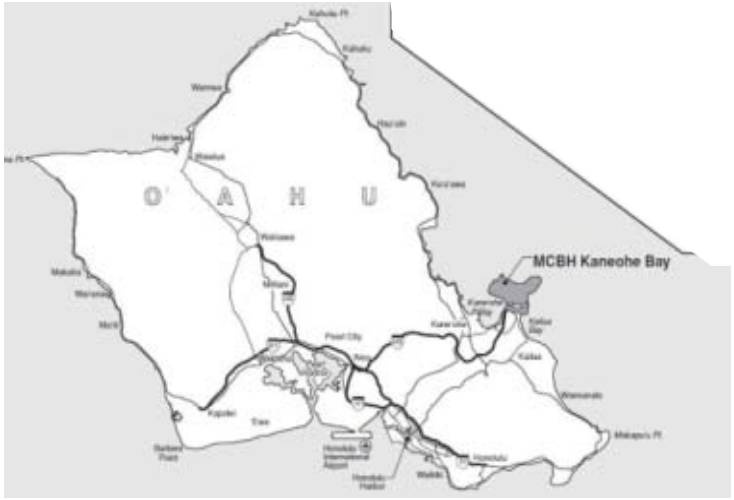
Wave Energy Test Site (WETS)

Marine Corps Base Hawaii (MCBH)



Alexandra DeVisser, NAVFAC-EXWC

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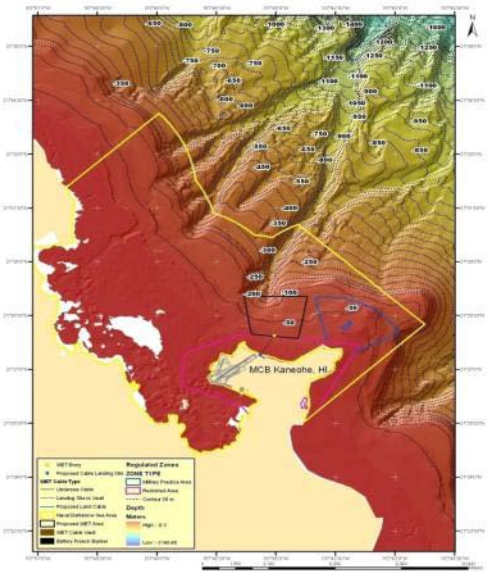
Energy Ocean International

June 10, 2013

Wave Energy Test Site (WETS)

