California Energy Commission

Huntington Beach Units 3 & 4 Entrainment and Impingement Study Results and Recommended Mitigation

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BACKGROUND

1995 – Units 3 & 4 retired due to non-use

2000 – AES files Application for Certification to retool Units 3 & 4

staff unable to assess impacts from entrainment and impingement

2001 – Energy Commission grants expedited certification

AES to fund 1 year study to assess impacts

provide funds to restore or create coastal habitat to mitigate impacts

CONDITIONS OF CERTIFICATIONS

- **BIO-3** Complete an impacts assessment of entrainment and impingement

- **BIO-4** Fund the impacts assessment

- **BIO-5** If impacts are significant, provide funds to restore or create coastal habitat to mitigate impacts

California Energy Commission

Huntington Beach Generating Station

STUDY DESIGN

Technical Working Group:

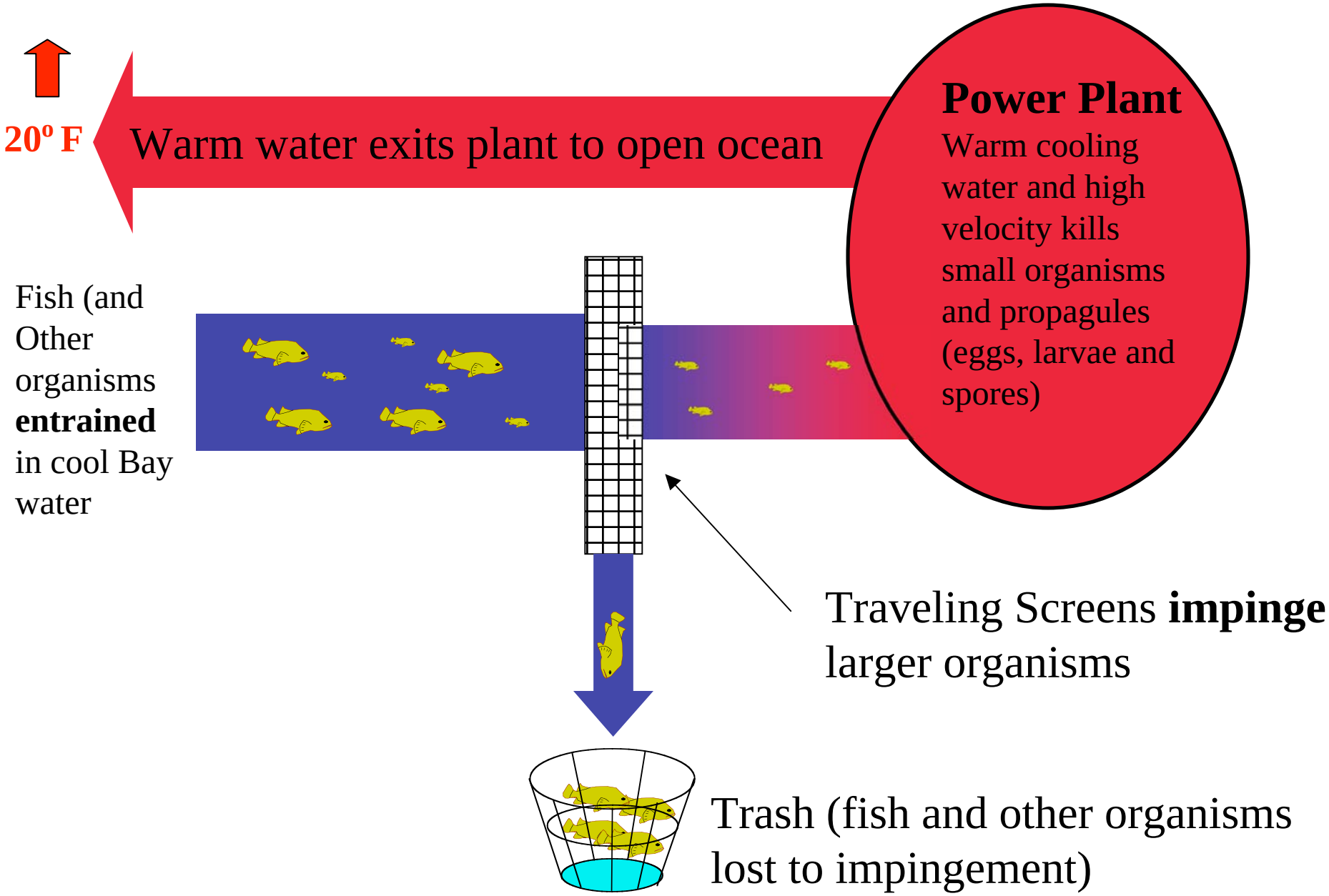
- California Energy Commission and Consultants
- California Coastal Commission
- Project owner and Consultants
- California Department of Fish and Game
- National Marine Fisheries Service
- Santa Ana Regional Water Quality Control Board

