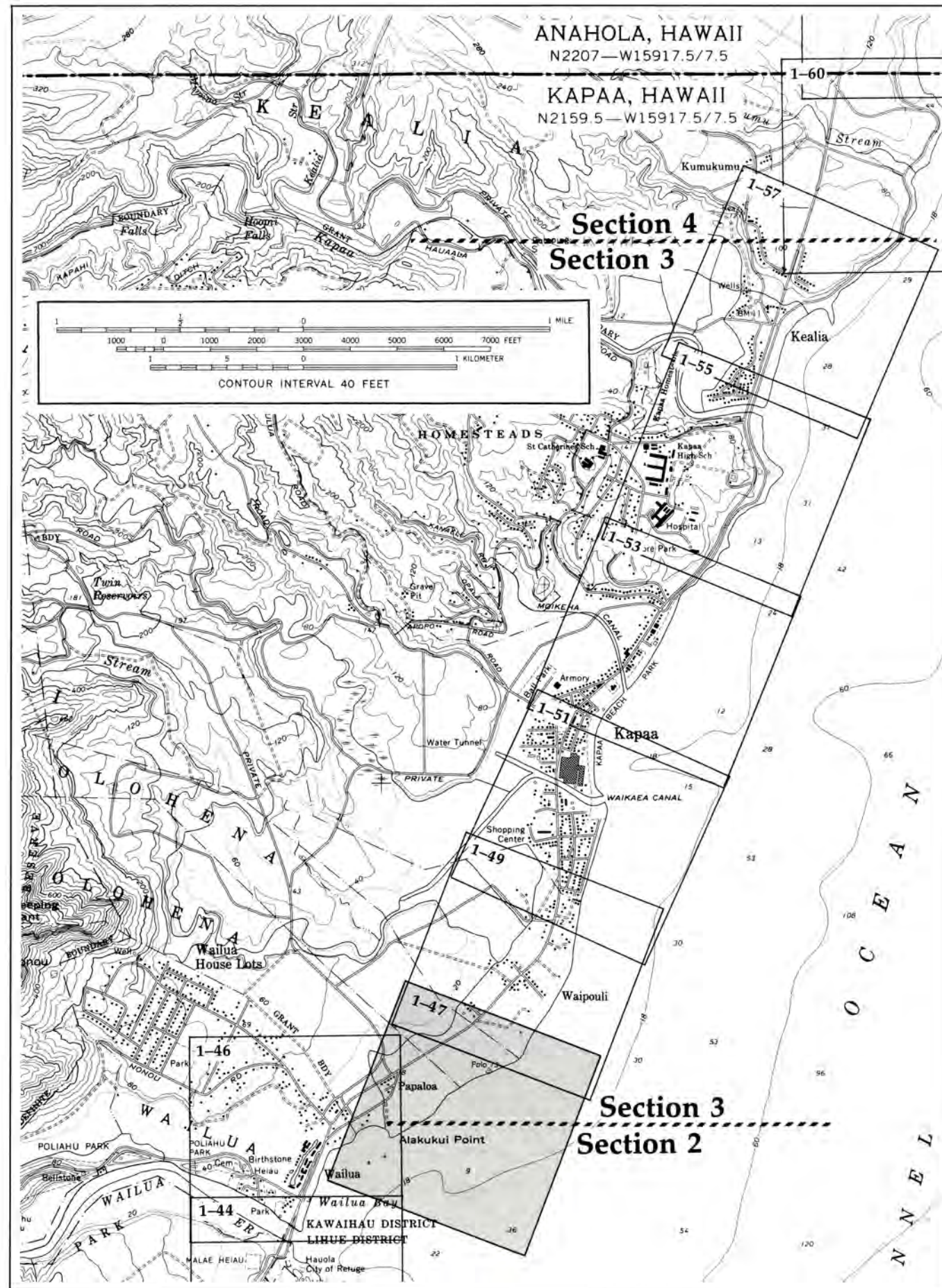
- Board surfing.
- Body surfing.
- Canoe paddling.
- Sailing.
- Aquatic recreation (smallcraft sailing, wind-surfing).
- Excursion boat.
- Anchorage.

Study Sites

- Shoreline (above water observations).
- Inshore (inside reef edge).
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- 
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- 
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- 
 Trapping.
- 
 Lobster.
- 
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- 
 Octopus (he'e).
- 
 Surround netting.
- 
 Aquarium fish collecting.
- 
 Seaweed (limu).
- 
 Sport-diving.
- 
 Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

- 
 Crabbing (kona, 'a'ama, swimming crab).
- 
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- 
 Trolling, bottom-fishing.
- 
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USES NOT RELATED TO BIOTA

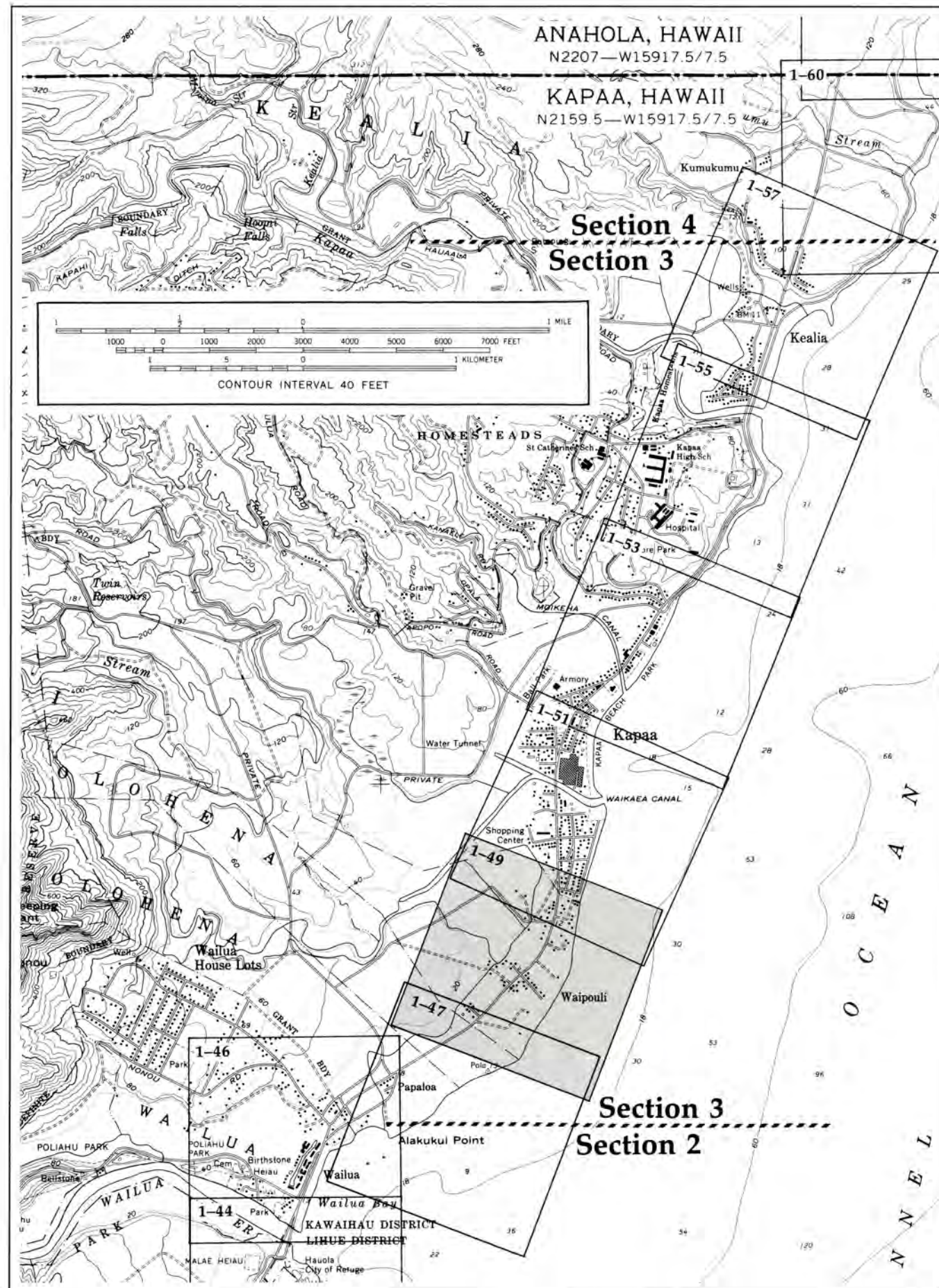
- 
 Board surfing.
- 
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- 
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- 
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- 
 Excursion boat.
- 
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- 
 Shoreline (above water observations).
- 
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Photograph 1-49: Section 3

Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

-  Pole-and-line fishing.
-  Gill-netting.
-  Throw-netting.
-  Spearfishing.
-  Torching.
-  Trapping.
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SHORELINE AND DEEP-WATER FISHING ACTIVITIES

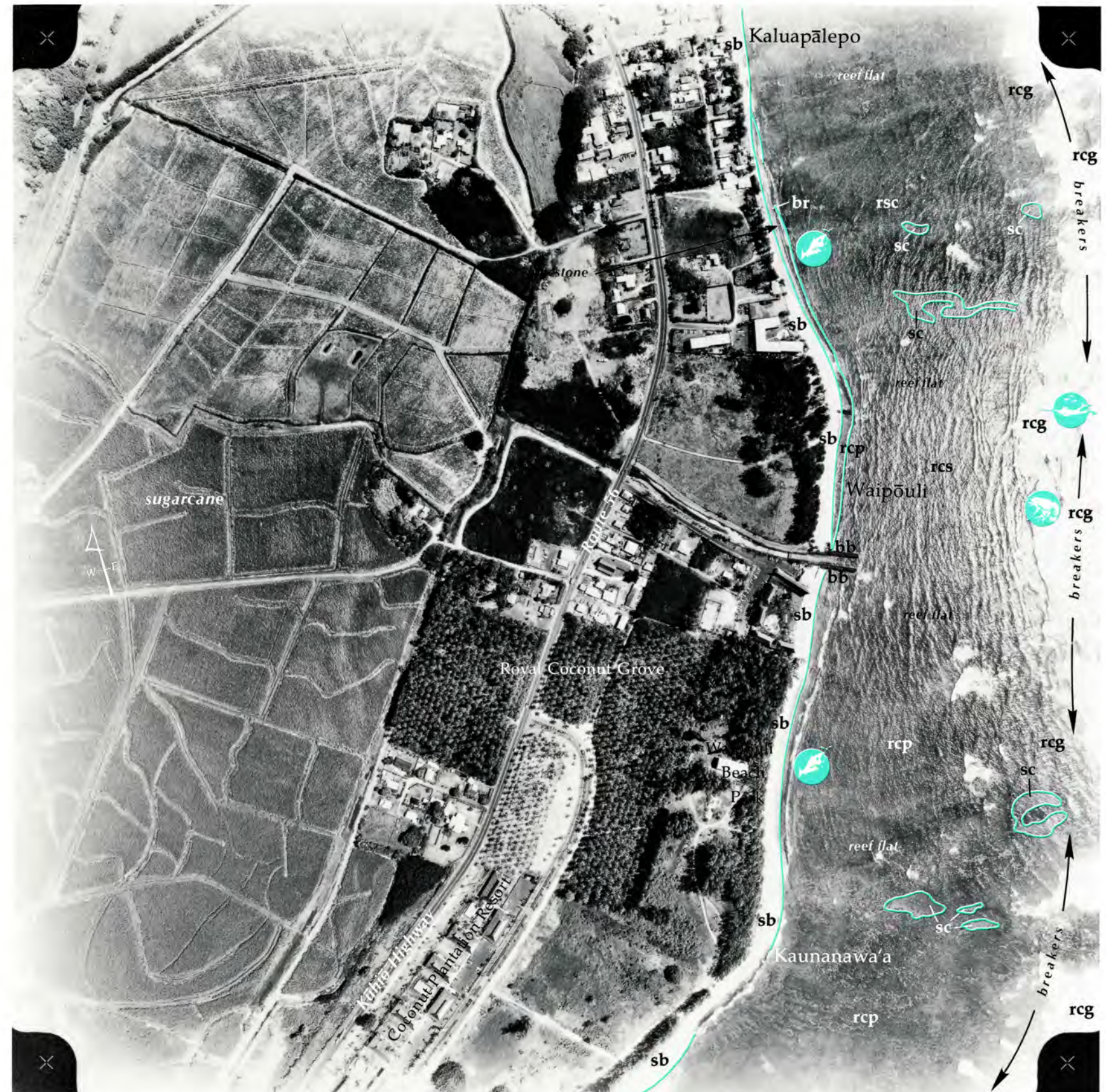
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USES NOT RELATED TO BIOTA

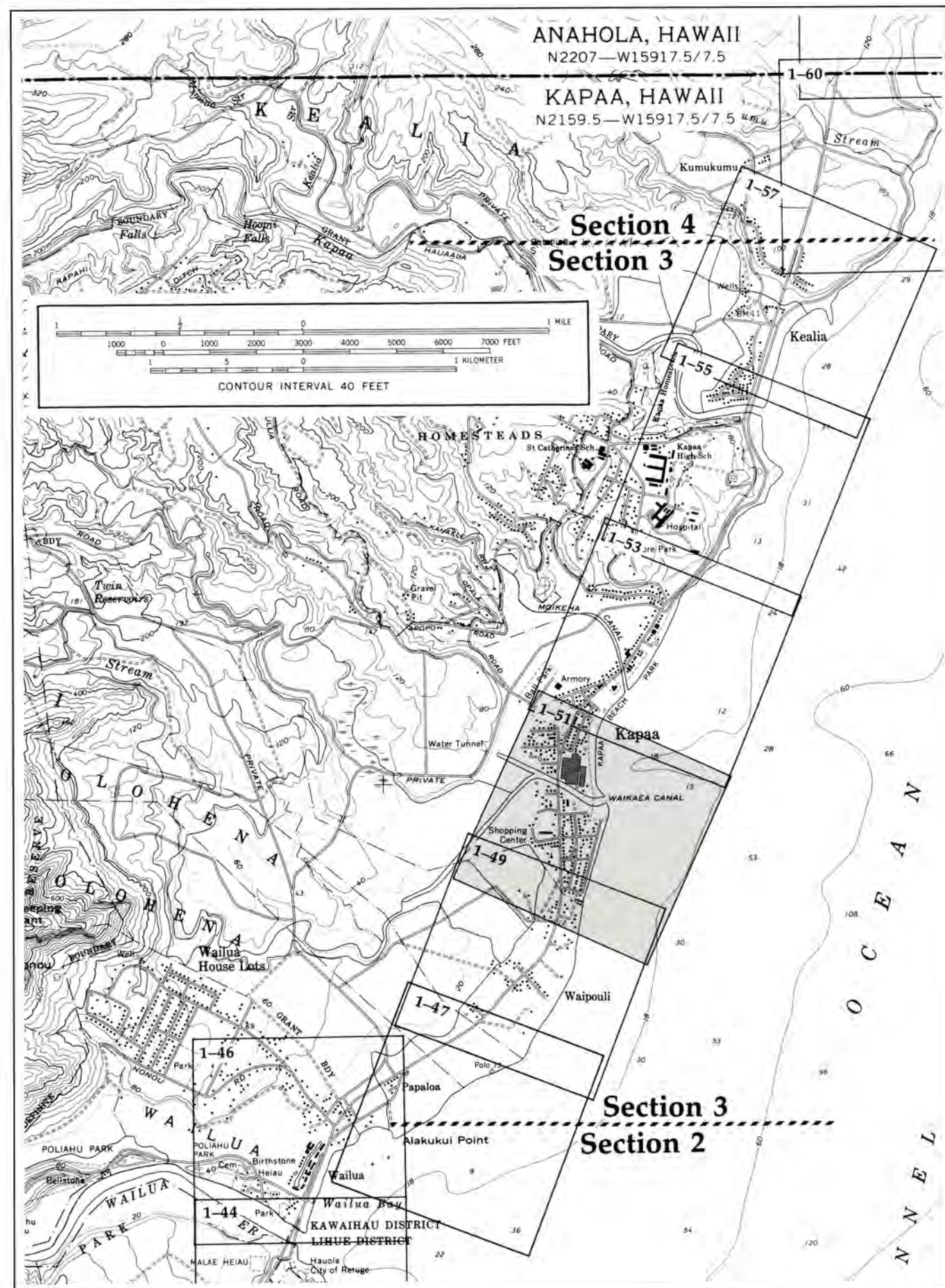
-  Board surfing.
-  Body surfing.
-  Canoe paddling.
-  Sailing.
-  Aquatic recreation (smallcraft sailing, wind-surfing).
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-  Anchorage.

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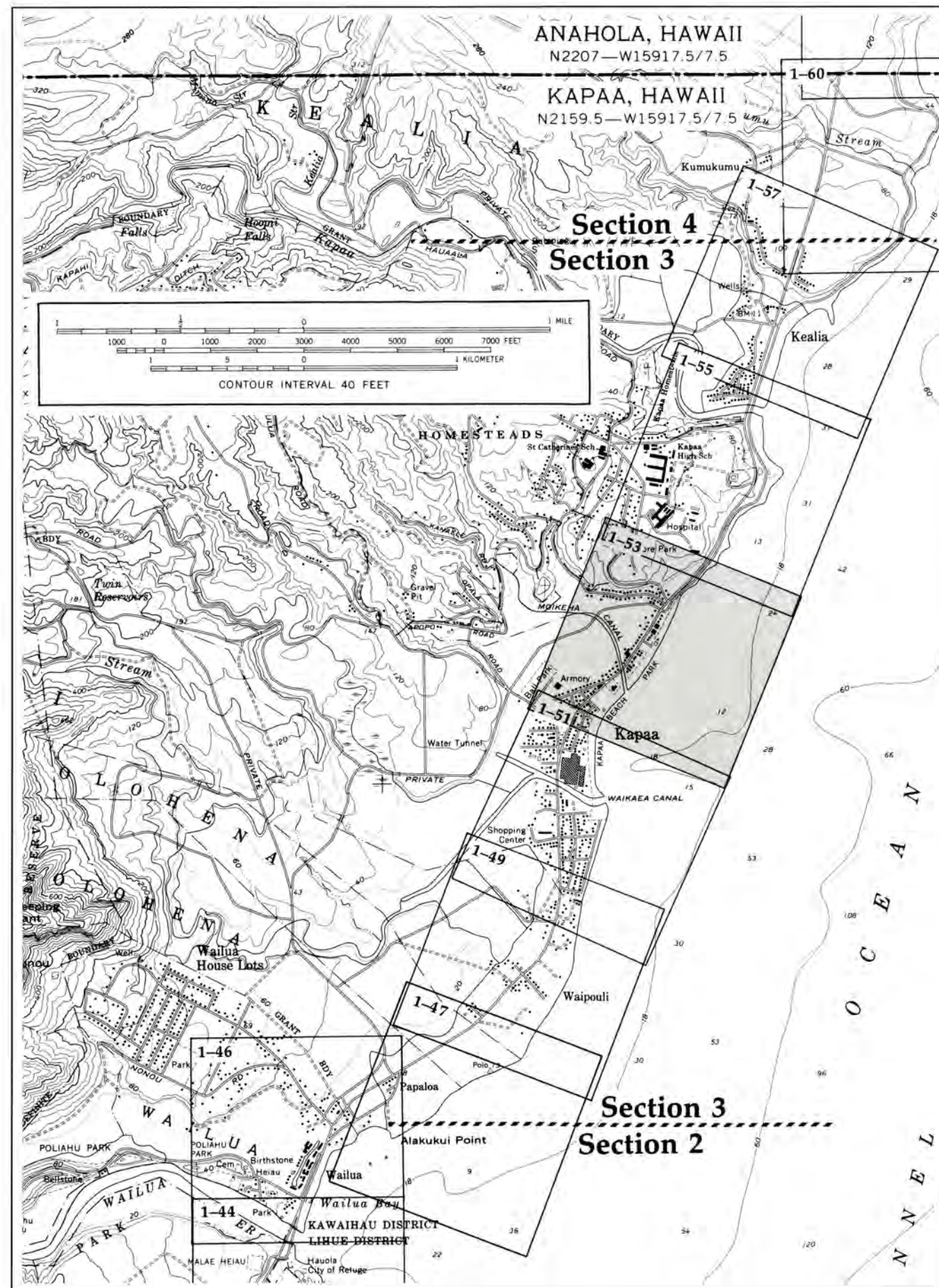
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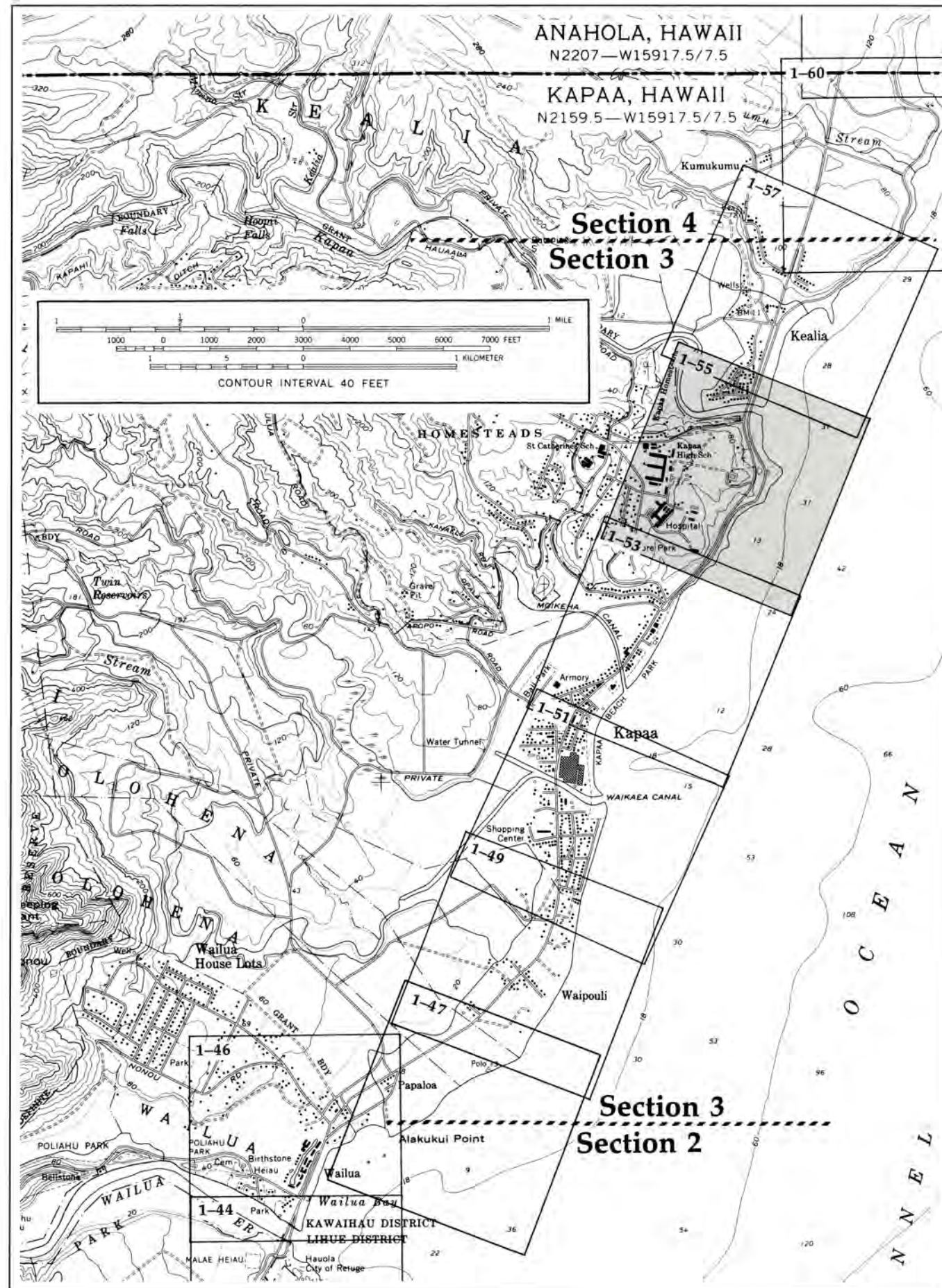
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- sbr - Poorly sorted deposits (common off stream mouths, sometimes shoreward extensions of rubble or sand beaches).

Special types.

- br - Beachrock (a specialized category normally formed at the shoreline).
- tp - Tidepools, where they are a prominent feature at the shoreline.

Offshore Bottom Type Summary

Categories	% Sand	% Rock
rbc, br, s, sb, sc, sd	100	—
rs	less than 50	more than 50
rbs, rcs, rsg	25 - 50	50 - 75
r, rc, co	less than 25	more than 75
rbb, rb, rcl, rcp, rcg	—	100

Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

-  Pole-and-line fishing.
-  Gill-netting.
-  Throw-netting.
-  Spearfishing.
-  Torching.
-  Trapping.
-  Lobster.
-  Sea urchin (wana).
-  Octopus (he'e).
-  Surround netting.
-  Aquarium fish collecting.
-  Seaweed (limu).
-  Sport-diving.
-  Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

-  Crabbing (kona, 'a'ama, swimming crab).
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-  Trolling, bottom-fishing.
-  Specialized fisheries (type indicated).

