Meeting Agenda

Carlsbad Desalination Project – NPDES Permit Development Update

Date and Time

Tuesday, March 28, 2017
9:00am-12:00pm

Location

California Regional Water Quality Control Board, San Diego Region
Library – Third Floor
2375 Northside Drive, Suite 100
San Diego, CA 92108

Teleconference

Phone number: 1-888-808-6929
Access code: 2535683

Global Meet weblink:

https://stateofcaswrcbweb.centurylinkccc.com/CenturylinkWeb/DASAll-Staff22

Meeting participants

Entity	Staff
Poseidon, LLC	Peter MacLaggan Josie McKinley Craig Johns (by phone) Kelly Huffman (by phone) Michael Welch Tim Hogan Michelle Powelson Pat Crain Eric Miller
San Diego County Water Authority	Robert Yamada Toby Roy Jeremy Crutchfield
San Diego Water Board	David Barker Brandi Outwin-Beals Ben Neill Dan Connally (USEPA contractor, by phone)
State Water Board	Claire Waggoner (by phone) Kim Tenggardjaja (by phone) Daniel Ellis (by phone Renan Jauregui (by phone) Phil Wyels (by phone) Marleigh Wood (by phone) Catherine Hagan

1. Introductions

2. Intake Structures Alternatives 15-20

3. Marine Life Mortality Report and Mitigation Calculations (Appendix ZZ)

4. Fish Return System

5. Schedule Update

   - Deliverables from Poseidon

   - Permit Development

6. Additional Discussion – Next meeting is tentatively scheduled for Tuesday April 25.

CARLSBAD DESALINATION PROJECT
PERMIT RENEWAL MEETING
MARCH 28, 2017

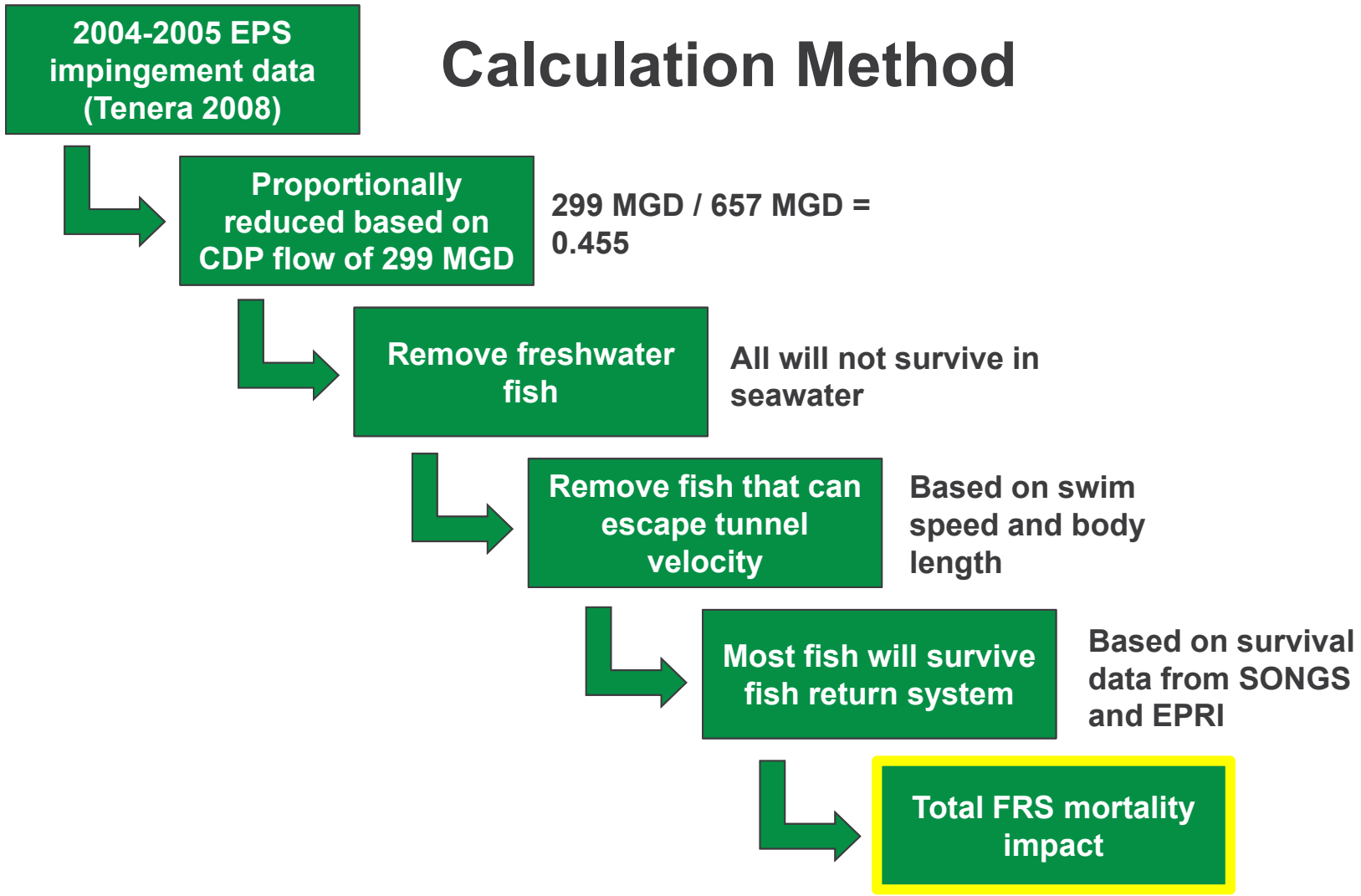
Discussion Topics

1. Response to State Water Board's request for an evaluation of additional intake alternatives
2. Marine Life Mortality
3. Mitigation Calculations
4. Fish Return Forms and Anti-degradation Analysis

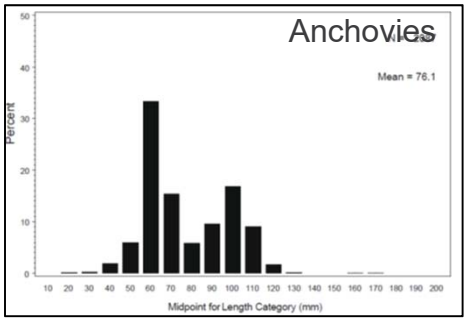
FISH RETURN MORTALITY ASSESSMENT
INTAKE ALTERNATIVES 1, 15 -20

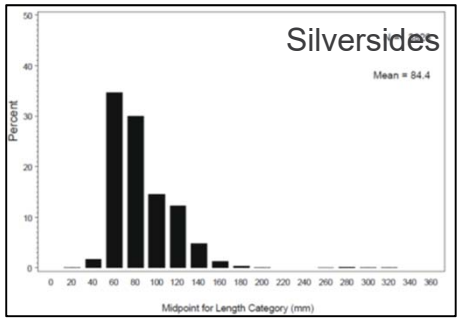
Fish Return Marine Life Mortality Assessment

