Toxicity Bioassays: A Useful Line of Evidence in Ecological Risk Assessment*

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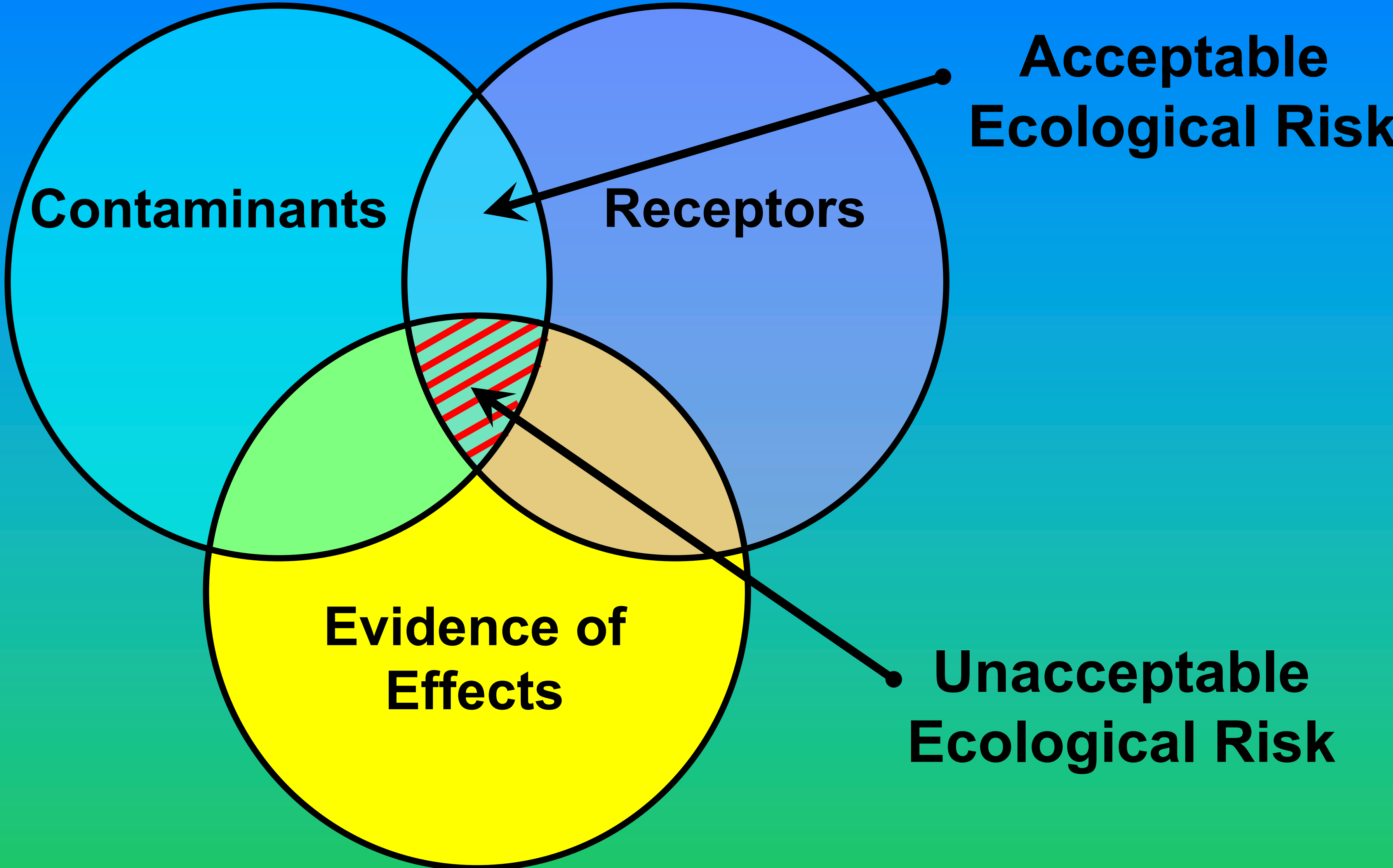
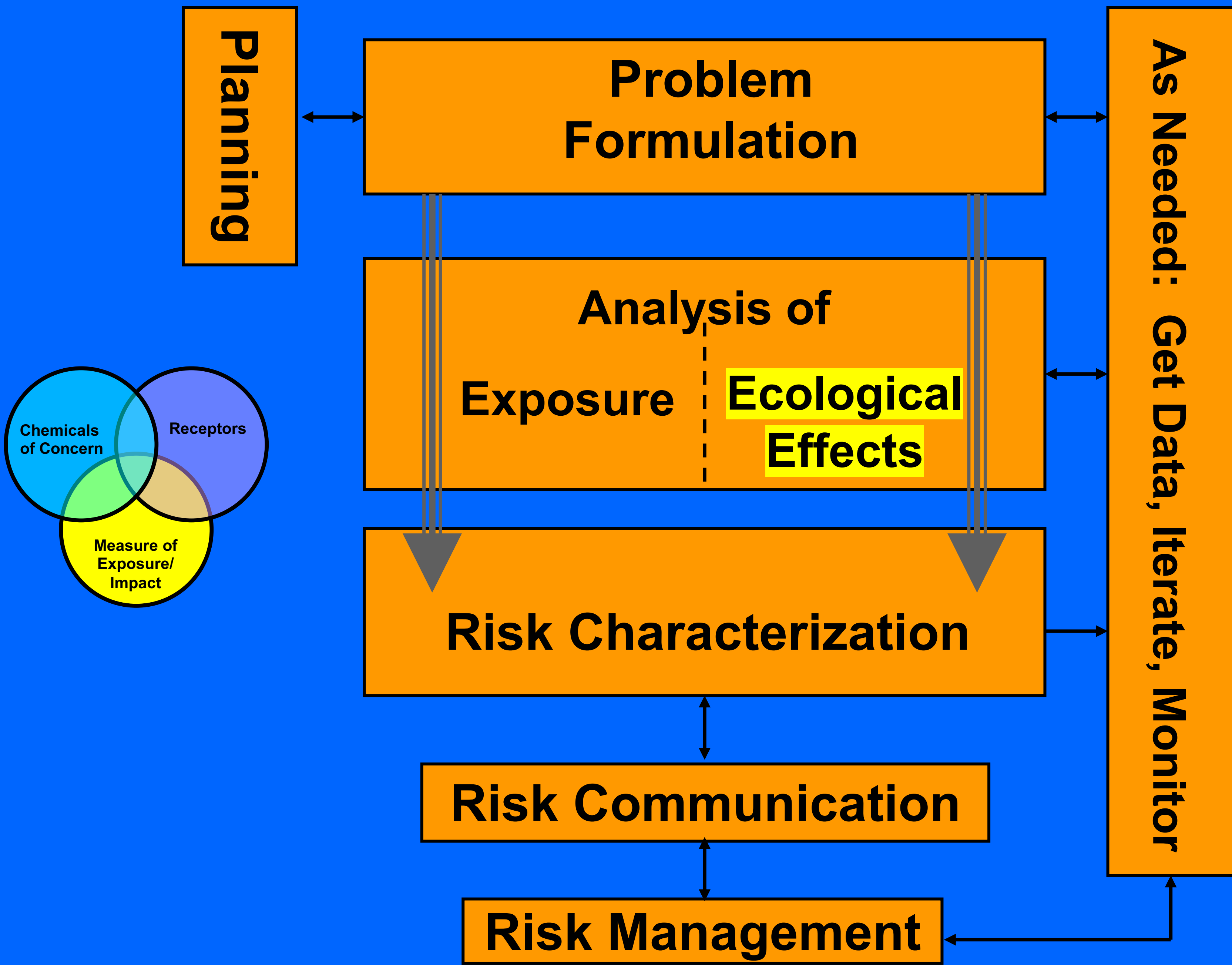
***if you know what you're doing**