USES NOT RELATED TO BIOTA

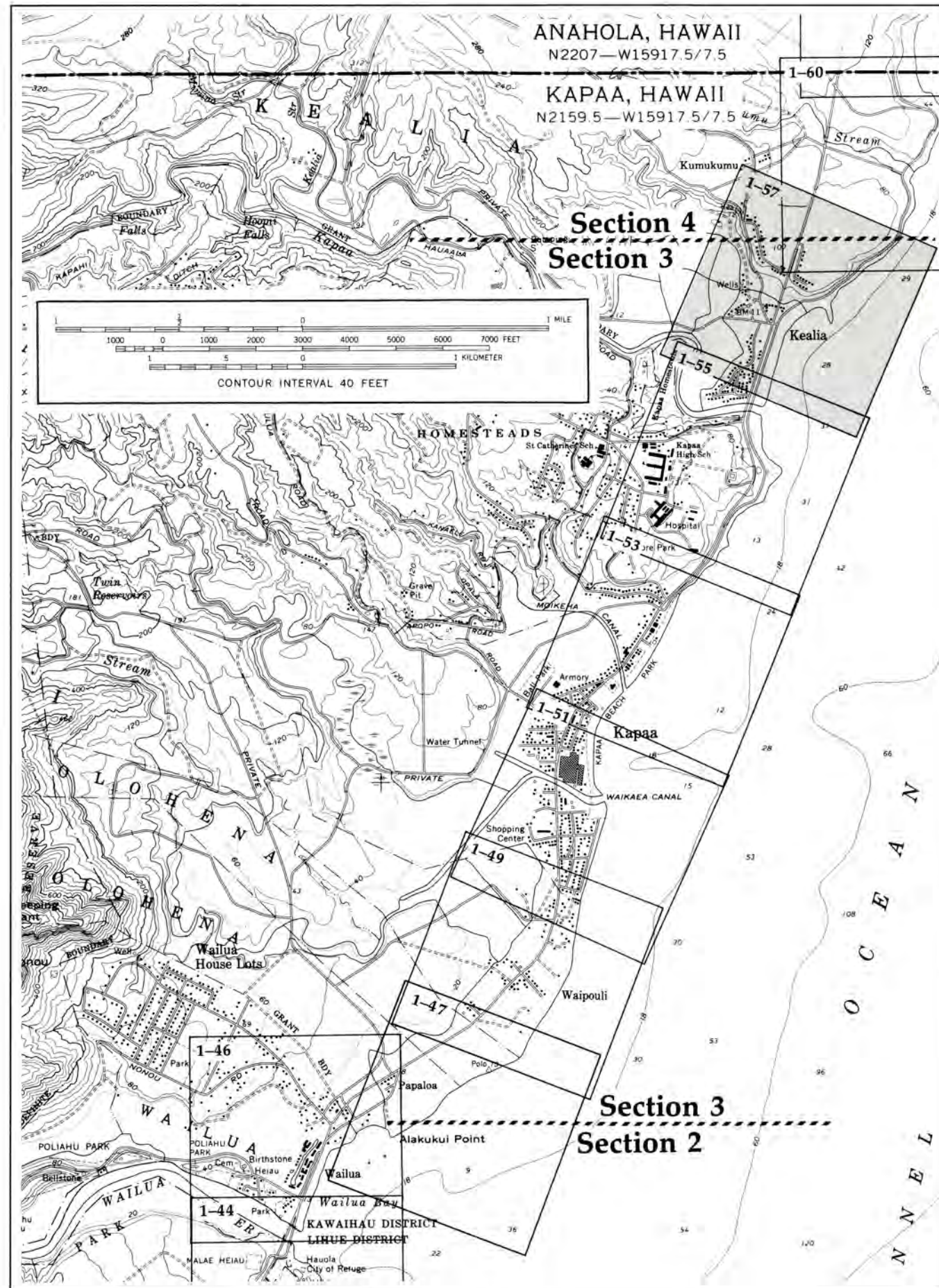
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-  Shoreline (above water observations).
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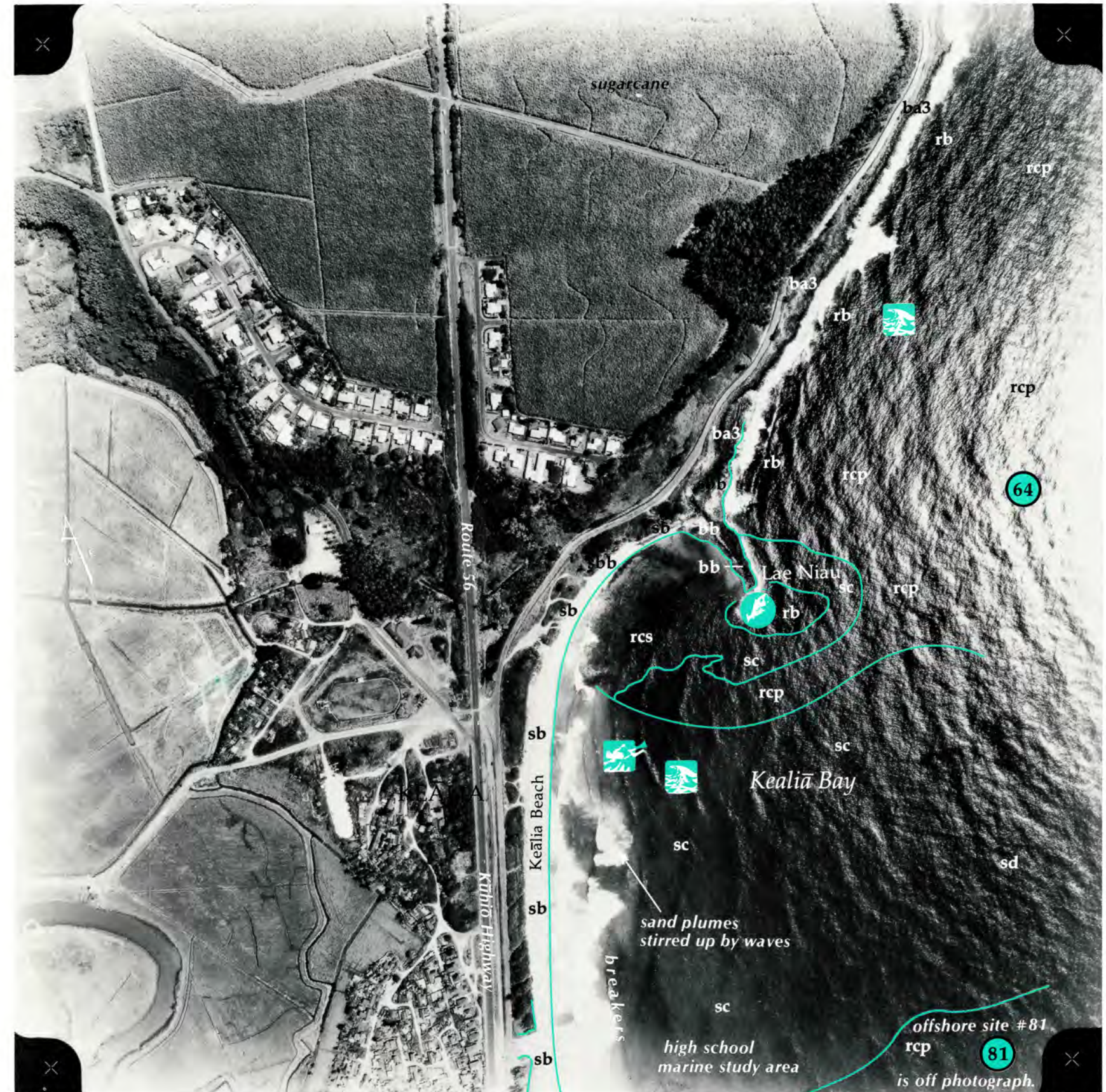
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-  Shoreline (above water observations).
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4

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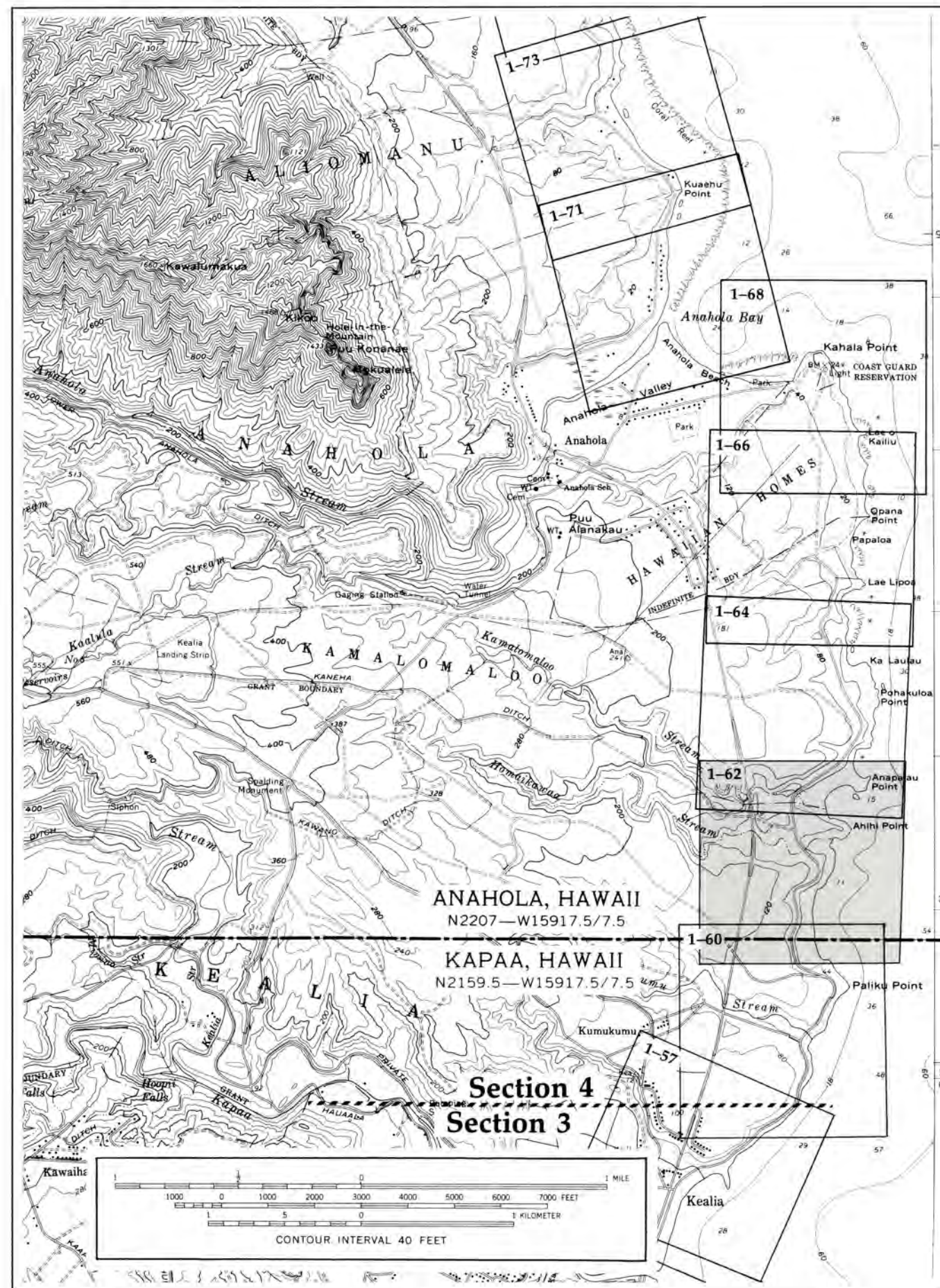
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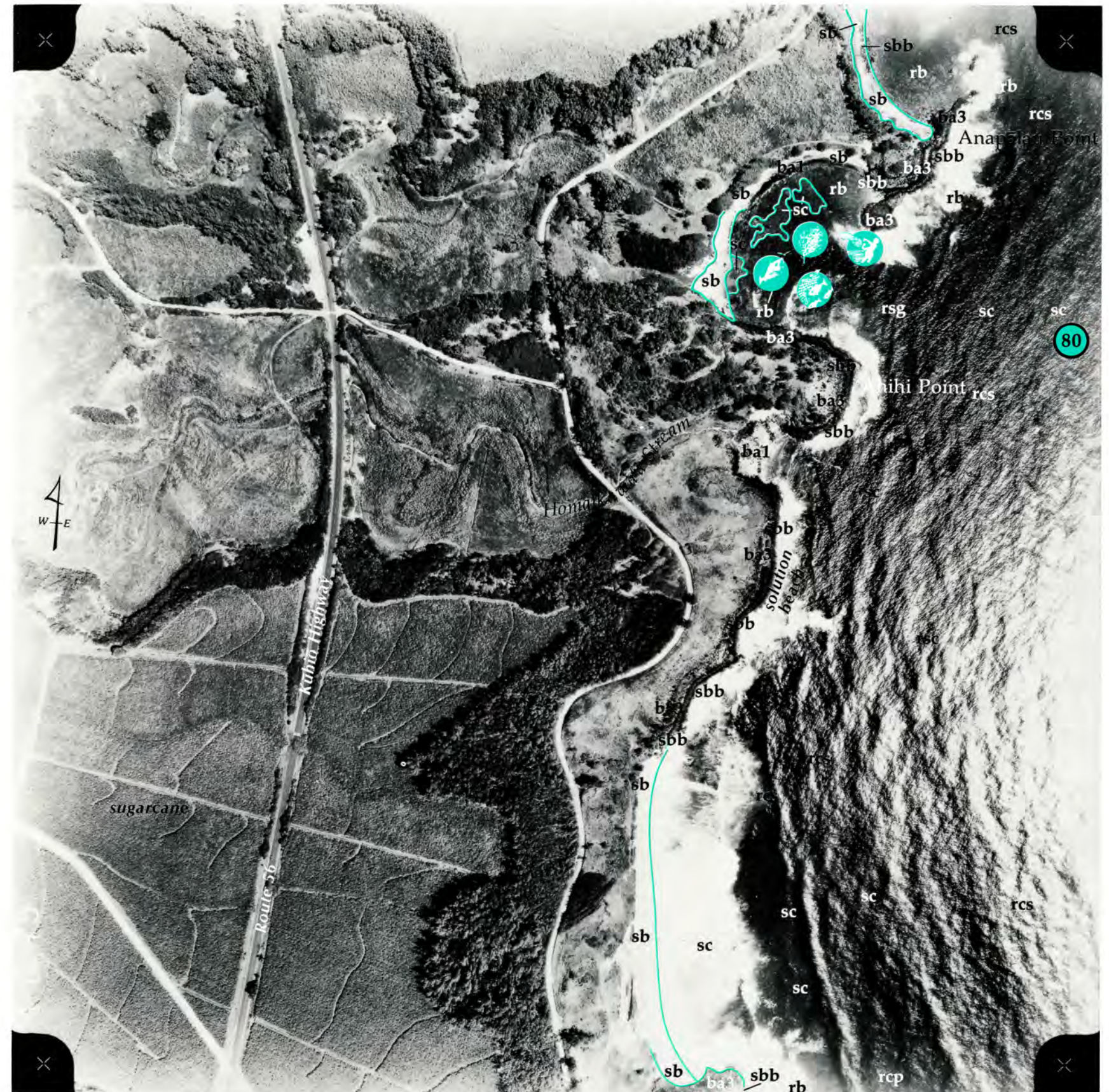
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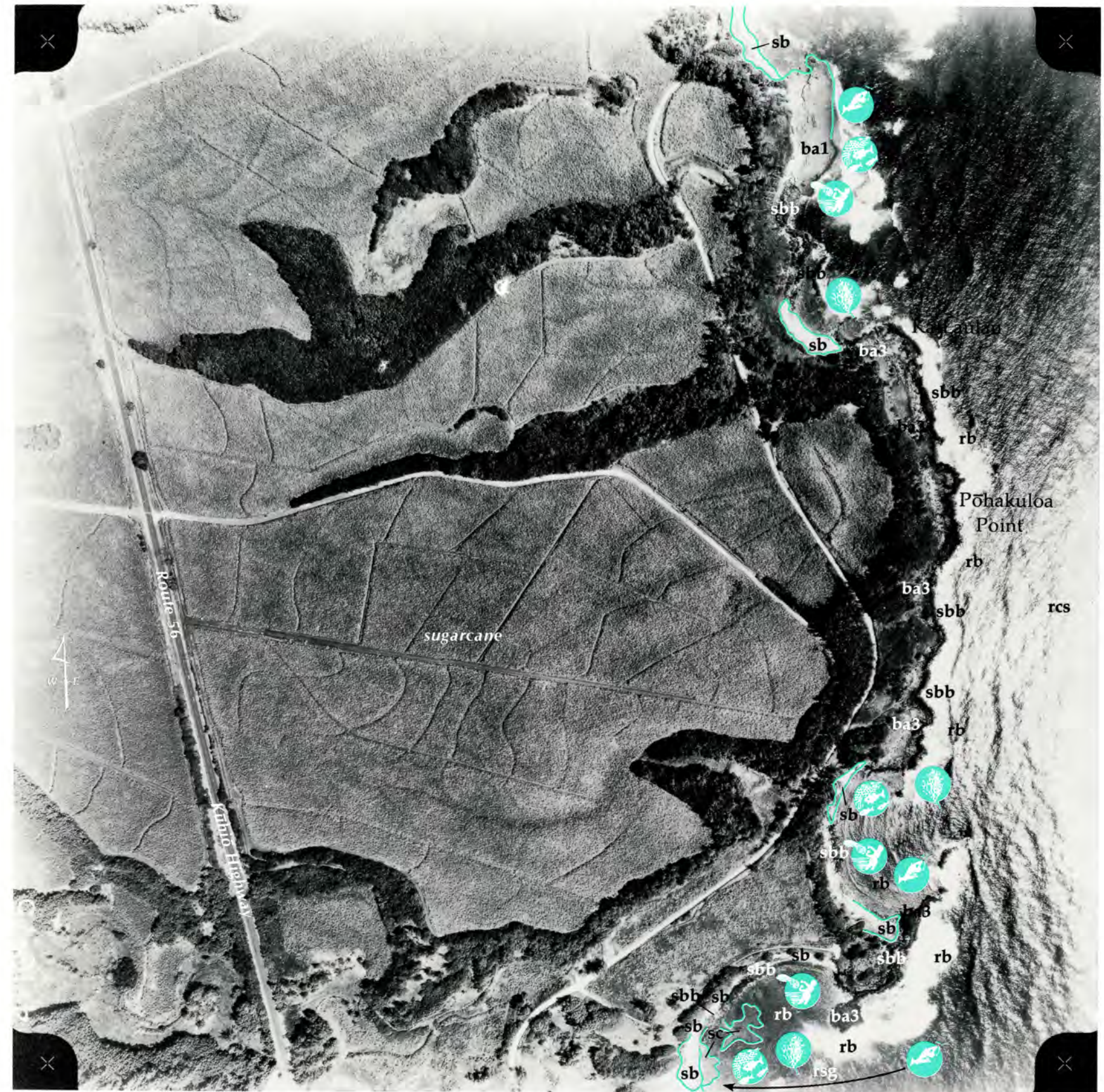
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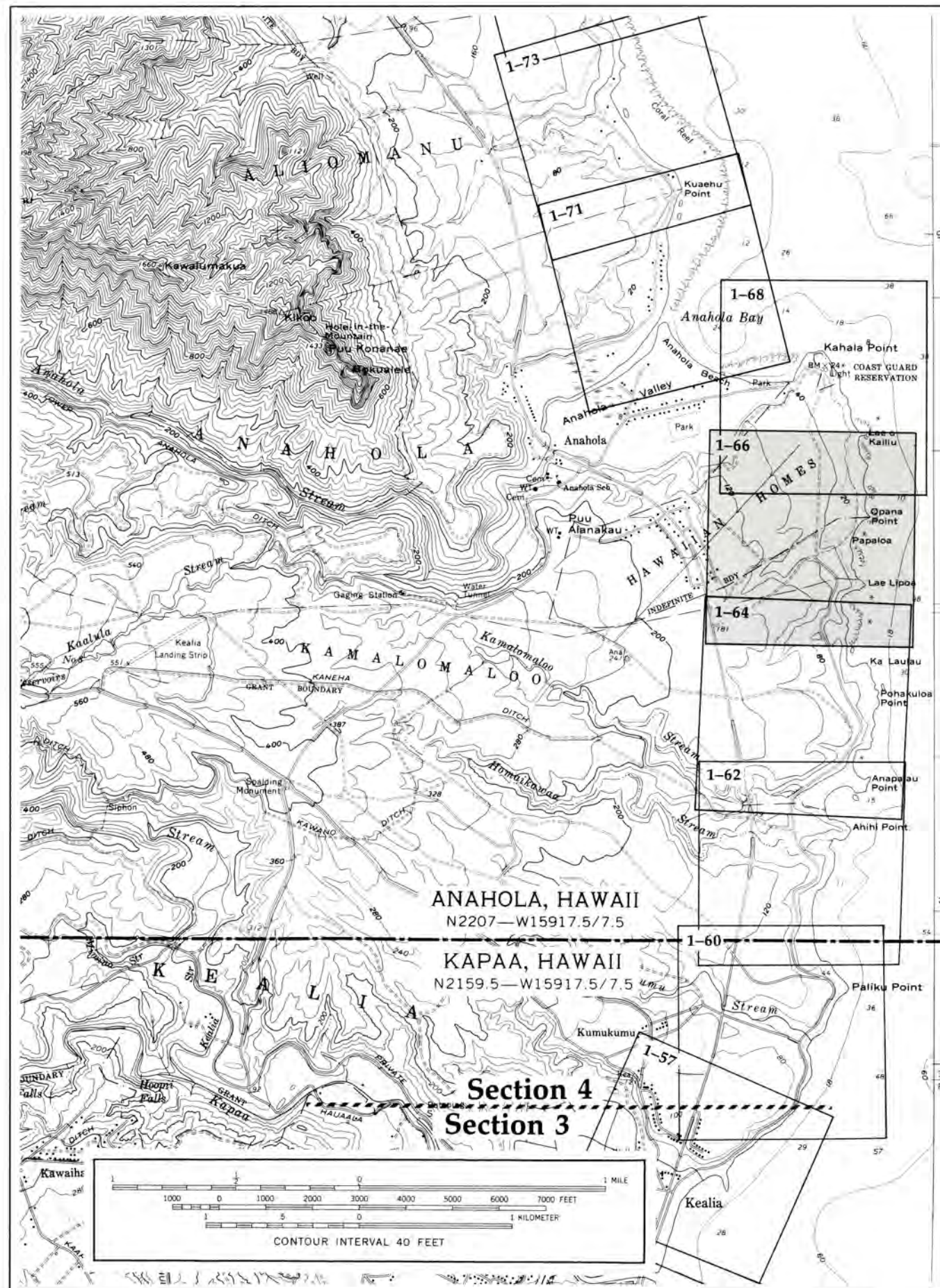
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A horizontal number line with two scales. The top scale is labeled 'meters' and has major tick marks at 0, 100, 200, 300, 400, 500, 600, and 700. The bottom scale is labeled 'feet' and has major tick marks at 0, 250, 500, 750, 1000, 1250, 1500, 1750, 2000, and 2250. Vertical lines connect the corresponding tick marks between the two scales, illustrating the conversion factor of 1 meter = 3.28 feet.



