

**STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
OFFICE OF CONSERVATION AND COASTAL LANDS  
Honolulu, Hawaii**

180-Day Exp. Date: July 8, 2008

April 28, 2008

**Board of Land and  
Natural Resources  
State of Hawaii  
Honolulu, Hawaii**

**REGARDING:** Conservation District Use Application (CDUA) OA-3450 for the Establishment of the Kalaeloa Artificial Reef and the Emplacement of the First Increment of Reef-Building Material

**APPLICANT:** Division of Aquatic Resources  
Department of Land and Natural Resources

**LANDOWNER:** State of Hawaii

**LOCATION:** Submerged Lands, Ewa, Oahu

**USE:** approximately ( $\approx$ ) 108-acre

**SUBZONE:** Resource

**BACKGROUND:**

This CDUA is being submitted to fulfill condition #17 of Conservation District Use Permit (CDUP) OA-2670 for the dredging of the Hoakalei Marina that states: *The applicant shall construct and maintain for a specified period of time as determined by the Department, an artificial reef subject to review and approval by the department. Prior to the construction of an artificial reef, the applicant shall apply for, and obtain a Conservation District Use Permit.*

In addition, condition #13 of the Department of the Army Permit also requires HASEKO to construct an artificial reef in the vicinity of the Marina to offset impacts to coral-reef habitat associated with construction of the entrance channel to the Marina. Under a Memorandum of Agreement (MOA) with the U.S. Army Corps of Engineers, HASEKO and the Division of Aquatic Resources (DAR) signed in 2004, DAR shall be responsible for the design, construction, and long-term maintenance of the artificial reef. Should approvals needed to construct the artificial reef not be obtained, HASEKO shall provide

DAR with the funds (\$150,000.00) committed to the first increment of reef construction to support DAR's artificial reef program at another location.

### **DESCRIPTION OF AREA AND CURRENT USE**

The approximately ( $\approx$ ) 108-acre project area exists on submerged lands of Oahu within the Resource subzone of the Conservation District. The site is more than a mile offshore of the former Barber's Point Naval Station at Kalaeloa, west of the Honouliuli sewer outfall and east of the oil tanker offshore unloading facilities. The proposed site is located within an underwater military installation (**Exhibit 1 & 2**).

The water depth ranges from 65-feet along the northern site boundary to 122-feet at the southeastern site corner. The mean depth of seafloor within the site is 98.7-feet. The Bathymetric (underwater topography) maps of the Kalaeloa area illustrates that the seafloor is comprised of a series of relatively broad, often sand-covered, wave-cut terraces in the nearshore region. 95% of the relatively flat gently sloping site consists of bare limestone substrate with a lack of forage and shelter for marine species. Coral covers less than 2% of the entire site, and the abundance and diversity of marine life is low.

It is unlikely that marine species of concern (e.g. sea turtles, humpback whales, monk seals) currently utilize the site for anything other than passing through the area. No shipwrecks have been located within the vicinity and it is believed that no cultural or archaeological remains are likely to be identified within the project area.

As part of the Department of the Army Permit, site selection and design must meet the following criteria: relatively flat hard bottom; water depths from 60-90 feet; located outside lanes of shipping and pleasure craft traffic; location devoid of live coral; location in a benthic community with appropriate forage for the fishes expected to be resident to the reef; materials and design which would provide a 40-year life expectancy and high stability as ascertained by a qualified engineer; and a navigation safety clearance of a minimum of 40 feet of water above the highest point of the artificial reef.

### **PROPOSED USE**

The proposed use is to establish the approximately ( $\approx$ ) 108-acre seafloor site to be utilized for long-term emplacement of artificial reef structures for fisheries enhancement and recreational use. Additional increments of similar design to the Z-block shall be deployed over time to create a large reef habitat area. The maximum theoretical build-out would be 70 sets of artificial reef structures within the proposed established area.  $\approx$  12 acres or 11% of the seafloor within the project area would be covered with the Z-block modules. Actual placement of the sets would depend upon individual site surveys to confirm appropriate seafloor types.

The proposed first increment of deployment shall consist of a minimum of two 'sets' of concrete Z-block modules ( $\approx$  8' x 4') placed 50-100 feet apart that will cover about 8,000

square feet of seafloor. The proposed design has been well tested and has produced successful artificial reefs in other areas (3, 4, 5 & 6) .

The reef modules have been constructed and consist of clean concrete that shall be washed down prior to deployment. Deployment of the modules could stir up what small amounts of bottom sand that exist at the site, however the sand would settle. Deployment will be accomplished by stationing a barge used to transport the modules above the intended location and using a front-end loader to push the modules off the barge. The barge will be held in place as precisely as possible so that the individual blocks will form a pile (set) on the seafloor. A total of 700-800 blocks will be used for the first increment.

It is anticipated that one or two mooring buoys for boats to anchor shall be installed with the first increment proposal. The buoys will be attached to the Z-blocks and deployed as part of the initial reef sets. The buoys will be inspected and maintained as needed during DAR's periodic monitoring of the reef's marine life.

Pre-deployment surveys will be conducted to ensure existing corals are avoided when possible. The first increment would provide shelter and elevated surface area needed for coral and benthic marine community development. Corals are expected to colonize much of the new reef substrate over time, potentially resulting in a several-fold increase in coral coverage over current conditions. The shelter provided by the reef may also increase the abundance and diversity of other marine life.

With the proposed first reef increment, the maximum relief from the seafloor would increase from a few inches to more than 10-feet. There would not be a measureable effect on surface waves at the Kalaeloa shoreline and near shore. The proposal is not expected to impact water temperature nor water quality. Effects to air quality and climate would be minor and temporary.

The artificial reef is not expected to exacerbate existing natural hazards. The proposed Z-block modules selected for the project have exhibited good stability when exposed to storm waves.

Deployment of the artificial reef is expected to lead to substantial local increases in the abundance and diversity of fishes over current conditions. It is anticipated the artificial habitat shall enhance scenic and aesthetic qualities of the underwater seascape by attracting colorful reef-dwelling fish and other organisms.