Provided input into sampling design and methods for impact analysis

Approved final study plan

Reviewed progress reports and approved final report in April 2005

Thermal Effects, Impingement and Entrainment



Huntington Beach Generating Station

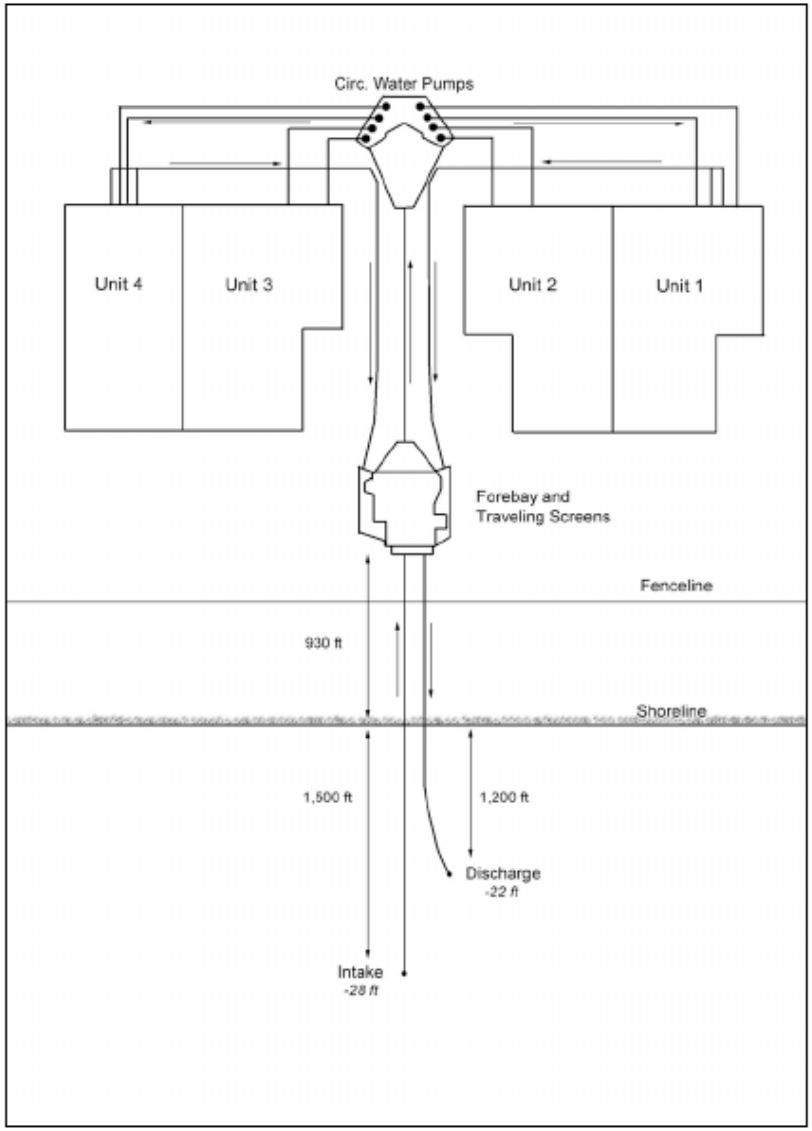
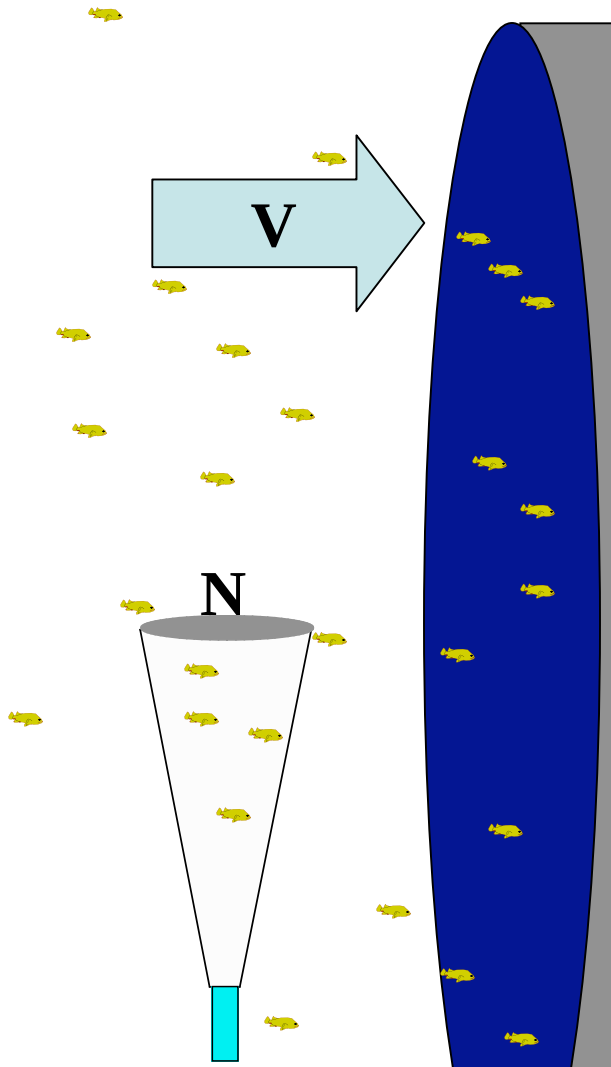


Figure 2-2. Schematic of the AES HBGS cooling water intake system.

Estimation of larval losses due to entrainment



1. Calculate volume of cooling water entering the plant per year (V)
2. Measure concentration of larvae (number per volume) that are entrained (N)
3. ***Assume no survival of larvae through the plant*** – then
4. NV = the annual loss of larvae due to entrainment
5. 57 fish species were collected during entrainment surveys

Estimation of Ecological Effects due to Entrainment

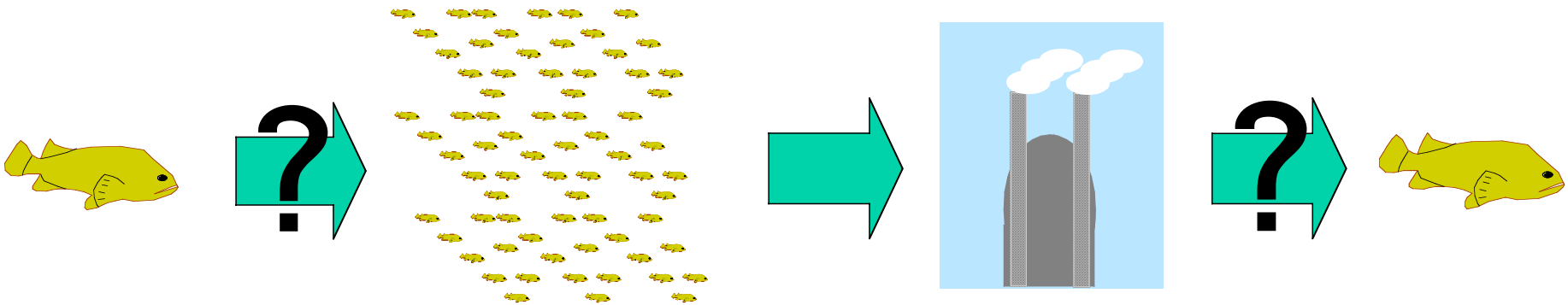
Methods of Estimation

- Fecundity Hindcast (FH)
- Adult Equivalent Loss (AEL)
- Proportional Mortality (PM)

Importance of larval losses due to entrainment

Fecundity Hindcast (FH)

Adult Equivalent Loss (AEL)



Adult Stock (Females)

Larvae

Loss of Adult fish

Question: How to estimate losses to adult populations?

Table 5-1. Summary of entrainment modeling estimates on target taxa based on the three modeling techniques (*FH, AEL,* and *ETM* [P_M]). The *FH* model estimates an equivalent number of breeding adult females, therefore this estimate is multiplied by two for comparison with the AEL model that estimates an equivalent numbers of adults irrespective of sex. The comparison assumes a 50:50 ratio of males:females in the population. The shoreline distance (km) used in the alongshore extrapolation of P_M is presented in parentheses next to the estimate.