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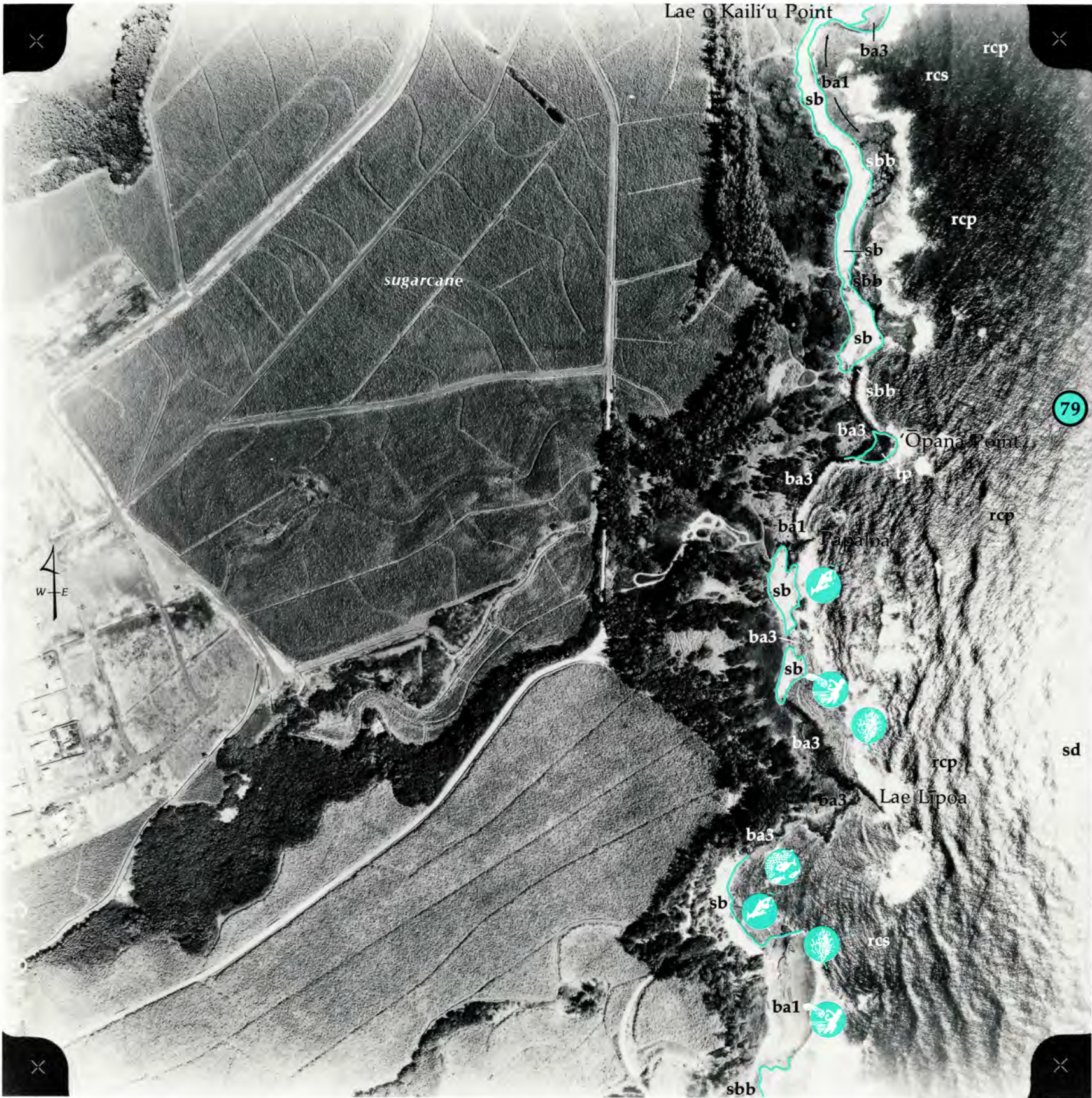
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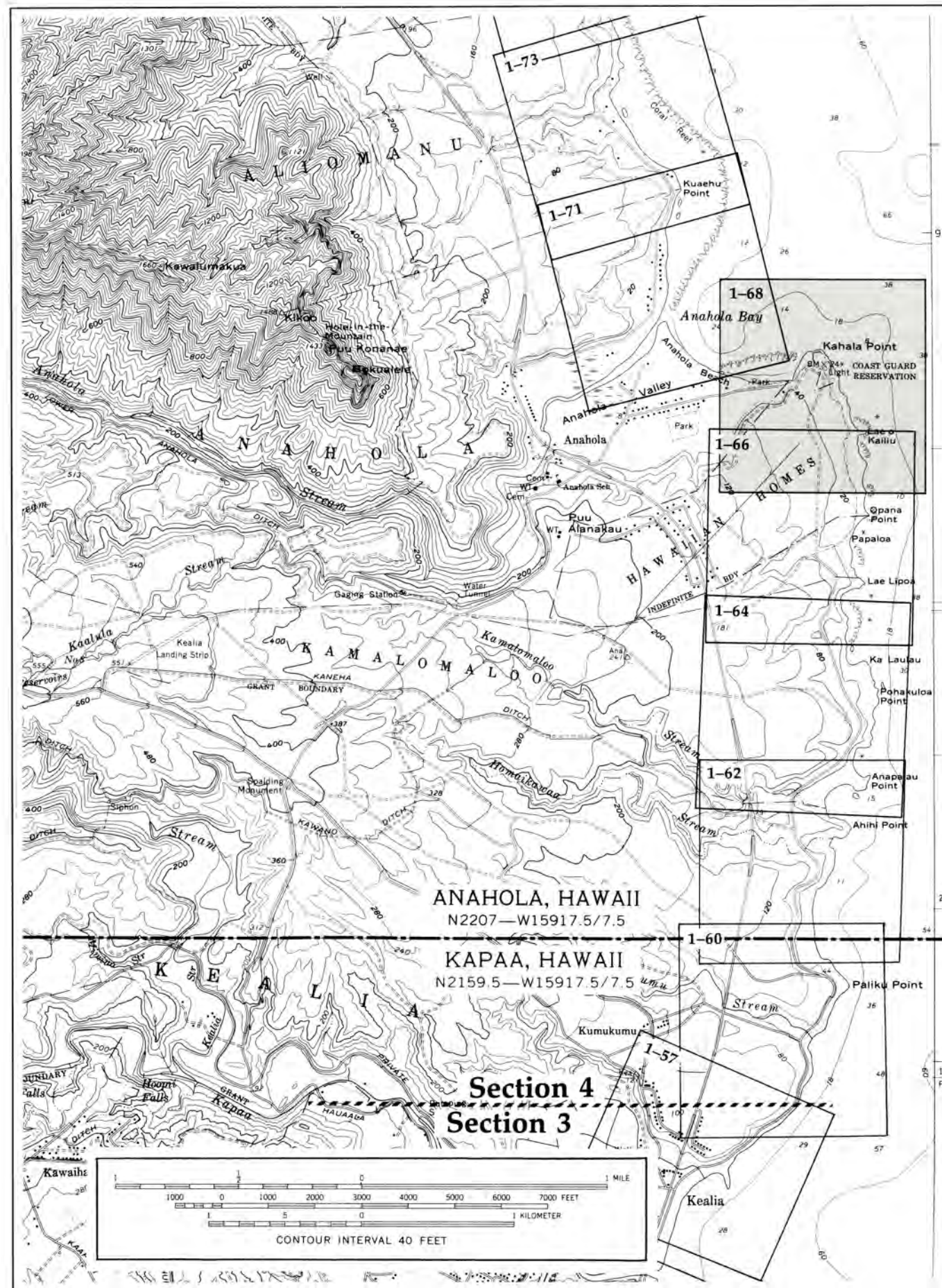
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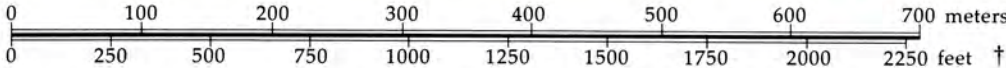
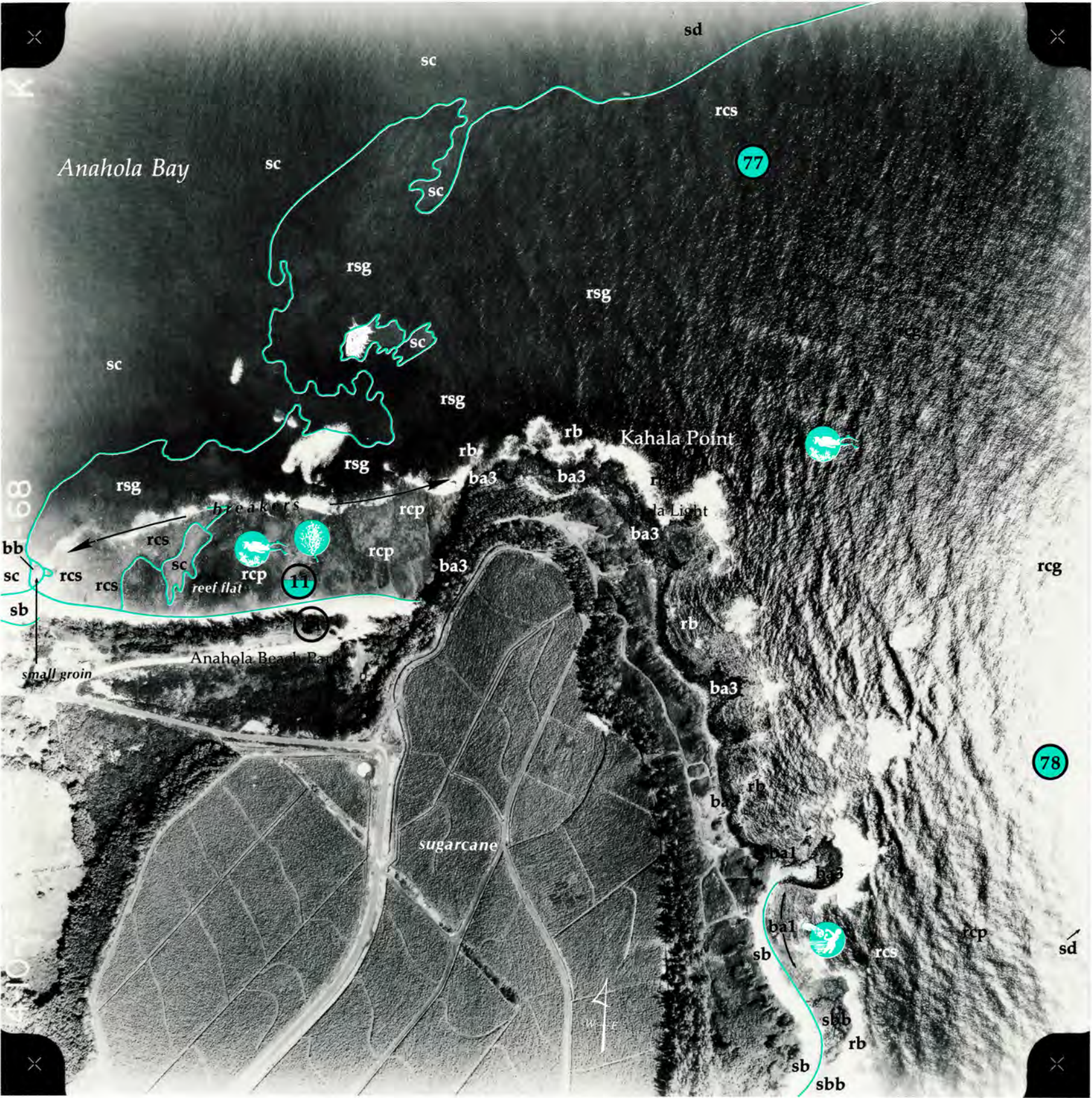
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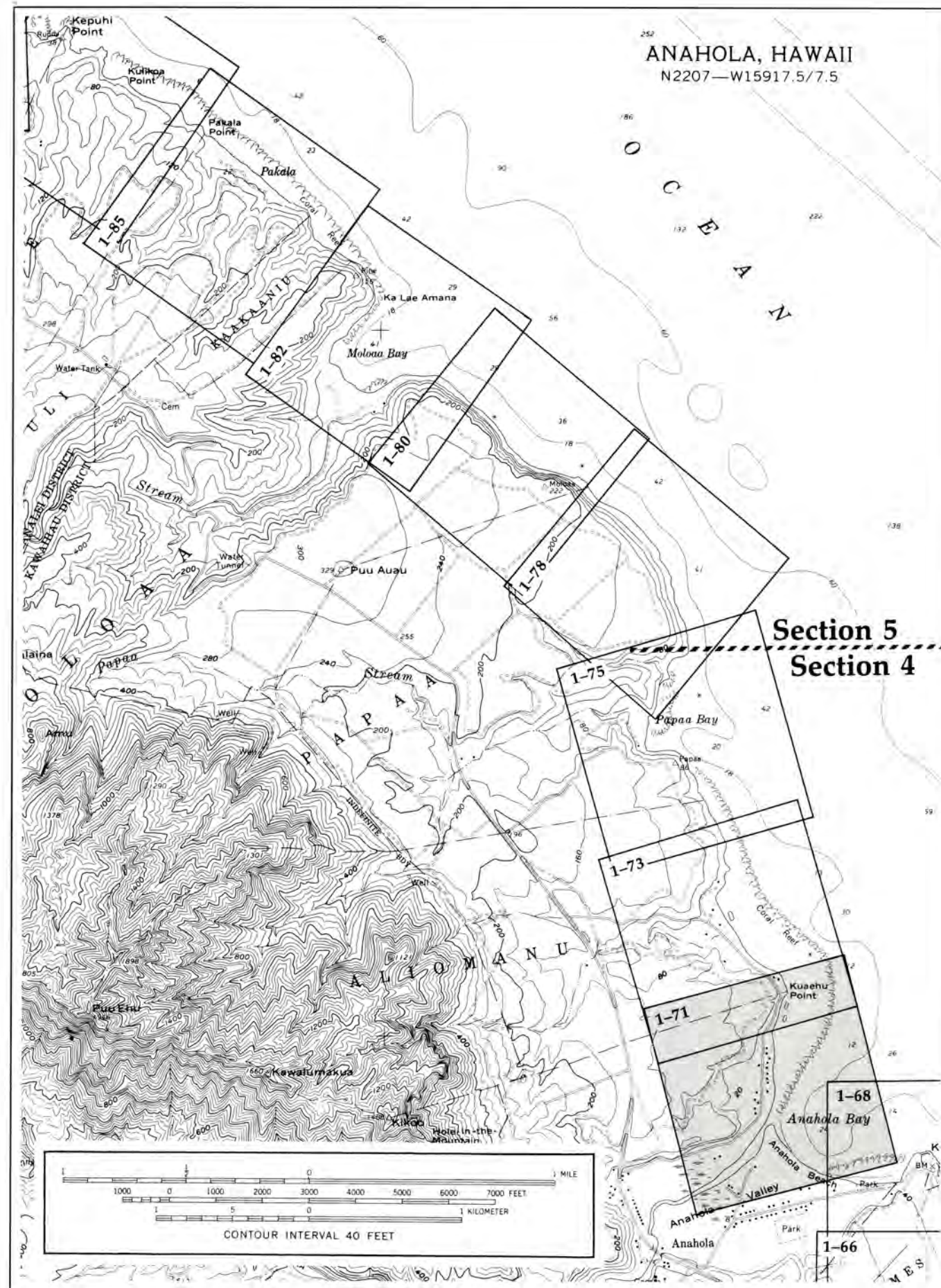
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rbs, rcs, rsg	25 – 50	50 – 75
r, rc, co	less than 25	more than 75
rbb, rb, rcl, rcp, rcg	—	100

Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

- Pole-and-line fishing.
- Gill-netting.
- Throw-netting.
- Spearfishing.
- Torching.
- Trapping.
- Lobster.
- Sea urchin (wana).
- Octopus (he'e).
- Surround netting.
- Aquarium fish collecting.
- Seaweed (limu).
- Sport-diving.
- Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

- Crabbing (kona, 'a'ama, swimming crab).
- Limpet (opihi).
- Trolling, bottom-fishing.
- Specialized fisheries (type indicated).

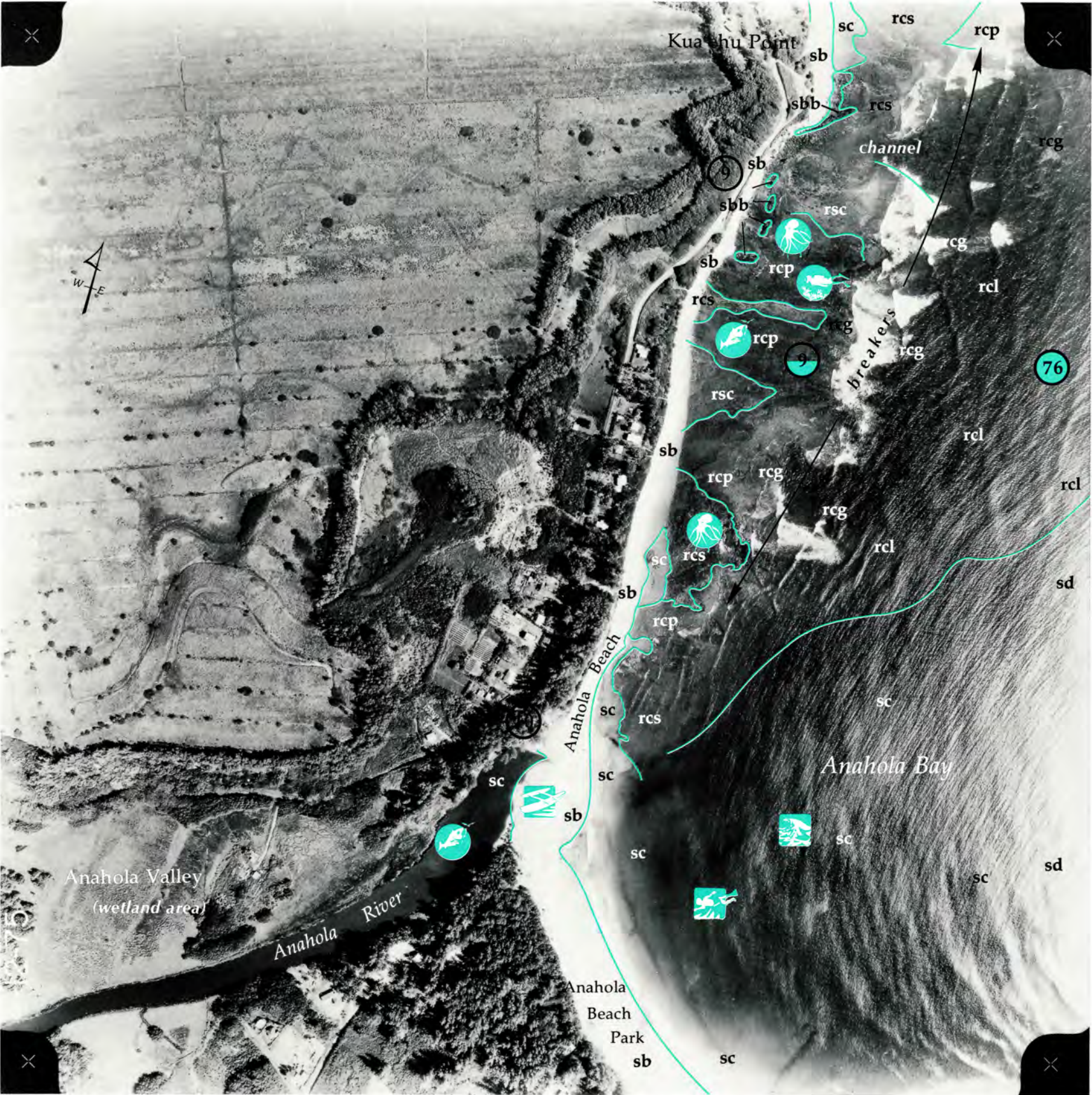
USES NOT RELATED TO BIOTA

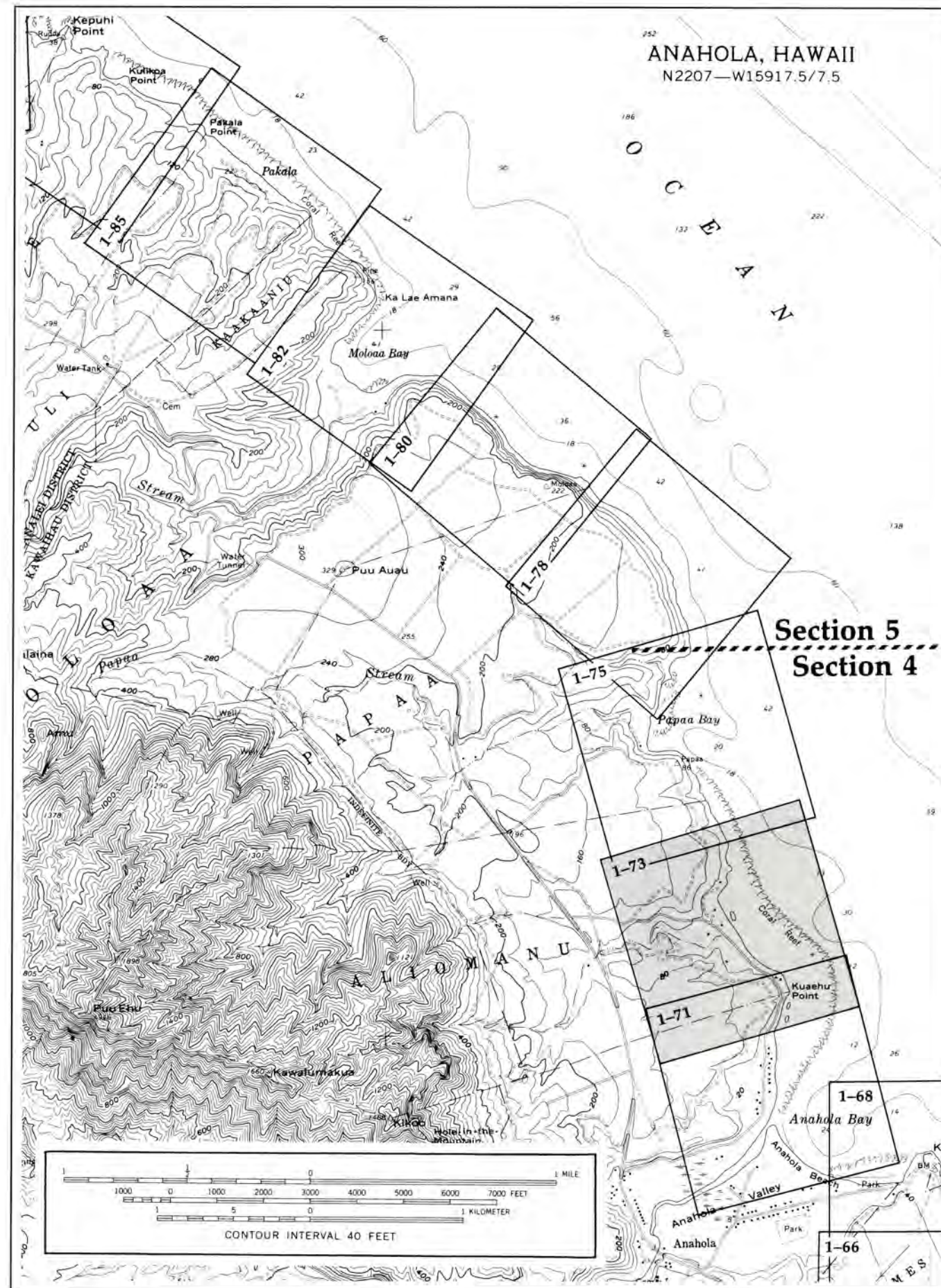
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Study Sites

- Shoreline (above water observations).
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r – Rock.

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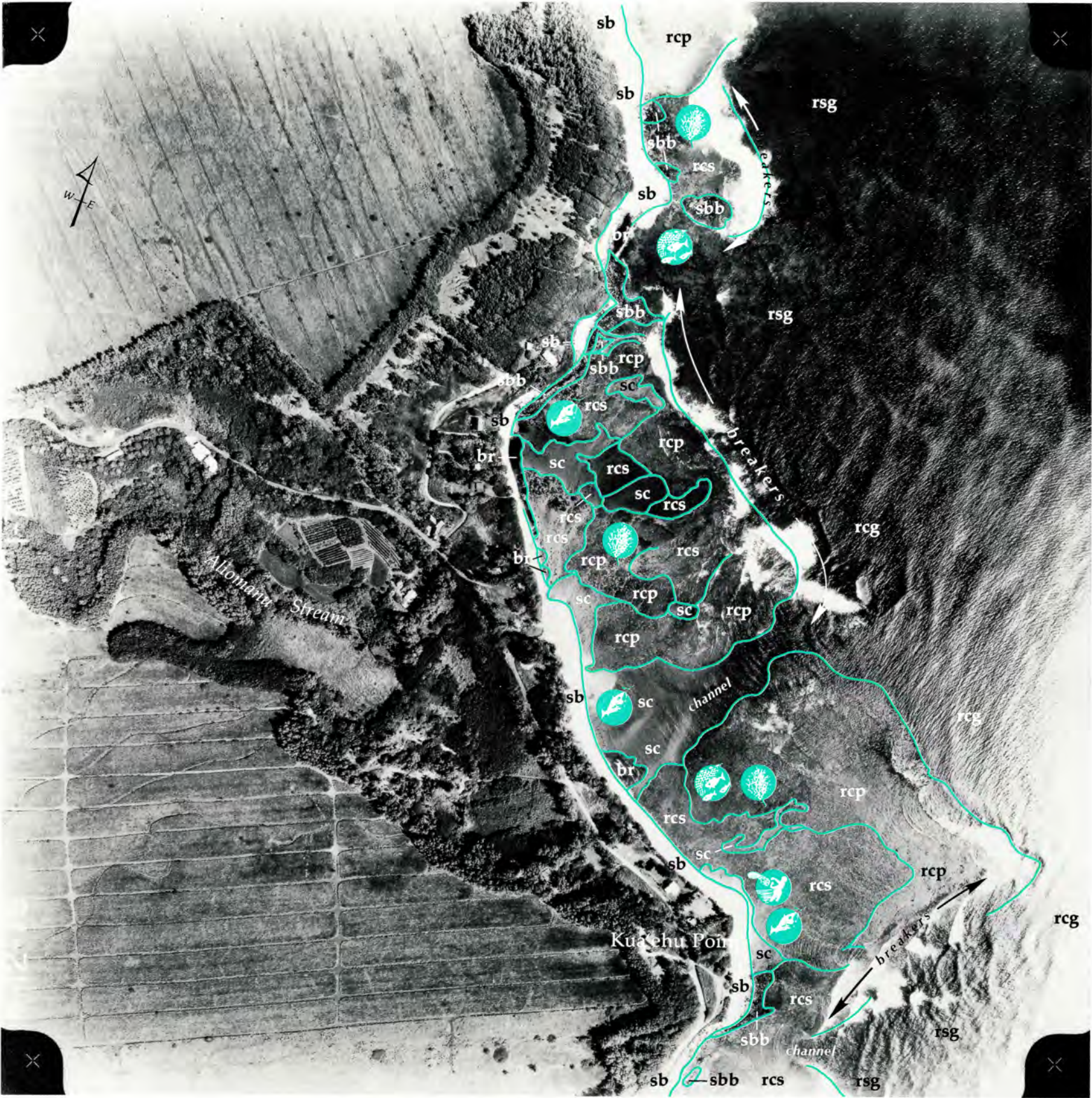
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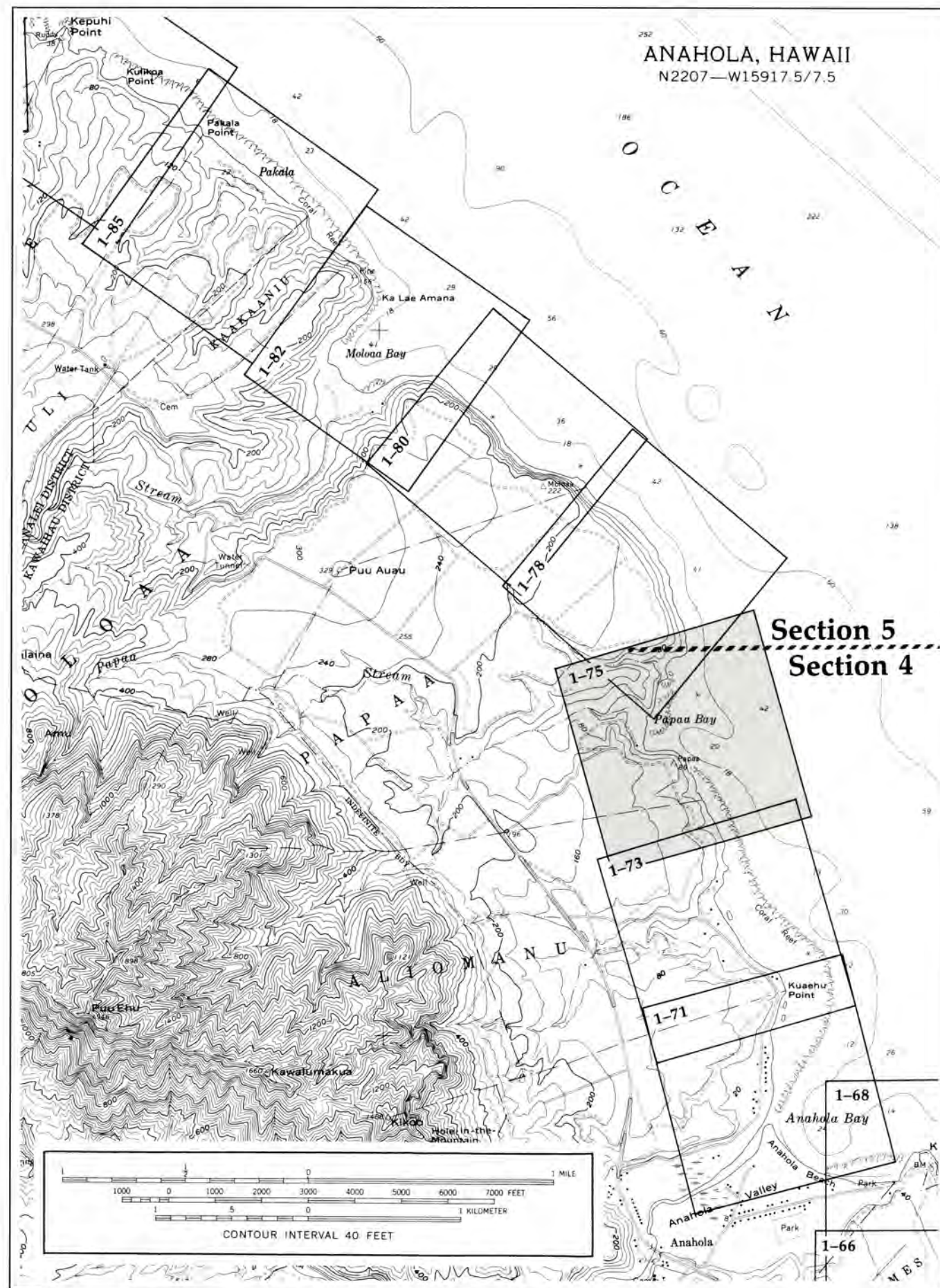
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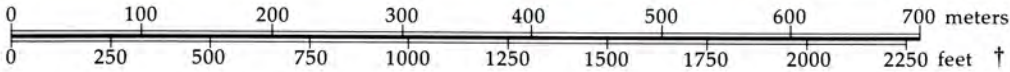
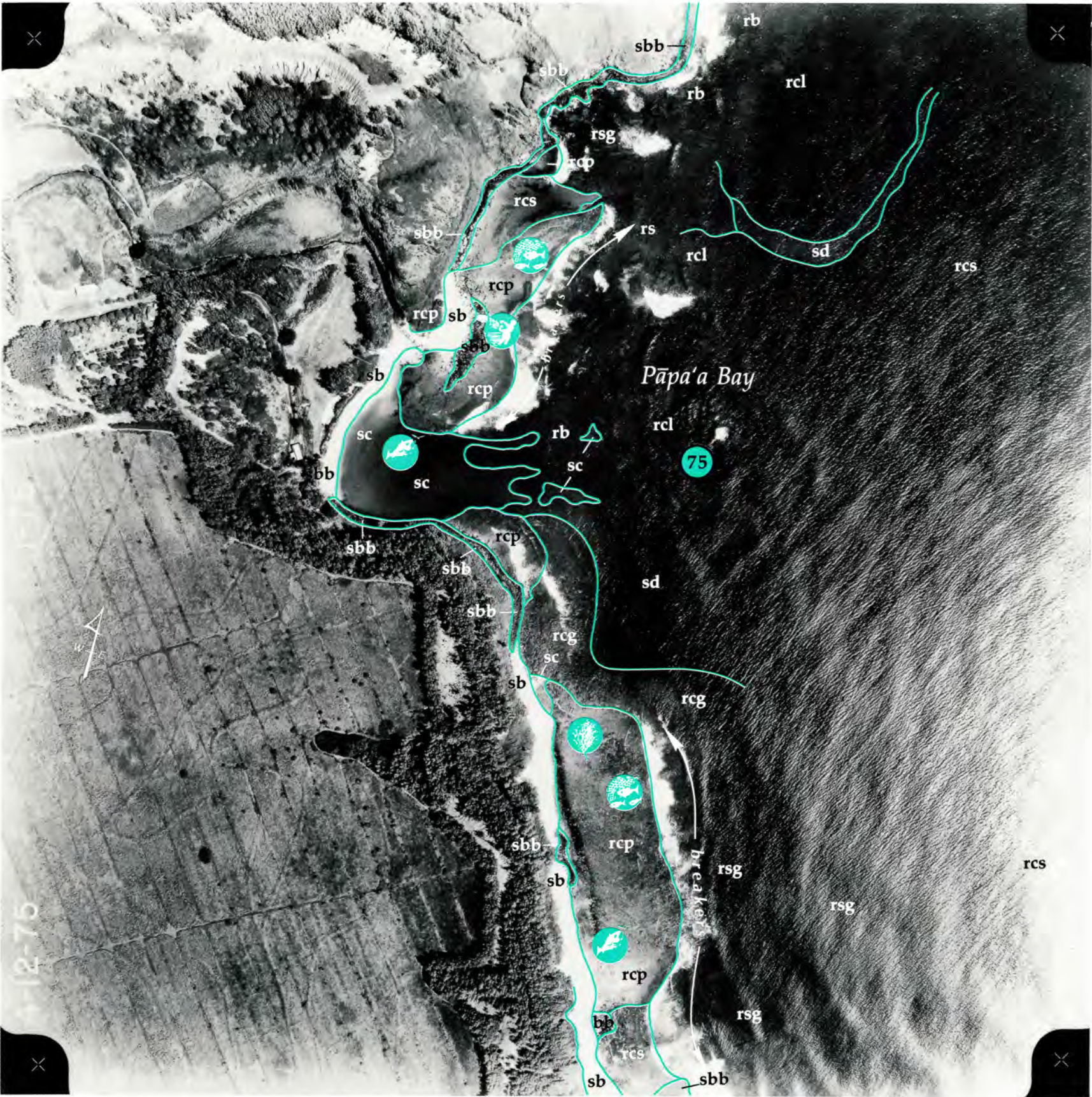
USES NOT RELATED TO BIOTA