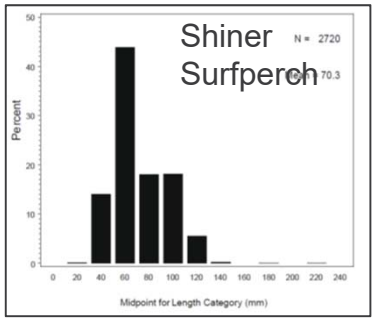
Calculation Method



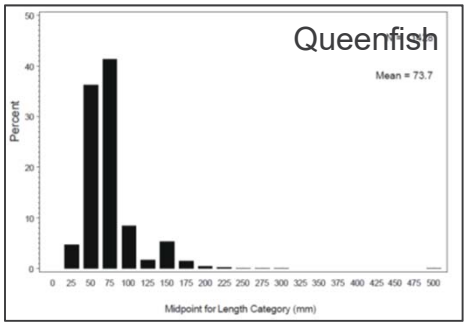
Incremental Increase in Fish Escape

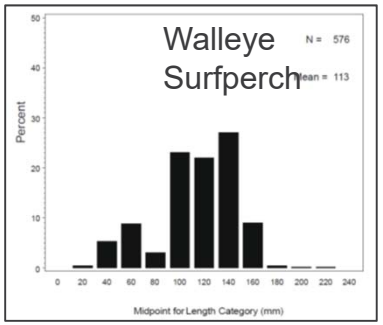


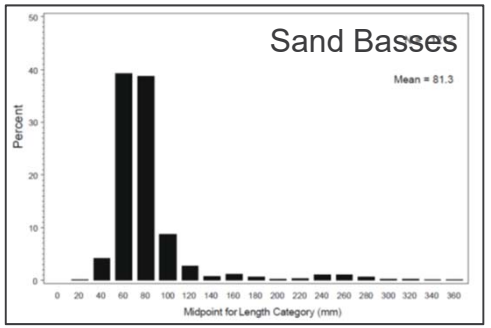


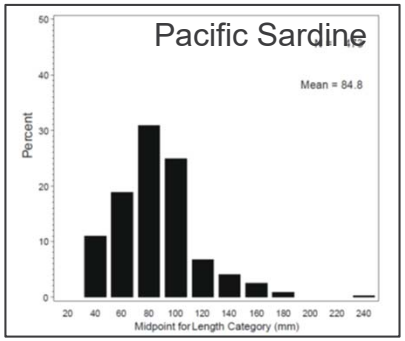


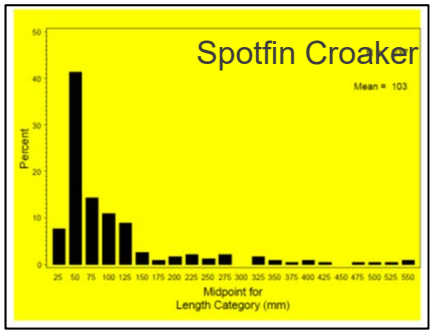
Length frequency distribution for dominant taxa

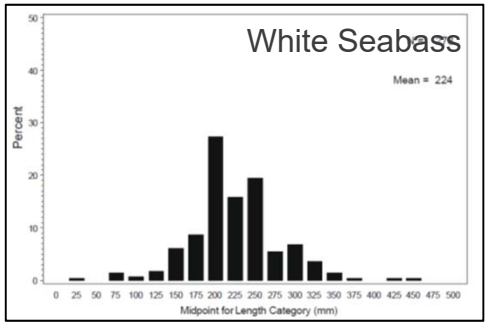












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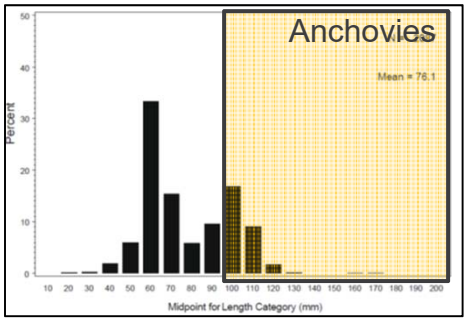
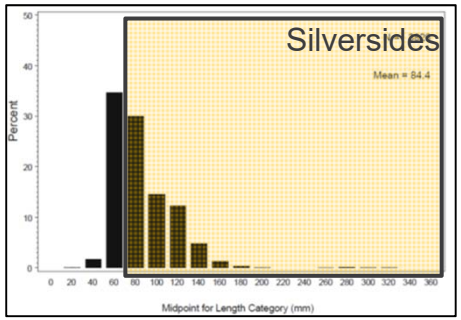
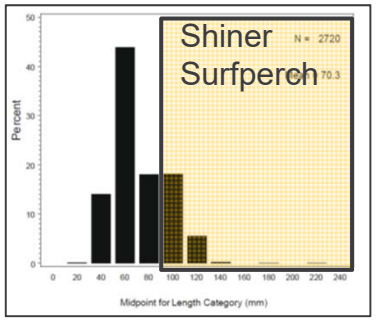
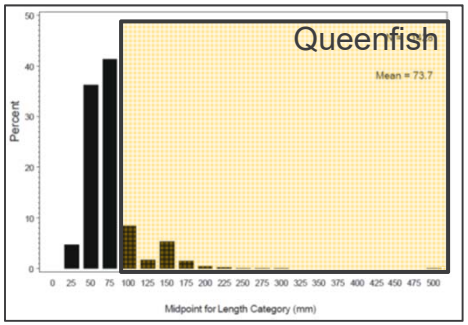
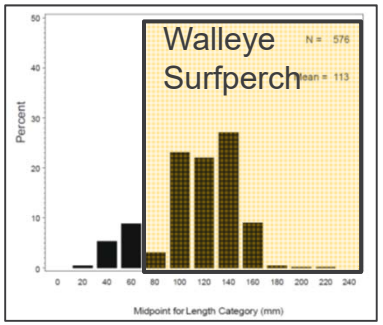


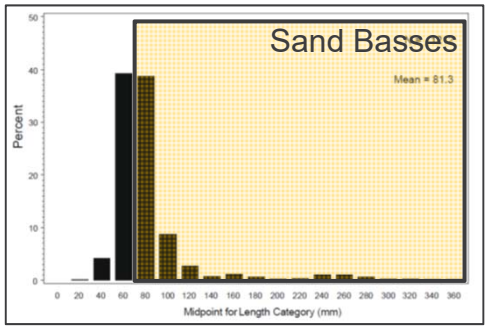


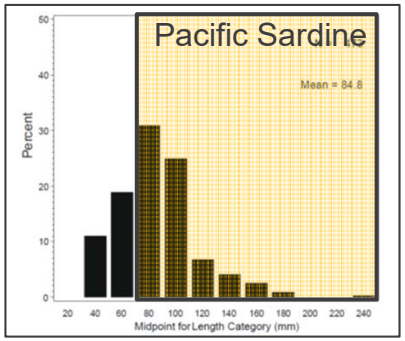


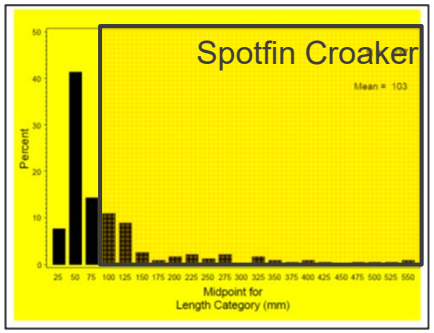
Fish that can escape
<u>2.6 ft/sec</u>

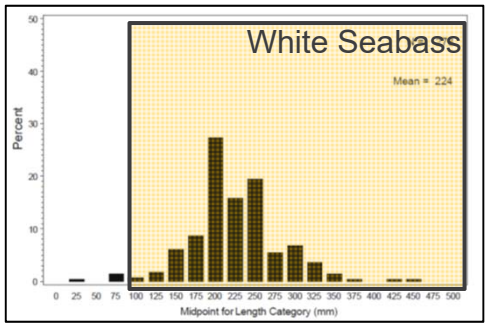












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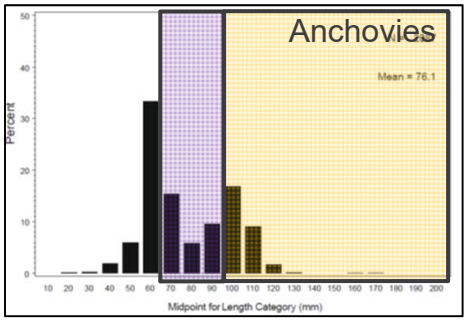