Taxon	Estimated Annual Entrainment	2·*FH*	*AEL*
CIQ goby complex	113,166,834	202,538	147,493
northern anchovy	54,349,017	53,490	304,125
spotfin croaker	69,701,589	NA	NA
queenfish	17,809,864	NA	NA
white croaker	17,625,263	NA	NA
black croaker	7,128,127	NA	NA
salema	11,696,960	NA	NA
blennies	7,165,513	6,466	NA
diamond turbot	5,443,118	NA	NA
California halibut	5,021,168	NA	NA
sand crab megalops	69,793	NA	NA
California spiny lobster	0	NA	NA
ridgeback rock shrimp	0	NA	NA
market squid	0	NA	NA
rock crab megalops	6,411,171	NA	NA

NA – Estimate not available due to either insufficient life history information or low abundance in entrainment samples.

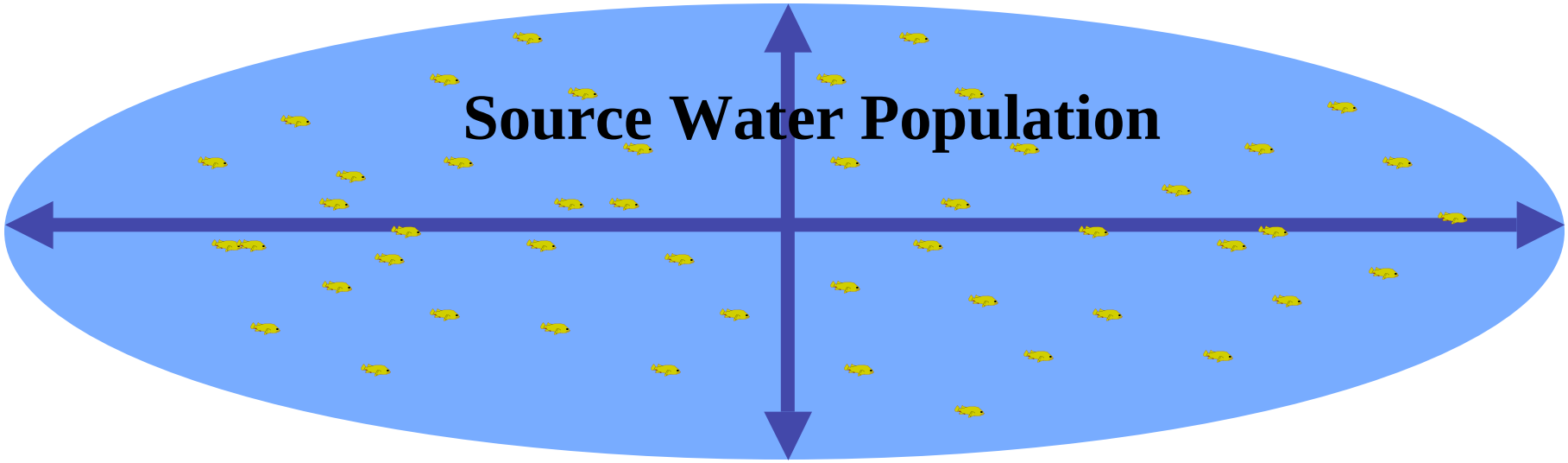
Estimation of Ecological Effects due to Entrainment

Methods of Estimation

- Fecundity Hindcast (FH) – insufficient info
- Adult Equivalent Loss (AEL) – insufficient info
- **Proportional Mortality (PM)**

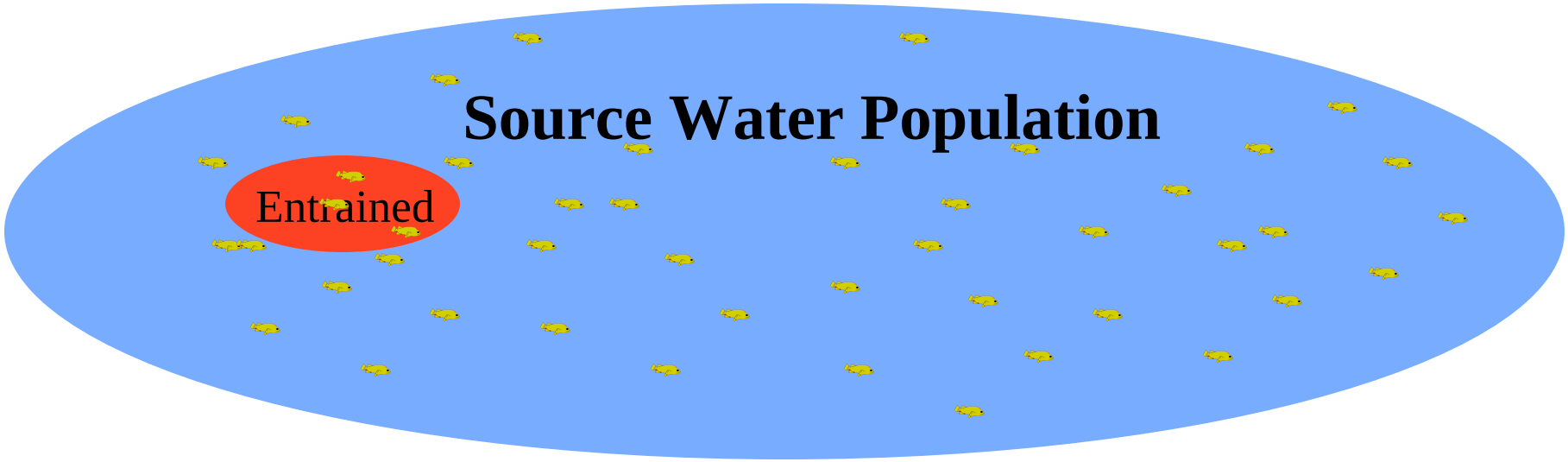
Understanding "Source Water Population" (SWP) and "Proportional Mortality" (P_m)

The SWP is that spatial area that contains the larvae at risk of entrainment.