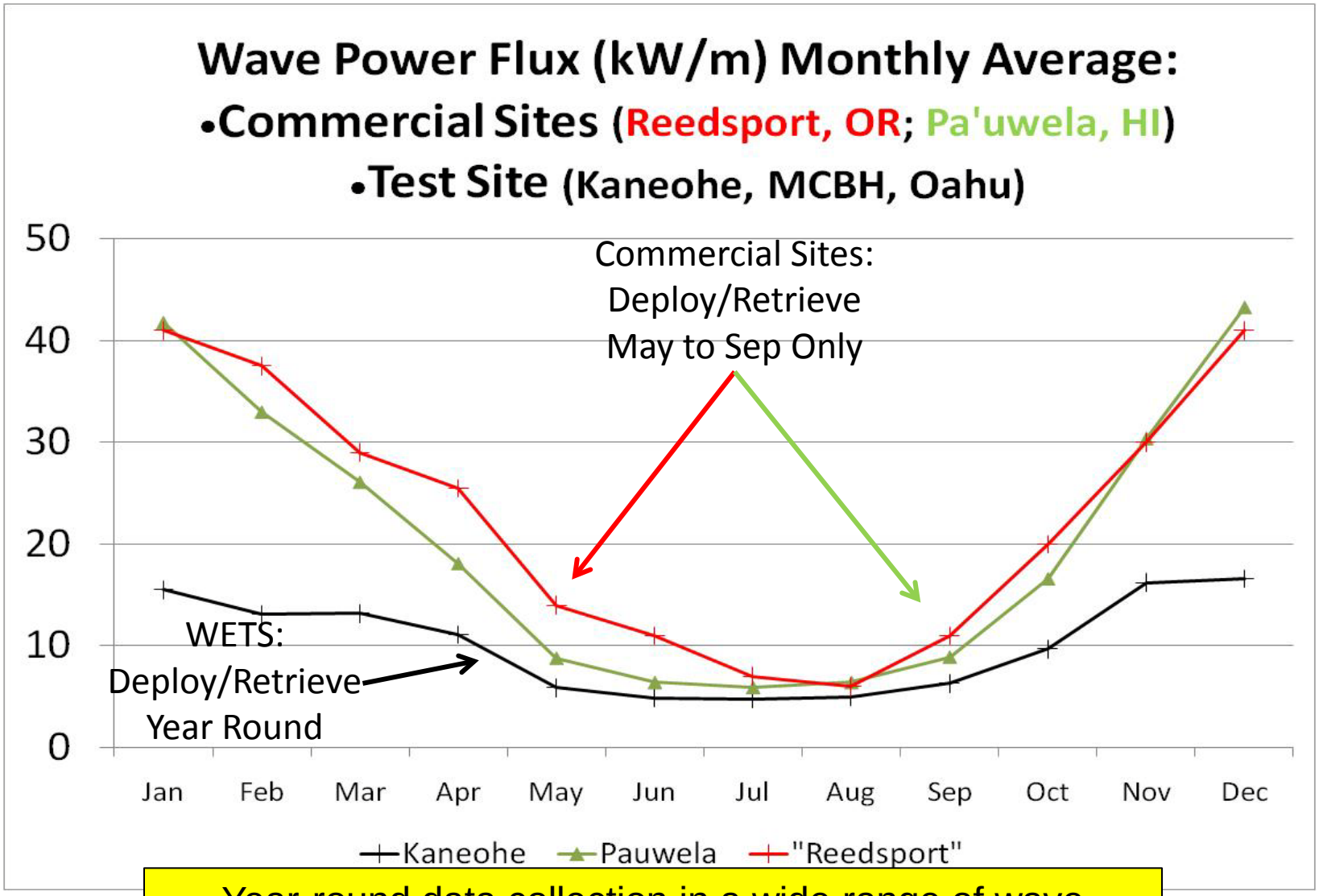
Objective: Provide location for year-long in-water technical and environmental-impact evaluation of WEC devices in the USA



Approach:

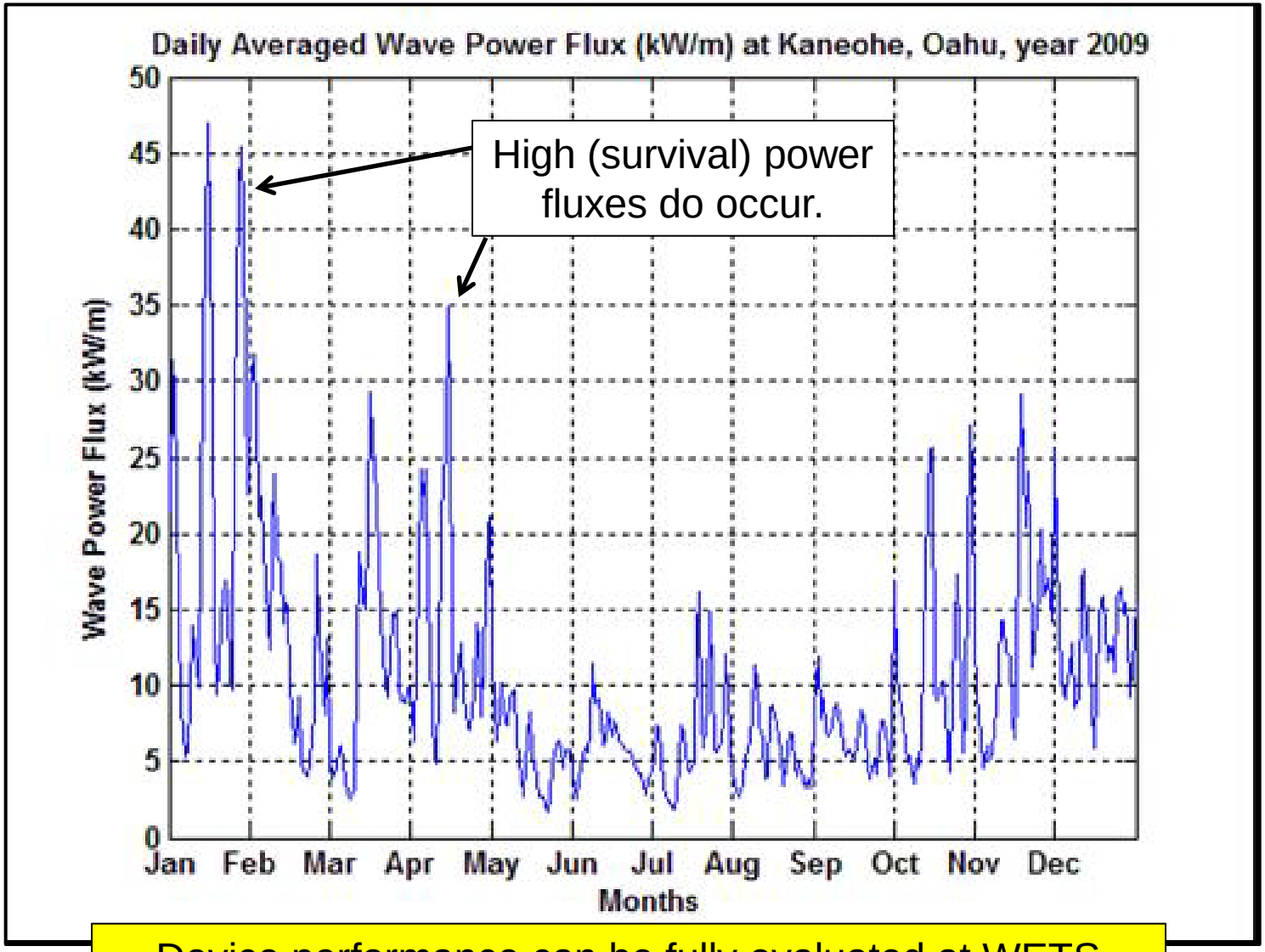
- Expand facility from one to three permitted berths (30, 60 & 80 m depths) leveraging:
  - DON/DOE funding;
  - NAVFAC: 10-year experience with previous tenant & ecological surveys;
  - Sound & Sea: Mooring/Berths Design; HINMREC/UH oceanography/ocean engineering.

Why WETS?



Year-round data collection in a wide range of wave conditions is possible.

Daily Wave Power Flux



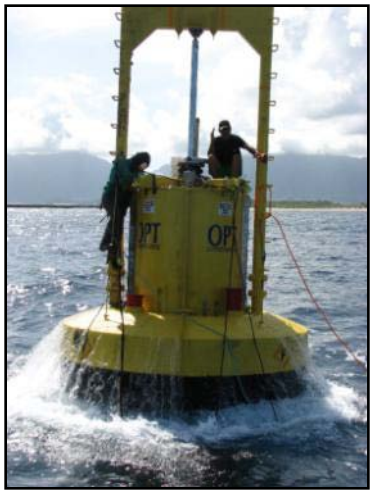
Device performance can be fully evaluated at WETS under all operational conditions

WETS End-Users Survey

- Industry surveys revealed that potential users are:

- Point Absorbers

(e.g., NWEI, Carnegie, Columbia Power, OPT)