CERCLA Risk Characterization



EPA Ecological Risk Assessment



Summary

- **Toxicity bioassays are lab or field experiments to test if a substance is poisonous**
- **There are many organisms and protocols used for tox bioassays; far too many to describe in a few minutes**
- **Tox bioassays often use small invertebrates, such as the amphipod *Hyalella azteca*, because they are easy to grow and study and are near the base of many food chains**

- **CERCLA risk model requires correlation of contaminant concentrations with amount of toxicity**
- **Confounding factors complicate interpretation of bioassay results**
- **Extra credit if you spot connections in my talk to the following presentations by Lawrence and Sharon**

McClellan Air Force Base Creeks Risk Assessment

Did sediment contaminant concentrations correlate with toxicity?

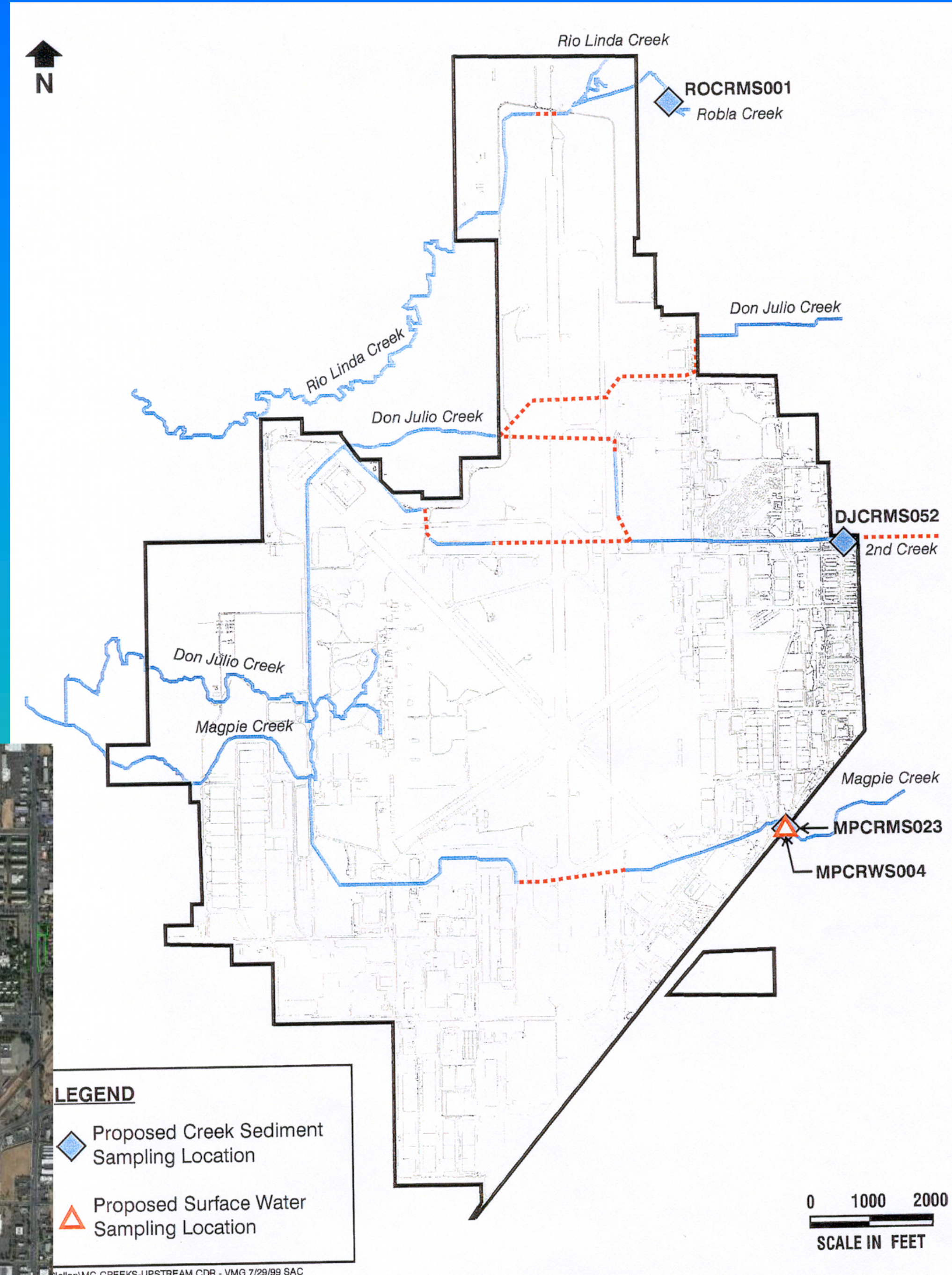
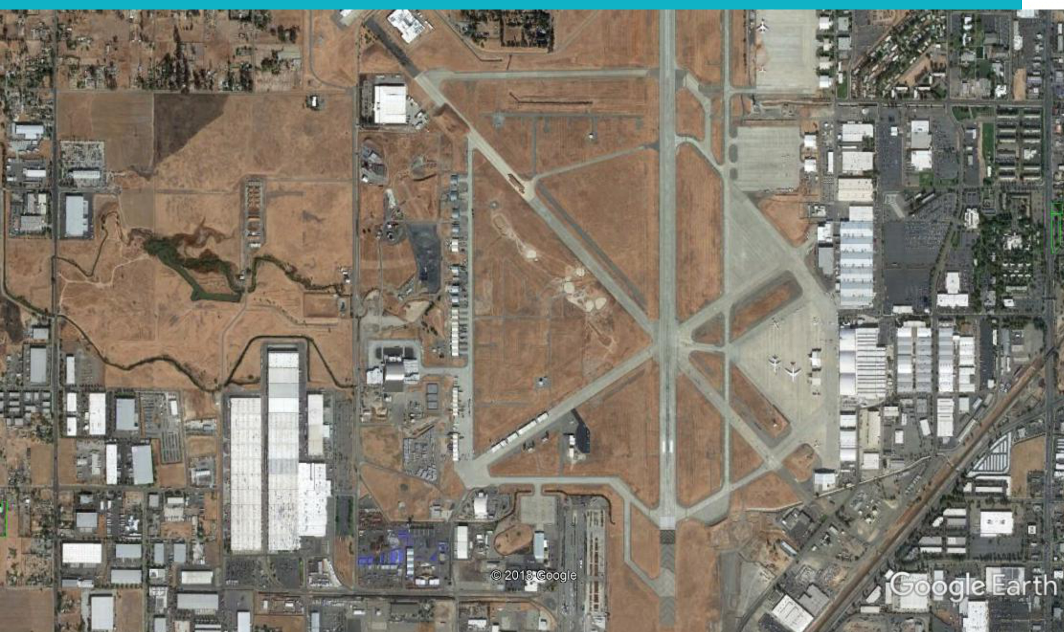