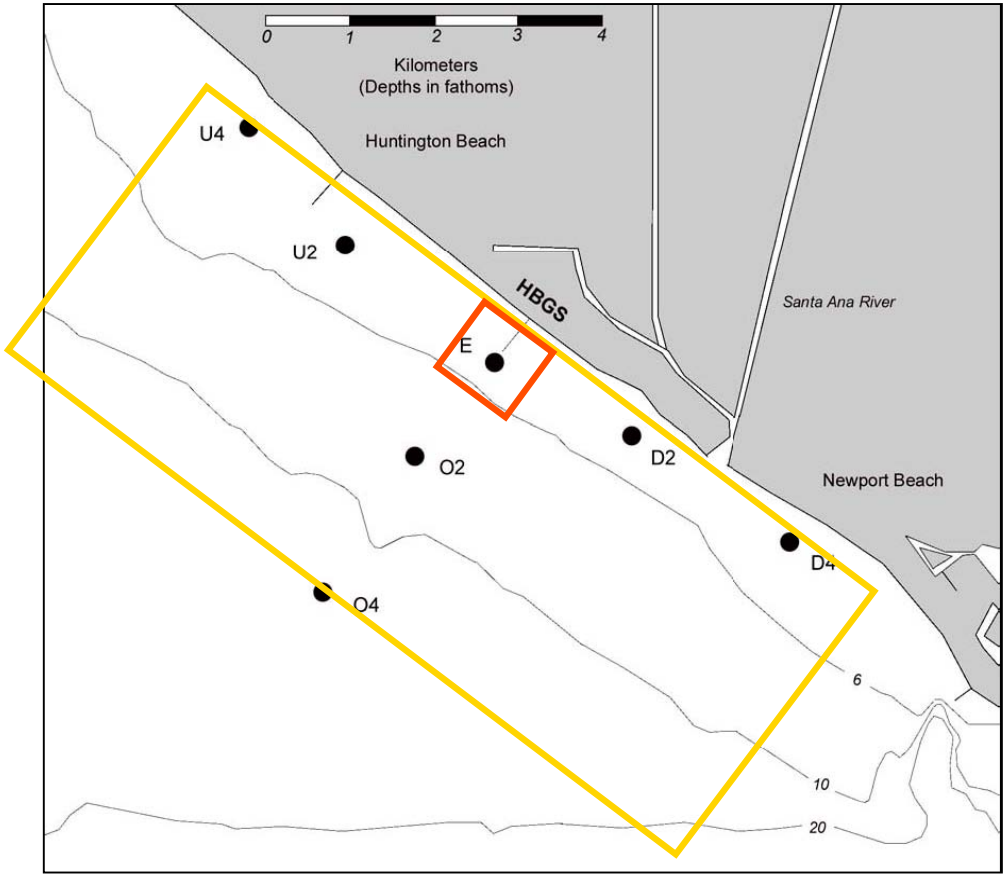


Understanding "Source Water Population" (SWP) and "Proportional Mortality" (P_m)

P_m is the percentage of the larvae at risk that are entrained and killed (e.g. 1%)

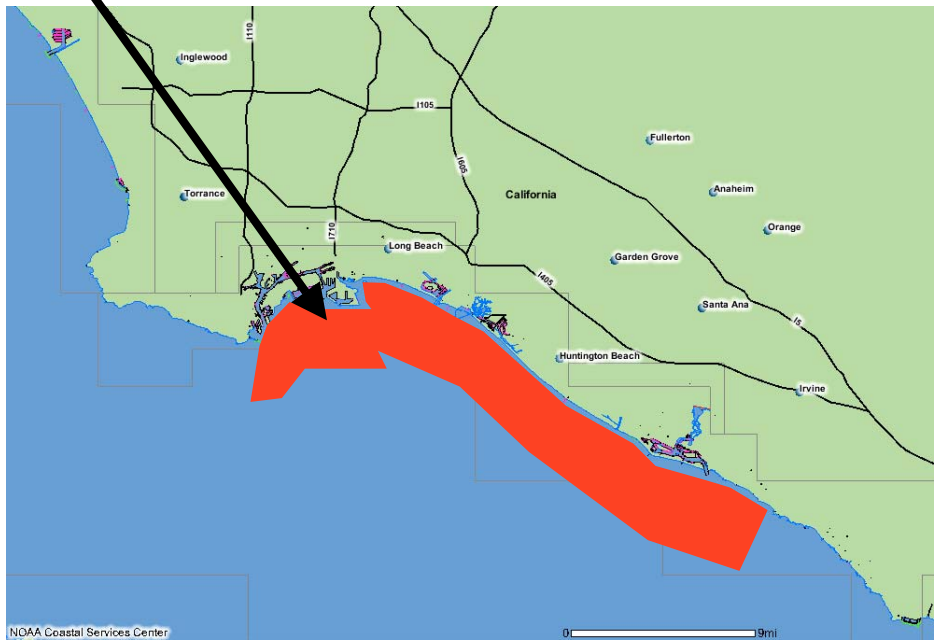


Source Water Sampling at Huntington Beach



Entrainment Study – ETM Model results

Taxon	Estimated Annual Entrainment	Length of Source Water Population (Miles)
spotfin croaker	69,701,589	**10.1**
queenfish	17,809,864	**50.9**
white croaker	17,625,263	**28.7**
black croaker	7,128,127	**11.6**
salema	11,696,960	
blennies	7,165,513	**7.7**
diamond turbot	5,443,118	**10.1**
California halibut	5,021,168	**18.5**
rock crab	6,411,171	**15.9**
AVERAGE		
AVERAGE (acres)		



The ETM Model: Calculation Of Average Mortality due to entrainment

There was Working Group concurrence on the following approach -

- Determine target species
- Determine period when larvae are at risk
- Calculate rates of mortality (P_m) for target species
- Assume that target species represent other species that were not targets
- These values represents the estimated rate of mortality for all species having a larval phase whose PM's were not directly determined

Entrainment Study – ETM Model results based on: (1) "best estimate" and estimate including uncertainty.

Taxon	Estimated Annual Entrainment	P_m Alongshore Extrapolation (Mean)	P_m Alongshore Extrapolation (+1 SE)
spotfin croaker	69,701,589	0.30%	37%
queenfish	17,809,864	0.60%	29%
white croaker	17,625,263	0.70%	24%
black croaker	7,128,127	0.10%	38%
salema	11,696,960	NA**	
blennies	7,165,513	0.80%	28%
diamond turbot	5,443,118	0.60%	28%
California halibut	5,021,168	0.30%	21%
rock crab	6,411,171	1.10%	35%
AVERAGE		**0.56%**	**30.0%**
AVERAGE (acres)			

Interpretation of estimate of LOSS (FH, AEL and PM)

- With FH and AEL we can estimate adult loss
- With PM we can estimate proportional larval loss

  - **Question: what level of loss is environmentally important?**
    - **What counts as important?**
      - **Local**
      - **Regional**
      - **National**

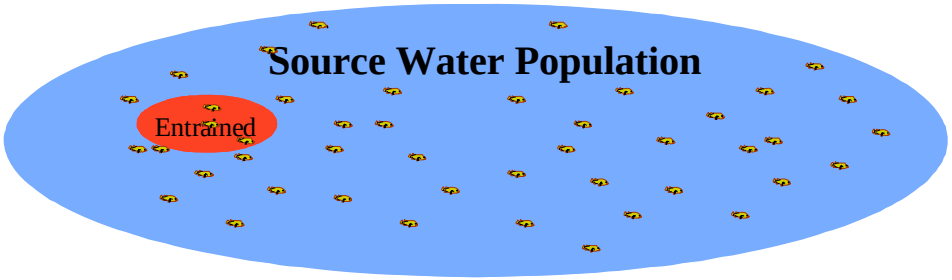
Area of Production Foregone – a way to interpret loss