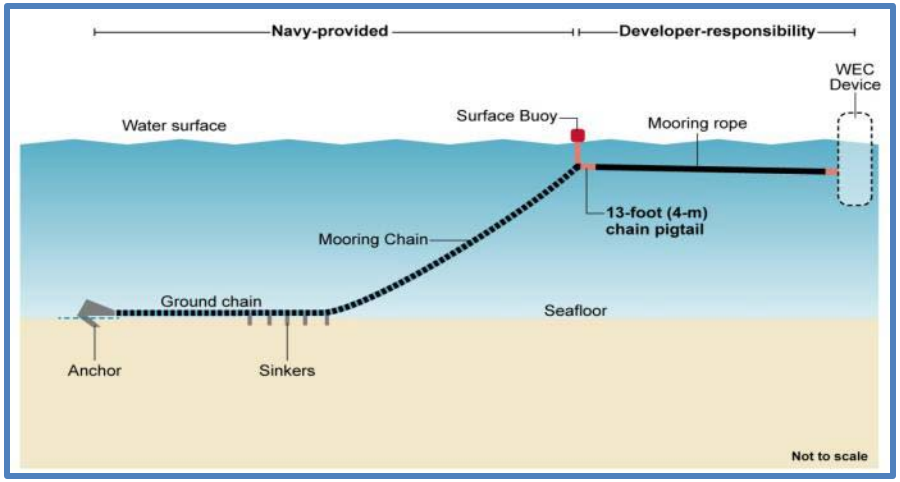


- Oscillating Water Column

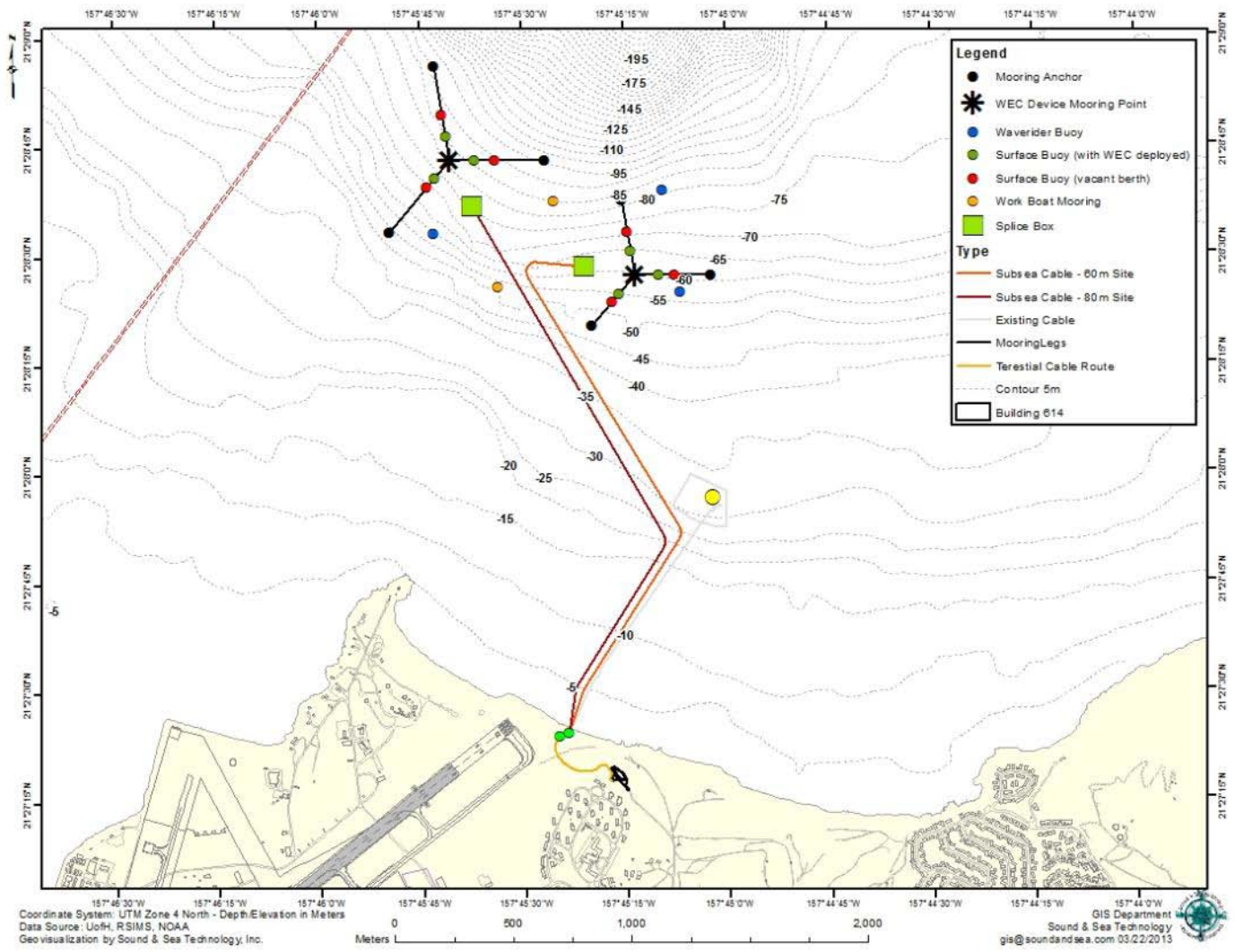
(e.g., Ocean Energy, Oceanlinx)

