West Basin Ocean Water Desalination Program High Salinity Study Results

Management of Brine Discharges

Science Advisory Panel Meeting

December 8, 2011

www.westbasin.org

Who is West Basin?

- **Wholesaler of imported water**
- **Industry leader in recycling & conservation**
- **Serve 1 million people in 17 cities**
- **Provide enough water to fill Rose Bowl 850 times each year**

Pilot Plant
Desalination Background

Project Objectives
Demonstration Project

- Step of Due Diligence in Full-Scale Development

- Certify Processes at Full-Scale Level
  - Intake Study
  - Process Optimization
  - Energy Minimization
  - High Salinity Study
  - Regulatory Compliance

- Stakeholder Education

Quick Facts
Demonstration Project

- Location: Redondo Beach, CA

- Intake:
  - Wedgewire Passive Screens (1mm & 2mm slot size)
  - Subsurface Infiltration Gallery Pilot

- Project Capacity:
  - 0.5 MGD (Intake)
  - 35 GPM (Product Water Production)

- Process:
  - Pretreatment/Ultra-Filtration (Zeeweed 1000)
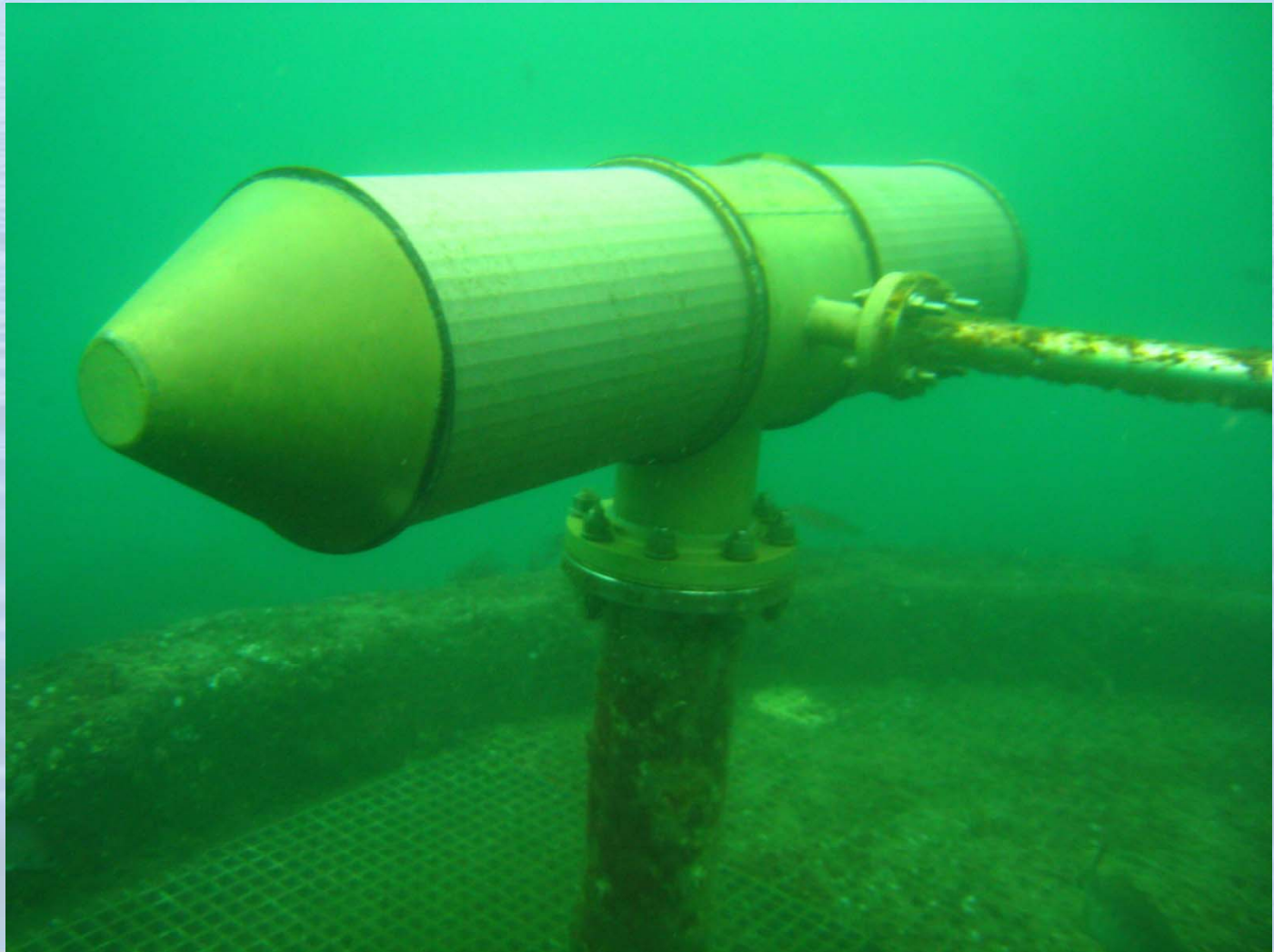 - Desalination/Reverse Osmosis (Hydranautics SWC5)