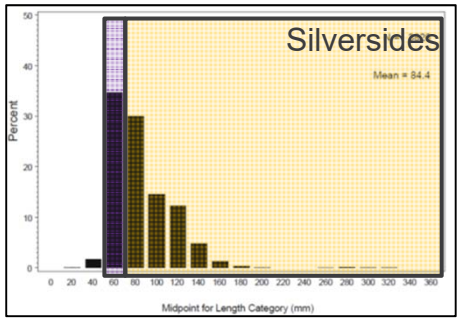

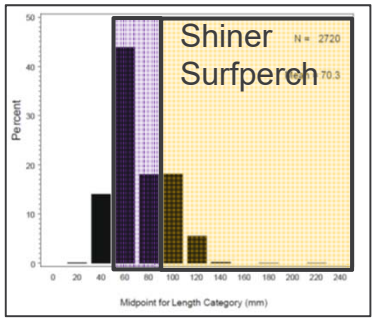

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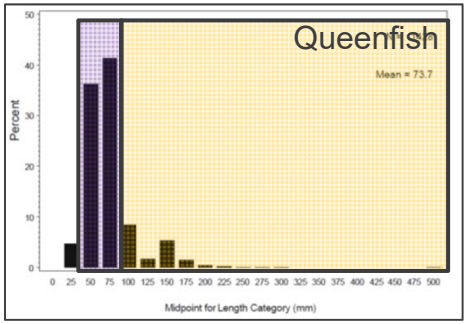

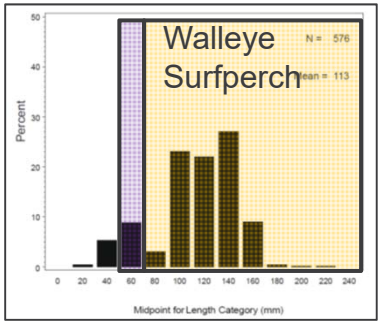

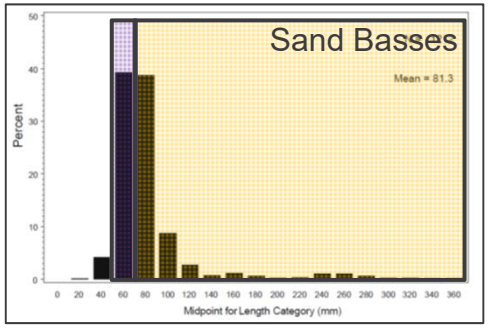

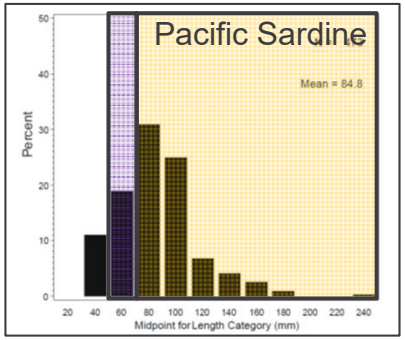

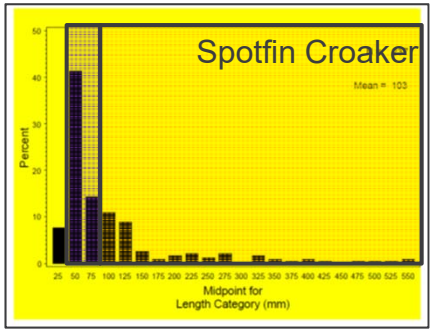

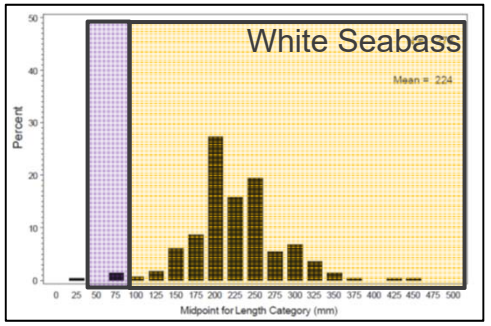

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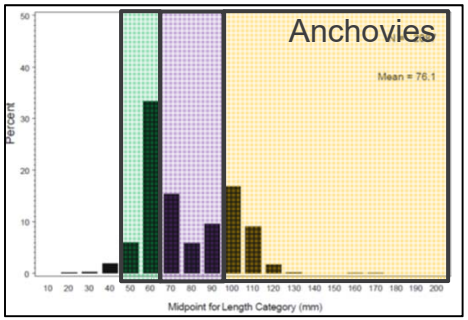

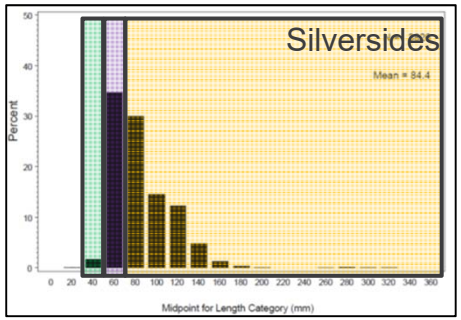

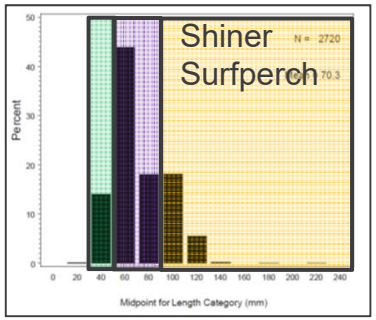

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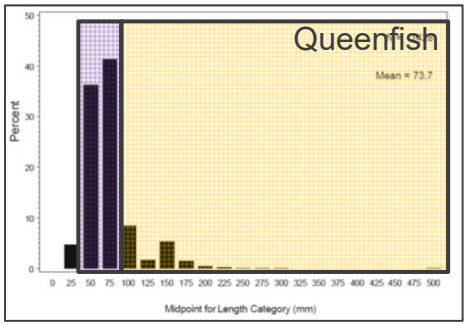
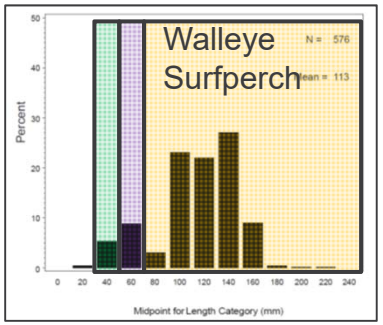
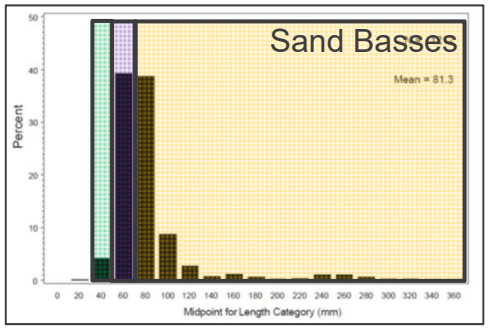
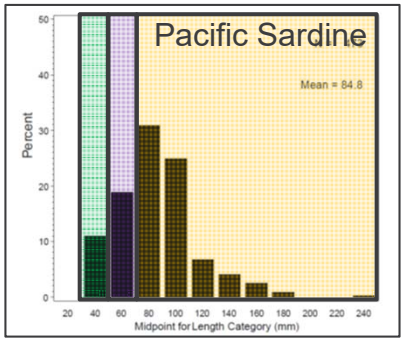
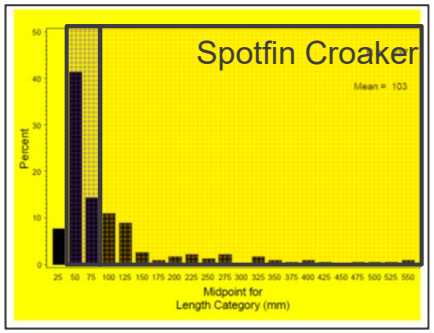
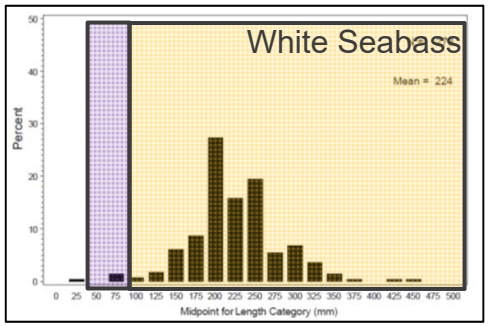