Figure 10-2. Proposed Sampling Locations Upstream from McClellan AFB



McClellan ERA

Some locations not toxic, some a little toxic, some are deadly…

Table 2. Toxicity of undiluted Don Julio Creek and Magpie Creek sediments to *Hyalella azteca* survival.

Sample Station I.D.	% Survival								
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Mean
Control #1	70	60	70	80	80	100	80	100	80
DJCRMS044	10	70	0	20	30	60	30	50	33.75 *
DJCRMS045	30	50	40	50	50	60	70	60	51.25 *
DJCRMS046	50	50	80	30	50	50	60	30	50 *
MPCRMS018	80	20	70	0	40	50	30	40	41.25 *
MPCRMS019	80	70	80	80	80	80	70	40	72.5
Control #2	90	80	100	80	70	90	70	100	85
DJCRMS047	0	0	0	0	0	0	0	0	0 *
MPCRMS017	0	0	0	0	0	0	0	0	0 *

* - Statistically less than the Control treatment at $p < 0.05$.

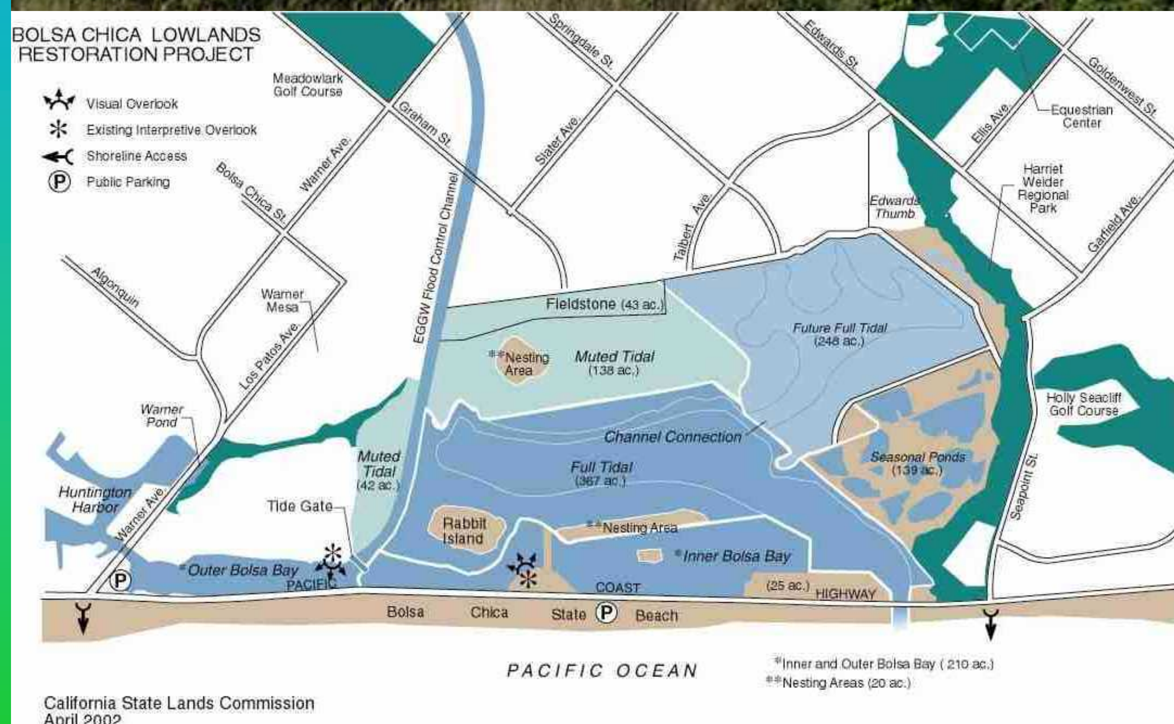
McClellan ERA

…but the search for toxicity drivers failed!