0.5 MGD Demonstration Project
Demonstration Project Highlights

Wedgewire Screen
Demonstration Project

Impingement & Entrainment (I&E) Study
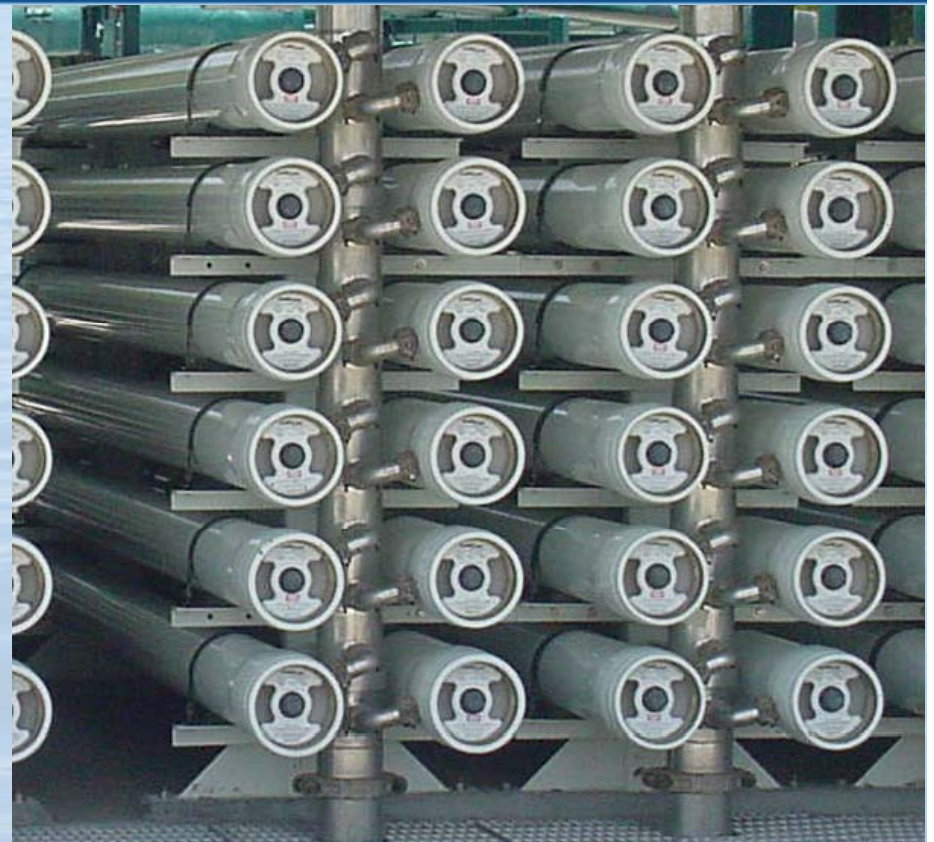## *Demonstration Project*

- Establish baseline characterization of fish eggs and larval stages of fish & invertebrates

- Evaluate operational effectiveness of intake technologies

- Model potential impacts to local fish and invertebrate populations

- Evaluate corrosion and biofouling of intake technologies

Process Optimization
Demonstration Project

- Minimize Operational Costs

- Minimize Capital Replacement

- Minimize Energy Consumption

Regulatory Compliance
Demonstration Project

- Performing Extensive Water Quality Discharge Compliance Test

- Performing Suite of DPH Water Qual[ity] Tests for Full-Scale Permitting

- Evaluating CECs

- Monitoring Harmful Algal Blooms

Stakeholder Education
Demonstration Project

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Study Objectives
High Salinity Study

- Research high salinity Impacts on local marine species

- Identify tolerance levels of indigenous organisms

- Identify salinity levels eliciting adverse effects on organisms

- Establish guidance on regulatory limits for concentrate discharge

Biological Impacts Study
High Salinity Study

- Assess short & long term impacts of high salinity discharges

  - Short-term: EPA Whole Effluent Toxicity (WET) methods
    * Accute Toxicity
    * Chronic Toxicity