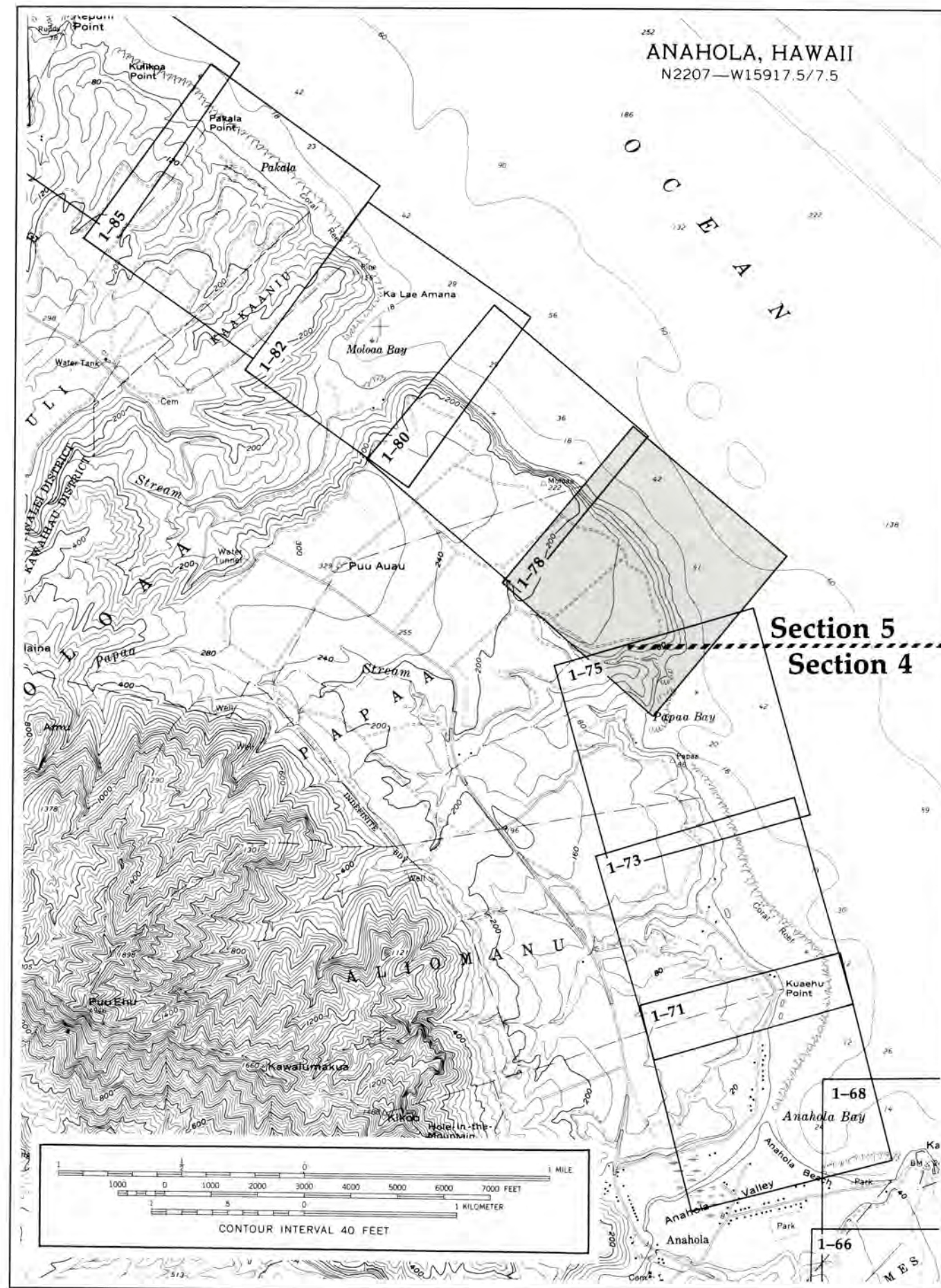
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- Trapping.
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- Seaweed (limu).
- Sport-diving.
- Shell collecting.

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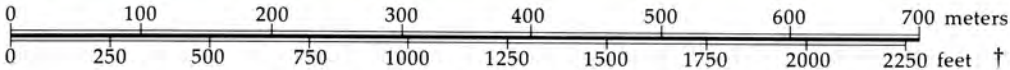
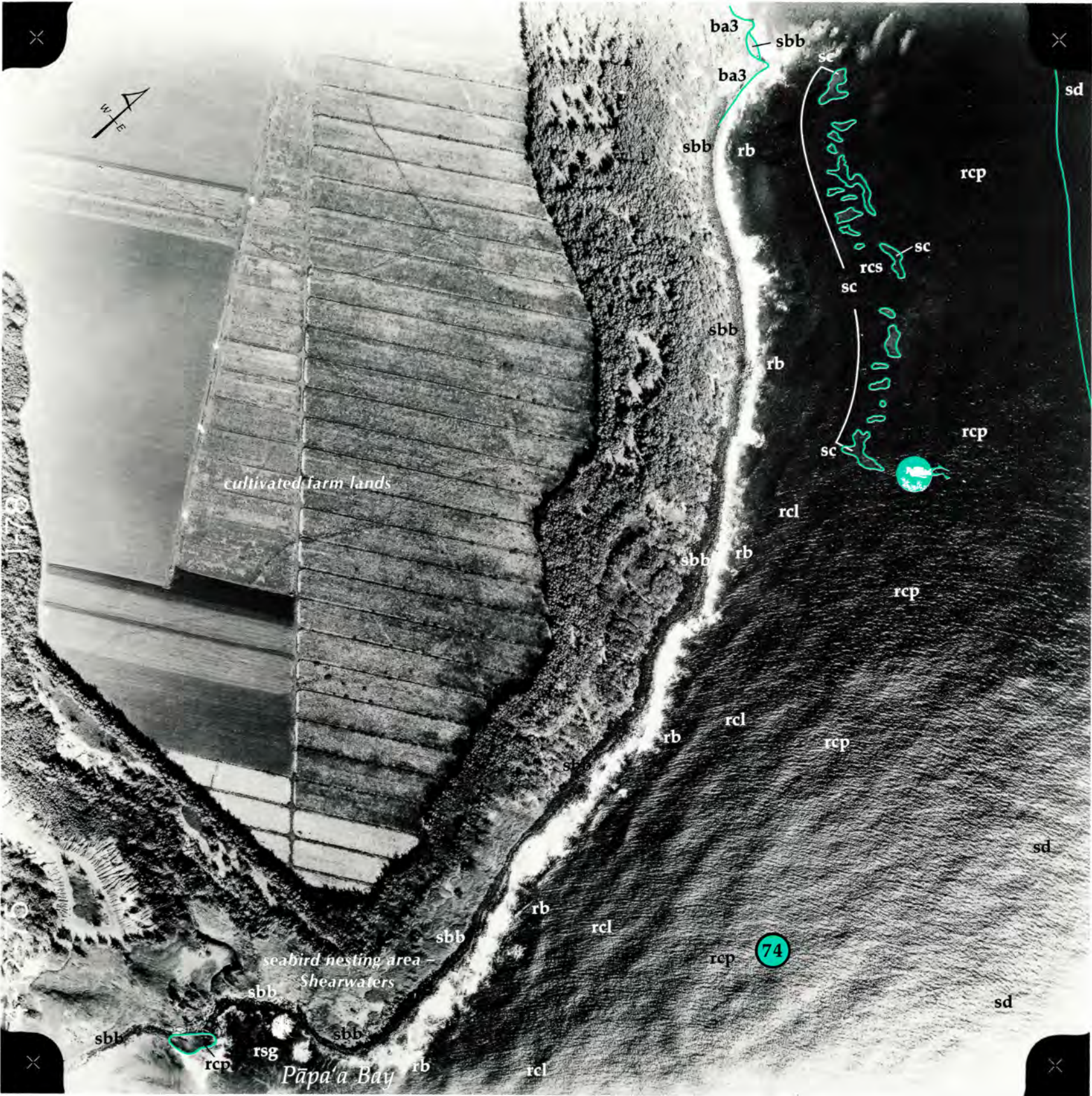
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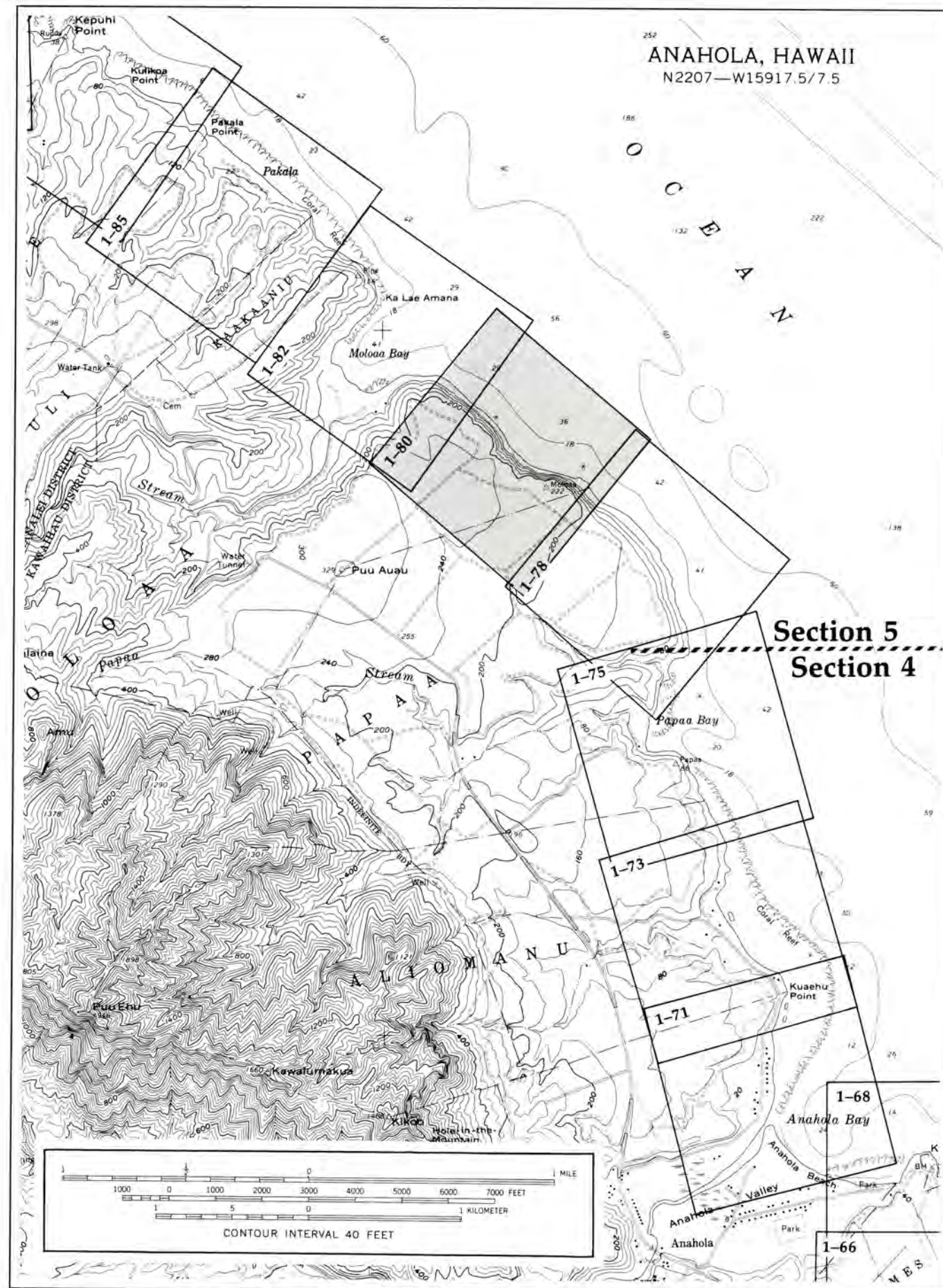
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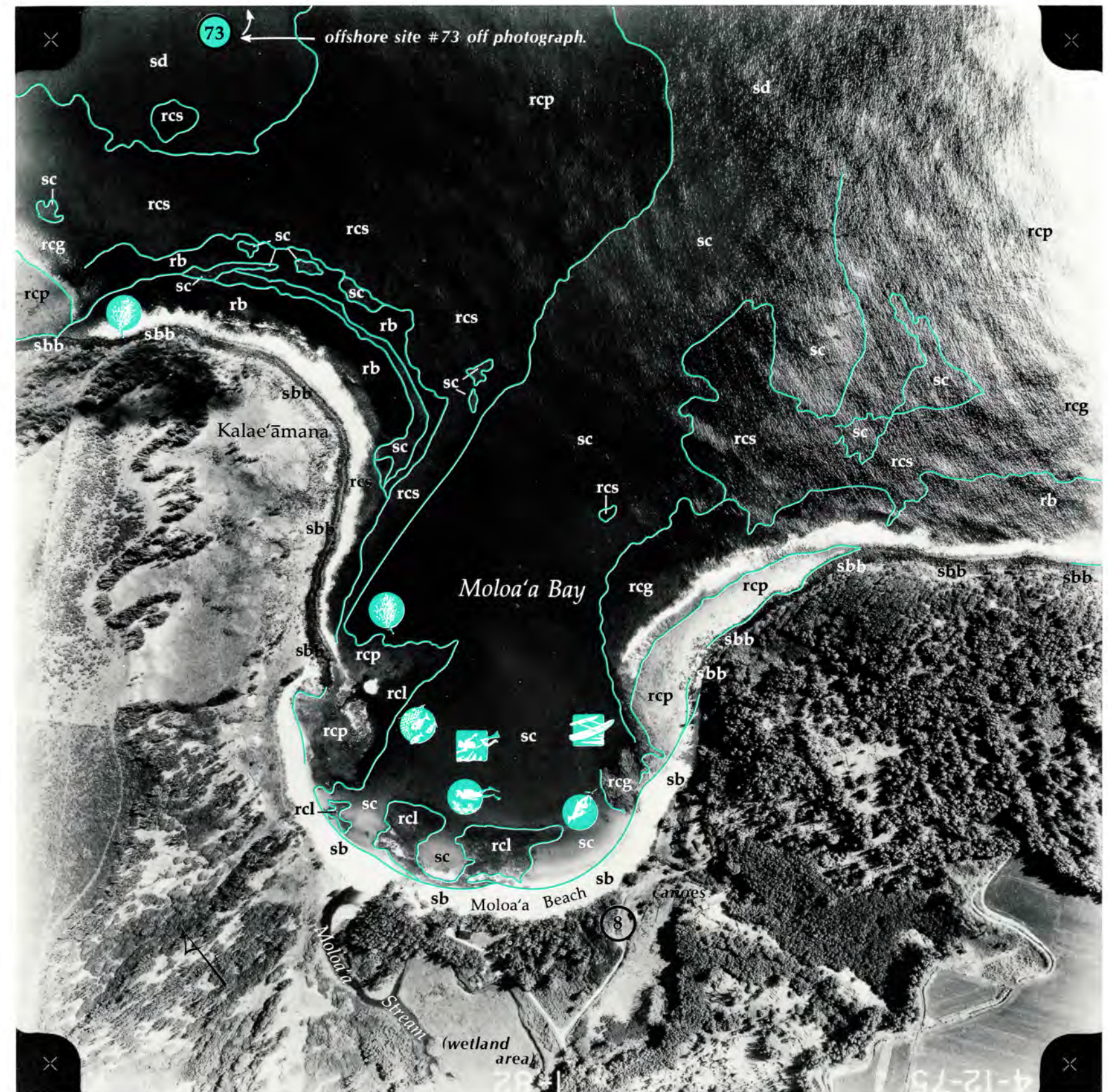
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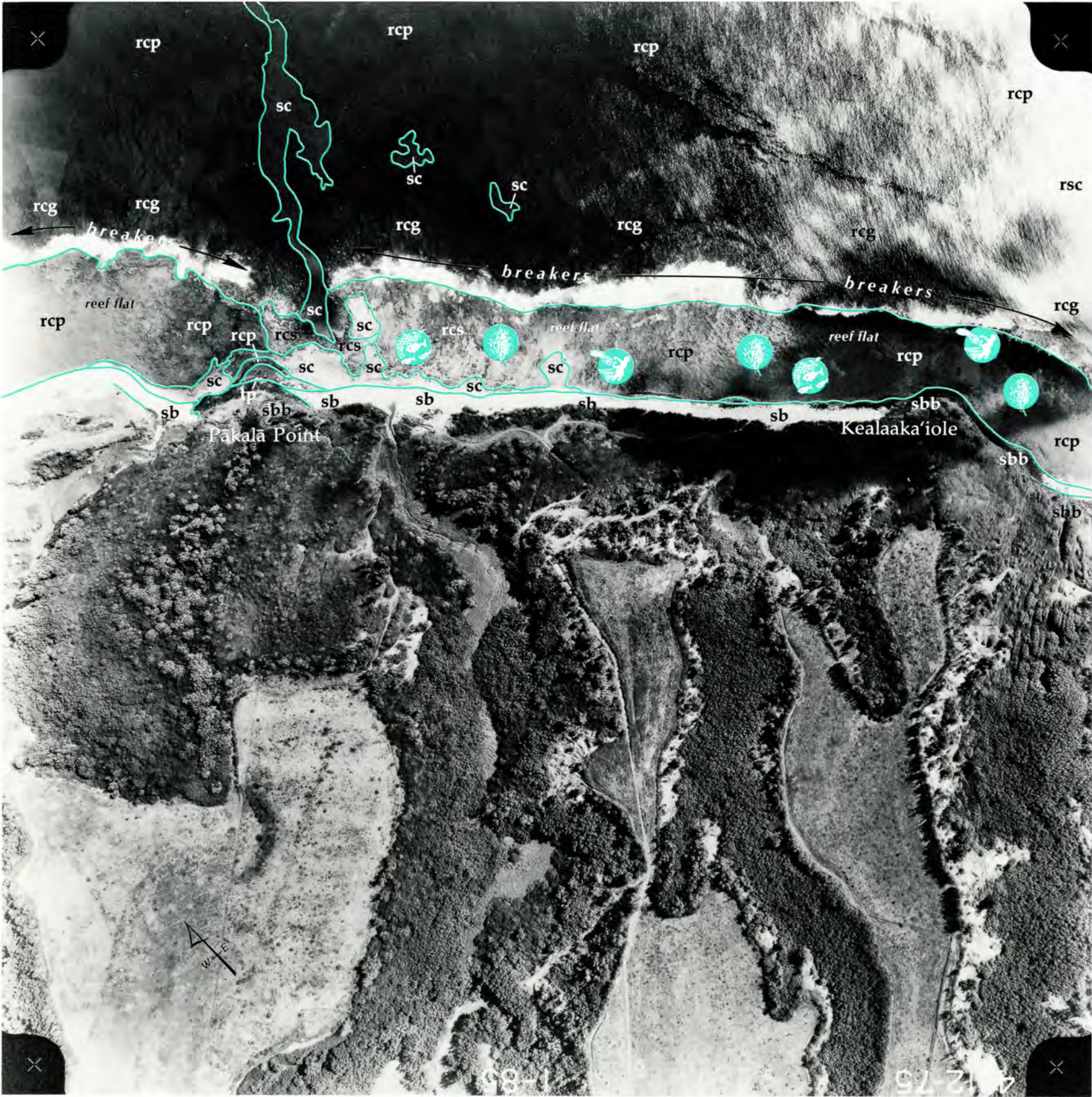
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0 100 200 300 400 500 600 700 meters
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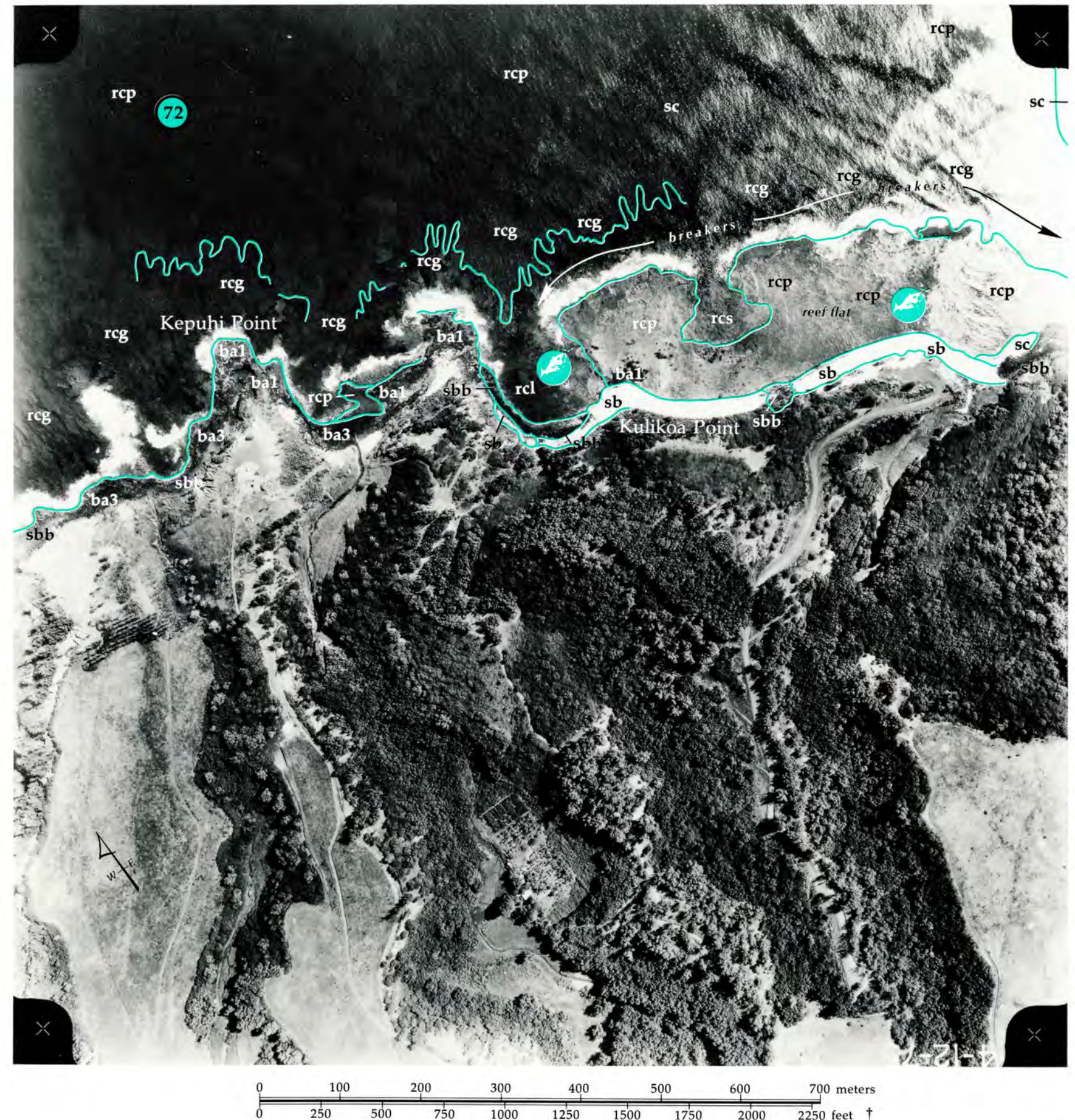
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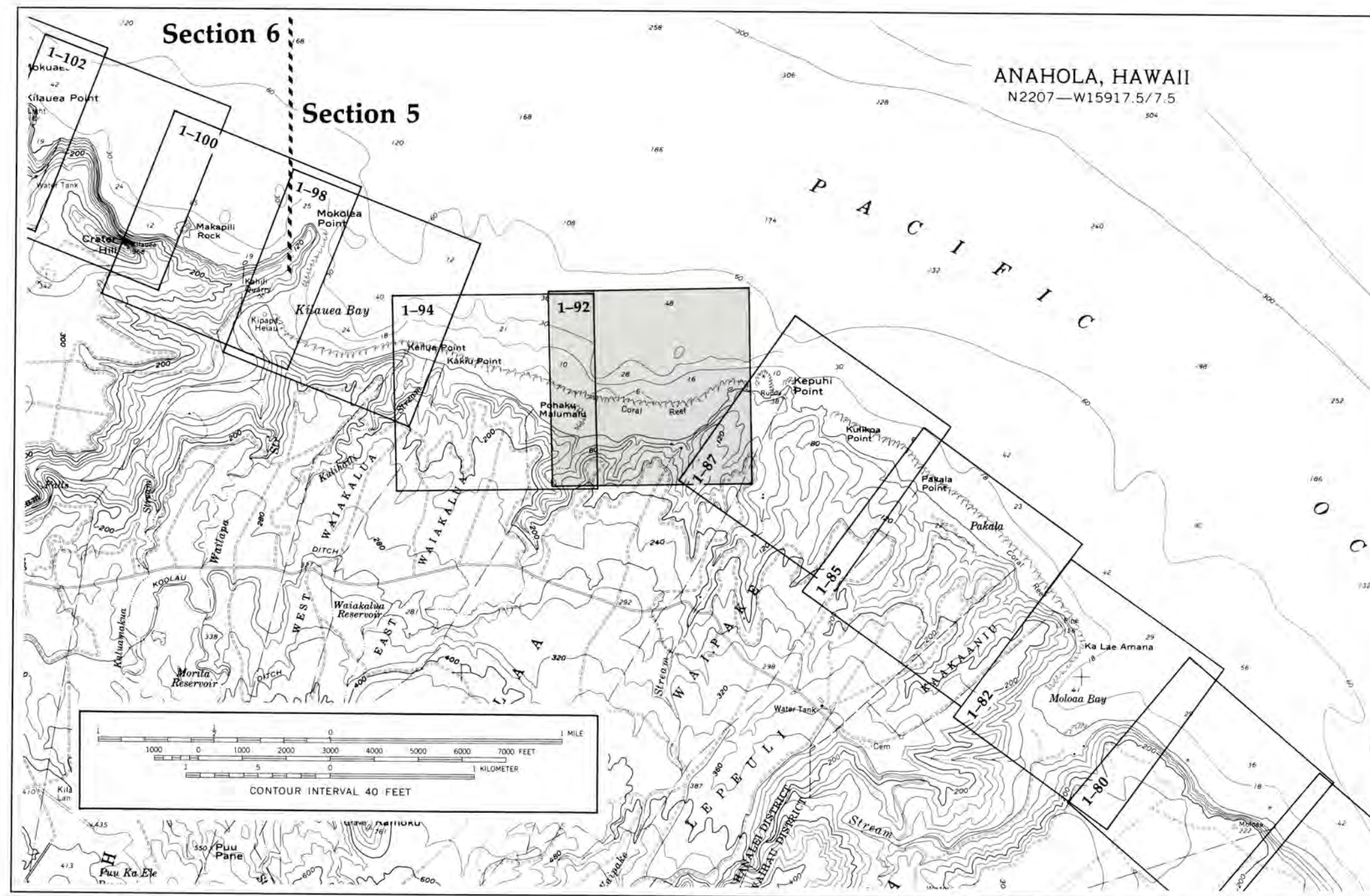
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Categories	% Sand	% Rock
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rbs, rcs, rsg	25 - 50	50 - 75
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Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