- **All toxic locations had elevated concentrations of contaminants.**
- **Contaminants were also present at some non-toxic locations**
- **No contaminant correlated with toxicity across sampling sites**
- **Sediment samples from locations upstream of McClellan had similar contaminants at low levels**
- **Remedial action based solely on comparison to toxicity benchmarks for highly bioaccumulative contaminants, e.g. PCBs & dioxins**

Bolsa Chica Wetlands

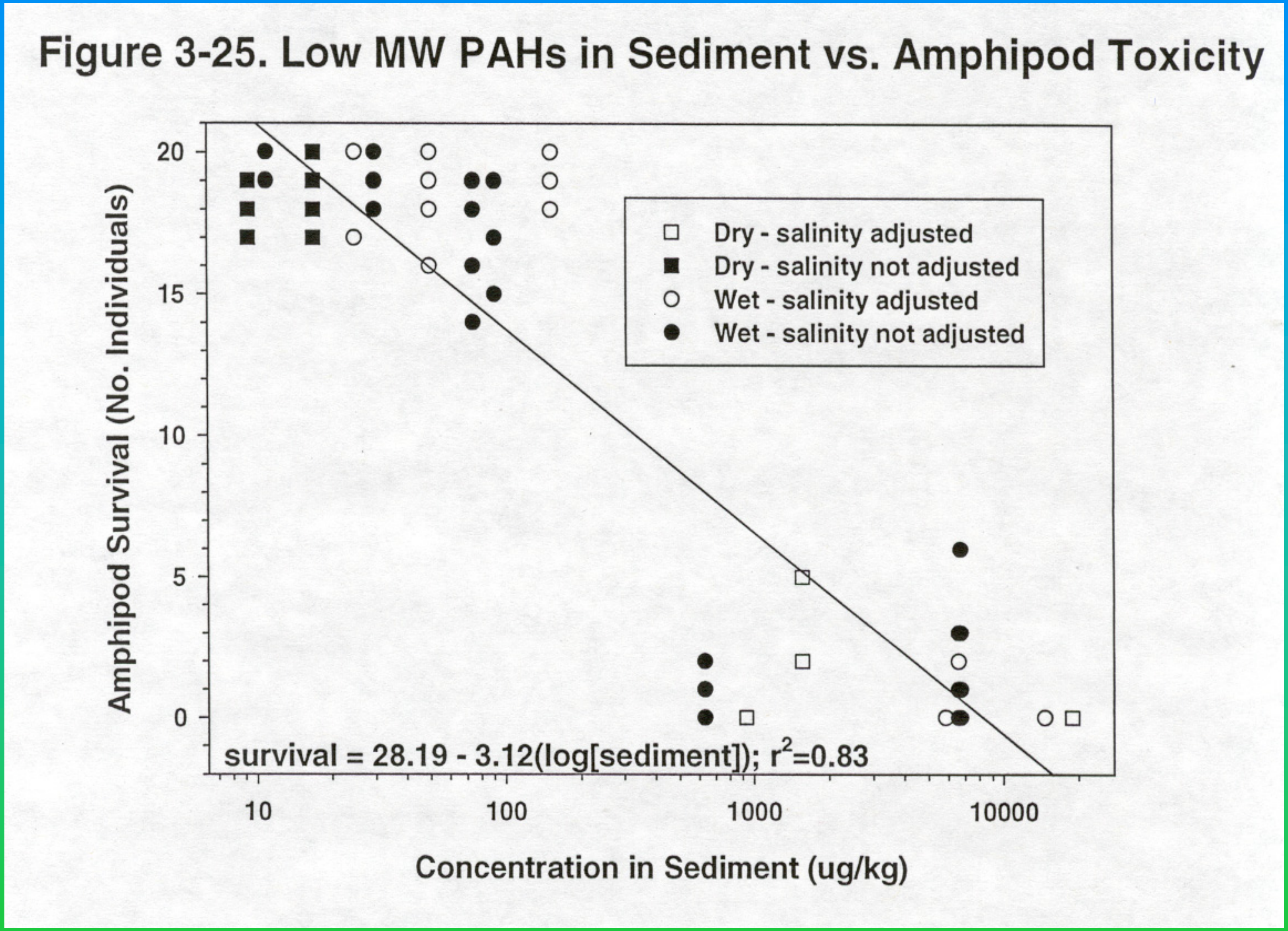
- **A former oil field near Los Angeles & adjacent to the Pacific Ocean**
- **Degraded seasonal wetland converted (back) to tidal and subtidal wildlife refuge**
- **Many contaminants: PAHs, metals, PCBs, pesticides**
- **Setting cleanup goals, or the search for risk drivers in "marine" sediment**