  - Long-term: On-site mesocosm exposures

Short-term WET Study
High Salinity Study

- Organism Selection

  - Sensitive life stage

  - Trophic representativeness

  - Regional presence

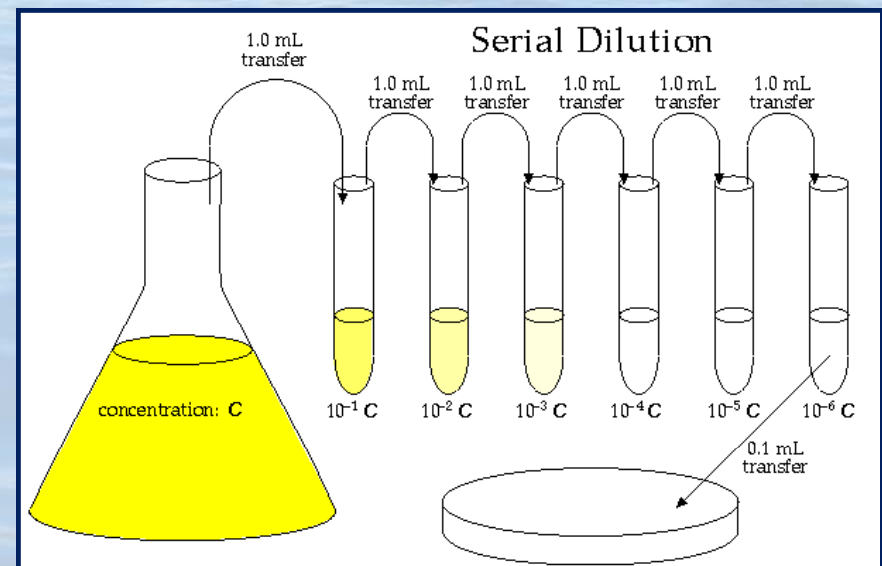 - Available protocols

  - Available organisms

- **Chronic Toxicity Species**

  - Larval mysid shrimp

  - Larval topsmelt

  - Giant kelp spores

- **Acute Toxicity Species**

  - Larval mysid shrimp

  - Larval topsmelt

  - Juvenile sanddabs

Three Episodes

Five or Six Brine Dilutions

Short-term WET Study
High Salinity Study

- **Chronic Toxicity Species**
  - Larval mysid shrimp
  - Larval topsmelt
  - Giant kelp spores

- **Acute Toxicity Species**
  - Larval mysid shrimp
  - Larval topsmelt
  - Juvenile sanddabs

EPISODE 1

33, 42, 51, 60, 70 PPT

EPISODE 2

33, 36, 39, 41, 45, 50 PPT

EPISODE 3

33, 36, 39, 42, 45, 60 PPT

Short-term WET Study
High Salinity Study

Acute Toxicity Results

SPECIES	MEAN LC50	LOEC			NOEC		
		E1	E2	E3	E1	E2	E3
Mysid shrimp	49.2	51	50	60	42	45	45
Topsmelt	50.4	51	>50	60	42	50	45
Sanddabs	55.5	60	NT	NT	51	NT	NT

Chronic Toxicity Results

SPECIES	LC50	Test	NOEC		
			E1	E2	E3
Mysid shrimp	49.0	Survival	42	42	45
		Biomass	42	41	41
Topsmelt	50.4	Survival	42	50	45
		Biomass	42	50	45
Giant Kelp	53.7	Prop Germ	42	41	39
		Growth	42	39	41

Short-term WET Study Conclusions
High Salinity Study

- Acute Salinity Limit: 45 ppt

- Chronic Salinity Limit: 41 ppt

- Most sensitive effects levels substantially higher than conceptual COP salinity thresholds.

- Species with highest exposure risk (demersal fish) appear to
  be least sensitive.

- Existing discharge technologies (i.e., Dilution/Diffusion) can meet the proposed Chronic and Acute thresholds