Comparison of Alternative Intake Velocity and Environmental Benefits

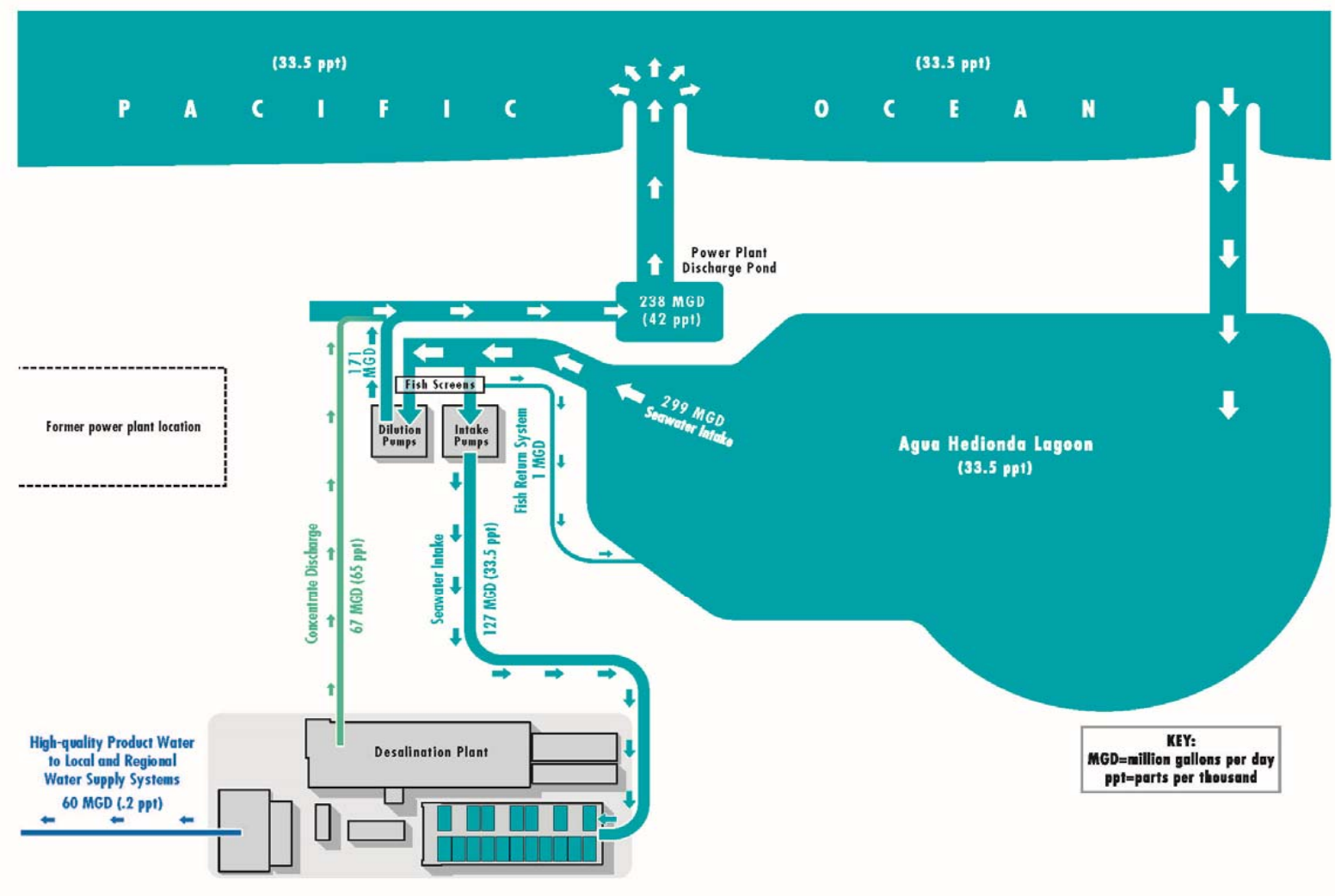
Alternative	Description	Velocity at Bar Rack at MLLW (ft/sec)	Mean Velocity in Tunnels at MLLW (ft/sec)	Mortality Estimate (lbs/day)	Incremental Mortality Reduction (lbs/day)
1	• Original Proposal	1.06	2.63	0.85	NA
15	Alternative 1 plus: • Convert discharge tunnel to intake	1.06	1.54	0.78	0.07
16	Alternative 1 plus: • Widen bar rack	0.53	2.63	0.85	0
17	Alternative 1 plus: • Convert discharge tunnel to intake • Widen bar rack	0.53	1.54	0.78	0.07
18	Alternative 1 plus: • Convert discharge tunnel to intake • Widen bar rack • New 20-ft wide open intake channel	0.53	• 0.85	• 0.75	0.10
19	Alternative 1 plus: • Convert discharge tunnel to intake • Raise intake/discharge tunnel roof to flow as open channel	1.06	• 1.01	• 0.75	0.10
20	Alternative 1 plus: • Convert discharge tunnel to intake • Dual flow screens	1.06	• 1.54	• 0.78	0.07

MARINE LIFE MORTALITY REPORT

Marine Life Mortality Report

- Intake Mortality
  - CDP Process Water
    - Entrainment
- Discharge Mortality
  - Flow Augmentation
    - Entrainment
    - Osmotic Stress
  - Multiport Diffuser
    - Entrainment
    - Osmotic Stress
  - Comparison of Discharge Alternatives
    - Flow Augmentation vs. Multiport Diffuser
- Fish Return Mortality
- Permanent Construction Impacts
- Summary of Marine Life Mortality Report for Proposed Project

Proposed Intake and Discharge Facilities



CDP Process Water – Entrainment Mortality

	CDP Process Water	Fish Return	Total	1 mm Screen Credit (1%)	Net Total	Supporting Documentation
Flow (MGD)	127	0.42	127.42			
Area of Production Foregone Total (Acres)	36.00	0.12	36.12	-0.36	35.76	Appendix K Appendix P

Discharge Mortality

- The Discharger is proposing to use flow augmentation as an alternative brine discharge technology.
- Section III.M.2.d.(2)(c) of the Ocean Plan Amendment provides that alternative brine discharge technologies may be used if:

  [A]n owner or operator can demonstrate to the regional water board that the technology provides a comparable level of intake and mortality of all forms of marine life as wastewater dilution if wastewater is available, or multiport diffusers if wastewater is unavailable. The owner or operator must evaluate all of the individual and cumulative effects of the proposed alternative discharge method on the intake and mortality of all forms of marine life, including (where applicable): intake-related entrainment, osmotic stress, turbulence that occurs during water conveyance and mixing, and shearing stress at the point of discharge.
- Wastewater dilution is not available, so the analysis that follows provides a comparison of the marine life mortality of the proposed flow augmentation system to that of the diffuser.

FLOW AUGMENTATION DISCHARGE MORTALITY

Flow Augmentation – Entrainment Mortality

	Flow Augmentation System	Fish Return	Total	1 mm Screen Credit (1%)	Net Total	ROWD Supporting Documentation
Flow (MGD)	171	0.58	171.58			
Entrainment Mortality APF (Acres)	48.00	0.16	48.16	-0.48	47.68	Appendix K Appendix P

Flow Augmentation Brine Mixing Zone (BMZ)

Flow Augmentation Osmotic Stress in BMZ Benthic Habitat

- Due to the negative buoyancy, the brine discharge flows offshore along the bottom of the BMZ under the force of gravity.
- Parts of the benthic habitat within the BMZ may be exposed to salinity in excess of 35.5 parts per thousand (ppt) for extended periods of time.
- The discharge mortality assessment conservatively assumes that 100% of the benthic area within the BMZ is exposed to toxic conditions.
- Based on this assumption, the impacted area within the BMZ is 18.51 acres.