- Therefore, EA & berth design →

(one leg of 3-point mooring design by SST shown)



WETS Notional Layout



- Shore station facility

- Moorings

New 3-point moorings (60m & 80m depths)

Existing 3-point mooring (30m depth)

- Power cables

Existing subsea cable at 30m site

Two new trunk cables to J-box and pigtail cables for deep sites

Designed by Sound & Sea Technology for NAVFAC

WETS: Site-Specific Parameters

Power	30m site	Deep sites
Water depth	One @ 30m	Two sites @ <100m
Maximum transmitted power	250kW @ 4160V	1 MW @11,500V

Moorings		
Water depth	One @ 30m	Two sites: 60m and 80m
Configuration	Tri-moor	Drag embedment anchor + concrete sinkers

WETS Modus Operandi

NAVFAC/MCBH

- Permitted berths with primary mooring, submarine power and data cable;
- office space; and,
- grid connection.

HINMREC/UH

- Evaluation of WEC system performance (power output as function of waves);
- Mooring system & power cable life expectancy evaluation;
- Environmental impact (acoustics, EMF, ecological surveys);
- Calibrated 7.5 days wave forecasting for operations planning.

TENANTS

- Connection to primary mooring and submarine cable socket;
- Additional proprietary data acquisition of subsystem parameters.

All

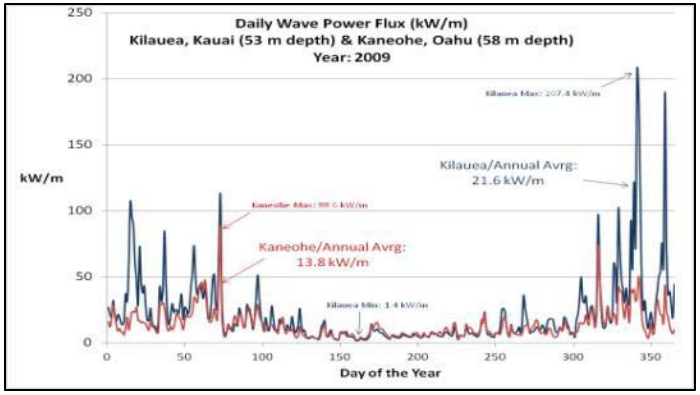
- Cooperative Research and Development Agreements (CRADAs).