- Method allows for conversion of organismal loss to habitat
- Can work for any source of loss
  - Impingement or entrainment
- Can work for any estimate of loss (e.g.)
  - Fecundity Hindcast
  - Adult Equivalent Loss
  - Proportional Mortality

Understanding "Source Water Population" (SWP) and "Proportional Mortality" (P_m)

You cannot interpret P_m without knowing the size of the SWP

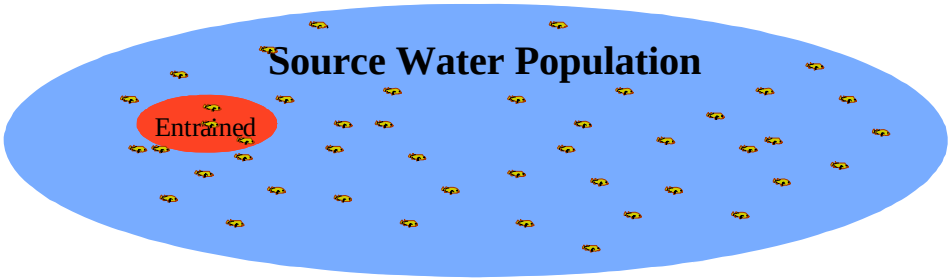
	Scenario 1	Scenario 2
P_m	10%	1% (.56%)
SWP		



Understanding "Source Water Population" (SWP) and "Proportional Mortality" (P_m)

You cannot interpret P_m without knowing the size of the SWP

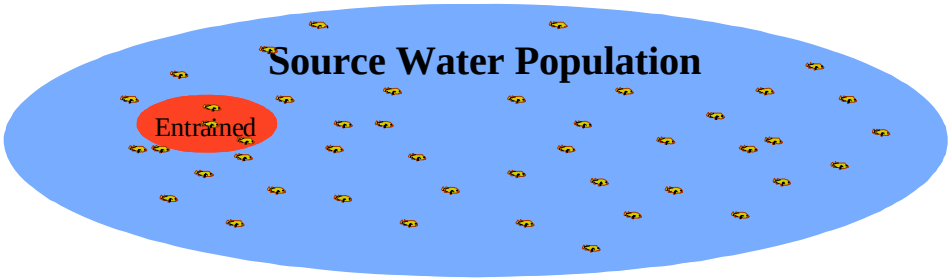
	Scenario 1	Scenario 2
P_m	10%	1% (.56%)
SWP	1 acre	640 acres



Understanding "Source Water Population" (SWP) and "Proportional Mortality" (P_m)

You cannot interpret P_m without knowing the size of the SWP. The product of P_m and SWP is the Area of Production Foregone (APF), which is the best way to understand the impact

	Scenario 1	Scenario 2
P_m	10%	1% (.56%)
SWP	1 acre	640 acres
APF	**0.1 acre**	**3.6 acres**



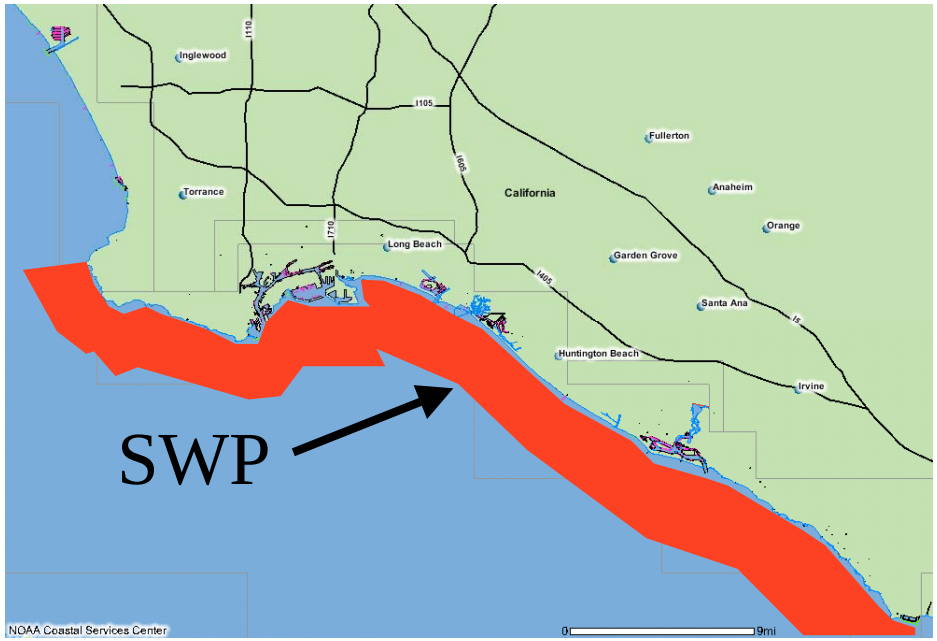
Example: Proportional mortality for Queenfish (average) = 0.60%

1. Calculate area of Source water Population (SWP)
2. Then the habitat required to compensate for larval losses =

SWP x 0.006

SWP = 89,920 acres (140.5 sq. miles)

89,920 x 0.006 = 539 **acres** (0.84 sq. miles) of new bay habitat would be needed to produce larvae equivalent to losses



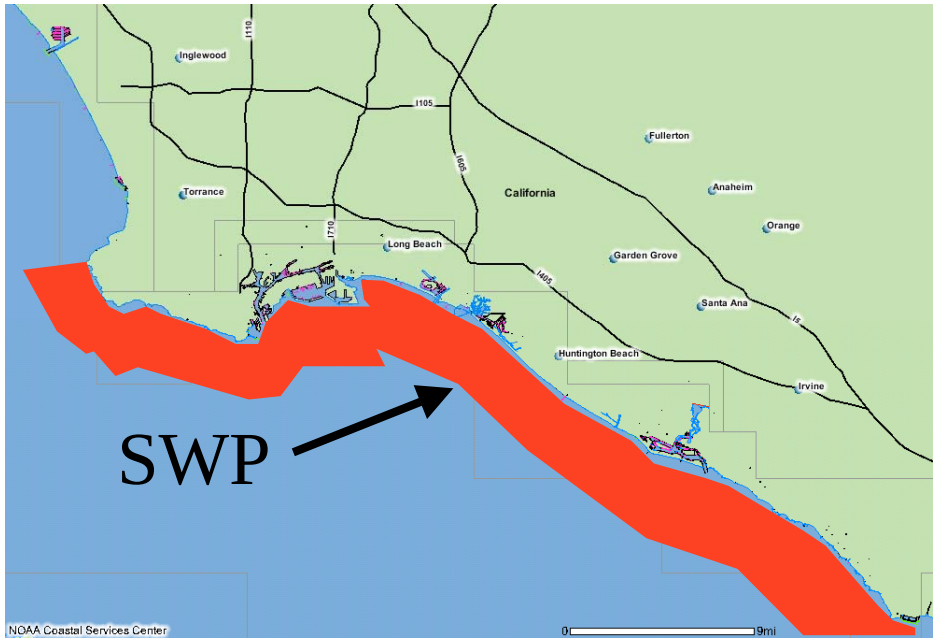
Example: Proportional mortality for Queenfish (+1 SE) = 29%