The first increment would provide shelter and elevated surface area needed for marine community development. Recreational use of the reef site is expected to diversify and intensify. It will most likely become a known point of interest among divers and fishermen, as well as a potential site for research and educational activities. While recreational use of the reef poses some risks to users and to the reef itself, overall it is anticipated to greatly benefit recreational users as well as marine communities.

Although there is no indication that the site has significant cultural resources, in the event that archaeological resources are encountered at the site during preconstruction surveys, the State Historic Preservation Division shall be notified.

The proposed reef site is well removed from public facilities and except during brief periods when reef elements are being deployed, vessels are temporarily precluded from entering the immediate area. Other than these brief moments, navigation in the area will not be constrained. DAR will also require recreational vessels to moor to permanent buoys rather than anchoring on the bottom to avoid damage to the reef.

The State of Hawaii began artificial reef development in the late 1950's to increase and enhance fishing opportunities. Regarding this particular artificial reef, the purpose of the artificial reef was to compensate for the loss of 1.1 acres of reef surface area from the excavation of the Hoakalei Marina. However, through the years, scientific understanding of the ecology of artificial reefs has improved and it is believed that rather than creating a stand alone equal area replacement reef, the development of a larger artificial reef complex would be much more beneficial as the larger habitat area would be less vulnerable to over fishing and would do more to replenish over-exploited fish species.

#### Alternatives

Should the process of permitting an artificial reef prove to be infeasible then DAR would utilize committed funding for the first reef increment to directly benefit marine habitat along Oahu's leeward coast. The designated funding may be applied to the existing Waianae Artificial Reef, or towards another project that would enhance recreational fishing opportunities of the Ewa coast.

The no action alternative would be unwise, as it would violate the terms of CDUP OA-2670 and the 2004 MOA of the Department of the Army Permit.

#### **SUMMARY OF COMMENTS**

CDUA OA-3450 was referred to the following agencies for their review and comment: the Federal-US Fish & Wildlife Service, the National Marine Fisheries Service, the U.S. Coast Guard, the Army Corps and the Department of the Navy; the State: Department of Land and Natural Resources Divisions of: Boating and Ocean Recreation, Conservation & Resource Enforcement, and the Oahu District Land Office; the Department of Health, the Office of Hawaiian Affairs, the Office of Environmental Quality Control; the City & County of Honolulu's Department of Planning and the Ewa Neighborhood Board. In addition, the CDUA was also sent to the nearest public library, the Ewa Public Library, to make this information readily available to those who may wish to review it.

Comments were received by the following agencies and summarized by Staff as follows:

UNITED STATES OF AMERICA

DEPARTMENT OF THE INTERIOR

*Fish and Wildlife Services*

The proposed project will require a U.S. Army Corps of Engineers Section 404 permit. We recommend that the USFWS standard Best Management Practices be incorporated into the project to minimize the degradation of water quality and impacts to fish and wildlife resources.

In general, the Service discourages placement of material in the marine environment in areas that support coral growth. However, since the proposed project aims to create substrate for coral recruitment as well as habitat for reef fishes and marine invertebrates, we would support the project as long as it is designed to avoid or minimize impacts to marine resources to the greatest extent possible.

We recommend that DLNR confirm that placement of the Z-blocks and mooring buoys to construct the artificial reefs will cause minimal negative impact to the reef substrate and biota. We also recommend that increased user conflicts be addressed through State regulation of the underwater installation. If these structures are intended to be Fish Aggregation Devices (FADs), more recreational fishermen and divers will likely be attracted to the area that currently has no enforcement present. Provided that these measures are incorporated into the project, we would agree that the proposed action should not result in significant adverse impacts to fish and wildlife resources at the site and would support approval of the CDUA.

Regarding full reef build-out, as the current EIS only includes the designation of the first increment, impacts of subsequent increments to the site should require a formal assessment when proposed. Regarding enforcement, due to the proximity to the new Ocean Point Marina, we recommend that DLNR place restrictions on use of the area, prohibit bottom anchoring at the site, and have personnel designated to enforce these rules.

Regarding mooring buoys and the anchor installation, impacts from mooring buoys and associated anchors are not examined. We recommend that an estimated number of permanent mooring buoys, their locations within the site, and their impacts to the substrate be included in the final analysis. We recommend DLNR ensure that no corals or other benthic marine life in the area are harmed by monitoring the installation of all mooring buoys. We recommend that a regularly scheduled buoy maintenance program be established in order to minimize the likelihood that an anchor line will break free and damage the marine environment as the free end whips around the ocean floor.

Regarding monitoring of artificial reefs, we recommend a monitoring program be established for each Z-block installation that tracks the succession and settlement off

organisms and reef fish diversity, density and biomass. Data collected will provide guidance for the future installation of additional Z-block reefs in the designated area.

*Applicant's response*

The impact analysis presented in the Final EIS confirms that the placement of the concrete structures and mooring buoys will cause minimal negative impact to the reef substrate and biota. DAR will also implement Best Management Practices during deployment. User conflicts will be minimized through State regulations.

As full build out shall occur over a period of 10-20 years and the proposed materials and reef configuration may change subject to advances in technology and research, DAR shall submit pre-deployment notifications for subsequent reef increments to the Department of the Army, State Department of Health and other government agencies for review.

A primary objective of the artificial reef program is to increase fishing opportunities for the recreational fisherman. If the new reef becomes too popular and user conflicts become a problem, restrictions could be placed on the use of the area. DAR also has an agreement with the Navy that DAR shall install mooring buoys and that anchoring shall be prohibited. The Division of Conservation and Resource Enforcement (DOCARE) shall handle enforcement of DAR regulations.

As stated in the FEIS, pre-deployment surveys will ensure that the modules will be deployed only on seafloor that is devoid of coral and benthic marine life. Divers shall attach the buoys directly to the reef sets by shackling a galvanized chain around several Z-blocks. The reef set locations shall correspond to the mooring buoy locations. Because the mooring buoys will not come into contact with the seafloor, there will be no impacts to the substrate. The mooring buoys will be inspected and maintained as needed during the periodic monitoring of the reefs marine life.