Long-term Mesocosm Study
High Salinity Study

- Long-term Component
  - 300 gallon aquarium divided into two compartments
  - 67 ppt RO concentrate and 33.5 ppt ocean water feeds
  - Carbon columns to remove chloramines
  - Stocked with species indigenous to Southern California
  - Three 2-week intervals at varying salinities: 40, 45 & 50 ppt
  - Three 8 week mesocosm iterations
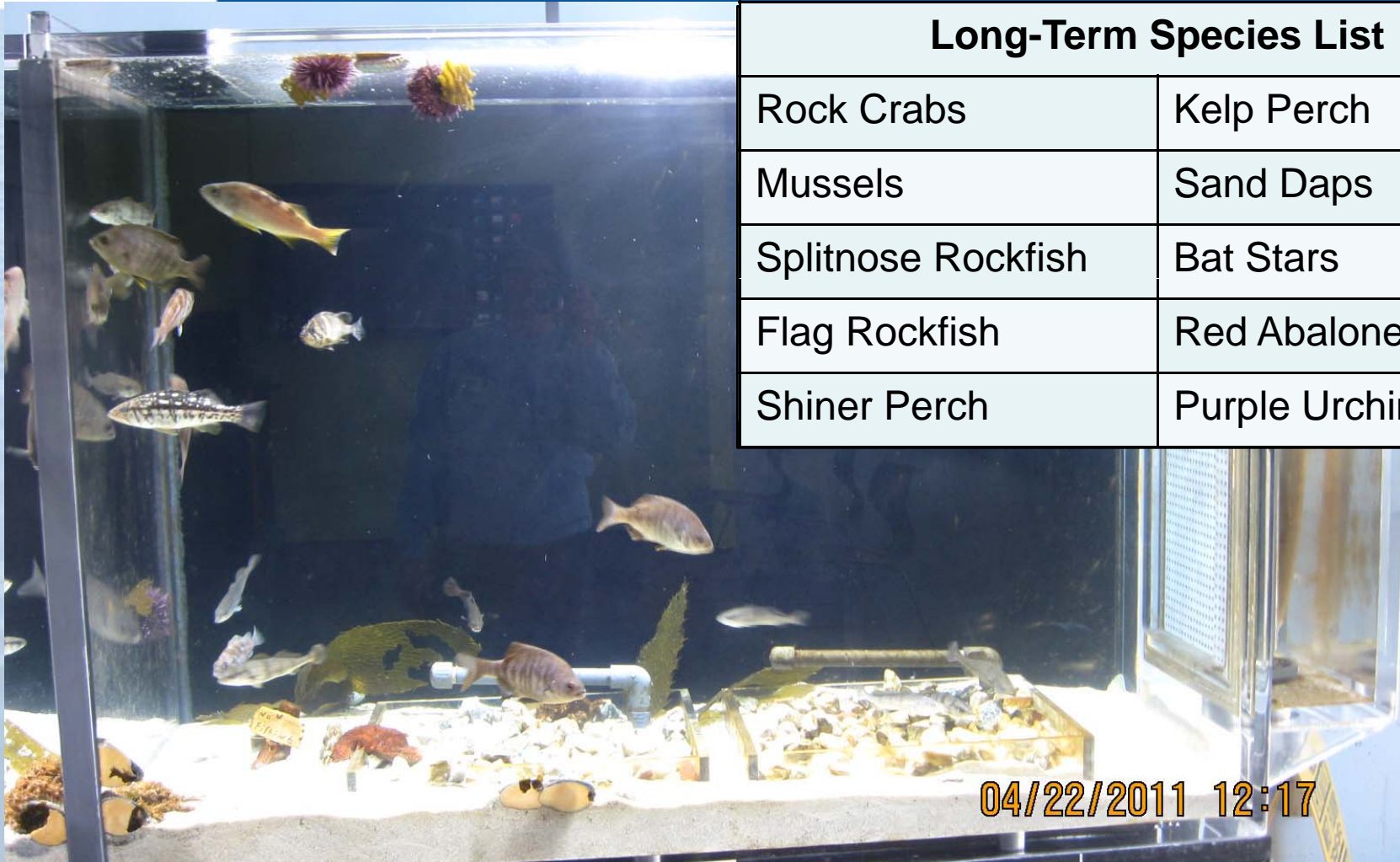 - Two sublethal endpoints measured at end of each iteration

Long-term Mescosm Exposure
High Salinity Study

Long-term Mesocosm Exposure
High Salinity Study

Long-Term Species List	
Rock Crabs	Kelp Perch
Mussels	Sand Daps
Splitnose Rockfish	Bat Stars
Flag Rockfish	Red Abalone
Shiner Perch	Purple Urchins

Long-term Mescosm Study
High Salinity Study

- 1st Mesocosm Results
  - All species survived 40 & 45 ppt @ 2 week exposures
  - No observed adverse effects on any species
  - Observed effects on Urchins and Red Abalone @ 50 ppt
  - No statistical impact to Sanddap weights/lengths @ 50 ppt

- Next Steps
  - Mesocosm Trial No. 2 & 3
  - Salinity Intervals Considered: 36.5, 40, & 47ppt
  - Evaluate post-salinity Purple Urchin embryo development @ 40
    and 47 ppt

Suggested SWRCB Policy Considerations

- Regulations to be based of site specific species salinity tolerance

- Best available discharge technology identified by project proponer

- Use of dilution & mixing allowed to meet salinity objectives

- Policy should support the concept of a large ZID for energy mixing

- Provide credit for gravity energy potential for falling brine and slop bottom

- Acceptable brine models should be identified and standardized

Questions ?????