Bolsa ERA

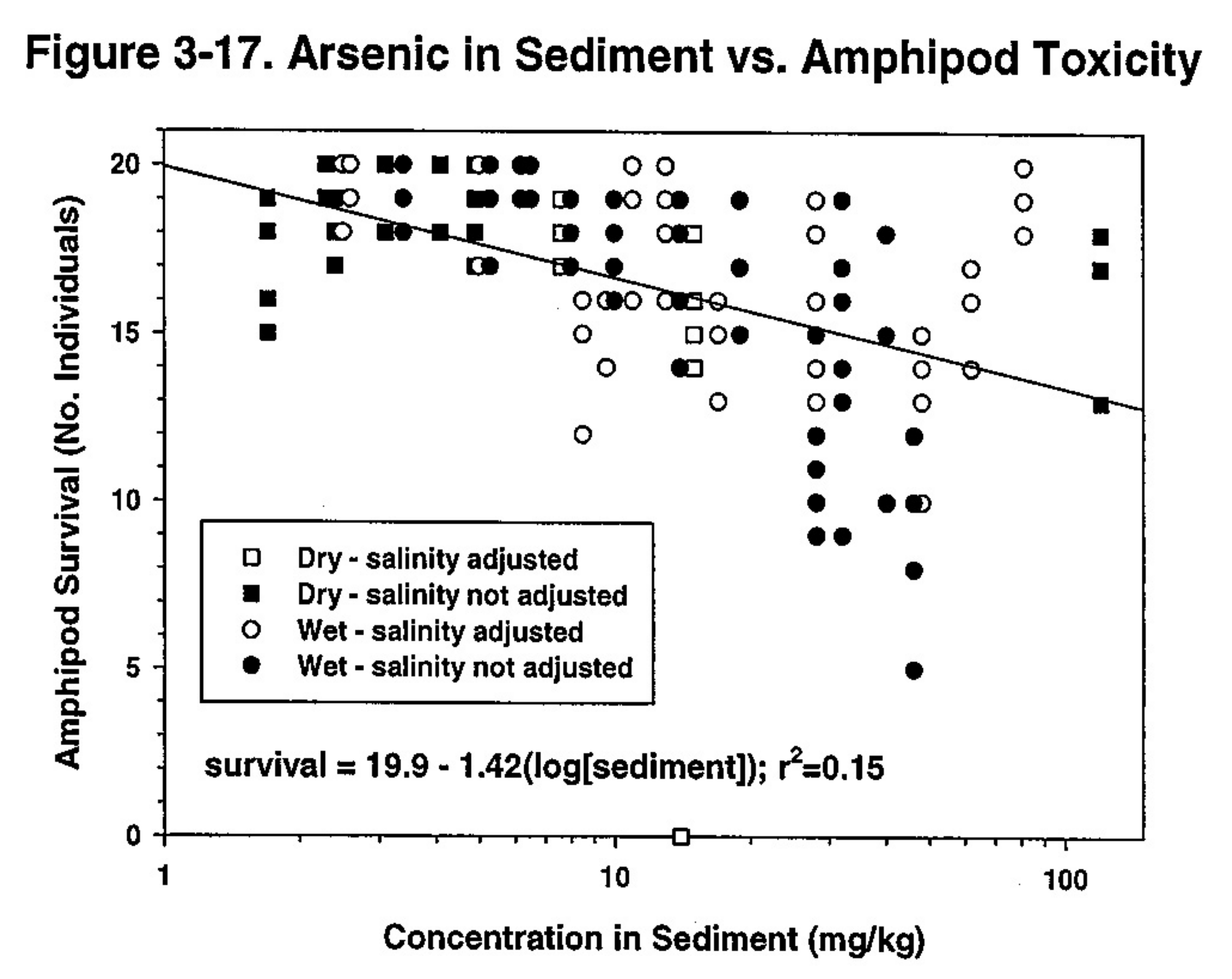
Exposure/Response!