DAR currently has a monitoring program in place for its artificial reefs. DAR surveys artificial reefs periodically to obtain information on fish abundance and diversity. DAR intends to monitor the proposed Kalaeloa Artificial reef most likely more frequent surveys may be conducted as part of a proposed project to document colonization of the new artificial reef.

DEPARTMENT OF THE NAVY

The proposed artificial reef site is located within a military restricted area. Use of the area is noted on navigational charts as being limited. Boating within the area is authorized, but anchoring and fishing operations that may foul the underwater installations within the area are prohibited. The Navy continues to operate, through the Office of Naval Research, a live electrical cable within this restricted area that carries lethal voltage should the cable be damaged or disturbed. We find no objection to the proposed artificial reef, provided the following conditions are met:

- The artificial reef shall maintain a minimum distance of 500 meters from any portion of the underwater navy cable to prevent damage to the cable;
- Restrictions, as defined under C.F.R. 334.1400 shall remain in effect. Mooring buoys shall be installed and anchoring prohibited within said area;
- Future users of the marina and artificial reef shall be informed of the location, restrictions and potential hazards relative to the existing military training areas and associated with the Navy cable.

The Navy finds that the proposed artificial reef will not be materially detrimental to public health, safety, and welfare. We reiterate that there may be potential risks associated with placing this recreational attraction in proximity to the active Navy cable. Any liability generated from introducing this new use to the area would rest with the State of Hawaii and not the United States Government or the Navy.

*Applicant's response*

DAR has coordinated with the Navy to ensure that: the reef site boundaries were revised so that no portion of the underwater navy cable is less than 500 meters from the artificial reef site; Restrictions defined under C.F.R.334.1400 will remain in place. Anchoring will be prohibited at the proposed artificial reef and potential users of the artificial reef will be informed of the location, restrictions, and potential hazards present in the area.

By prohibiting anchoring in the area, informing users of risks, and siting reef sets at least 500 meters from the Navy cable, DAR is confident that risks to reef users will be minimized. Increased user traffic in the area resulting from planned and approved development remains an issue for which the State cannot reasonably accept full liability.

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

*Boating and Ocean Recreation (DOBOR)*

No comments

*Oahu District Land Office (ODLO)*

The proposed establishment of the offshore Kalaeloa Artificial reef would require a written request from the Division of Aquatic Resources that a Governor's Executive Order be processed to establish the jurisdiction and maintenance of the reef to be under the Division of Aquatic Resources.

*Applicant's Response*

DAR shall prepare a letter to request setting aside the area through Governor's Executive Order to DAR for the jurisdiction and maintenance of the reef.

**OFFICE OF HAWAIIAN AFFAIRS (OHA)**

OHA is generally is hesitant to support projects that include additions to the sea floor particularly because submerged lands are ceded lands and any change to the sea floor can have a ripple effect throughout an area that our beneficiaries frequently use for a variety of cultural and traditional practices. However, as 98% of the bottom currently has no coral and that future stocks of both coral and fish are expected to improve, this project may have a beneficial effect to our beneficiaries and therefore we offer our support for this project.

We note that future reef increments shall require DAR approval as well as the Department of the Army review and State Department of Health compliance. Regarding enforcement at the project site, OHA recommends that restrictions be placed on anchoring types and funding be provided so that enforcement and compliance with these and other rule can realistically be achieved.

*Applicant's Response*

As full build out shall occur over a period of 10-20 years and the proposed materials and reef configuration may change subject to advances in technology and research, DAR shall submit pre-deployment notifications for subsequent reef increments to the Department of the Army, State Department of Health and other government agencies for review.

A primary objective of the artificial reef program is to increase fishing opportunities for the recreational fisherman. If the new reef becomes too popular and user conflicts become a problem, restrictions could be placed on the use of the area. DAR also has an agreement with the Navy that DAR shall install mooring buoys and that anchoring shall be prohibited. The Division of Conservation and Resource Enforcement (DOCARE) shall handle enforcement of DAR regulations.

**ANALYSIS**

After reviewing the application, the Department has found that:

1. The proposed use is an identified land use in the Resource subzone of the Conservation District, pursuant to §13-5-24, Hawaii Administrative Rules (HAR), R-2 ARTIFICIAL REEFS. Please be advised, however, that this finding does not constitute approval of the proposal;
2. Pursuant to §13-5-40 of the HAR, a Public Hearing will be required;

3. In conformance with Chapter 343, Hawaii Revised Statutes (HRS), as amended, and Chapter 11-200, HAR, the Final Environmental Impact Statement has been reviewed and accepted by the Department on October 24, 2007 and notice was published in the November 23, 2007 issue of the Environmental Notice.
4. The proposed project is located makai of the certified shoreline and as such, is outside of the Special Management Area.

A Public Hearing was scheduled for March 19, 2008 at 6 pm at the Kalanimoku Building. No one from the general public attended the Public Hearing.

### CONSERVATION CRITERIA

The following discussion evaluates the merits of the proposed land use by applying the criteria established in Section 13-5-30, HAR.

1. *The proposed land use is consistent with the purpose of the Conservation District.*

The objective of the Conservation District is to conserve, protect and preserve the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare.

The project is considered an identified land use in the subject area of the Conservation District; as such, it is subject to the regulatory process established in Chapter 183C, HRS and detailed further in Chapter 13-5, HAR. This process provides for the application of appropriate management tools to protect the relevant resources, including objective analysis and thoughtful decision-making by the Department and Board of Land and Natural Resources.

The proposed artificial reef is expected to improve public recreation and educational opportunities, enhance fish stocks and create habitat for corals and other reef-dependent organisms.

2. *The proposed land use is consistent with the objectives of the subzone of the land on which the use will occur.*

The objective of the Resource subzone is to develop, with proper management, areas to ensure sustained use of the natural resources of those areas. Staff believes the proposal is consistent with the objectives of the Resource subzone as the proposed artificial reef is intended to conserve and enhance existing fish stocks and coral reef habitat for biological, recreational, and educational purposes.