1. Calculate area of Source water Population (SWP)
2. Then the habitat required to compensate for larval losses =

SWP x 0.29

SWB = 89,920 acres (140.5 sq. miles)

89,920 x 0.29 = 26,077 **acres** (40.74 sq. miles) of new bay habitat would be needed to produce larvae equivalent to losses



Entrainment Study – ETM Model results

Taxon	Estimated Annual Entrainment	P_m Alongshore Extrapolation (Mean)	Pm Alongshore Extrapolation (+ 1 SE)	Length of Source Water Population (Miles)	Area (mi^2) of Production Foregone (Mean)	Area (mi^2) of Production Foregone (+1 SE)
spotfin croaker	69,701,589	0.30%	37%	10.1	0.085	10.3141
queenfish	17,809,864	0.60%	29%	50.9	0.911	40.7404
white croaker	17,625,263	0.70%	24%	28.7	0.583	19.0109
black croaker	7,128,127	0.10%	38%	11.6	0.039	12.1661
salema	11,696,960	NA**				
blennies	7,165,513	0.80%	28%	7.7	0.170	5.9506
diamond turbot	5,443,118	0.60%	28%	10.1	0.170	7.8053
California halibut	5,021,168	0.30%	21%	18.5	0.131	10.7226
rock crab	6,411,171	1.10%	35%	15.9	0.486	15.3594
AVERAGE (sq. miles)					0.325	15.26
AVERAGE (acres)					**208**	**9765**
Based on Units 3 & 4 (acres)					**104**	**4,882.5**

What does this mean?

If 104 (4,882.5) acres of new bay habitat were added to the system (in general area of source water body) then (for Units 3 & 4):

- Direct impacts to sampled fish and invertebrates would be mitigated
- Direct impact to other entrained species would probably be mitigated (assuming the P_m values were proxies for all species)
- Indirect impacts would also probably be mitigated

Assuming that new bay habitat was a comparable mixture of habitats to that in source water body

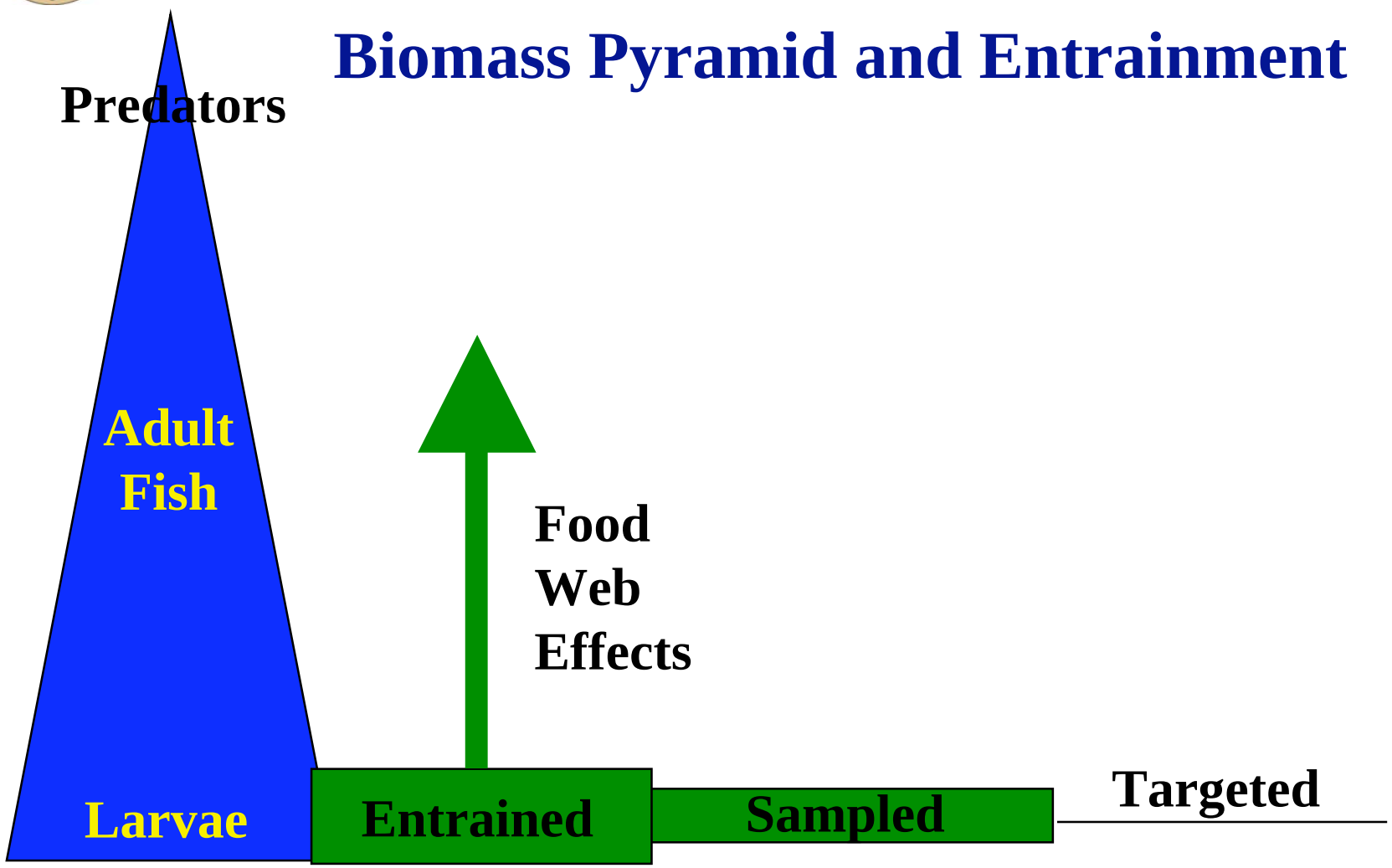
THRESHOLDS OF SIGNIFICANCE

An impact is significant:

- **if state- or federal-listed species, state Fully Protected species, candidates for state or federal listing and/or Species of Concern are impacted;**
- if migration of a species is interrupted;
- **if there is a reduction of native fish, wildlife and plant habitat;**
- if a fish or wildlife population is caused to drop below self-sustaining levels;
- if a wetlands, marsh, riparian area or other wildlife habitat is disturbed;
- **if there is substantial degradation in the quality of the environment.**

In addition, CEQA Guidelines specify a Mandatory Finding of Significance if the project has possible environmental effects that are individually limited but cumulatively considerable (CEQA Guidelines Section 16065(a)(3)).