-  Pole-and-line fishing.
-  Gill-netting.
-  Throw-netting.
-  Spearfishing.
-  Torching.
-  Trapping.
-  Lobster.
-  Sea urchin (wana).
-  Octopus (he'e).
-  Surround netting.
-  Aquarium fish collecting.
-  Seaweed (limu).
-  Sport-diving.
-  Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

-  Crabbing (kona, 'a'ama, swimming crab).
-  Limpet (opihi).
-  Trolling, bottom-fishing.
-  Specialized fisheries (type indicated).

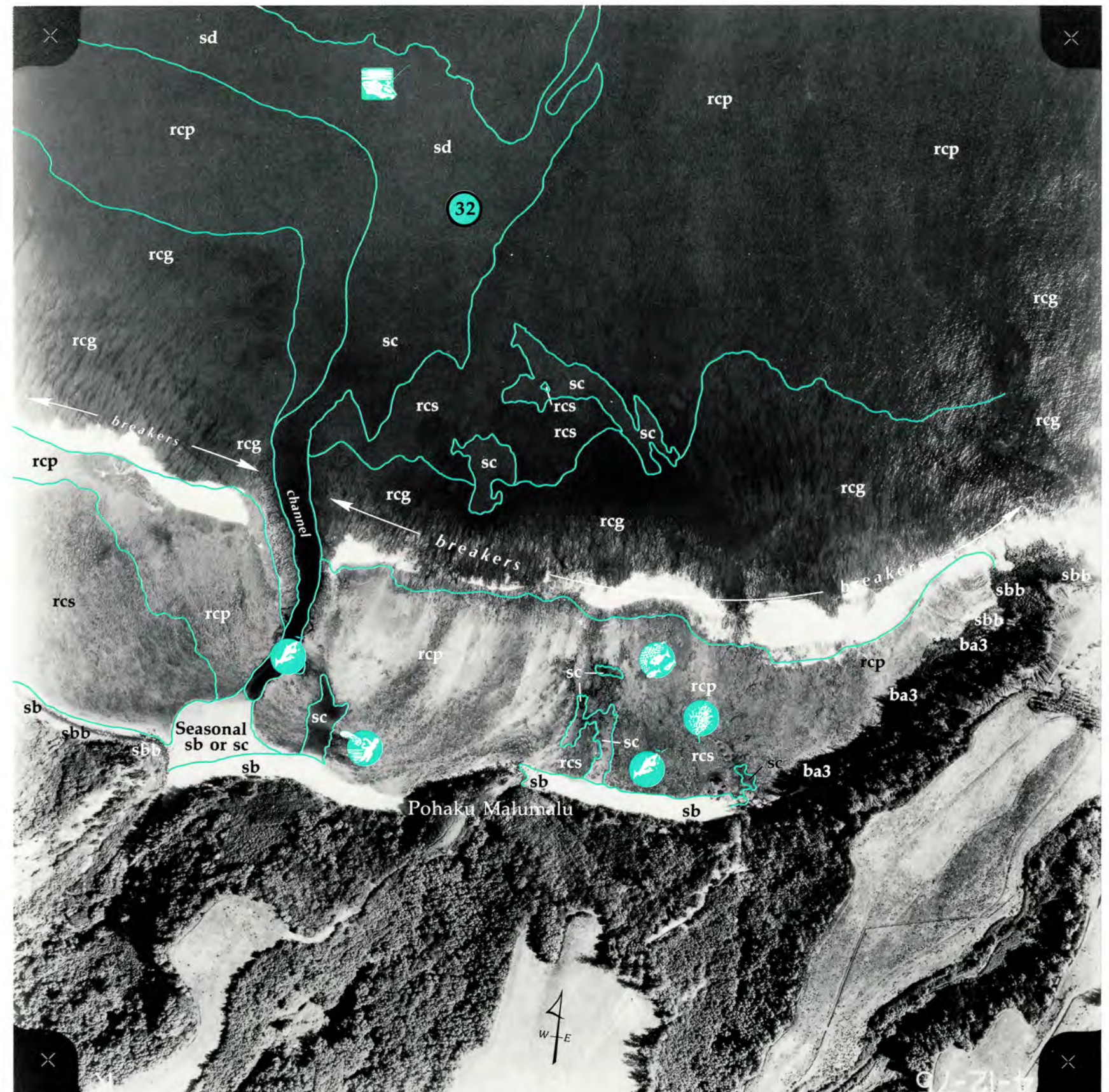
USES NOT RELATED TO BIOTA

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Study Sites

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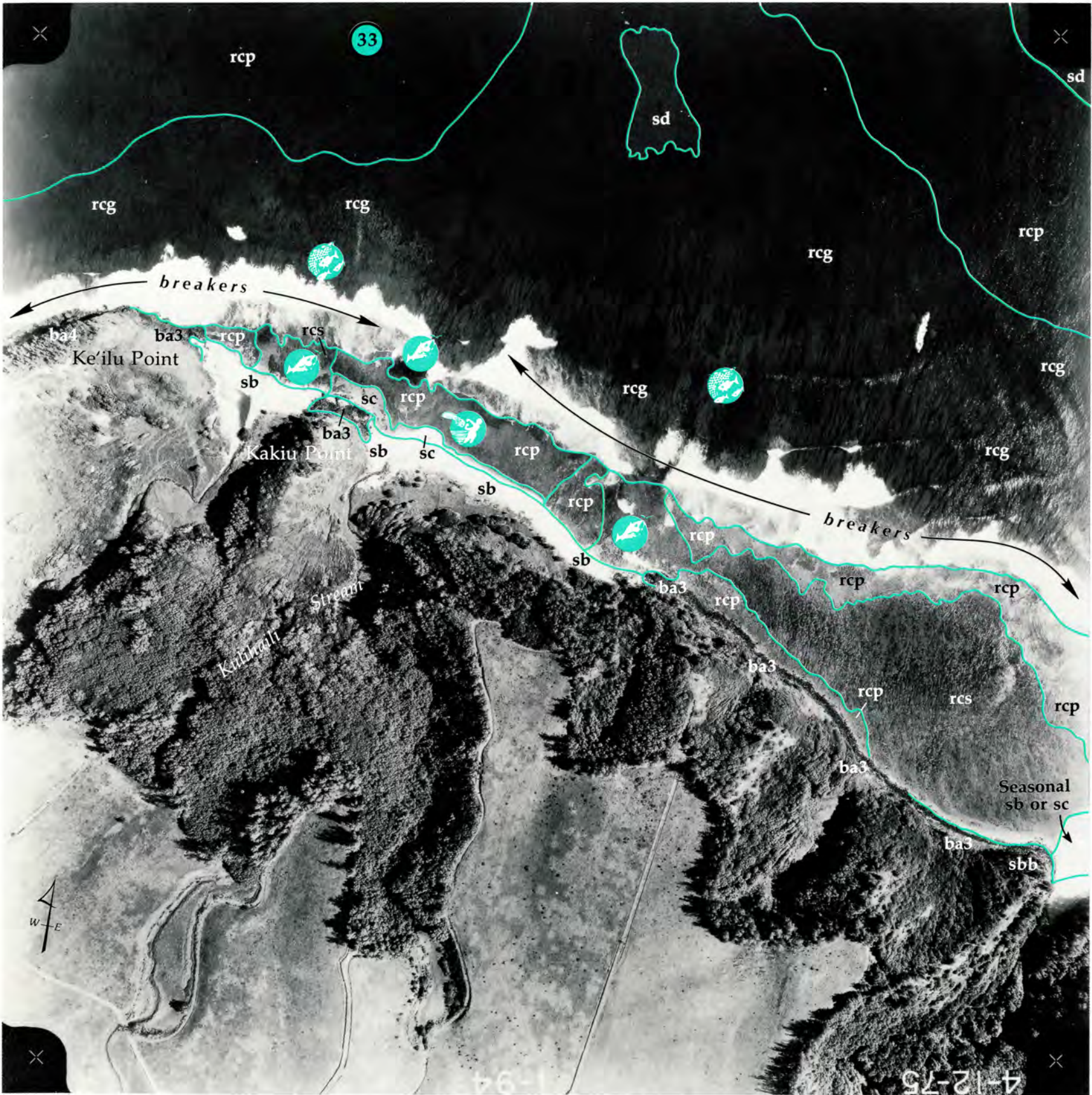
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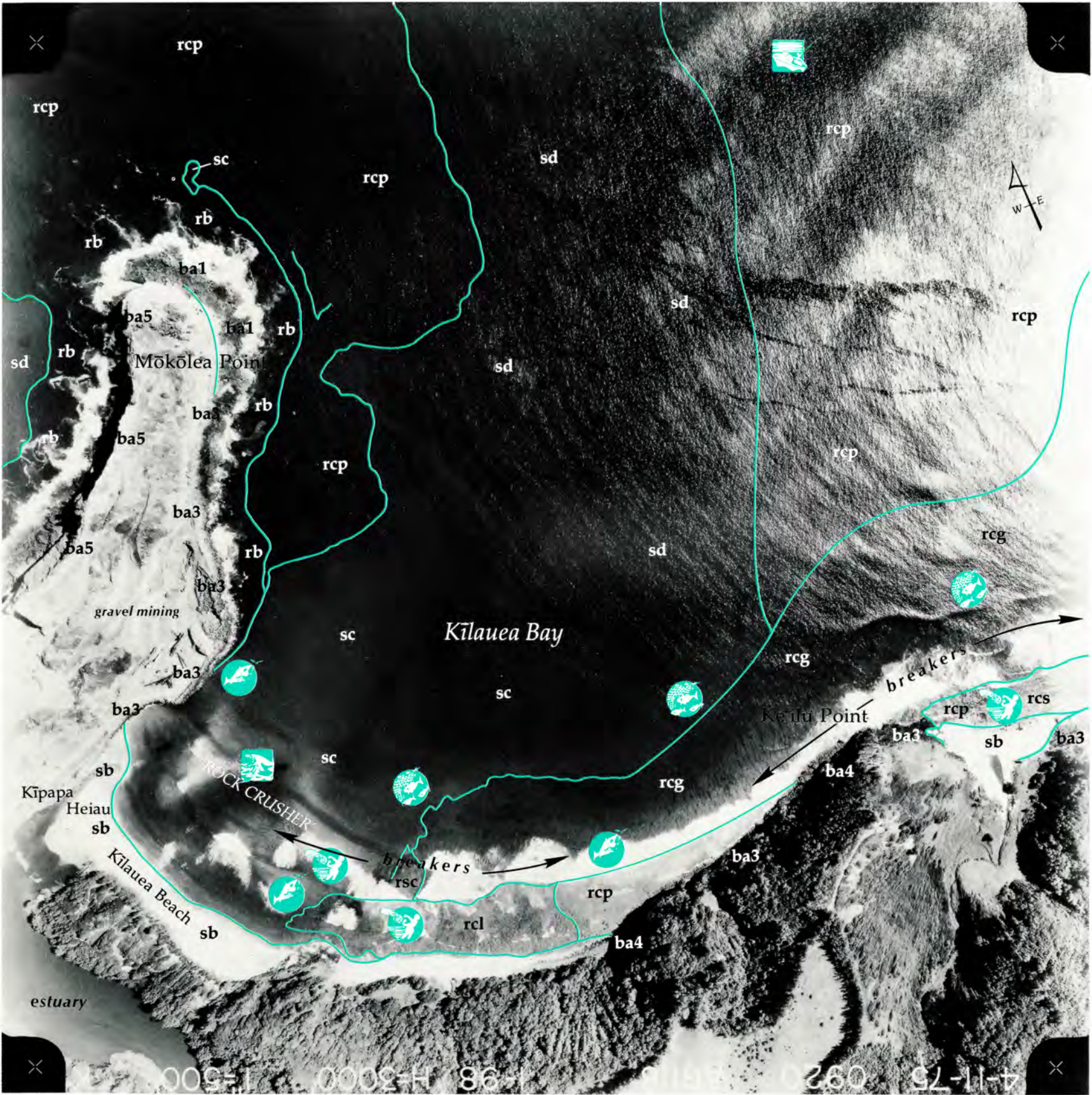
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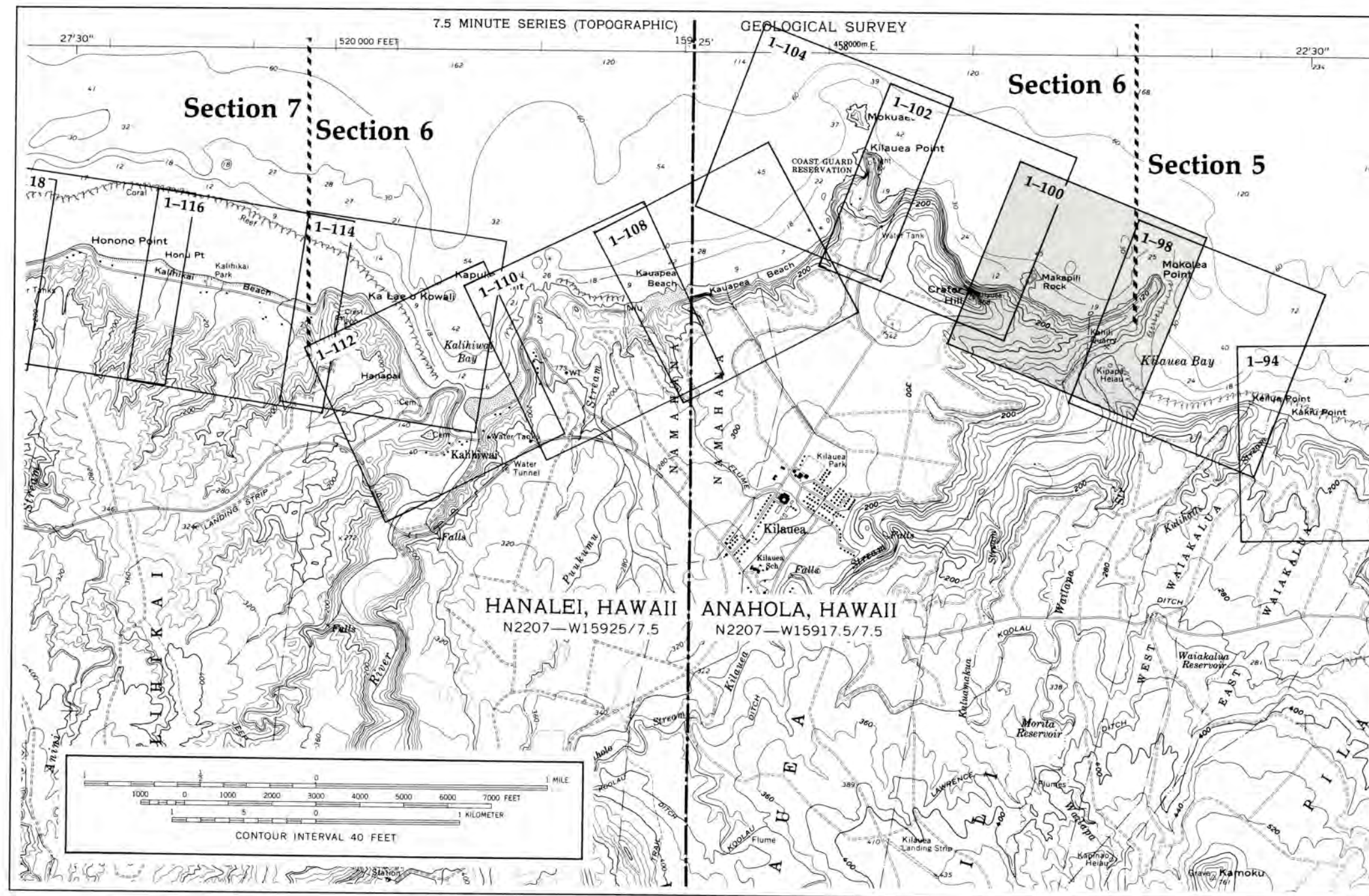
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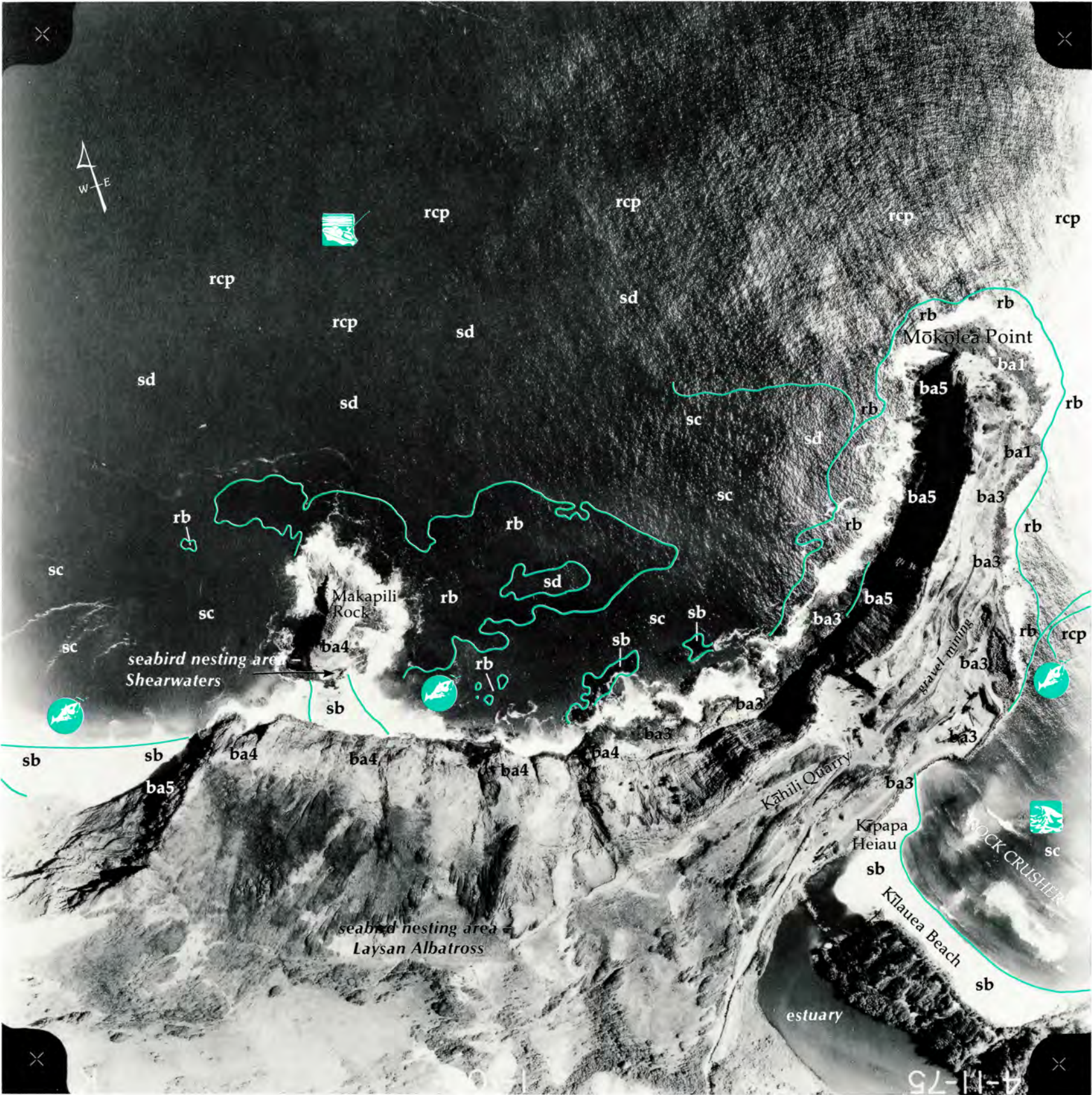
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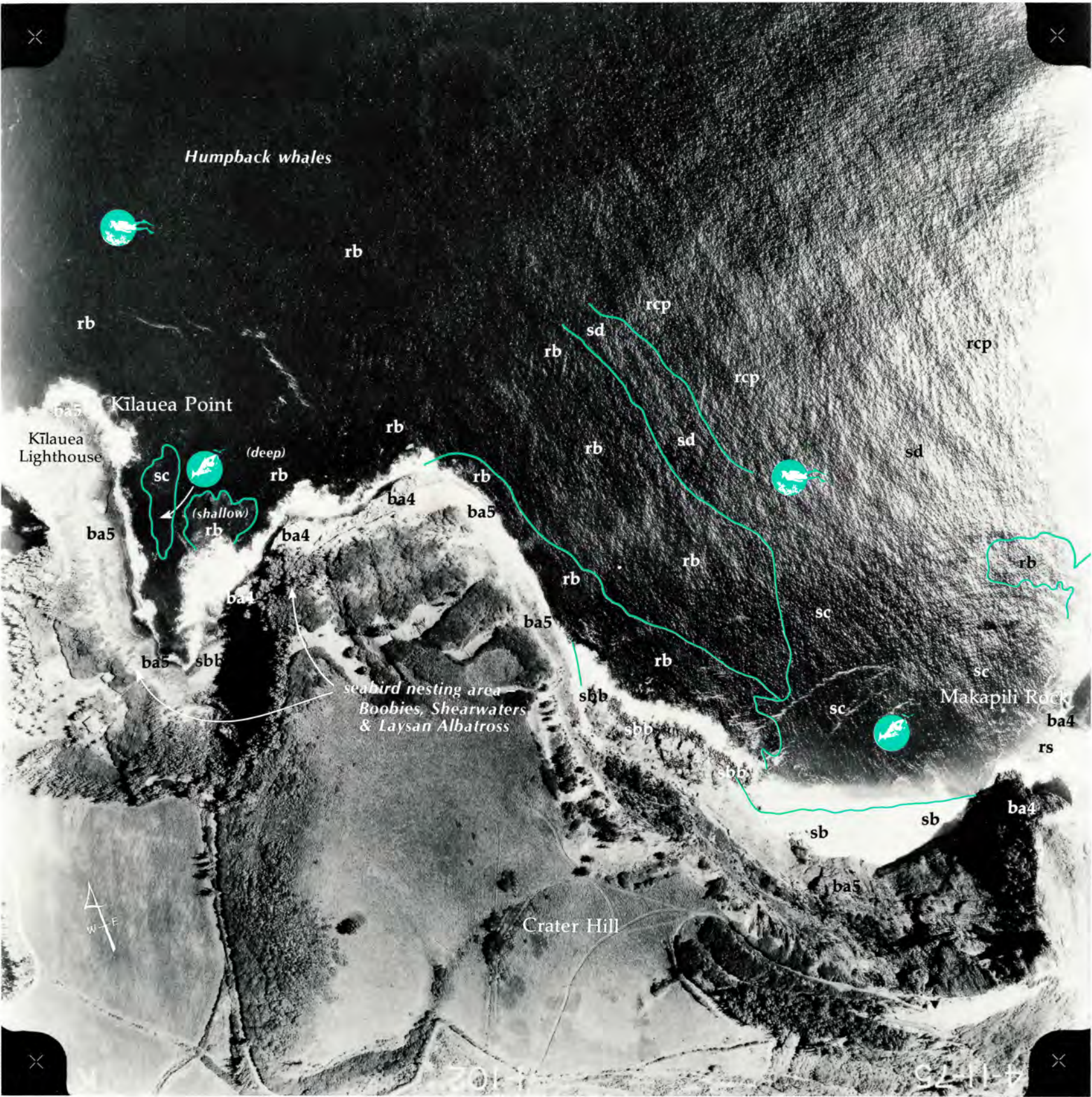
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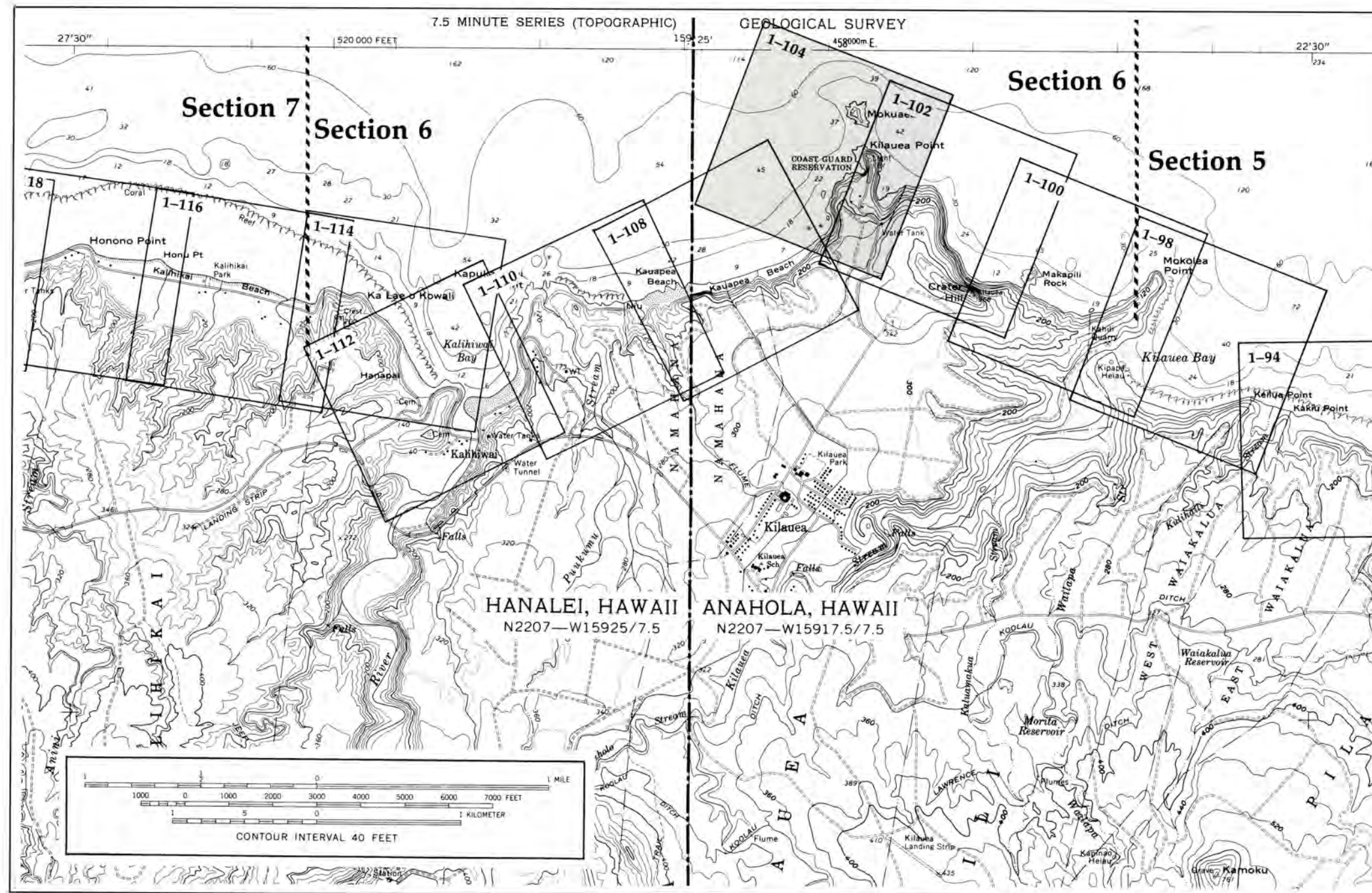
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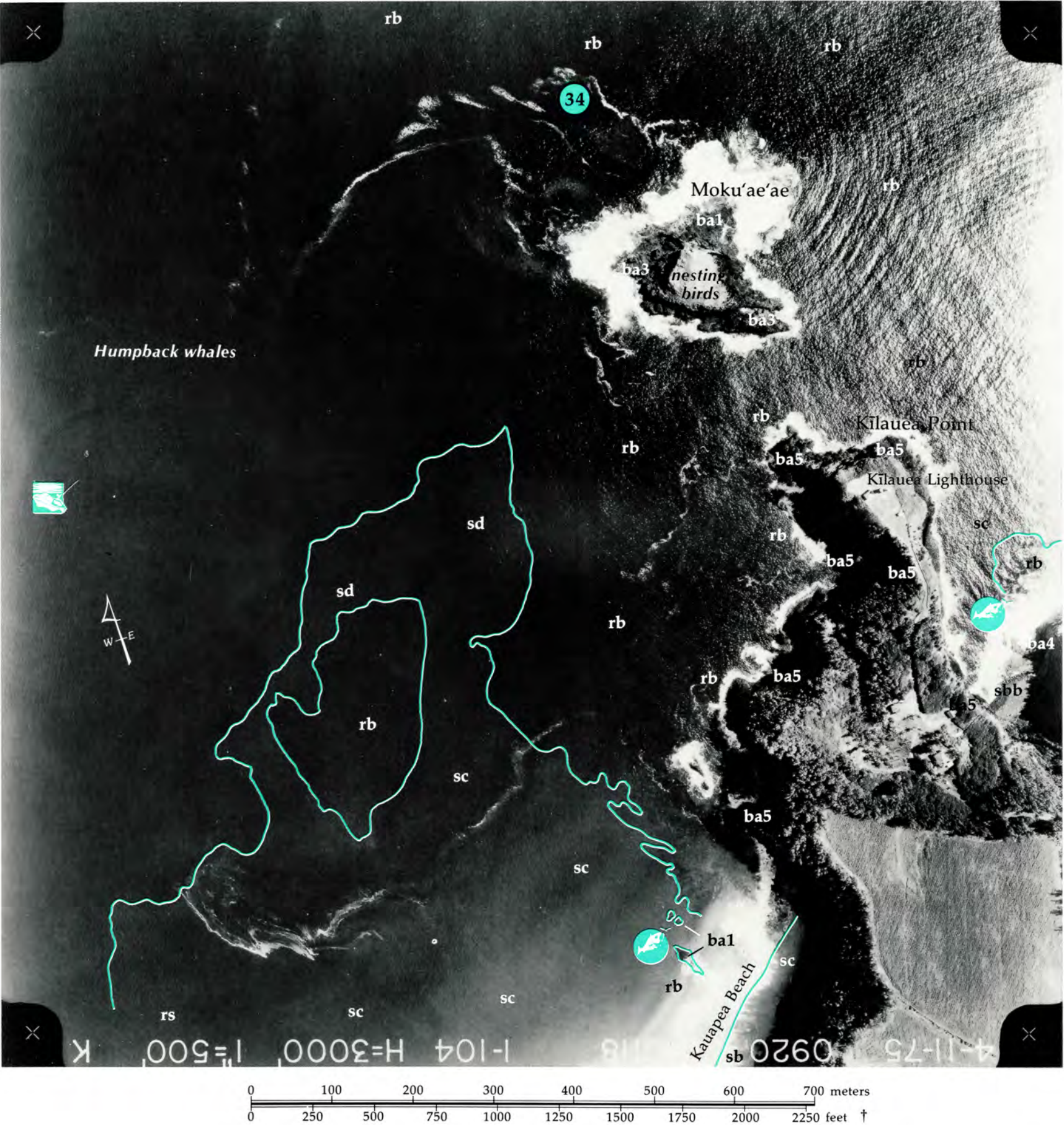
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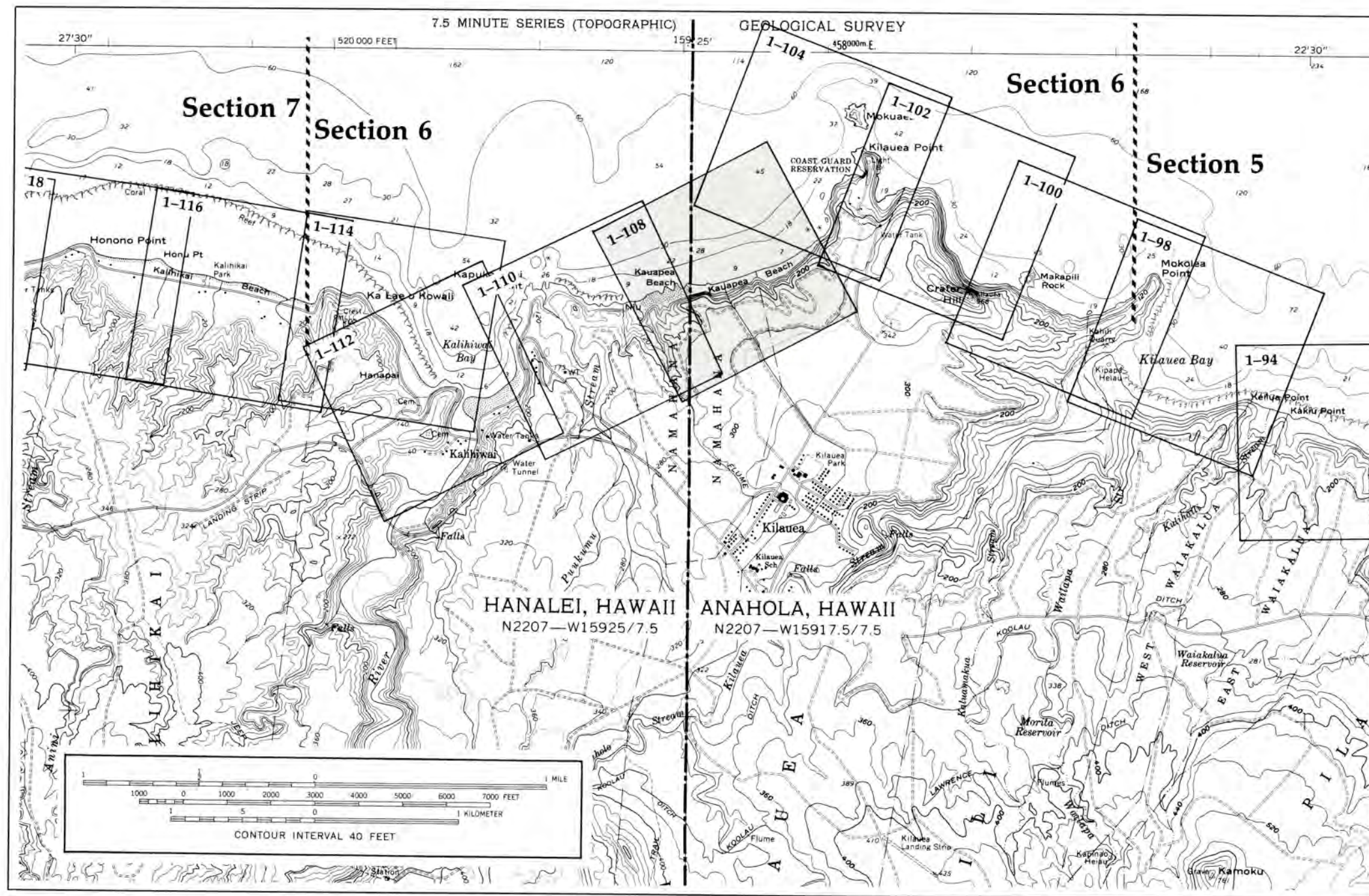
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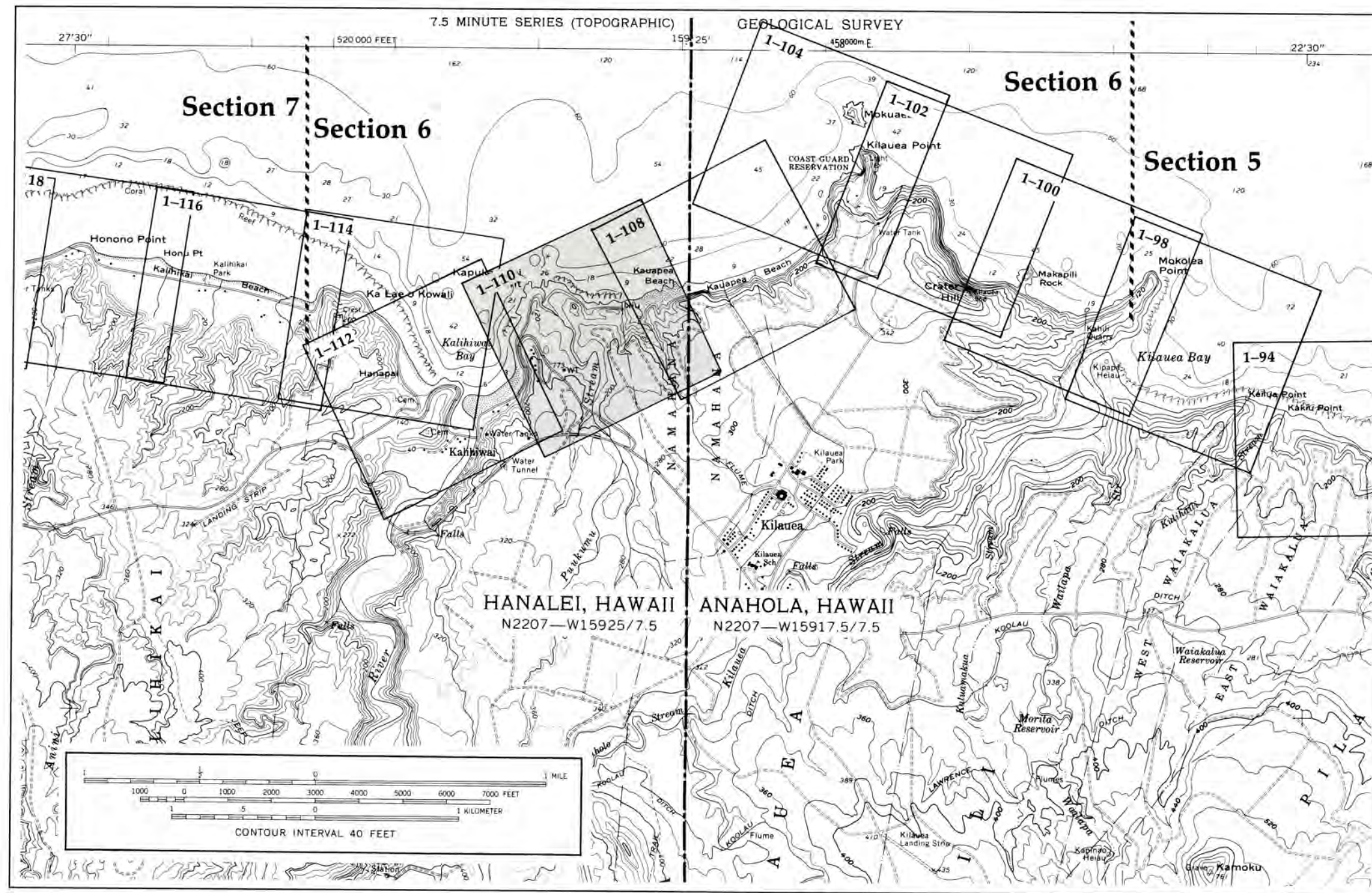
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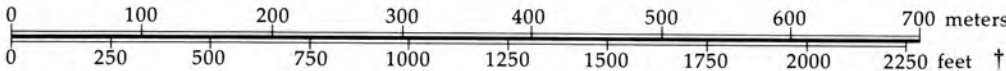
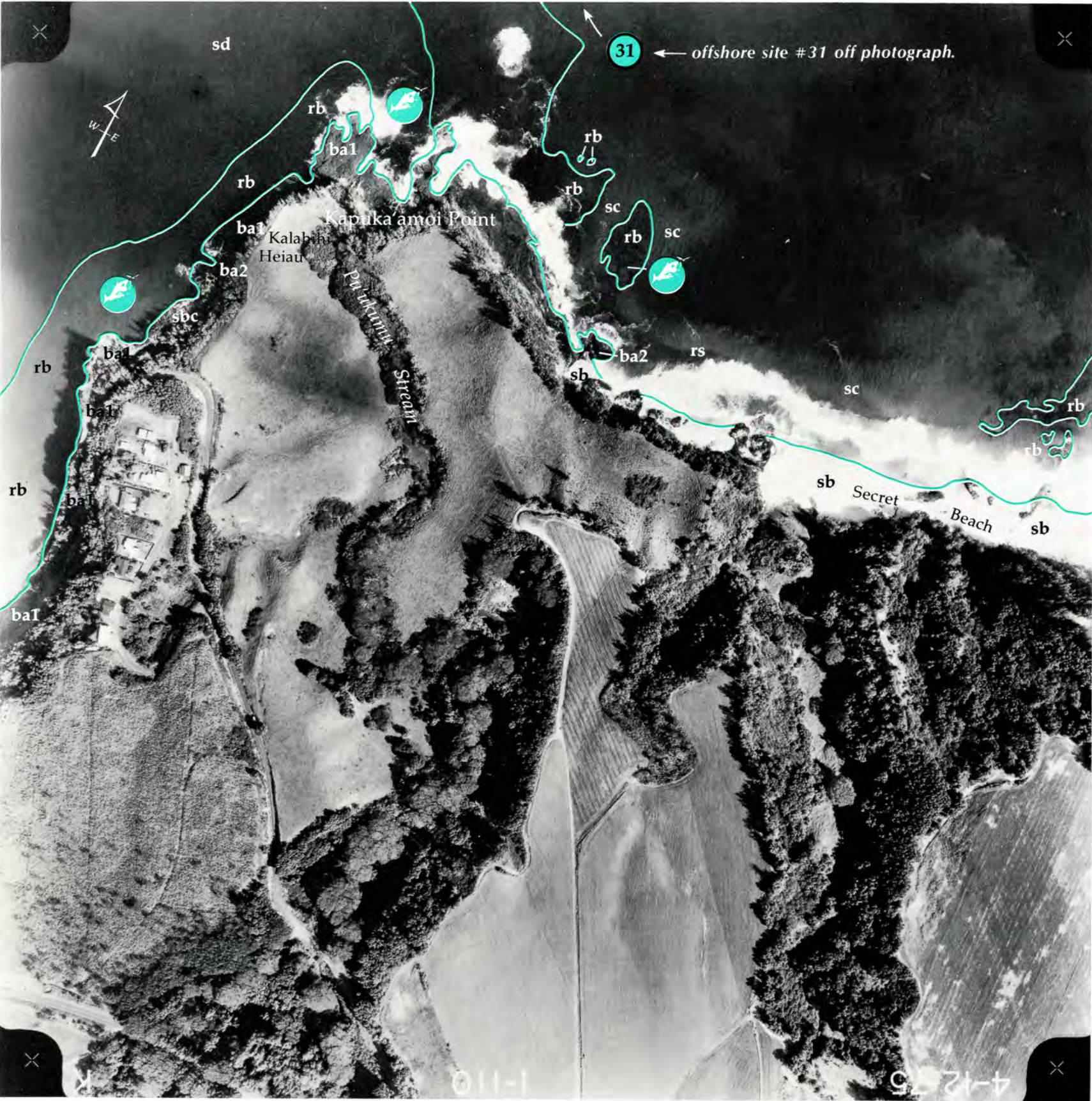
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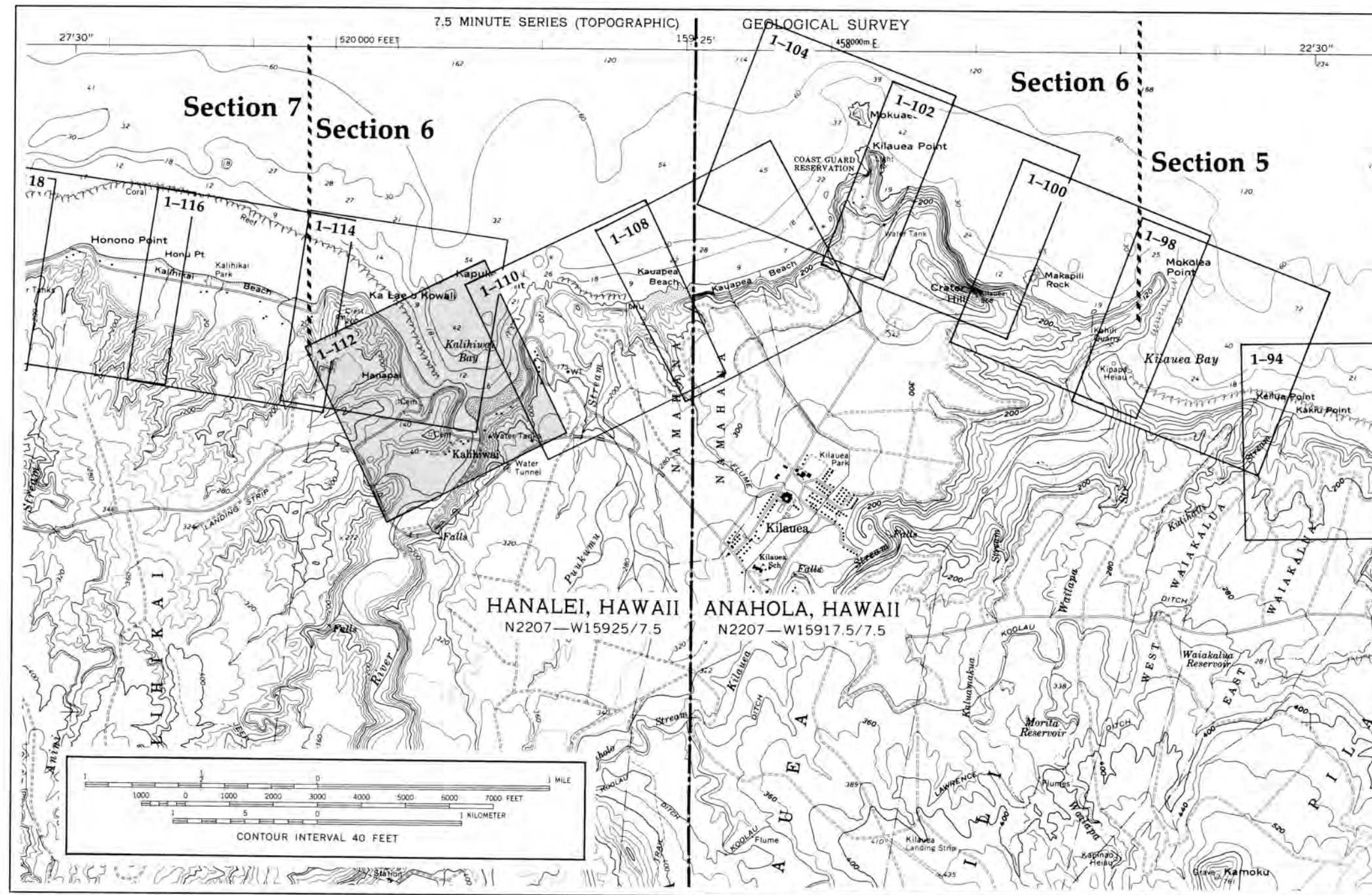
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- Aquatic recreation (smallcraft sailing, wind-surfing).
- Excursion boat.
- Anchorage.

Study Sites