3. *The proposed land use complies with provisions and guidelines contained in Chapter 205A, HRS, entitled "Coastal Zone Management," where applicable.*

Staff believes that the proposed use complies with the Chapter 205A, HRS by providing coastal recreational opportunities and by promoting the protection, use and development of marine and coastal resources to assure their sustainability.

4. *The proposed land use will not cause substantial adverse impacts to existing natural resources within the surrounding area, community, or region.*

Staff believes the proposed land use will not cause substantial adverse impacts to existing natural resources within the surrounding area, community or region. The proposed land use does not change the existing use of the area. The proposed artificial reef is intended to conserve and enhance existing fish stocks and coral reef habitat.

5. *The proposed land use, including buildings, structures and facilities, shall be compatible with the locality and surrounding area, appropriate to the physical conditions and capabilities of the specific parcel or parcels.*

Staff believes the proposal shall be compatible with the locality and surrounding area. The project site is relatively flat, barren substrate mostly devoid of corals and other marine life.

6. *The existing physical and environmental aspect of the land, such as natural beauty and open space characteristics, will be preserved or improved upon, which ever is applicable.*

The existing underwater landscape at the proposed site is relatively flat and devoid of marine life. The proposed reef shall add structural relief that will attract a diversity of fish and marine organisms.

7. *Subdivision of the land will not be utilized to increase the intensity of land uses in the Conservation District.*

There will be no subdivision of land for this proposed project.

8. *The proposed land use will not be materially detrimental to the public health, safety and welfare.*

Staff believes that the proposed use shall not be materially detrimental to the public health, safety and welfare. However Staff notes the artificial reef shall create an offshore recreational resource that like all offshore uses, poses inherent safety risks to users. Staff believes individual users are responsible for their own well-being.

## **DISCUSSION**

Artificial reefs are attempts to replicate naturally productive habitats in relatively unproductive locations. Population growth has exerted pressure on fish stocks and advanced technology has given commercial fisherman the ability to effectively exploit many coral reef fish species. Land based activities such as industrial and agricultural operations; stormwater runoff, harbor dredging and infill contribute to the decimation of our fisheries and degradation of our nearshore waters. The artificial reef program is one tool that could be utilized to rejuvenate our ocean resources.

The State of Hawaii began artificial reef development in the late 1950's to increase and enhance fishing opportunities. Regarding this particular artificial reef, the purpose of the artificial reef was to compensate for the loss of 1.1 acres of reef surface area from the excavation of the Hoakalei Marina. However, through the years, scientific understanding of the ecology of artificial reefs has improved and it is believed that rather than creating a stand alone equal area replacement reef, the development of a larger artificial reef complex would be much more beneficial as the larger habitat area would be less vulnerable to over fishing and would do more to replenish over-exploited fish species.

Although the proposed site is within an underwater military installation, the Navy has concluded that the proposed artificial reef would not interfere with Navy operations. DAR has coordinated with the Navy to ensure that: the reef site boundaries were revised so that no portion of the underwater navy cable is less than 500 meters from the artificial reef site; Restrictions defined under C.F.R.334.1400 will remain in place, that anchoring will be prohibited at the proposed artificial reef, and potential users of the artificial reef will be informed of the location, restrictions, and potential hazards present in the area.

As full build out shall occur over a period of 10-20 years and the proposed materials and reef configuration may change subject to advances in technology and research, DAR shall submit pre-deployment notifications for subsequent reef increments to the Department of the Army, State Department of Health, the Office of Conservation and Coastal Lands and other government agencies subject to review.

## **RECOMMENDATION:**

Based on the preceding analysis, Staff recommends that the Board of Land and Natural Resources APPROVE this application for the establishment of the Kalaeloa Artificial Reef and the emplacement of the first increment of reef-building material located offshore of Ewa, Oahu subject to the following conditions:

1. The Applicant shall comply with all applicable statutes, ordinances, rules, regulations, and conditions of the Federal, State, and County governments, and applicable parts of the Hawaii Administrative Rules, Chapter 13-5;
2. The Applicant shall obtain a land disposition from the Land Division for the project site;

3. The Applicant shall comply with all applicable Department of Health administrative rules;
4. Before proceeding with any work authorized by the Board, the Applicant shall submit two (2) copies of the construction plans and specifications to the Chairperson or his authorized representative for approval for consistency with the conditions of the permit and the declarations set forth in the permit application. One copy will be returned to the applicant. Plan approval by the Chairperson does not constitute approval required from other agencies;
5. Any work or construction to be done on the submerged land shall be initiated within one year of the approval of such use, in accordance with construction plans that have been signed by the Chairperson, and, unless otherwise authorized, shall be completed within twenty (20) years of the approval. The Applicant shall notify the Department in writing when construction activity is initiated and when it is completed;
6. The Applicant shall submit plans for each subsequent reef increment to the Office of Conservation and Coastal Lands for approval prior to each deployment;
7. All representations relative to mitigation set forth in the accepted environmental impact statement for the proposed use are incorporated as conditions of the permit;
8. The Applicant understands and agrees that this permit does not convey any vested rights or exclusive privilege;
9. In issuing this permit, the Department and Board have relied on the information and data that the Applicant has provided in connection with this permit application. If, subsequent to the issuance of this permit, such information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Department may, in addition, institute appropriate legal proceedings;
10. Where any interference, nuisance, or harm may be caused, or hazard established by the use, the Applicant shall be required to take the measures to minimize or eliminate the interference, nuisance, harm, or hazard;
11. Anchoring shall be prohibited at the proposed artificial reef;
12. The Applicant shall notify potential users of the artificial reef of the location, restrictions, and potential hazards present in the area;
13. The Applicant shall submit pre-deployment notifications for subsequent reef increments to the Department of the Army, the State Department of Health, the

Office of Conservation and Coastal Lands and other government agencies for review;

14. Should historic remains be encountered during construction activities, work shall cease immediately in the vicinity of the find, and the find shall be protected from further damage;
15. Other terms and conditions as may be prescribed by the Chairperson; and
16. Failure to comply with any of these conditions shall render this Conservation District Use Permit null and void.