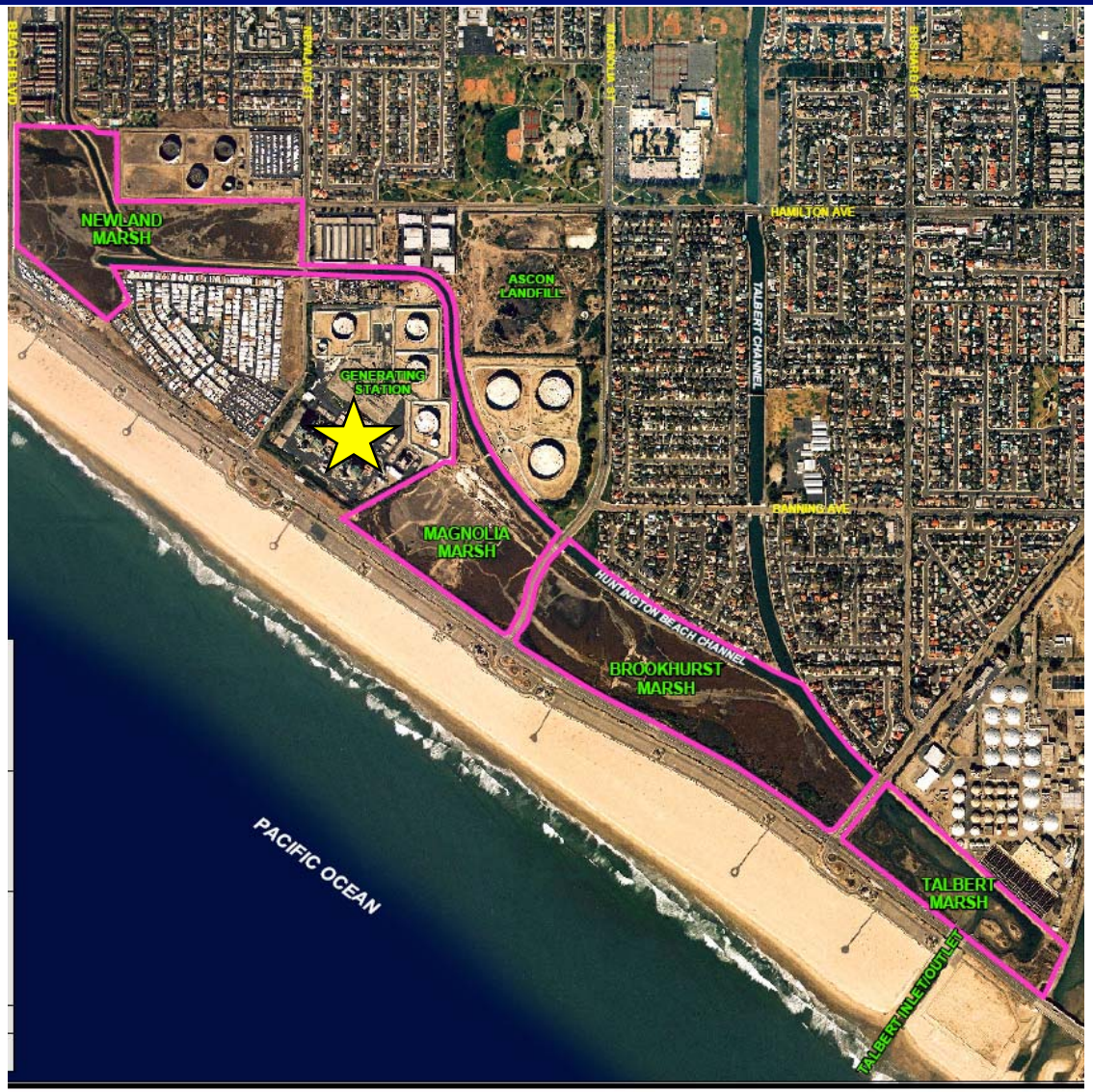
Biomass Pyramid and Entrainment



AGENCY CONCURRENCE WITH STAFF FINDING OF SIGNIFICANT IMPACT

- National Marine Fisheries Service
- California Department of Fish and Game
- Santa Ana Regional Water Quality Control Board
- California Coastal Commission

California Energy Commission



Huntington Beach Wetlands

RECOMMENDED MITIGATION

- 1:1 Acreage Mitigation Ratio

- Contribute money sufficient to restore 104 acres of the Huntington Beach Wetlands and maintain them for 10 years - $7,956,000