- Shoreline (above water observations).
- Inshore (inside reef edge).
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- rcg - Consolidated reef with well defined groove-and-spur system.
- rsg - Sand predominates in the depressions of conspicuous groove-and-spur system.
- rcs - Mostly consolidated reef with some (25-50%) sediment bottom.

SHORELINE

- ba - Volcanic rock shorelines.**
 - ba1 - Low basalt outcrops/shoreline less than 1 meter high, including ramps.
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- bc - Concrete/cement masonry seawalls and shorelines.**
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Special types.

- br - Beachrock (a specialized category normally formed at the shoreline).
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Aerial Photograph Based Classification System

OFFSHORE

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rc - Reef complex.

- rc - Shallow reef flats or structural reefs, normally (but not exclusively) in water depths less than 2 meters.
- rcl - Consolidated limestone; lacking sediment (also a catch-all for moderate to high relief areas).
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Offshore Bottom Type Summary

Categories	% Sand	% Rock
rbc, br, s, sb, sc, sd	100	—
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rbs, rcs, rsg	25 - 50	50 - 75
r, rc, co	less than 25	more than 75
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-  Throw-netting.
-  Spearfishing.
-  Torching.
-  Trapping.
-  Lobster.
-  Sea urchin (wana).
-  Octopus (he'e).
-  Surround netting.
-  Aquarium fish collecting.
-  Seaweed (limu).
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-  Shell collecting.

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-  Limpet (opihi).
-  Trolling, bottom-fishing.
-  Specialized fisheries (type indicated).