Respectfully submitted,

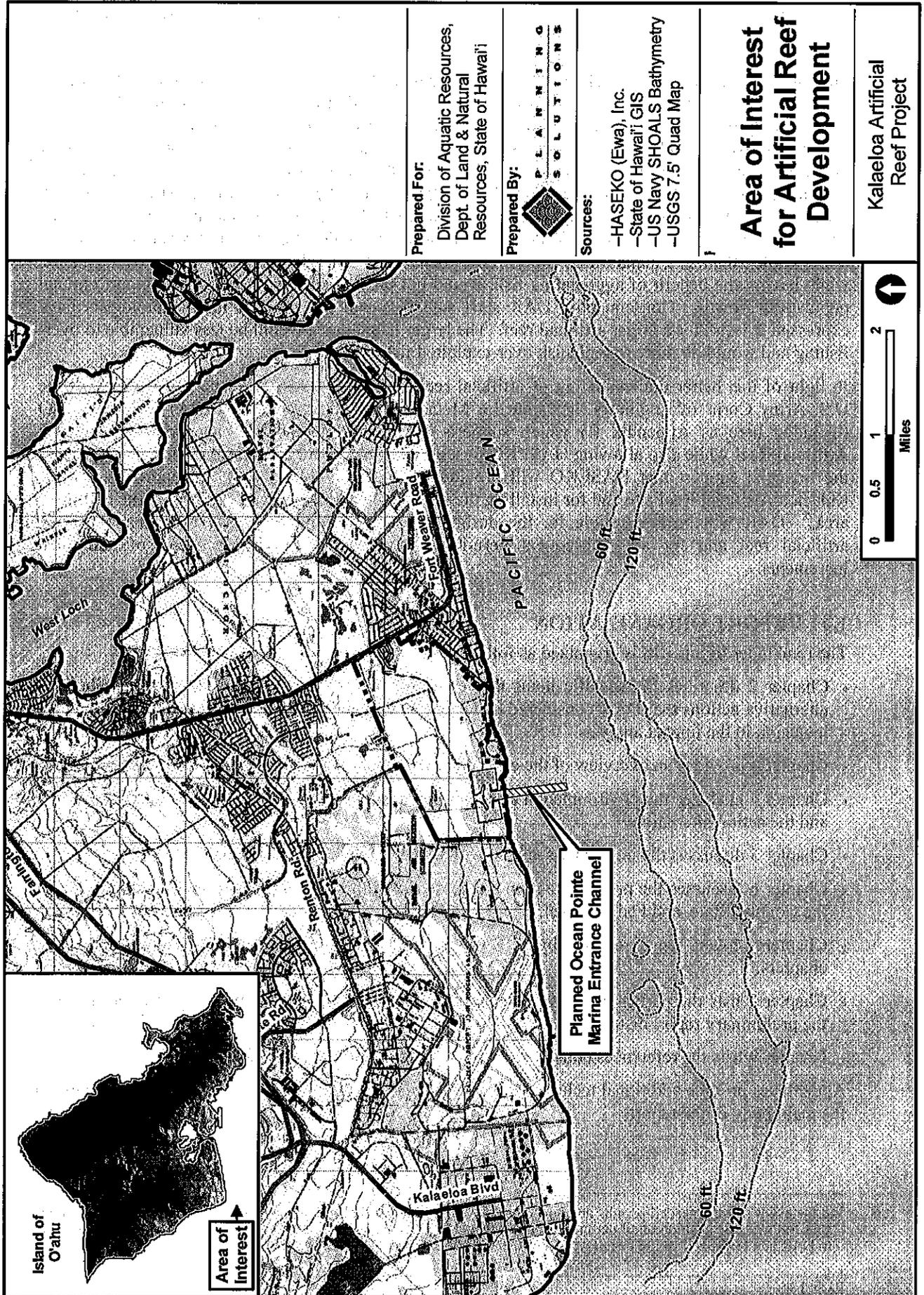


K. Tiger Mills, Staff Planner  
Office of Conservation and Coastal Lands

**Approved for submittal:**



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Laura H. Thielen, Chairperson  
Board of Land and Natural Resources



**Prepared For:**

Division of Aquatic Resources,  
Dept. of Land & Natural  
Resources, State of Hawai'i