Flow Augmentation Shear and Osmotic Stress in BMZ Water Column

- The brine discharge flows offshore under the force of gravity.
- Organisms drifting through the BMZ would not be exposed to excessive shear or turbulence.
- Parts of the water column within the BMZ can be exposed to salinity in excess of 35.5 parts per thousand (ppt).
- Modified WET testing was conducted to determine the potential salinity-induced adverse effects on organisms traveling through all three phases of the brine dilution process (ROWD Appendix I).
- The brine dilution toxicity study focused on the species that are most sensitive to elevated salinity.
- These species experienced no significant toxic effects after being exposed to elevated salinity conditions similar to those that would exist during transit through: (1) the discharge tunnel; (2) discharge pond; (3) discharge channel; (4) BMZ; and (5) from the edge of BMZ to the location offshore where discharge salinity would be match the surrounding seawater.
- Organisms drifting through the BMZ would experience lower salinity concentrations and lower exposure times than the study design, so it is reasonable to conclude that these organisms would not be exposed to adverse salinity effects while drifting through the BMZ.

Flow Augmentation Toxicity Test Results

Scenario #	Scenario Description	Test date	Species Tested	Mean Normal Development			
				Sample	Phase 1	Phase 2	Phase 3
1	P1: 44 ppt for 2.8 minutes; P2: 39 min.; P3: 30 min.	2/6/15	Abalone Development	Control	83.8	77.7	80.5
				Brine Exposure	76.7*	79.1	78.8
1	P1: 44 ppt for 2.8 min.; P2: 39 min.; P3: 30 min.	2/17/15	Urchin Development	Control	93.7	92.0	89.3
				Brine Exposure	91.3	90.3	91.3
2	P1: 42 ppt for 2.2 min.; P2: 36 min.; P3: 30 min.	1/30/15	Abalone Development	Control	94.0	93.7	94.3
				Brine Exposure	95.7	92.7	91.7
3	P1: 40 ppt for 1.7 min.; P2: 34 min.; P3: 30 min.	1/22/15	Abalone Development	Control	66.0	61.0	67.3
				Brine Exposure	68.5	67.0	60.3

Flow Augmentation - Combined Discharge Mortality

Impacted Area	Flow Augmentation	Fish Return	Total Impacted Area (Acres)	1 mm Screen Credit (1%)	Net Impacted Area (Acres)	Supporting Documentation
Flow Subject to 100% Mortality (MGD)	171	0.58				
Entrainment Mortality APF (Acres)	48.00	0.16	48.16	-0.48	47.68	Appendix K Appendix P
BMZ - Adverse Salinity Effects Benthic Habitat (Acres)	NA	NA	18.51	0	18.51	Appendix I Appendix BB Appendix QQ Appendix XX
Total Impacted Area (Acres)			66.67		66.19	

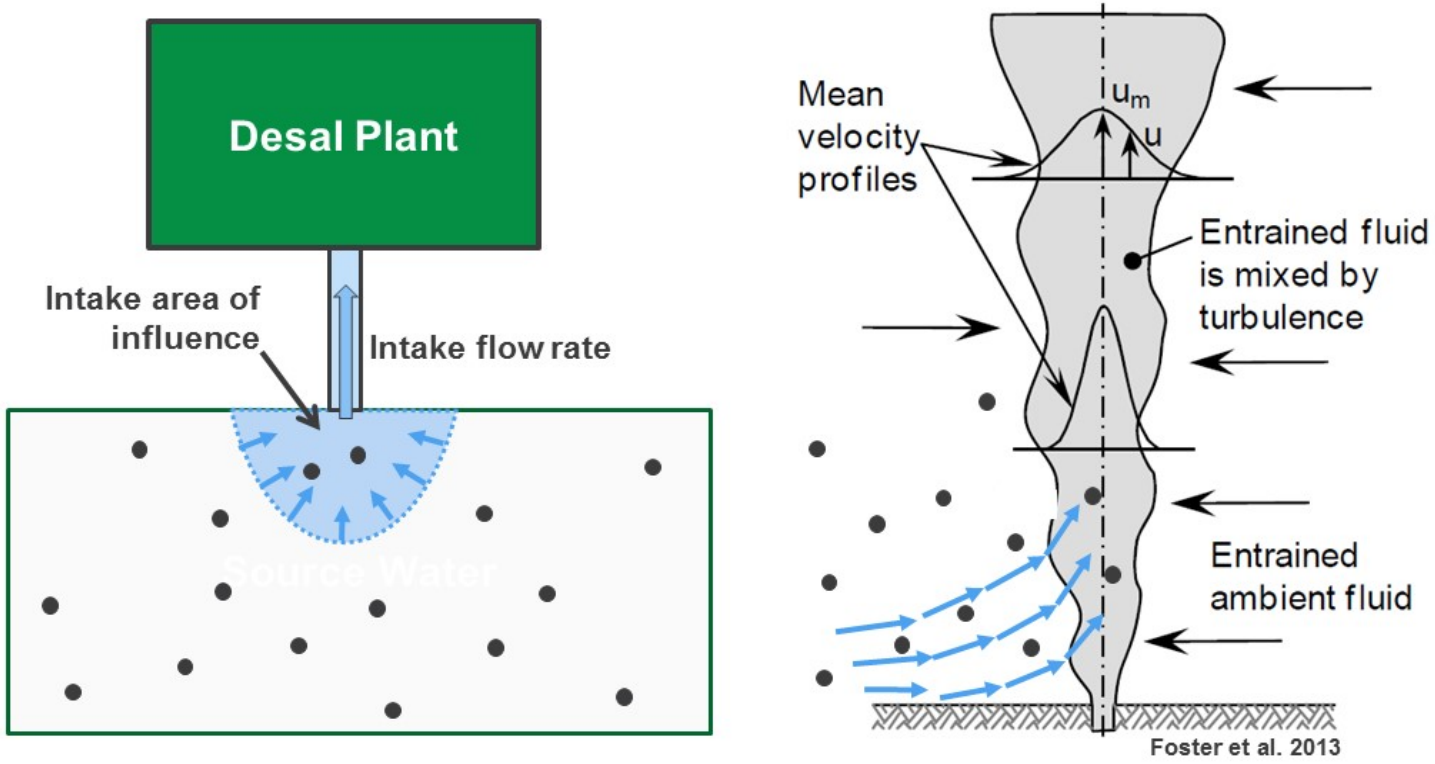
MULTIPORT DIFFUSER DISCHARGE MORTALITY

Multiport Diffuser – Shear Stress Mortality

- The multiport diffuser alternative contemplates that the CDP will discharge approximately 60 MGD of brine through a 72” outfall pipeline extending approximately 4,000 feet offshore to four duck-bill diffuser ports would eject the brine into the water column at a high velocity to promote rapid mixing.
- In order to comply with the Ocean Plan Amendment requirement that the brine is diluted to a salinity of no greater than 2 ppt over natural background salinity, 945 MGD of the surrounding seawater needs to be entrained in the discharge.
- The Staff Report/SED direction for calculation of shear-related mortality:

  [U]ntil additional data is available, we assume that larvae in 23 percent of the total entrained volume of diffuser dilution water are killed by exposure to lethal turbulence.
- 23 percent of the total entrained volume of diffuser dilution water is 217 MGD.
- Entrainment estimate calculated using the methodology set forth in Ocean Plan Amendment Appendix E.

Multiport Diffuser – Calculation of Shear Stress Mortality



Conceptual schematics of how ambient flow and passive marine life are drawn into 1) a desalination intake and 2) a desalination discharge diffuser. Blue arrows indicate ambient water flow and black dots represent passive marine organisms.

Multiport Diffuser – Shear Stress Mortality

	Multiport Diffuser	Supporting Documentation
Flow Exposed to 100% Shear Mortality (MGD)	217	SED §8.6.2.2.1
Shear Stress Mortality APF (Acres)	48.00	Appendix K Appendix P Appendix WW

Multiport Diffuser Osmotic Stress in the BMZ

Benthic Habitat

- Parts of the benthic habitat in the BMZ may be exposed to salinity in excess of 35.5 ppt.
- Consistent with the approach taken in the analysis of the flow augmentation system, the discharge mortality assessment for the multiport diffuser conservatively assumes that 100% of the benthic area within the BMZ is exposed to toxic conditions.
- The BMZ extends 100 meters (328 ft.) out from each of the four discharge points with an impacted area inside the BMZ of 14.4 acres.