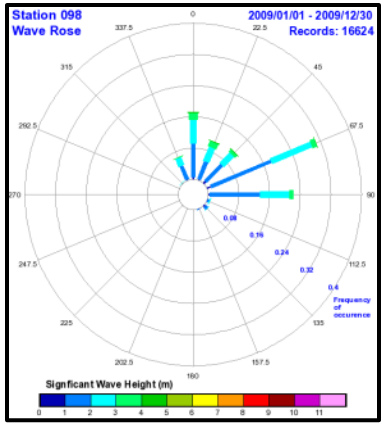
WETS Schedule

- Existing 30 m/1.2 km offshore berth to be occupied by NWEI 03/14
- HINMREC Waverider buoy operational (providing real time wave data for eventual evaluation of WEC device performance and to calibrate models to provide 7.5 days wave forecasts at the test berths)
- WETS expansion design by Sound & Sea Tech. completed (two additional berths at 60 and 80 m depth)
- EA/FONSI process expected to be completed by 09/13
- WETS Acquisition and Construction Phase after FONSI
- Additional berths operational by 09/14

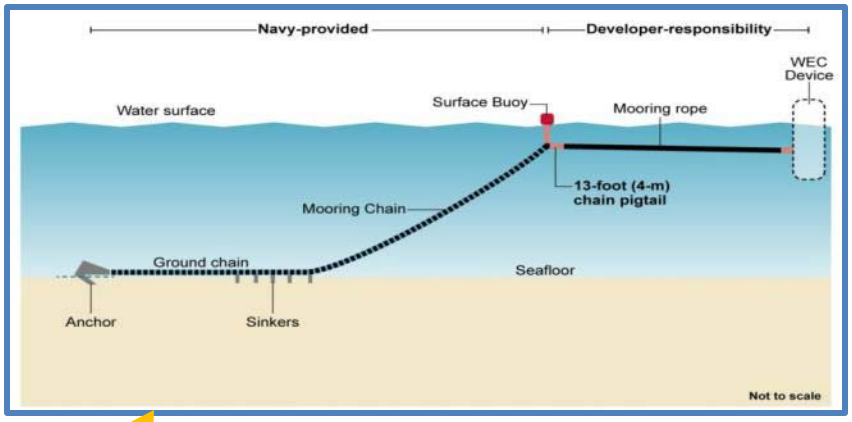
The HINMREC/UH Team: *Supporting NAVFAC in WETS Environmental Assessment and Design*