- Agencies agree with approach

California Energy Commission

Figure 1
Huntington Beach Wetlands

California Energy Commission

Prepared by: Merkel & Associates
April 2005
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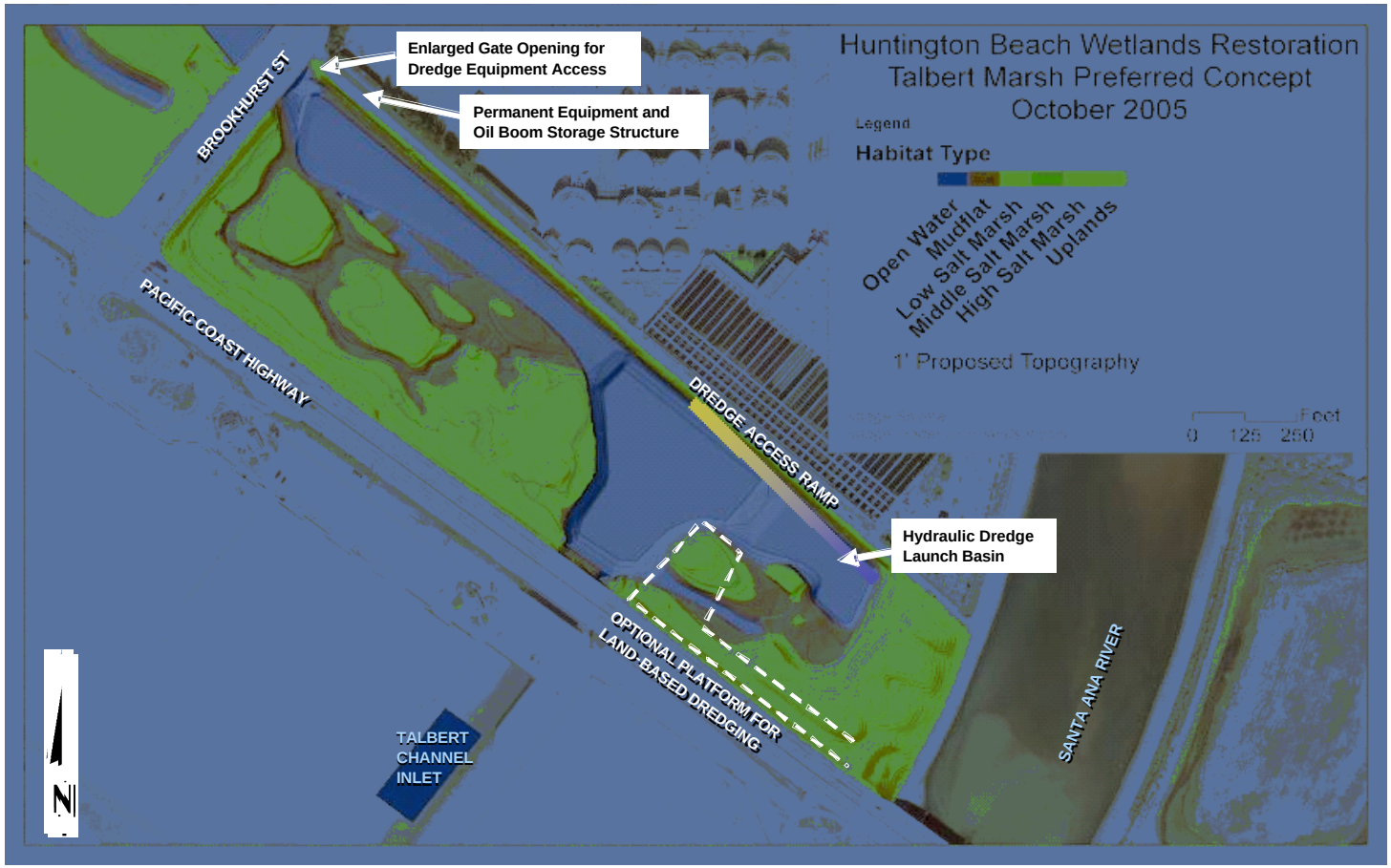
Huntington Beach Wetlands Conceptual Restoration Plan Revised Final Report	Proposed Brookhurst Marsh	Figure 2

California Energy Commission



Prepared by: Merkel & Associates
April 2005
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Huntington Beach Wetlands Conceptual Restoration Plan Revised Final Report	Proposed Talbert Marsh	Figure 3

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April 2005
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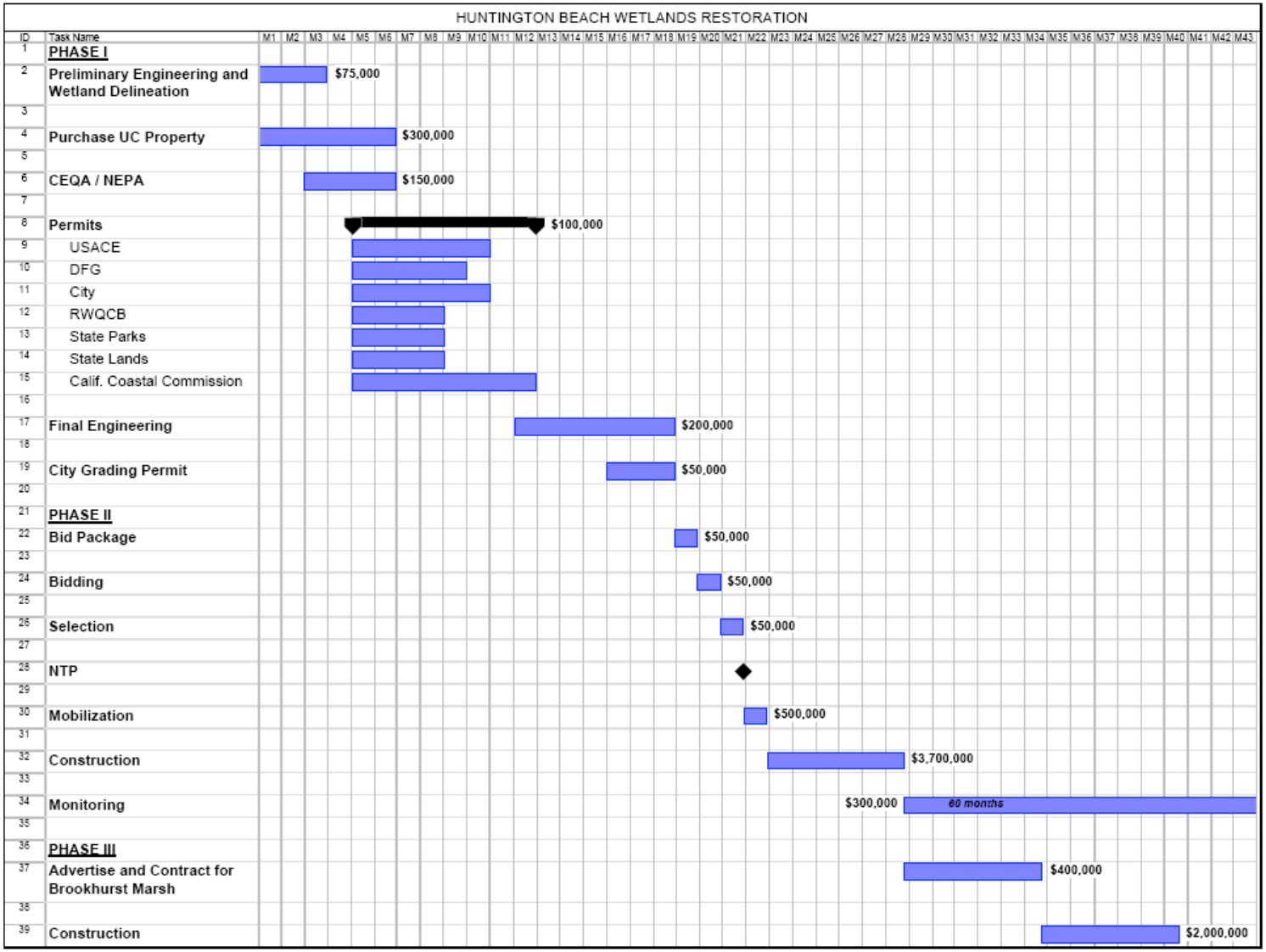
Huntington Beach Wetlands Conceptual Restoration Plan Revised Final Report	Proposed Magnolia Marsh	Figure 4

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