**Prepared By:**



**PLANNING  
SOLUTIONS**

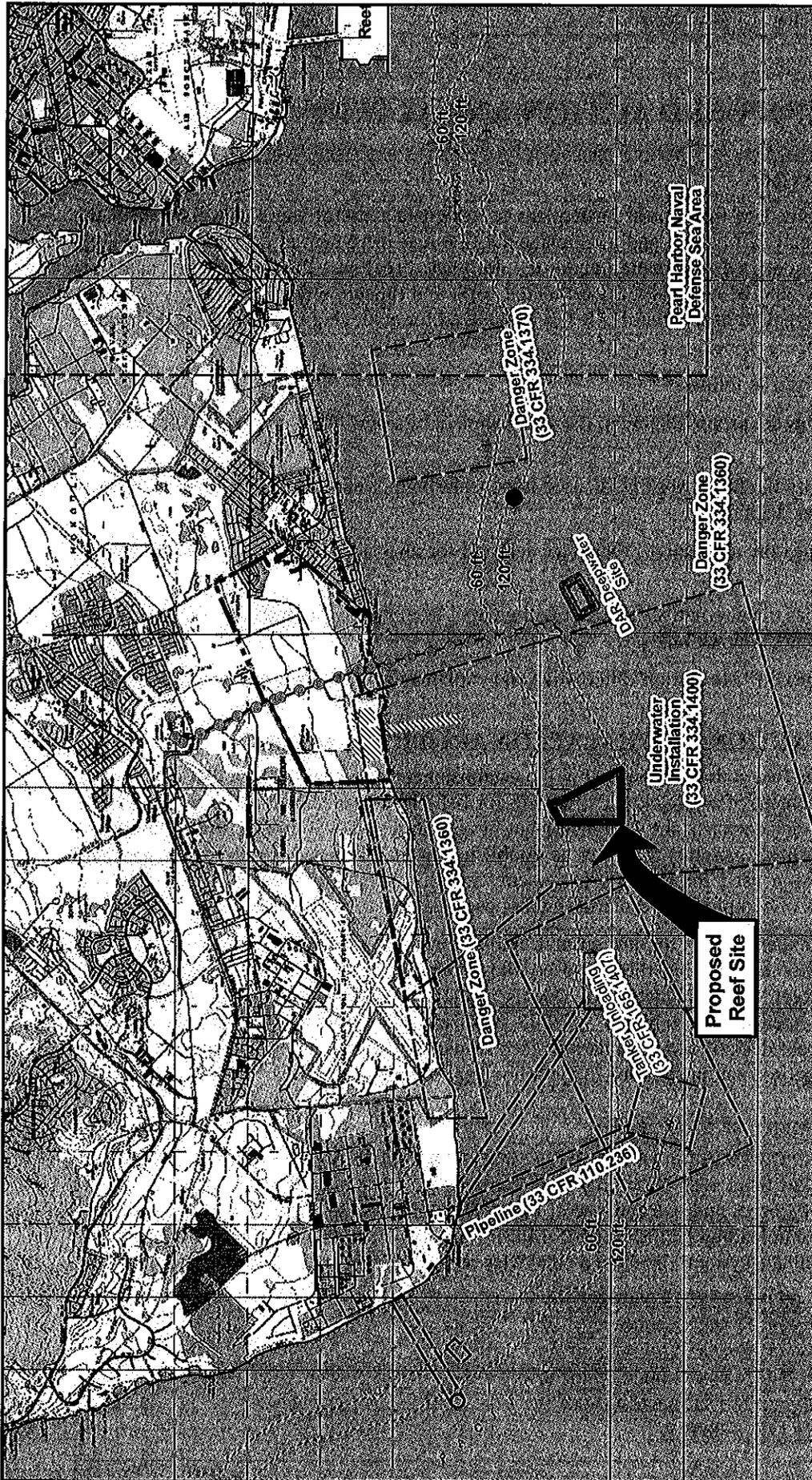
**Sources:**

- HASEKO (Ewa), Inc.
- State of Hawai'i GIS
- US Navy SHOALS Bathymetry
- USGS 7.5' Quad Map

# Area of Interest for Artificial Reef Development

Kalaheo Artificial  
Reef Project

# EXHIBIT 2



**Prepared For:**  
Division of Aquatic Resources  
Dept. of Land & Natural Resources

**Prepared By:**  
 **PLANNING SOLUTIONS**

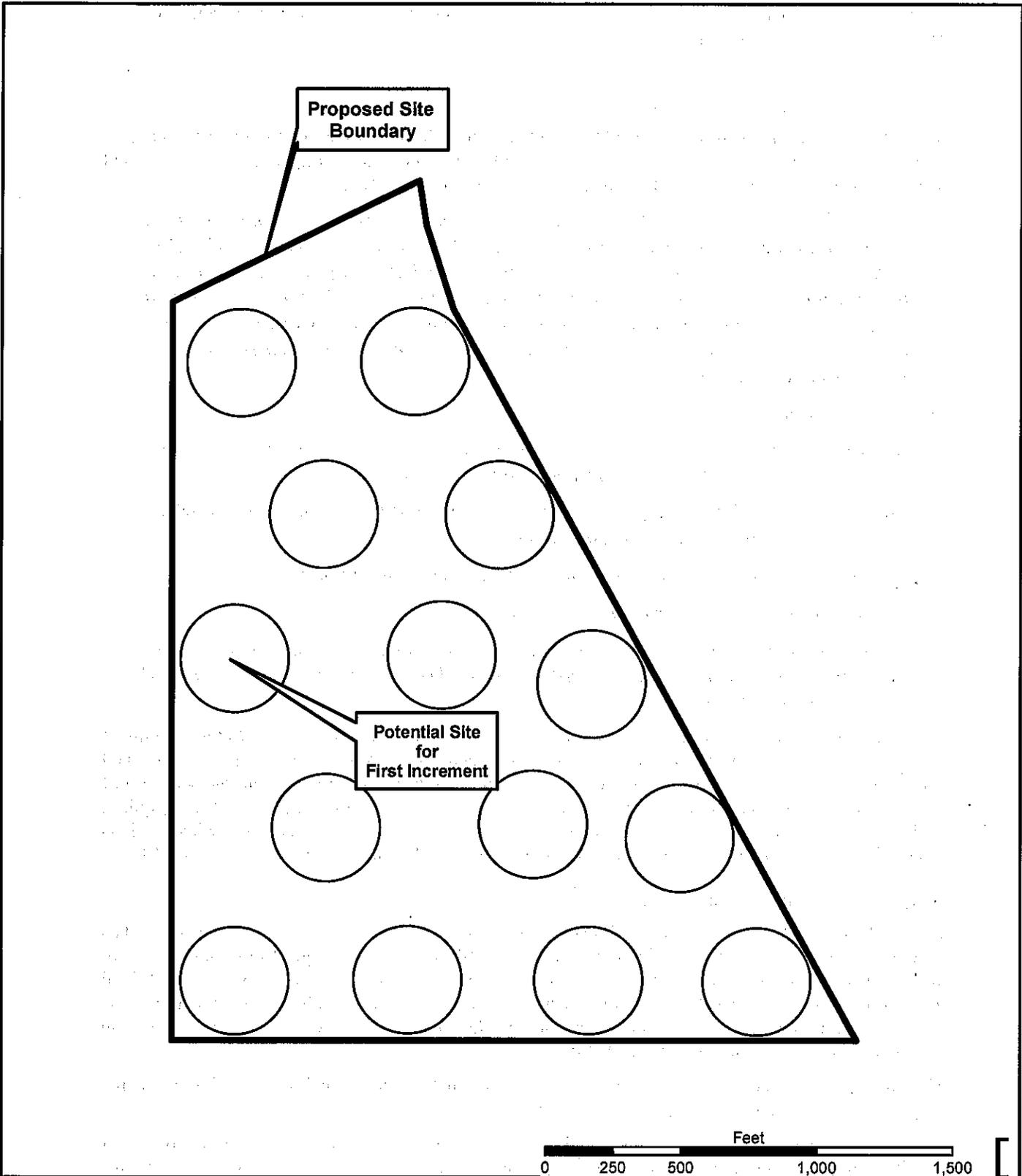
**Sources:**  
-HASEKO (Ewa), Inc.  
-USGS 7.5' Quad Maps