Water Column

- The organisms drifting through the BMZ associated with the multiport diffuser may be exposed to somewhat higher salinity concentrations than in the BMZ with flow augmentation system;
- However, overall exposure time would be shorter due to the rapid entrainment and mixing that occurs within the turbulent plume created by high velocity discharge from the multiport diffuser.
- The impact assessment assumes there would be no adverse salinity effects on organisms drifting through the BMZ associated with the multiport diffuser.

COMPARISON OF DISCHARGE MORTALITY FLOW AUGMENTATION AND MULTIPORT DIFFUSER

Comparison of Discharge Mortality – Flow Augmentation and Multiport Diffuser

	Flow Augmentation	Multiport Diffuser
Flow Subject to 100% Mortality (MGD)	171	217
Entrainment Shear Mortality APF (Acres)	47.68	67.00
BMZ - Adverse Salinity Effects Benthic Habitat (Acres)	18.51	14.4
Total Impacted Area (Acres)	66.19	81.40

FISH RETURN SYSTEM MORTALITY

Fish Return System Mortality

Fish Return Mortality

- The methodology described in slide 4 estimated the fish return system mortality to be 0.85 for Alternative 1, and 0.78 lbs/day for Alternative 15.
- Order R9-2009-0038 estimated the CDP stand-alone operations would result in 10.36 lbs/day of impingement mortality, which would be offset by 11.3 acres of estuarine habitat restoration.
- A proportional reduction of the 11.3 acres yields the impacted area associated with the fish return system:

  Alternative 1 - 0.85 lbs/d/10.36 lbs/d x 11.3 acres = 0.93 acres

  Alternative 15 - 0.78 lbs/d/10.36 lbs/d x 11.3 acres = 0.85 acres

Permanent Construction Impacts

- The discharge end of the fish return system will be in Agua Hedionda Lagoon.
- The entire area within Agua Hedionda Lagoon that would be permanently impacted by the fish return system is less than 0.1 acres.

COMBINED MARINE LIFE MORTALITY PROPOSED PROJECT (ALTERNATIVE 1 AND ALTERNATIVE 15)

Combined Marine Life Mortality Proposed Project (Alternative 1 and Alternative 15)

Impact	Impact Assessment Method	Impacted Area (Acres)	
		Alternative 1	Alternative 15
Intake	APF calculated per Appendix E of the Staff Report/SED to the Ocean Plan Amendment using a 95% confidence bound for an assumed 100% mortality of all forms of marine life entrained by 127 MGD CDP process water with an APF of 35.76 acres and 171 MGD flow augmentation with an APF of 47.68 acres after accounting for a 1% credit for 1 mm screening technology.	83.44	83.44
	Potential mortality associated with the operation of the fish return system.	0.93	0.85
Discharge	Area within the BMZ potentially exposed to a salinity in excess of 2 ppt over natural background salinity.	18.51	18.51
Construction	Permanent footprint of the fish return within lagoon	0.10	0.10
	Total Impacted Area	102.98	102.90

MITIGATION CALCULATION

Mitigation Calculation Proposed Project (Alternative 1 and Alternative 15)

- The impacted area identified in the CDP Marine Life Mortality Report for the proposed project is 102.90 acres for Alternative 15 to 102.98 acres for Alternative 1.
- There are four types of habitats impacted by the CDP:
  - Estuarine habitat Alternative 1 - 62.73 acres and Alternative 15 - 62.72 acres;
  - Open water habitat Alternative 1 - 21.64 acres and Alternative 15 – 21.57 acres;
  - Soft bottom habitat for both Alternative 1 and Alternative 15 the impacted area is 18.20 acres;
  - Rock jetty habitat both Alternative 1 and Alternative 15 the impacted area is 0.31 acres.
- The Discharger is proposing to restore estuarine habitat to satisfy all of the CDP mitigation requirements.
- The mitigation calculation contemplates 1:1 in-kind mitigation for estuarine species and the rocky jetty habitat, and 1:10 mitigation for open ocean species and soft bottom habitat potentially impacted by the CDP.
- The mitigation calculation takes into account all of the impacted habitat.
- The total mitigation required for the proposed project prior to any adjustment for double counting of mitigation is 67.13 acres for Alternative 1 and 67.11 acres for Alternative 15.
- An adjustment is necessary to account for the soft bottom habitat within the flow augmentation BMZ that is within the same source water body as the open water area impacted by the intake. The mitigation for the open water habitat impacted by the intake fully mitigates for the soft bottom habitat in the BMZ.
- The net mitigation after adjustment is 65.31 acres for Alternative 1 and 65.29 acres for Alternative 15.

Mitigation Ratio

- The Discharger conducted an assessment of existing habitat value in the BMZ to determine the appropriate mitigation ratio based on the productivity of the existing BMZ habitat as compared to that of the restoration project (ROWD Appendix UU).
- This assessment found that the soft bottom habitat underlying the BMZ outside the discharge channel is sand.
- Within the discharge channel, the rocky jetties defining the channel represent higher productivity rocky habitat that warrants a 1:1 mitigation ratio.
- The sand bottom habitat within the BMZ has a relatively low infaunal diversity and abundance.
- Three key factors for measuring habitat productivity.
- For each of the parameters, (vegetation production, fish count, and fish productivity) the productivity of the estuarine habitat contemplated under the restoration project is significantly greater than that of the soft bottom area of the BMZ.
- This information conservatively supports a 1:10 mitigation ratio as appropriate for the soft-bottom sandy habitat impacted by the BMZ (i.e., 10 acres of impacted soft-bottom habitat would be fully mitigated by the restoration of one acre of estuarine habitat).

Mitigation Ratio

Natural Resource	Mitigation Ratio[b]
Vegetation (Net prod. g C/m^2/y)	>10:1[a]
Fish (count/m^2)	650:1 to 9,750:1
Fish Productivity	6:1 to 12:1

a. Since there is no aquatic vegetation present in the BMZ, a true ratio cannot be calculated. However, given the high productivity of the estuarine habitat (1,680 g C/m^2/y) compared to no aquatic vegetation in the BMZ, a ratio of 10:1 is extremely conservative.

b. (ROWD Appendix UU)

Mitigation Calculation (Alternative 1)

Type of Impact Measured	Impacted Area (Acres)	Impacted Habitat	Impacted Area By Habitat Type (Acres)	Mitigation Ratio	Required Mitigation (Acres)	Mitigation Area Habitat Type
Intake	83.44	Estuarine	62.58	1:1	62.58	Estuarine
		Open Water	20.86	1:10	2.09	Estuarine
Fish Return	0.85	Estuarine	0.15	1:1	0.15	Estuarine
		Open Water	0.78	1:10	0.08	Estuarine
Discharge	18.51	Soft Bottom	18.20	1:10	1.82	Estuarine
		Rock Jetties	0.31	1:1	0.31	Estuarine
Construction	0.10	Estuarine	0.10	1:1	0.10	Estuarine
Subtotal	102.90		102.98		67.13	
Adjustment to Eliminate Double Counting of BMZ Mitigation					-1.82	
Total	102.90		102.98		65.31	

Mitigation Calculation (Alternative 15)

Type of Impact Measured	Impacted Area (Acres)	Impacted Habitat	Impacted Area By Habitat Type (Acres)	Mitigation Ratio	Required Mitigation (Acres)	Mitigation Area Habitat Type
Intake	83.44	Estuarine	62.58	1:1	62.58	Estuarine
		Open Water	20.86	1:10	2.09	Estuarine
Fish Return	0.85	Estuarine	0.14	1:1	0.14	Estuarine
		Open Water	0.71	1:10	0.07	Estuarine
Discharge	18.51	Soft Bottom	18.20	1:10	1.82	Estuarine
		Rock Jetties	0.31	1:1	0.31	Estuarine
Construction	0.10	Estuarine	0.10	1:1	0.10	Estuarine
Subtotal	102.90		102.90		67.11	
Adjustment to Eliminate Double Counting of BMZ Mitigation					-1.82	
Total	102.90		102.90		65.29	

MITIGATION PROJECT AND SECURITY

Mitigation Project Timeline

- The Marine Life Mitigation Plan (MLMP) approved by the Regional Water Board provides that construction of the wetland restoration project must commence within six months of approval of the necessary permits.
- The Discharger expects the permitting of the restoration project to be complete in the first half of 2018, and that the mitigation project construction would be complete in 2020.
- The Discharger is responsible for monitoring, management, maintenance and remediation of the wetlands (MLMP Obligations) for a period of thirty years from the date the as-built plans are submitted to the Commission.
- Based on the current schedule, the MLMP Obligations will run from 2020 to 2050.