Wave & Current Climate

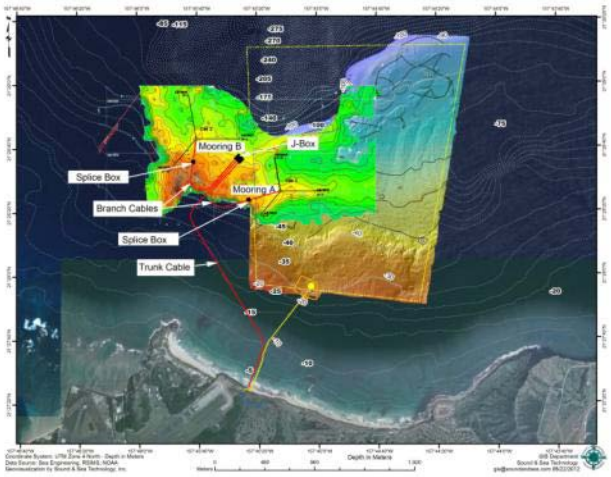




Waverider In-situ Measurements



Bathymetry & Sediment Profile

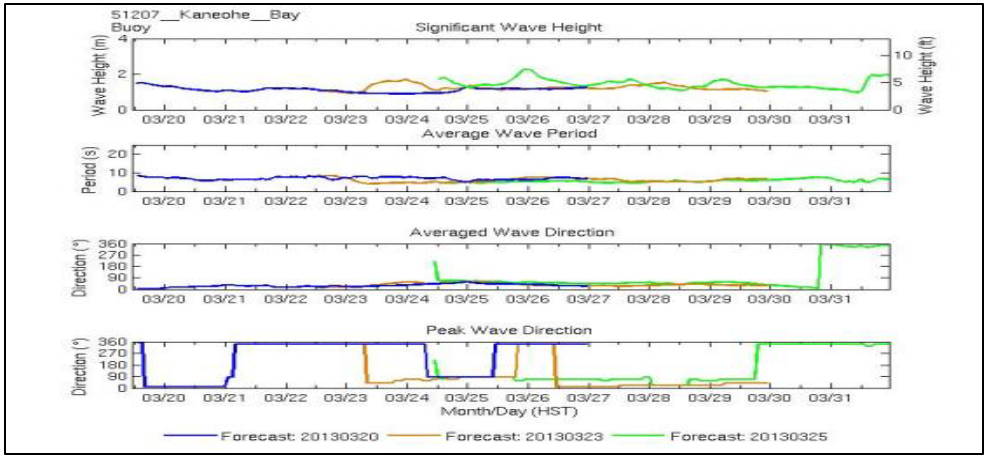


Output

- Mooring Design by SST
- Power cable routing

The HINMREC/UH Team: *Will Support Testing Operations & Provide Independent Assessment of Performance*

Provide Calibrated Wave Forecasting



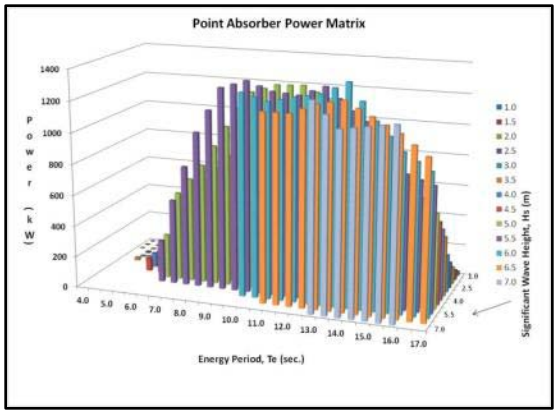
WEC Device Environmental Impact:

- Chemical & Ecological site surveys
- Acoustic & EMF signatures →

Database to address regulatory and stakeholder issues

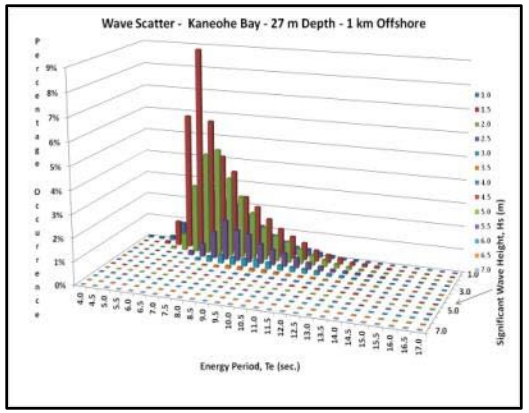
Device Power Performance:

- Electrical output vs. wave parameters



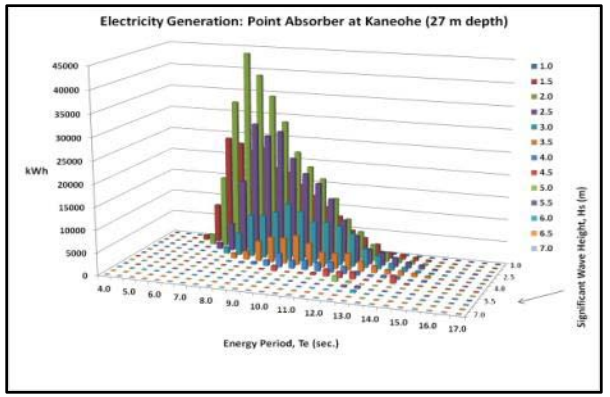
Power Matrix:
kW vs. Hs/Te

X



Wave Scatter:
Occurrence vs. Hs/Te

=



kWh vs. Hs/Te