## Proposed Artificial Reef Site

Kalaeloa Artificial Reef Project

**Legend:**

- ..... 60 & 120 ft. Depth Contours
- Cates Aquaculture Facility
- Hono'uliuli Waste Water Treatment Plant Outfall
- ▨ Proposed Marina & Entrance Channel
- Restricted Areas



**Prepared For:**  
 Division of Aquatic Resources; Dept.  
 of Land & Natural Resources

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**Prepared By:**  
 **PLANNING SOLUTIONS**

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**Sources:**  
 -HASEKO Hawaii, Inc.  
 -US Navy SHOALS Bathymetry

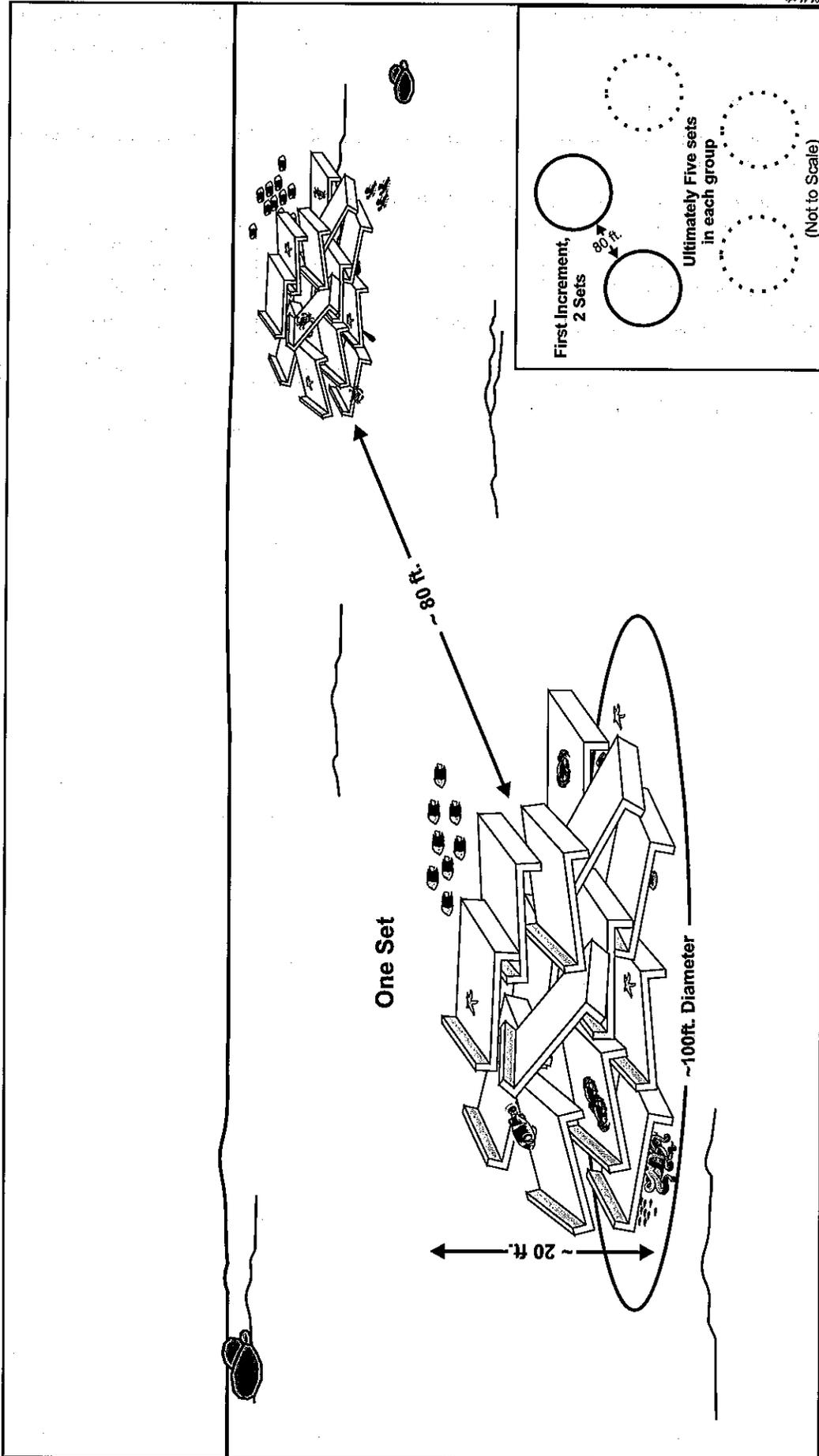
Note: Circles (400-ft. dia.) denote tentative containing areas for groups of 5 reef sets

**Theoretical Full Reef Build-out**

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Kalaeloa Artificial Reef Project