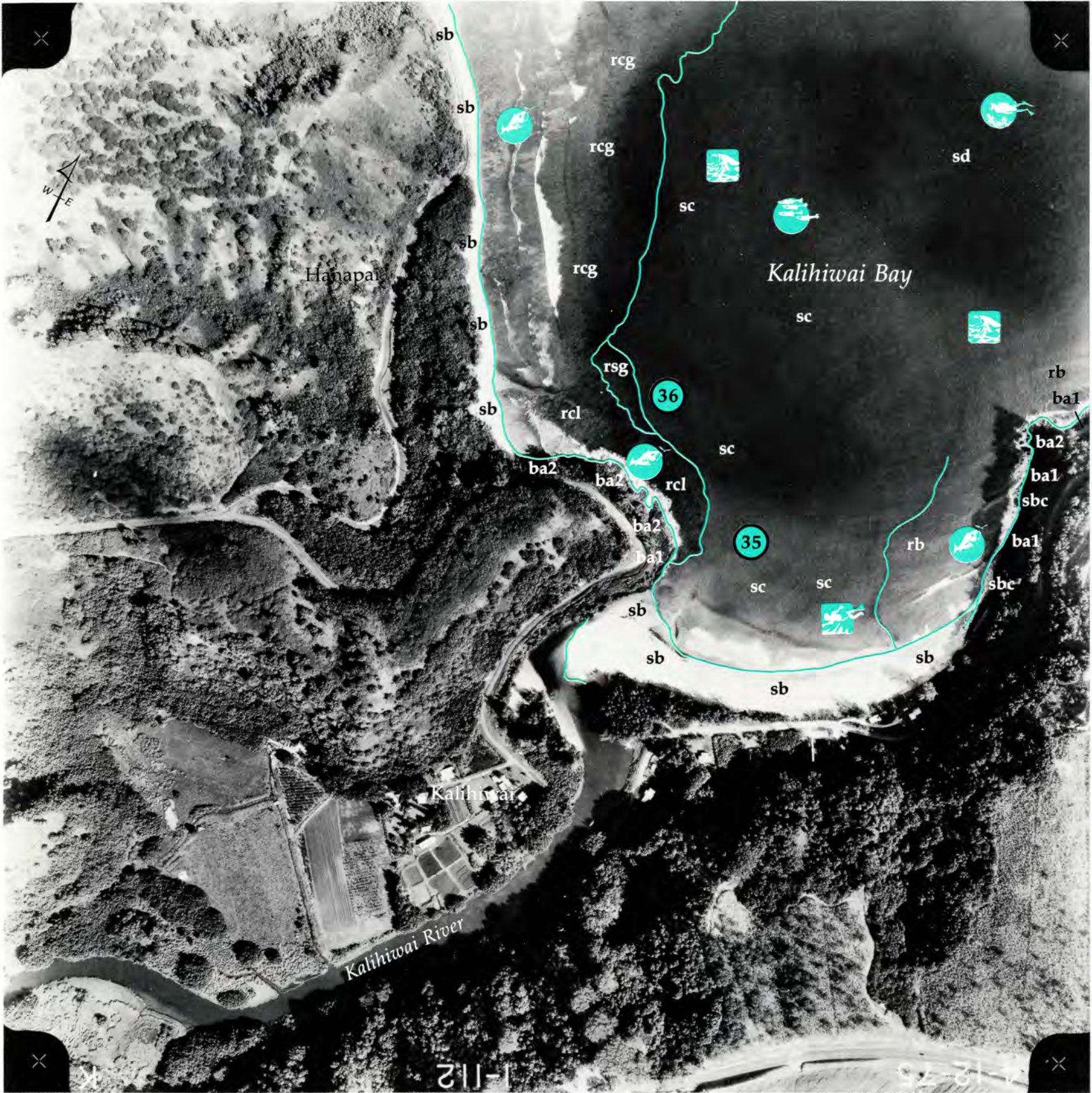
USES NOT RELATED TO BIOTA

-  Board surfing.
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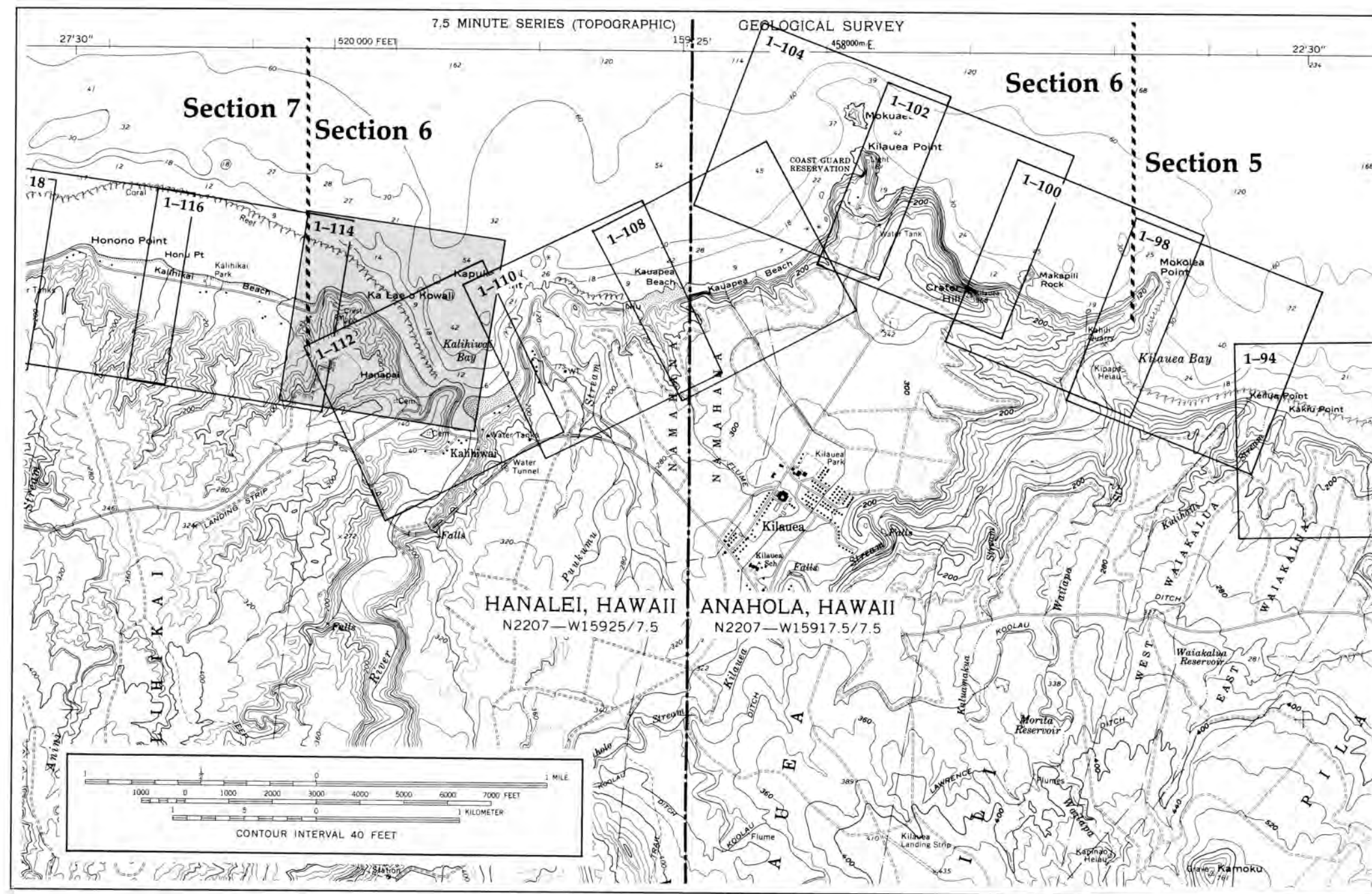
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0 100 200 300 400 500 600 700 meters
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- Torching.
- Trapping.
- Lobster.
- Sea urchin (wana).
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- Surround netting.
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- Seaweed (limu).
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- Shell collecting.

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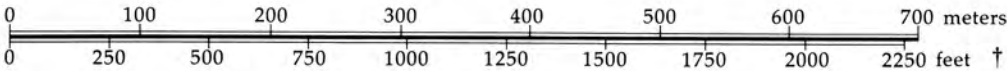
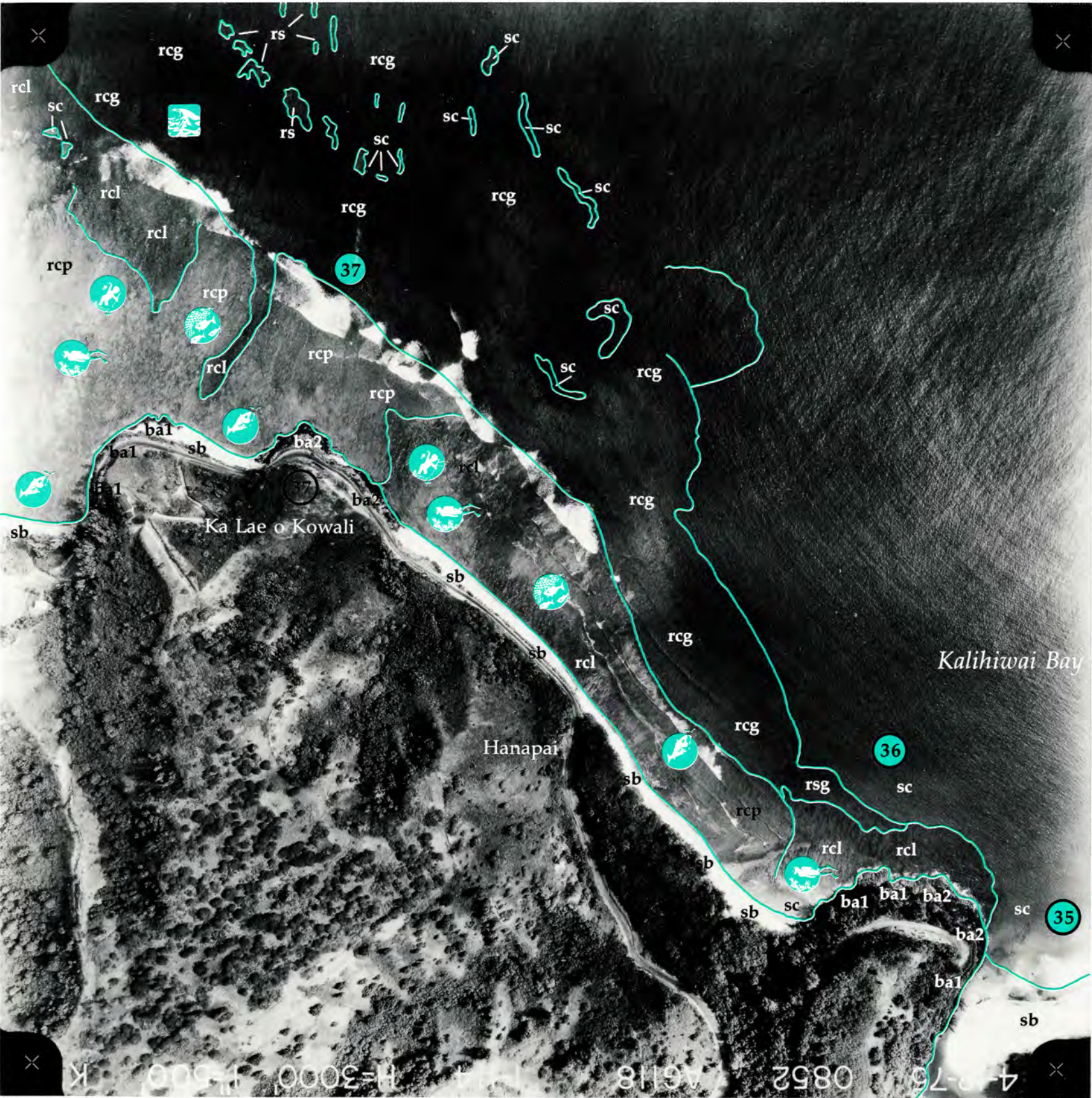
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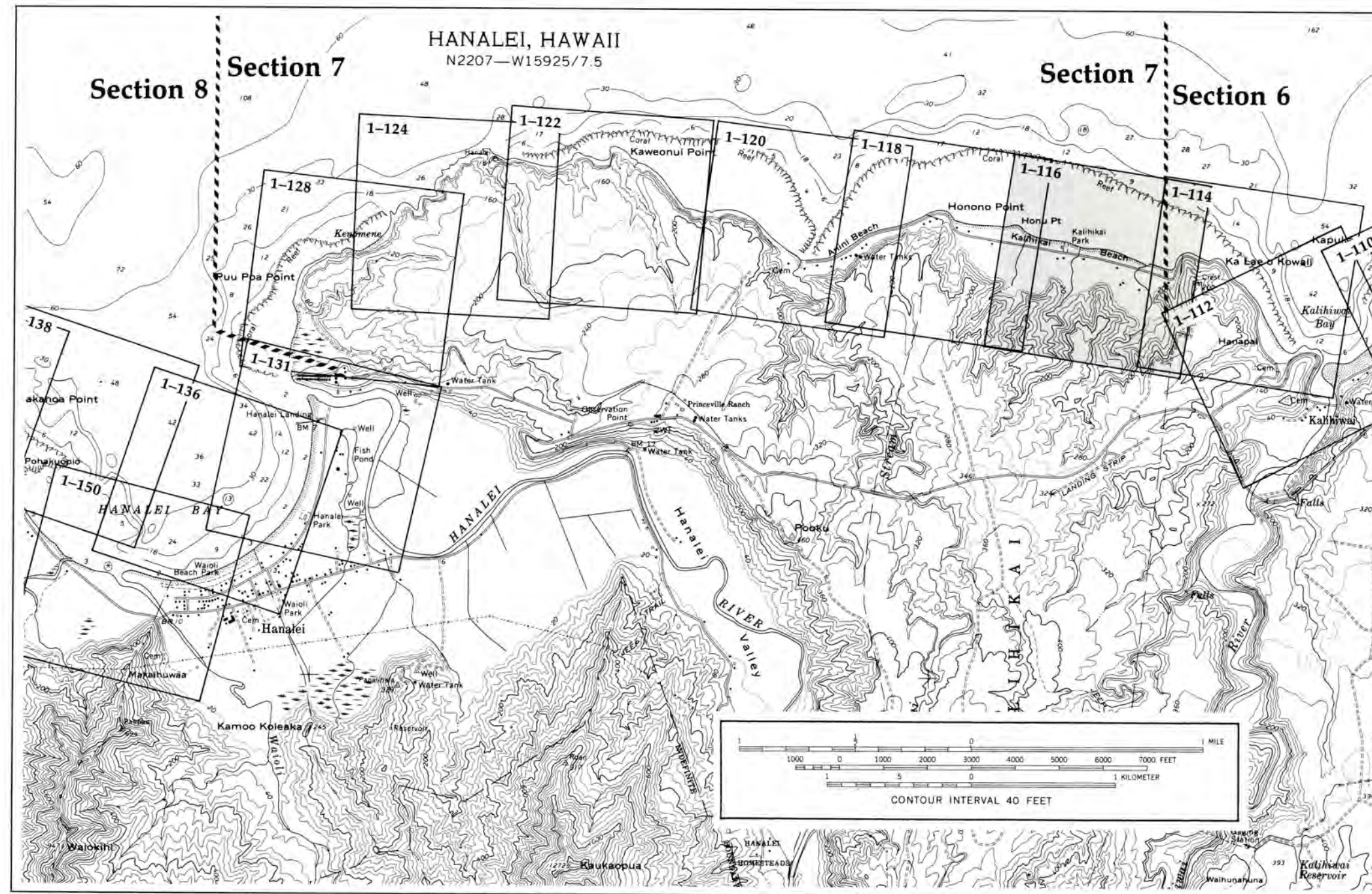
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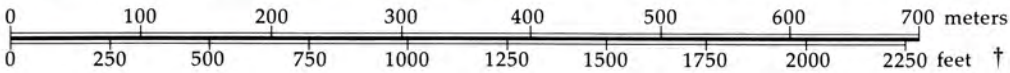
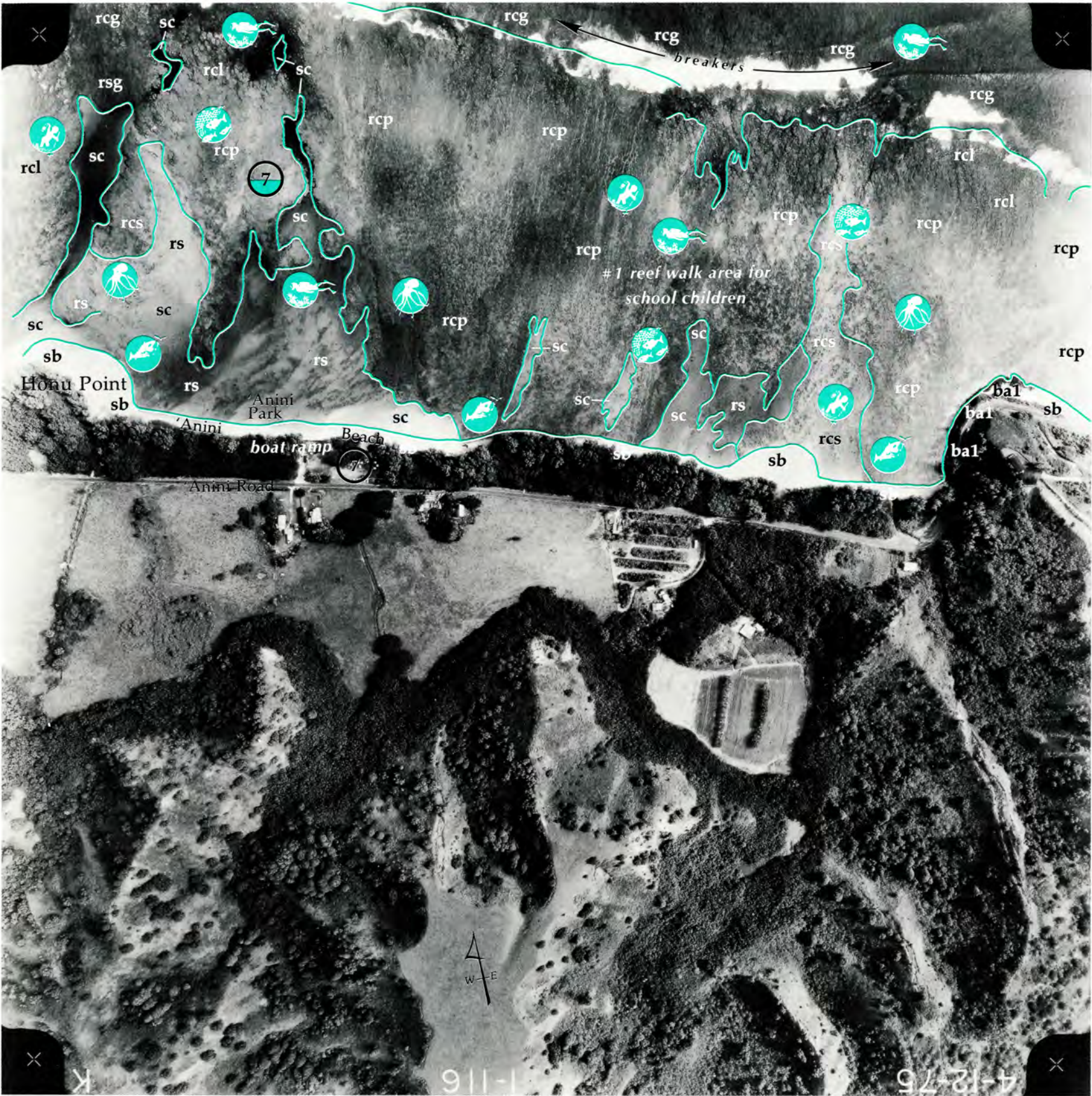
USES NOT RELATED TO BIOTA

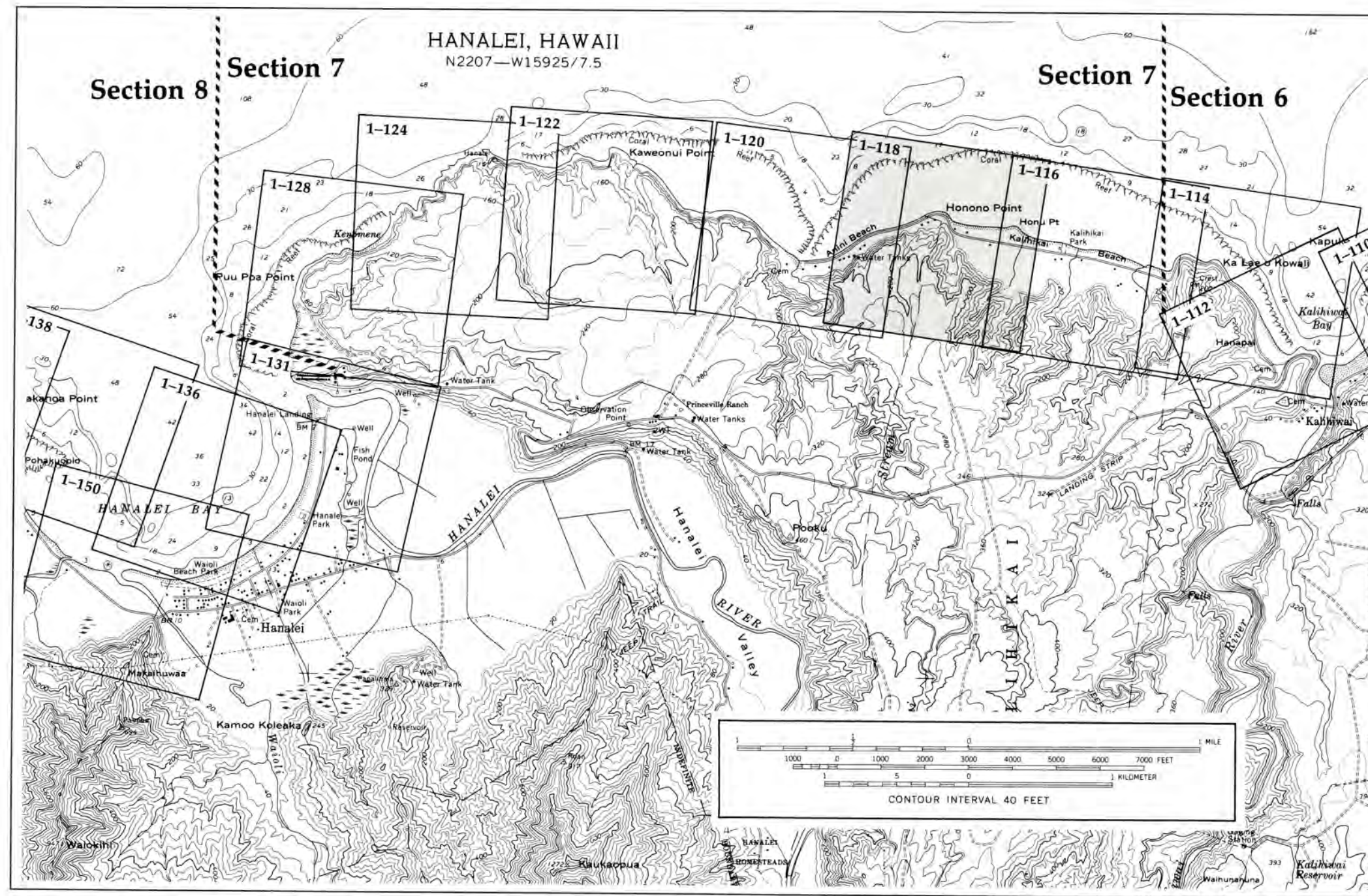
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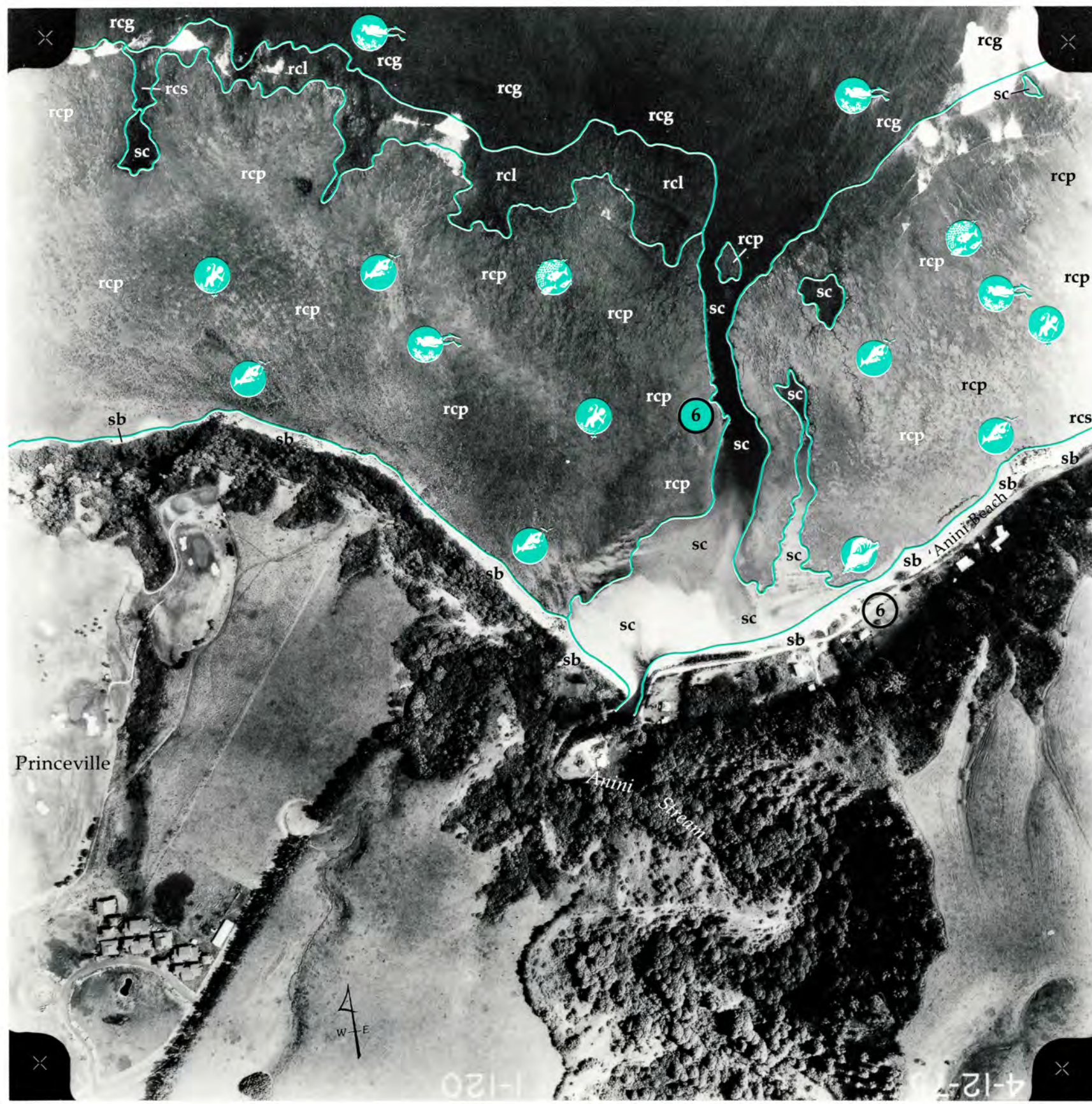
USES NOT RELATED TO BIOTA