Used to support TPH cleanup goal



Bolsa ERA

Exposure/Response? Confounding factors?
Cleanup goal set at LC20 = 20 mg/kg



Pearl Harbor

Bioassays to Proposed Plan

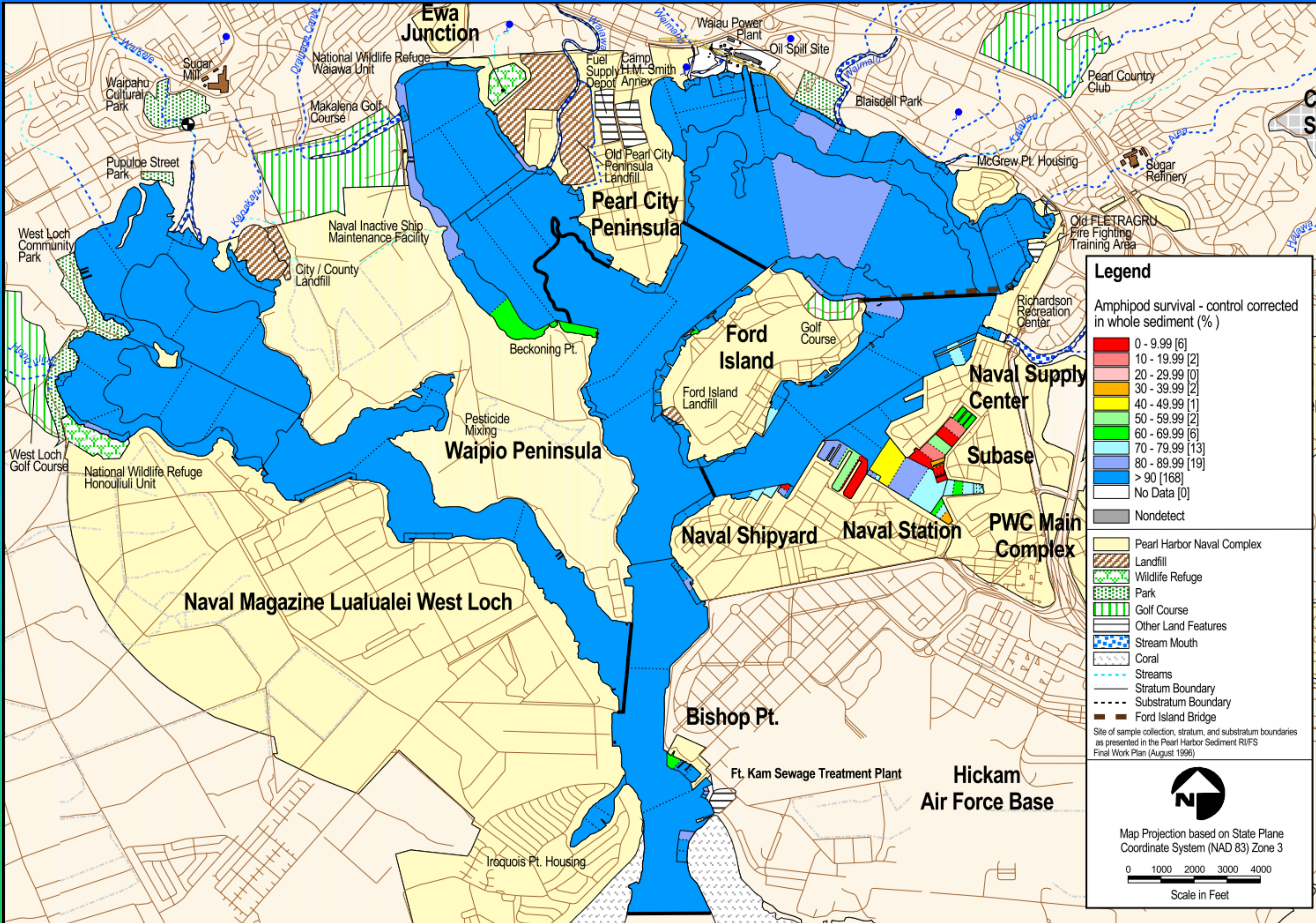
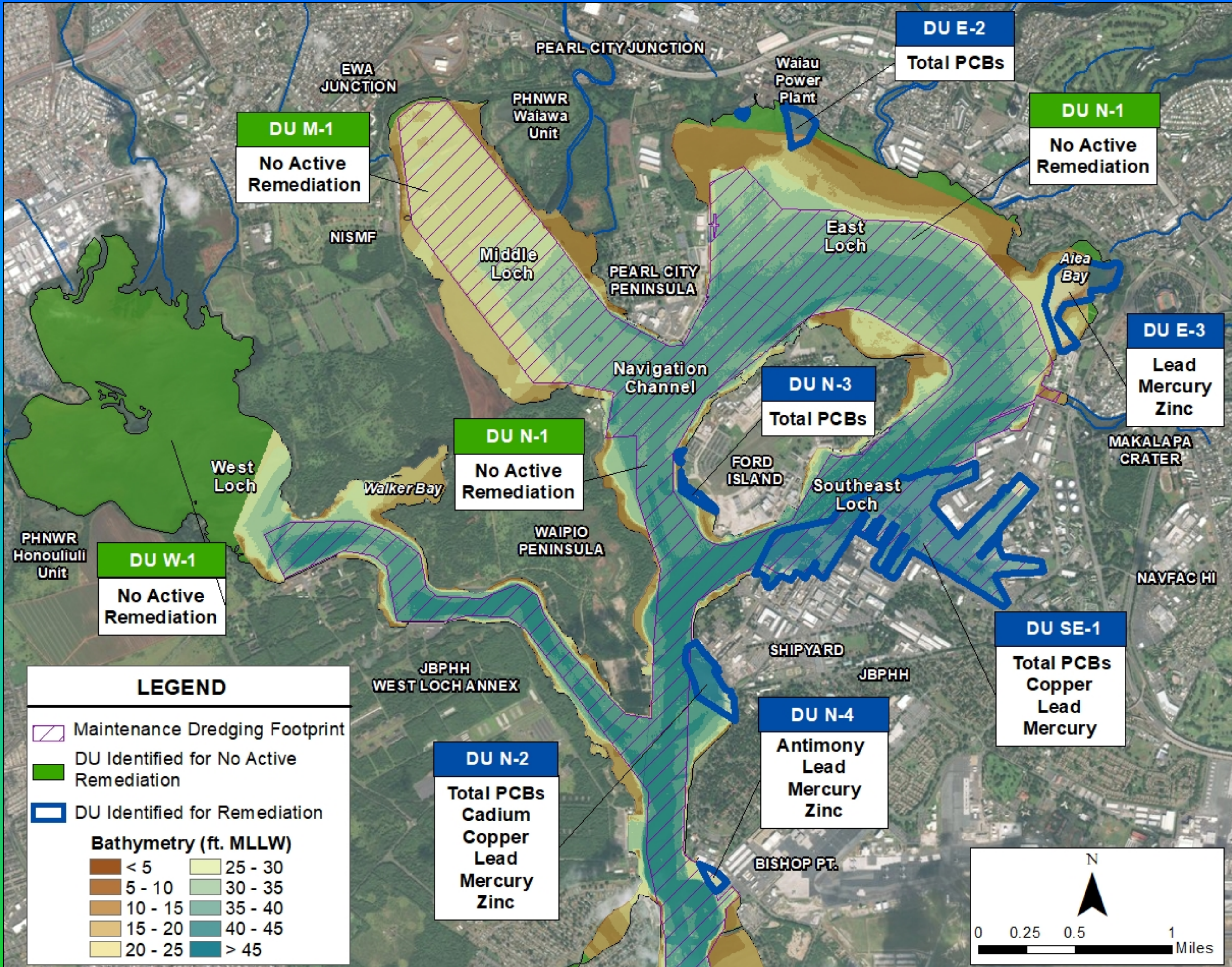