Figure 2-5 Possible Configurations of Full Build-out 2007-10-04.mxd



# Preliminary Plan for Reef Deployment Pattern

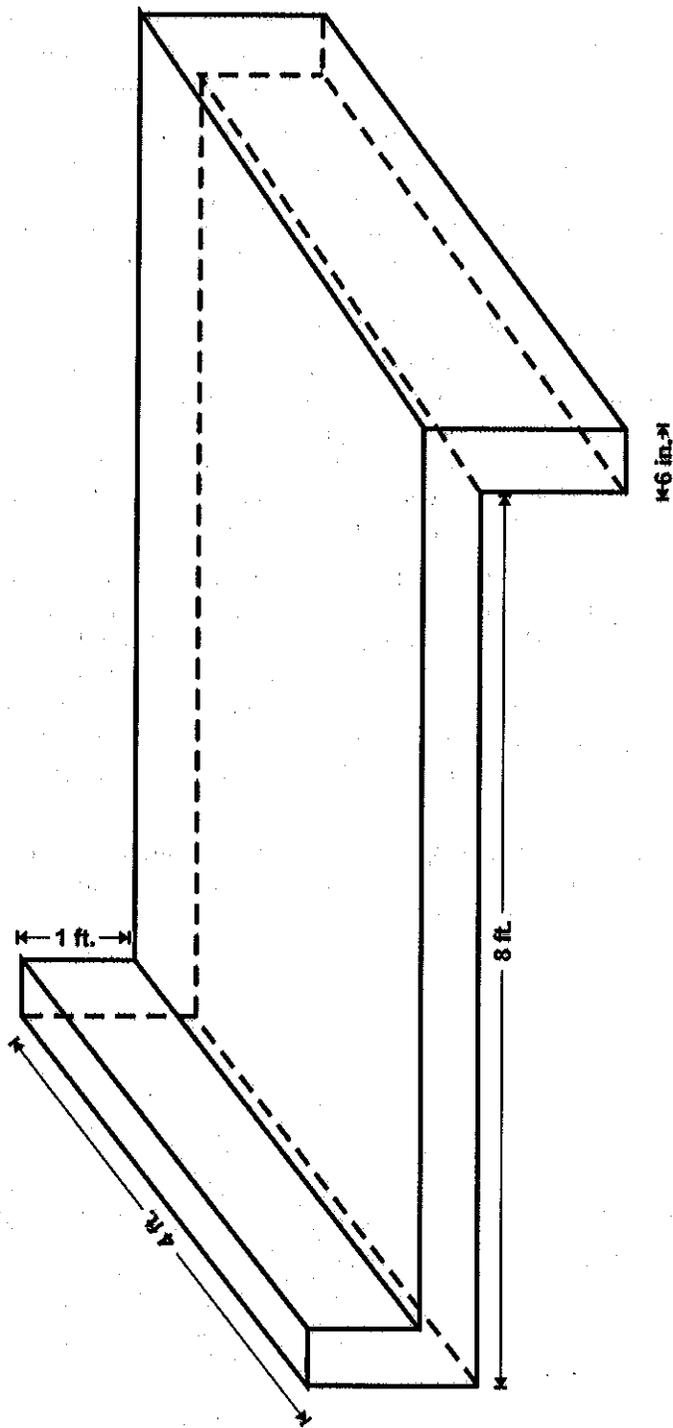
Kalaeloa Artificial Reef Project

Prepared For:  
 Division of Aquatic Resources  
 Dept. of Land & Natural Resources

Prepared By:  

 PLANNING  
 SOLUTIONS

Source:  
 -Division of Aquatic Resources  
 -R. Brock



Prepared For:  
 Division of Aquatic Resources  
 Dept. of Land & Natural Resources

Prepared By:



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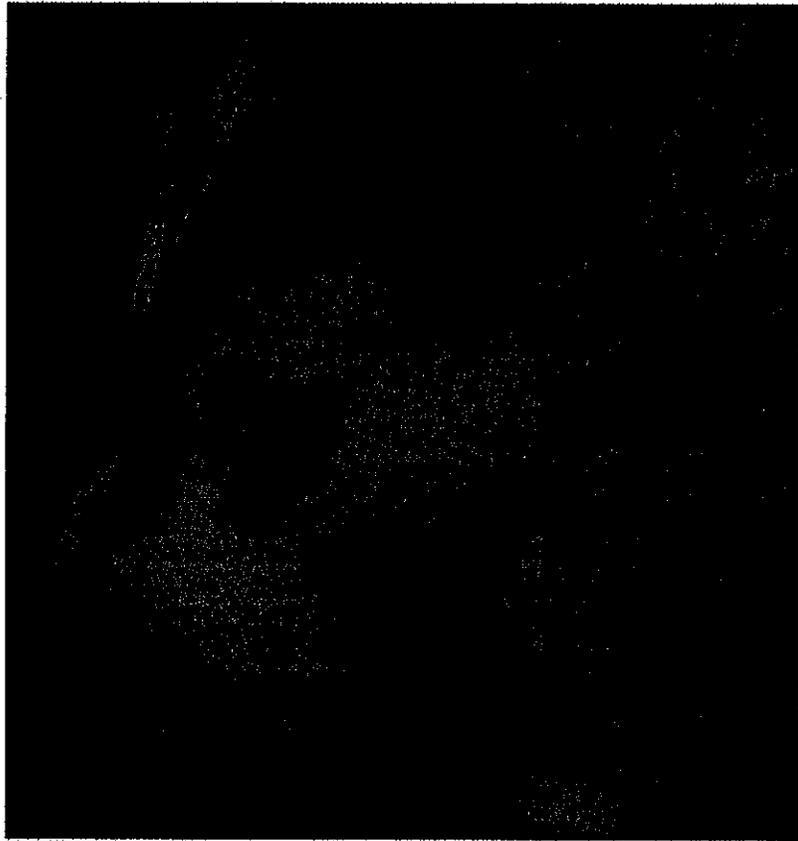
Source:  
 Division of Aquatic Resources (1991)

# The Z-Block

Kalaheo Artificial Reef Project

EXHIBIT 5

# EXHIBIT 6



A. Configuration of deployed Z-Blocks.



B. Example of artificial habitat created with deployed Z-Blocks.

Prepared For:  
Division of Aquatic Resources  
Dept. of Land & Natural Resources

Prepared By:  
  
PLANNING  
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Source:  
Division of Aquatic Resources  
Dept. of Land & Natural Resources

Maunaloa Artificial Reef  
Oahu

Artificial Reef Constructed  
From Z Blocks

Kalaheo Artificial Reef Project