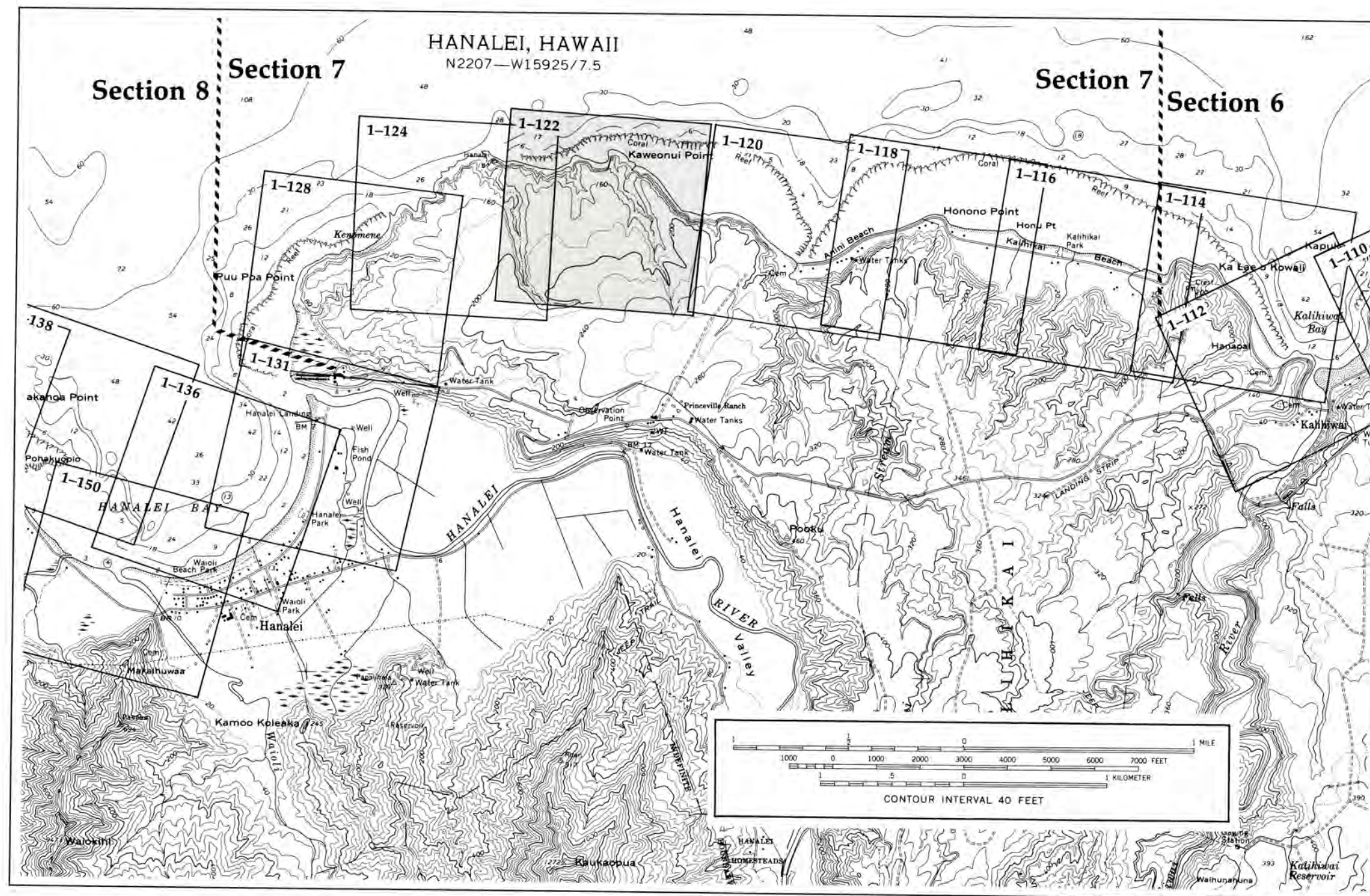
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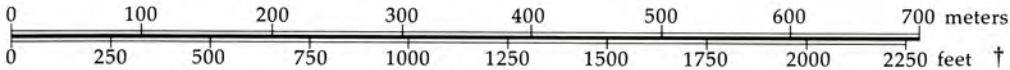
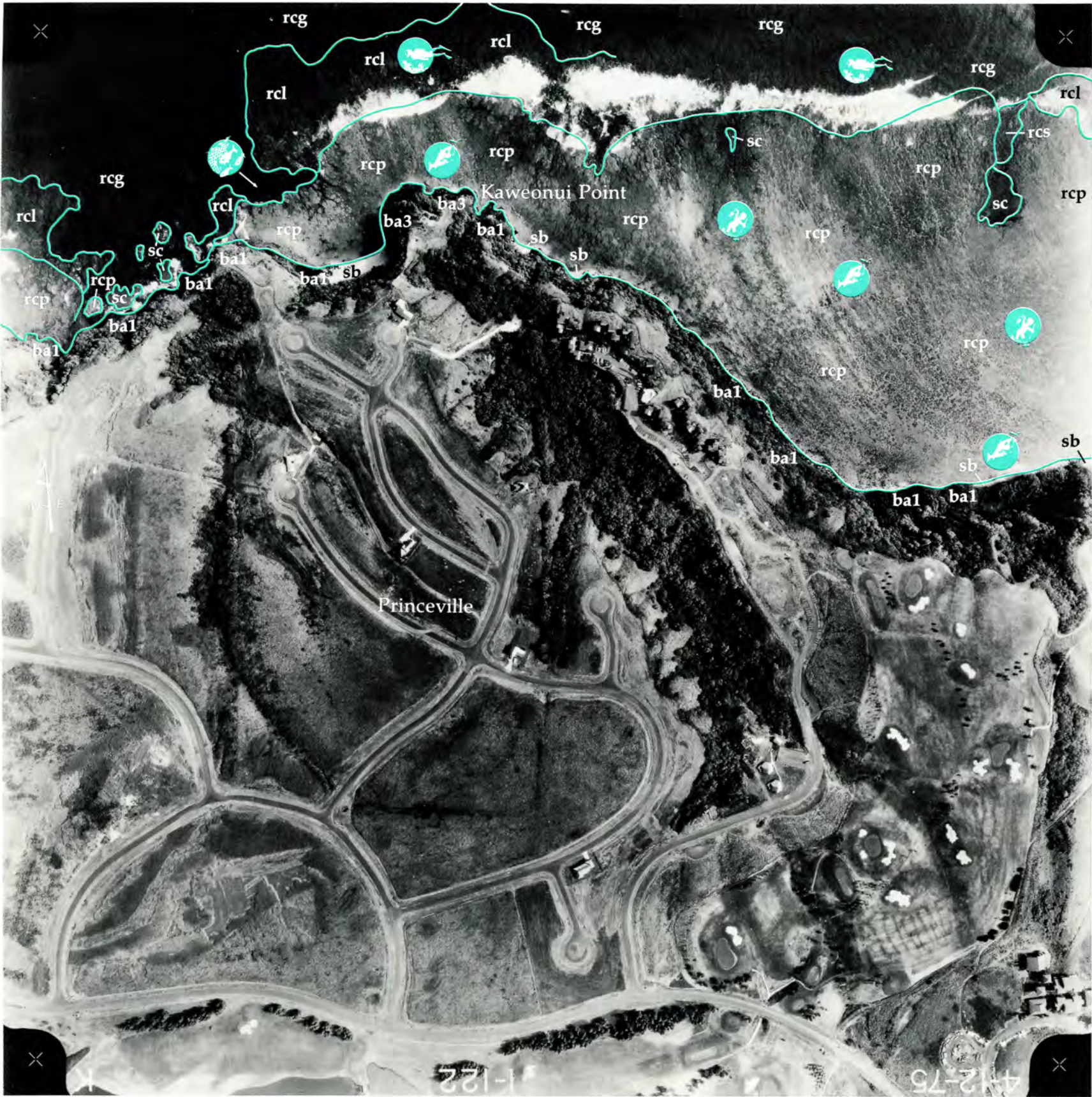
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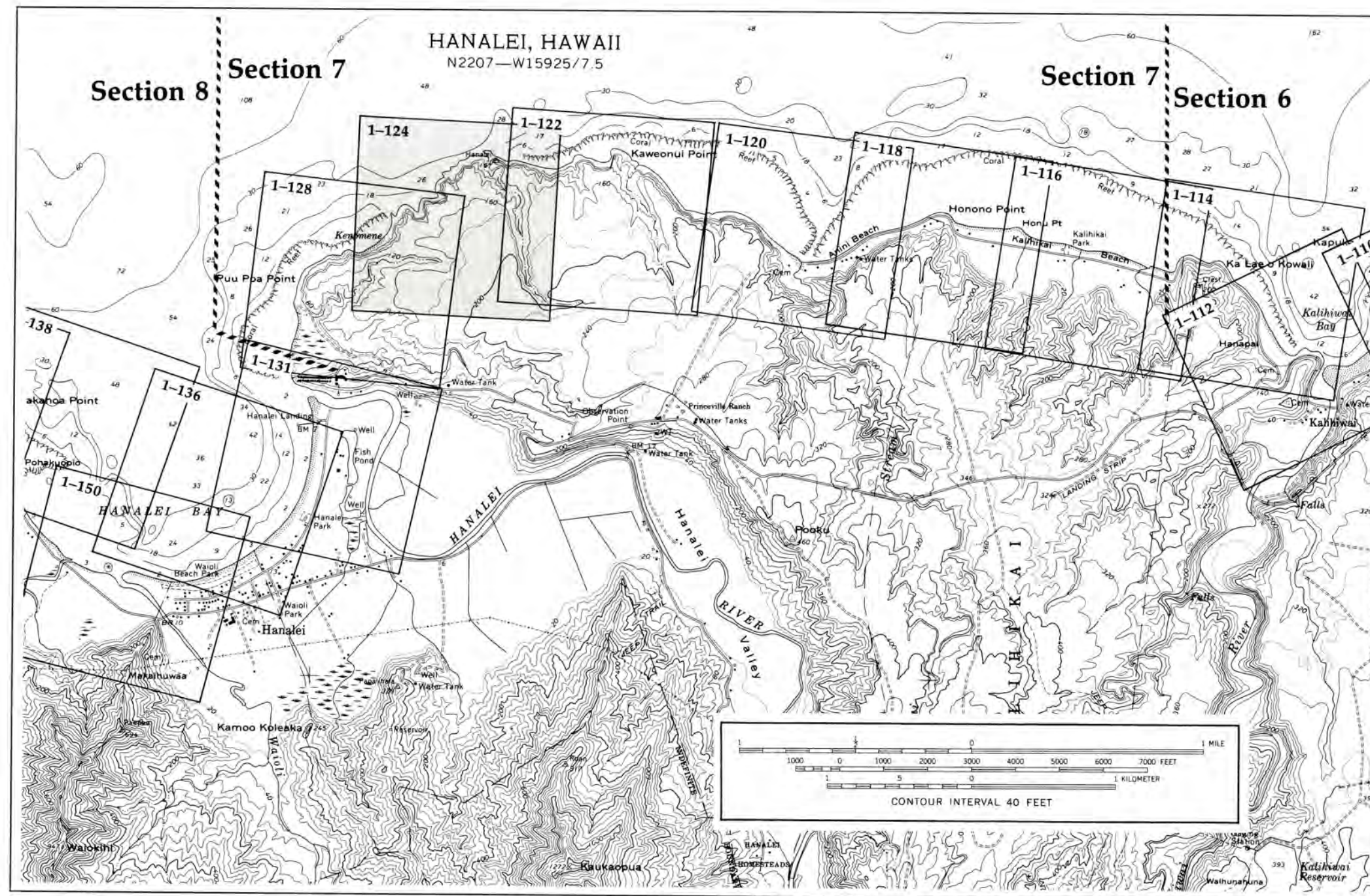
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HANALEI, HAWAII
N2207—W15925/7.5

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- sc - Sand bottom, including channels, in water depths less than 10 meters (especially common offshore from beaches).
- sd - Sand bottom, deeper than 10 meters (some possibility of error, such as white reflecting rock in deep water, not checked by dives).

Special types.

- co - Areas of greater than 50% live coral cover (spot checked for verification).
- br - Beachrock (offshore).

r - Rock.

- rs - Mostly sand bottom but with some rocky features; rock bottom covered by a veneer of sand.
- rbs - Hard bottom, but with conspicuous sediment up to 50% coverage.
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- rbc - Seaward extensions of cobble beaches (rocks smaller than boulders).

rc - Reef complex.

- rc - Shallow reef flats or structural reefs, normally (but not exclusively) in water depths less than 2 meters.
- rcl - Consolidated limestone; lacking sediment (also a catch-all for moderate to high relief areas).
- rcp - Consolidated smooth limestone pavement.

Offshore Bottom Type Summary

Categories	% Sand	% Rock
rbc, br, s, sb, sc, sd	100	—
rs	less than 50	more than 50
rbs, rcs, rsg	25 - 50	50 - 75
r, rc, co	less than 25	more than 75
rbb, rb, rcl, rcp, rcg	—	100

Uses and Activities Along and Off the Coast

USES RELATED TO NEARSHORE BIOTA

- Pole-and-line fishing.
- Gill-netting.
- Throw-netting.
- Spearfishing.
- Torching.
- Trapping.
- Lobster.
- Sea urchin (wana).
- Octopus (he'e).
- Surround netting.
- Aquarium fish collecting.
- Seaweed (limu).
- Sport-diving.
- Shell collecting.

SHORELINE AND DEEP-WATER FISHING ACTIVITIES

- Crabbing (kona, 'a'ama, swimming crab).
- Limpet (opihi).
- Trolling, bottom-fishing.
- Specialized fisheries (type indicated).

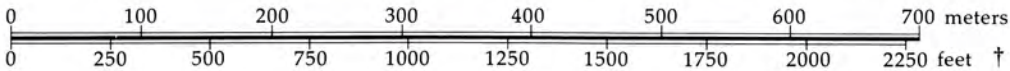
USES NOT RELATED TO BIOTA

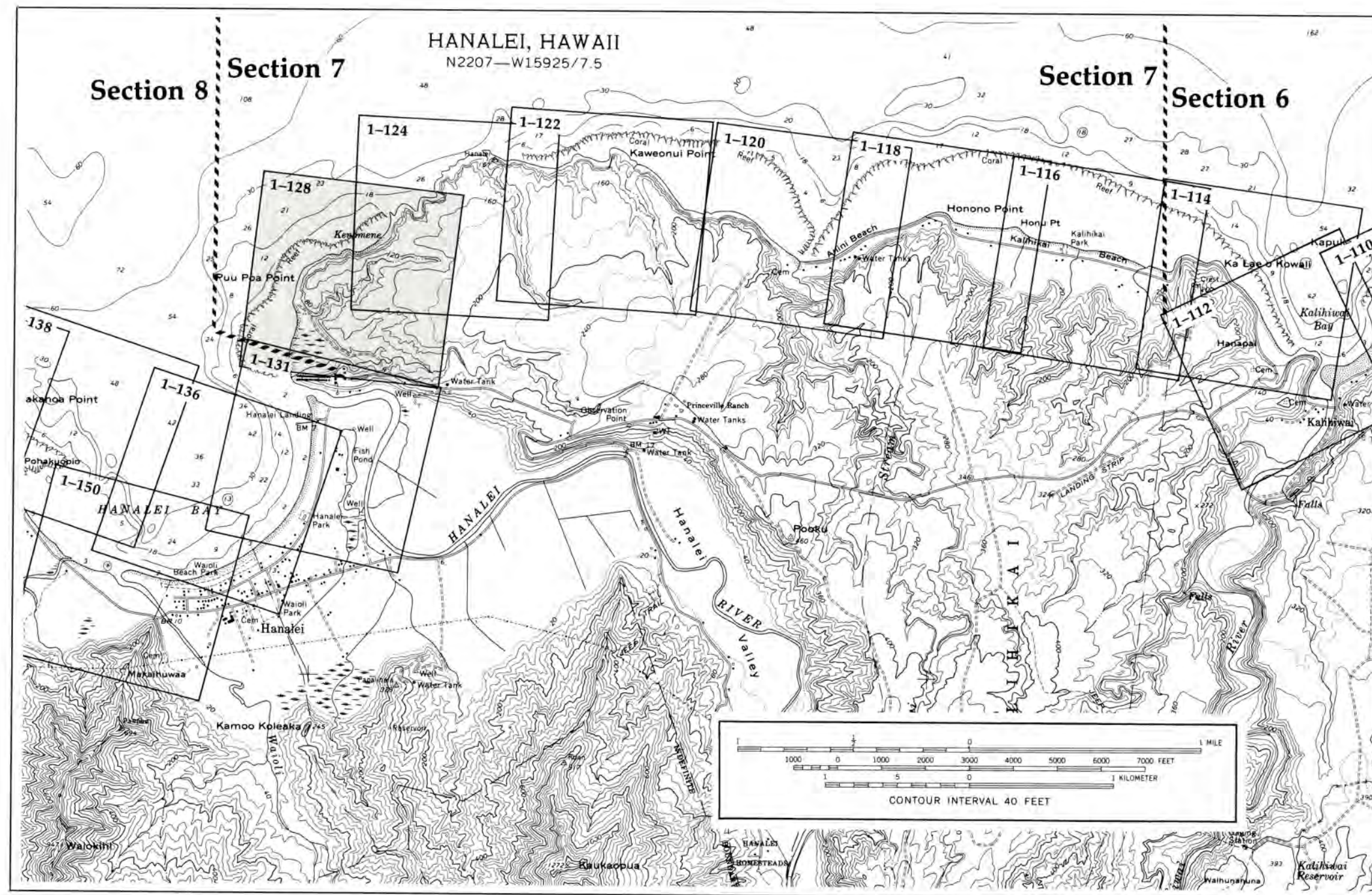
- Board surfing.
- Body surfing.
- Canoe paddling.
- Sailing.
- Aquatic recreation (smallcraft sailing, wind-surfing).
- Excursion boat.
- Anchorage.

Study Sites

- Shoreline (above water observations).
- Inshore (inside reef edge).
- Offshore (beyond reef edge).

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- rcg – Consolidated reef with well defined groove-and-spur system.
- rsg – Sand predominates in the depressions of conspicuous groove-and-spur system.
- rcs – Mostly consolidated reef with some (25–50%) sediment bottom.

SHORELINE

- ba – Volcanic rock shorelines.
 - ba1 – Low basalt outcrops/shoreline less than 1 meter high, including ramps.
 - ba2 – Talus rocks at the base of high sea cliffs (clearly not reworked by waves into a beach); sometimes this unit is seaward of ba4 or ba5 cliffs.
 - ba3 – Low outcrops to low cliffs (1–3 meters high), shoreline access possible.
 - ba4 – Sea cliffs more than 10 meters high; access difficult to dangerous.
 - ba5 – Sea cliffs more than 10 meters high; access dangerous to impossible.
- bb – Man-made boulder shorelines (blue rock, revetments, rip-rap, etc.).
- bc – Concrete/cement masonry seawalls and shorelines.
- lm – Limestone rock shorelines.
 - lm1 – Low outcrops, boulders of limestone, including ramps.
 - lm2 – Limestone talus (probably rare, since limestone cliffs are not expected to be high).
 - lm3 – 1–3 meter high limestone cliffs.
 - lm4 – Limestone cliffs 3–10 meters high.
- s – Sedimentary shoreline.
 - sa – Storm beach, deposited by large waves well inland and/or above shoreline.
 - sb – White sand beaches.
 - sb1 – Detrital sand beach.
 - sb2 – Black sand beach.
 - sbb – Boulder beach.
 - sbc – Cobble, pebble beach.
 - sbr – Poorly sorted deposits (common off stream mouths, sometimes shoreward extensions of rubble or sand beaches).

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- tp – Tidepools, where they are a prominent feature at the shoreline.

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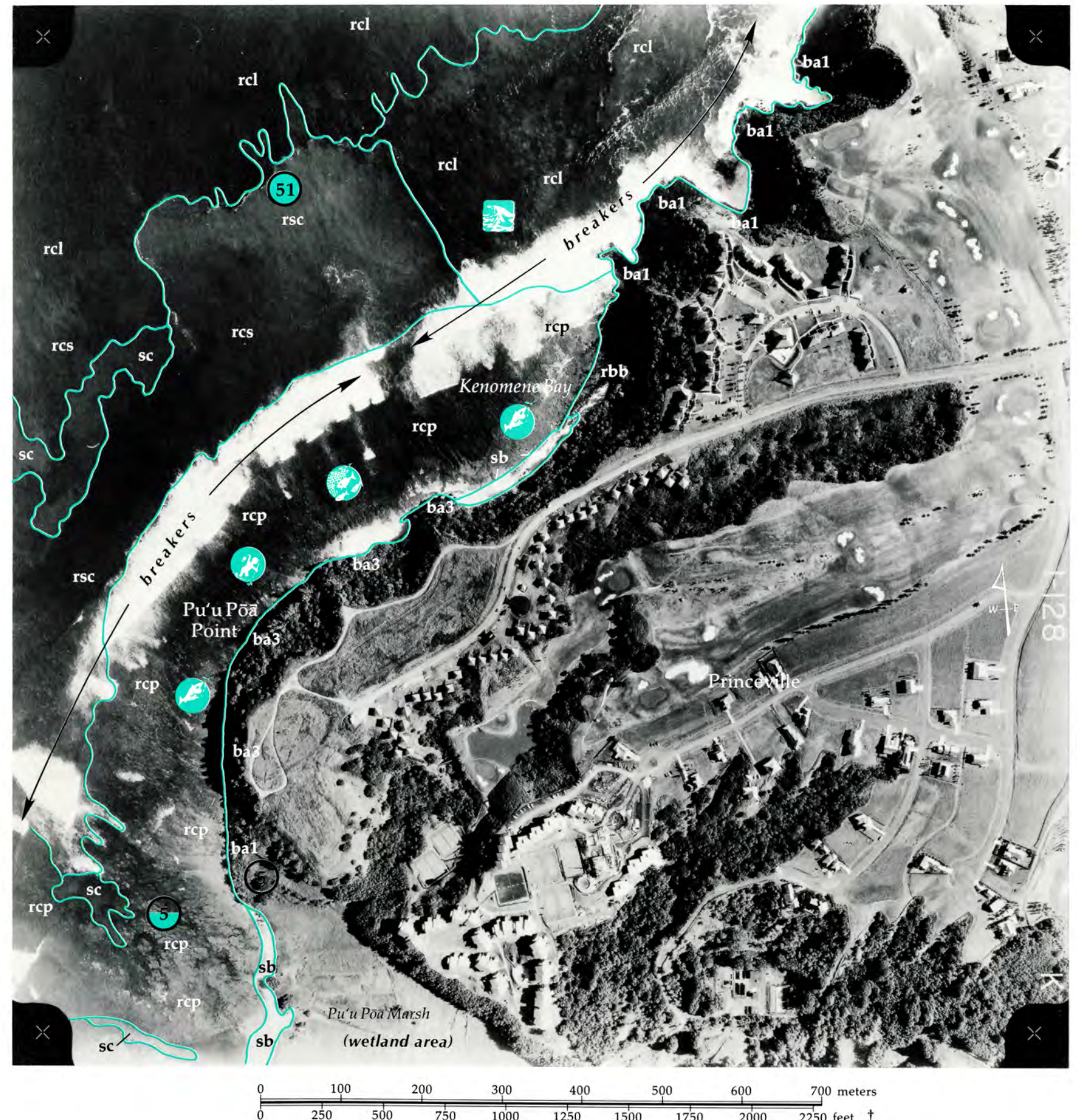
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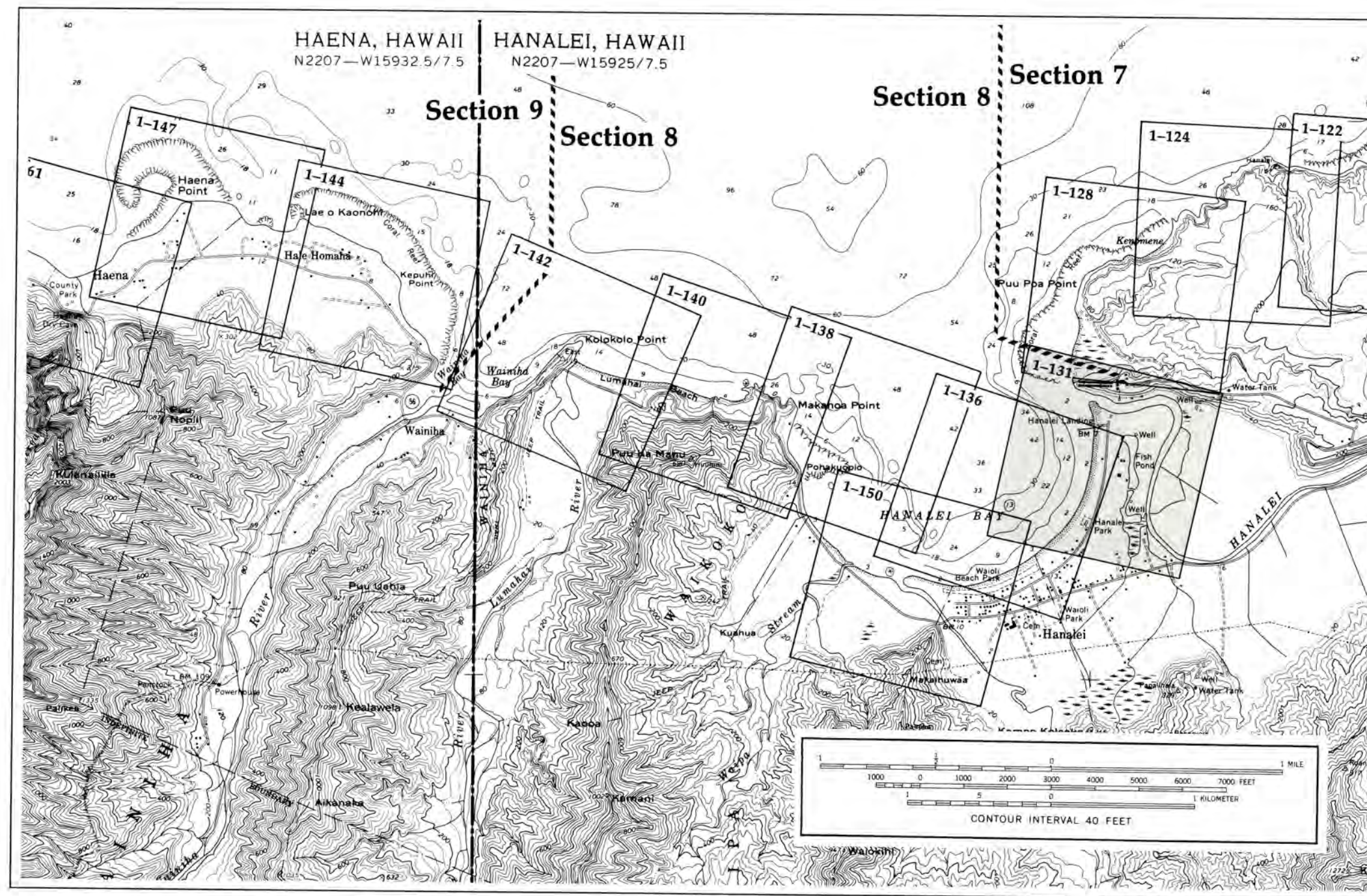
- | | |
|---|--|
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