Figure 5-1. Spatial Distribution of Amphipod (Ampelisca abdita) Survival in Pearl Harbor



PEARL CITY JUNCTION
EWA JUNCTION
DU E-2
Total PCBs
Waiau Power Plant
PHNWR Waiawa Unit
DU M-1
No Active Remediation
DU N-1
No Active Remediation
NISMF
Middle Loch
PEARL CITY PENINSULA
East Loch
Aiea Bay
DU E-3
Lead
Mercury
Zinc
Navigation Channel
DU N-3
Total PCBs
DU N-1
No Active Remediation
MAKALAPA CRATER
West Loch
Walker Bay
FORD ISLAND
Southeast Loch
WAIPIO PENINSULA
PHNWR Honouliuli Unit
DU W-1
No Active Remediation
NAVFAC HI
DU SE-1
Total PCBs
Copper
Lead
Mercury
SHIPYARD
JBPHH
JBPHH WEST LOCH ANNEX
LEGEND
Maintenance Dredging Footprint
DU Identified for No Active Remediation
DU Identified for Remediation
Bathymetry (ft. MLLW)
< 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 45
> 45
DU N-4
Antimony
Lead
Mercury
Zinc
DU N-2
Total PCBs
Cadium
Copper
Lead
Mercury
Zinc
BISHOP PT.
N
0 0.25 0.5 1
Miles


FORD ISLAND
Southeast Loch
LEGEND
Maintenance Dredging Footprint
Dredging Remedy Footprint
ENR Remedy Footprint
ENR + AC Remedy Footprint
MNR Remedy Footprint
MNR + AC Remedy Footprint
No Remediation Required Area
Under-pier AC Treatment Area
Under-pier MNR Area
N
0
500
1,000
2,000
Feet