Mitigation Performance Security

- The Water Purchase Agreement (WPA) between the Discharger and the San Diego County Water Authority is scheduled to expire on December 23, 2045.
- If the WPA is not amended or extended, MLMP Obligations are expected to continue for approximately five years beyond the end of the term of the WPA.
- The Discharger proposes the following performance security to ensure the MLMP Obligations continue to be met after the WPA term expires:
  - One year prior to the end of the term of the WPA, the Discharger shall confirm the number of years remaining on the MLMP Obligations after the WPA is terminated and submit for review and approval by the Regional Water Board the expected cost of the MLMP Obligations for this period.
  - Prior to the end of the term of the WPA, the Discharger shall provide (or cause to be provided) the Regional Water Board a non-cancelable mitigation performance security in the amount of the expected cost of the MLMP Obligations for this period.
  - The performance security may take one of the forms below:
    - Cash;
    - Non-Cancelable Bond;
    - Irrevocable letter of credit; or
    - Renewable time certificate of deposit.

BIOLOGICAL PERFORMANCE STANDARD

Biological Performance Standard

The ROWD includes a request that the renewed NPDES CA0109233 acknowledge that biological performance standards established in the March 27, 2009 Minimization Plan are no longer applicable:

- The BPS is no longer needed because subsequent to the adoption of Order R9-2009-0038, the Discharger agreed to increase the size of the MLMP from 55.4 acres to 66.4 acres.
- The provision of the additional 11 acres to ensures that the potential impingement impacts associated with the temporary stand-alone operation of the CDP are fully mitigated independent of the 55.4 acres of mitigation provided for entrainment impacts, thereby eliminating the need for the Biological Performance Standard.
- The destructive nature of the biological performance tests would result in adverse impacts to wetlands habitat and organisms.
  - The biological performance tests would impact fish populations and the salt march habitat of the restored site, potentially reducing the Discharger's ability to meet the MLMP performance standards.
  - The Science Advisory Panel voiced concerns that the depletion of fish populations and that hauling nets through the restored wetlands could trample vegetation, detracting from the Discharger's ability to demonstrate fish productivity and canopy development.
  - These impacts are contradictory to the goals of the MLMP.

FISH RETURN SYSTEM

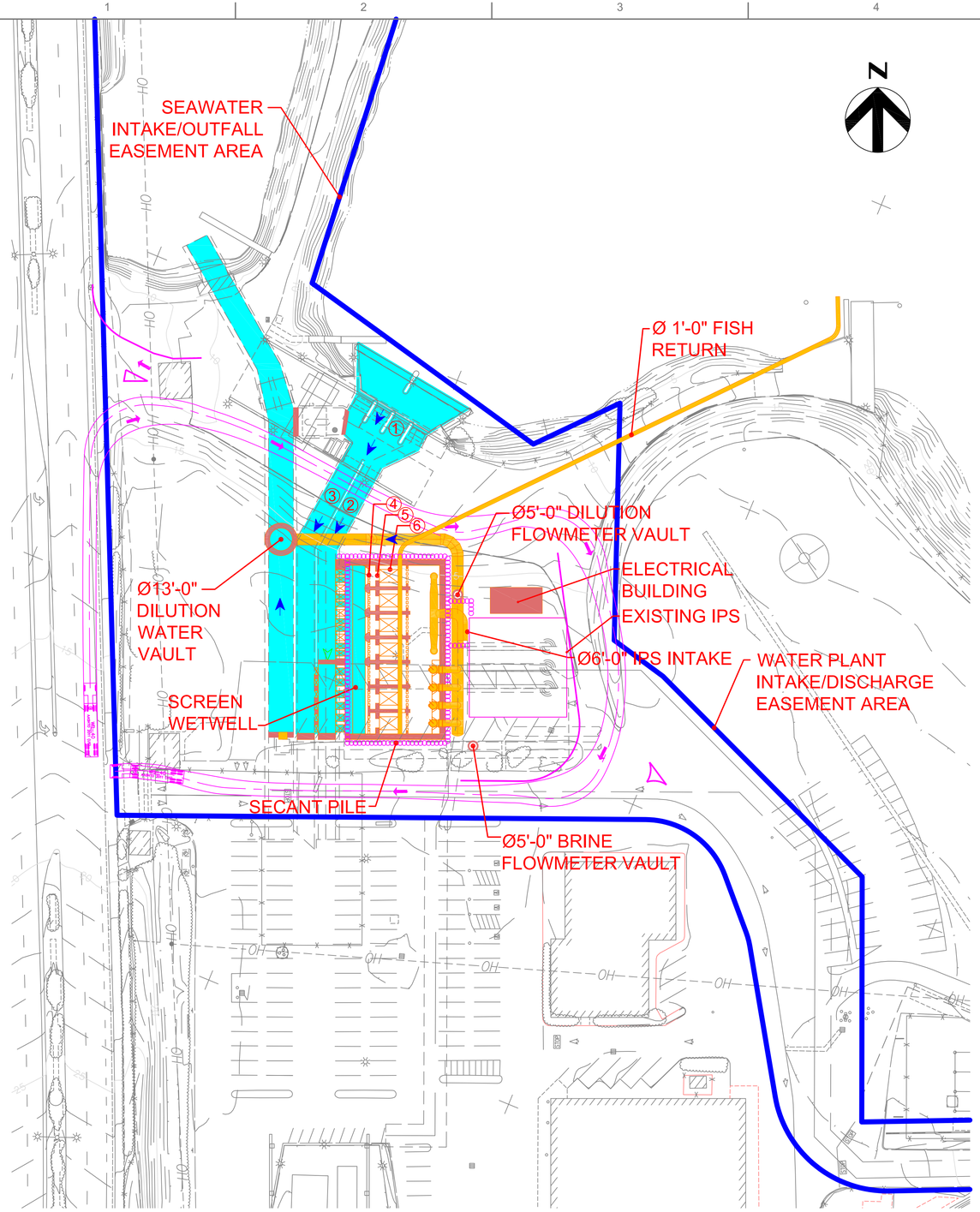
Lagoon Fish Return

Revised Permit Application Forms

- Revised Form 2D/Form 200 with new outfall designated “002”
- Supporting water quality table for fish return Outfall 002
- Fish return discharge location figure

Fish Return Antidegradation Analysis

- Potential exists for fish return discharge to contain higher concentrations of larger suspended particles greater than 1 mm (e.g., kelp, eel grass, etc.) than the ambient lagoon water
- No lowering of water quality for smaller suspended particles or any other water quality parameter
- Analysis concludes that implementation of the fish return alternative protects beneficial uses, complies with applicable water quality standards, and is consistent with maximum benefit to the state



ALTERNATIVE EVALUATION

ITEM	COMMENT
ALTERNATIVE	1 (Original Proposal)
DESCRIPTION	Discharger's proposed project
KEY ELEMENTS	• Existing bar rack at 1.06 fps inlet velocity. • 2 east intake channels at 2.63 fps respectively. • 7-1mm center flow screens. • Existing west channel for combined dilution and brine line.
CONSTRUCTION COST	$ 34.7 Million *
PHASING	Phase 1-Screen Intake Structure
FOOTPRINT	Original Proposal
CONSTRUCTION DURATION	2.1 Years (24.7 Months) (107 Weeks)
OPERATION & MAINTENANCE	Original Proposal
COMPLEXITY	Original Proposal
PLANT SHUT DOWN IMPACT	42 days to connect 1st and 2nd tunnels to screen wet well
PLANT SHUT DOWN COST($182,000/day)	$ 7,644,000 *
FISH RETURN MARINE LIFE MORTALITY - JUVENILE AND ADULT FISH (LBS/D)	0.85
SITE INGRESS/EGRESS IMPACT	Fish return line construction Dilution line construction

* 2017 Dollar Value

ALTERNATIVE 1			
No.	DESCRIPTION	VELOCITY *	COMMENT
1	EXIST. BAR RACK INTAKE	1.06 FPS **	(4)-10 FT BAR RACK
2	EXIST.INTAKE CHANNEL EAST	2.63 FPS	149.5 MGD
3	EXIST.INTAKE CHANNEL WEST	2.63 FPS	149.5 MGD
4	SCREEN UPSTREAM CHANNEL	0.33 FPS	4.0 METER
5	SCREEN INFLUENT THROAT	0.73 FPS	1.82 METER
6	THROUGH SCREEN VELOCITIES WITH 15% FOULING	0.44 FPS	3.5 METER CENTER FLOW

* ALL VELOCITY SHOWN ARE AT MLLW UNLESS OTHERWISE NOTED.

** VELOCITY THROUGH BAR RACK.

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ALTERNATIVE-1

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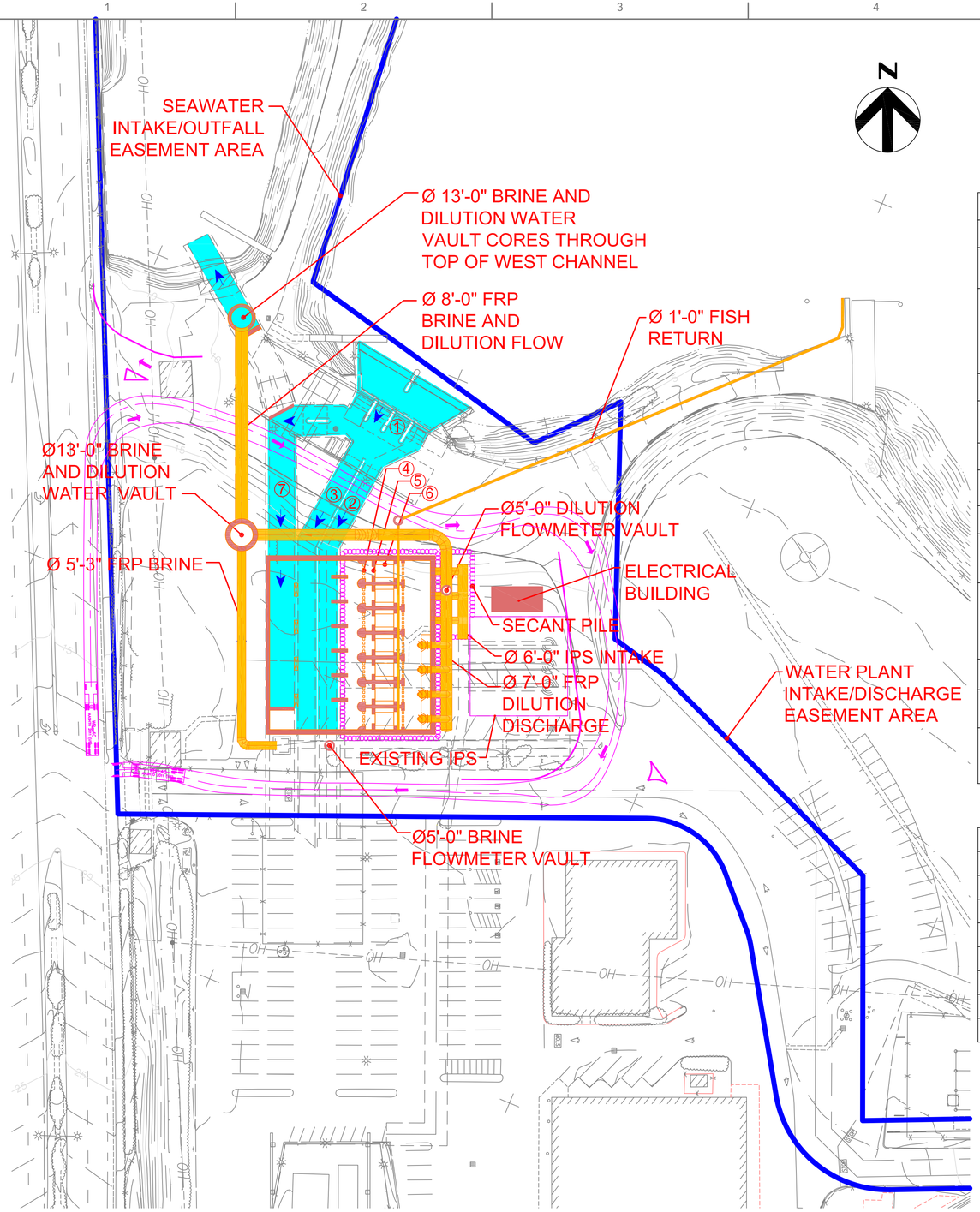

ALTERNATIVE EVALUATION

ITEM	COMMENT
ALTERNATIVE	15
DESCRIPTION	Discharger's proposed project with discharge channel repurposed as an intake.
KEY ELEMENTS	• Existing bar rack at 1.06 fps inlet velocity. • 3 intake channels at 1.54, 1.54 and 1.60 fps inlet velocity respectively. • 7-1mm center flow screens. • Additional brine discharge and combined dilution and brine line.
CONSTRUCTION COST	$ 38.3 Million* (Incremental increase from Alt 1 is $ 3.6 Million)
PHASING	Phase 1A-Screen intake structure Phase 1B-Dilution and brine line
FOOTPRINT	Same as original proposal
CONSTRUCTION DURATION	2.2 Years (26.1 Months) (113 weeks) (Incremental increase from Alt 1 is 6 weeks)
OPERATION & MAINTENANCE	Same as original proposal
COMPLEXITY	3rd inlet tunnel New combined dilution and brine discharge
PLANT SHUT DOWN IMPACT	42 days to connect 1st and 2nd tunnels to screen wet well 28 days for blocking existing channel and cutting roof and connect to 3rd tunnel 14 days for pipeline connection. Total of 84 days
PLANT SHUT DOWN COST($182,000/day)	$ 15,288,000* (INCREMENTAL INCREASE FROM ALT 1 is $ 7,644,000)
FISH RETURN MARINE LIFE MORTALITY - JUVENILE AND ADULT FISH (LBS/D)	0.78
SITE INGRESS/EGRESS IMPACT	Fish return line construction Dilution line construction Combined dilution and brine line construction

* 2017 Dollar Value

ALTERNATIVE 15			
No.	DESCRIPTION	VELOCITY *	COMMENT
1	EXIST. BAR RACK INTAKE	1.06 FPS **	(4)-10 FT BAR RACK
2	EXIST.INTAKE CHANNEL EAST	1.54 FPS	87.5 MGD
3	EXIST.INTAKE CHANNEL WEST	1.54 FPS	87.5 MGD
4	SCREEN UPSTREAM CHANNEL	0.33 FPS	4.0 METER
5	SCREEN INFLUENT THROAT	0.73 FPS	1.82 METER
6	THROUGH SCREEN VELOCITIES WITH 15% FOULING	0.44 FPS	3.5 METER CENTER FLOW
7	EXIST.DISCH. CHANNEL REPURPOSED	1.60 FPS	124 MGD

* ALL VELOCITY SHOWN ARE AT MLLW UNLESS OTHERWISE NOTED.

** VELOCITY THROUGH BAR RACK.

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ALTERNATIVE-15

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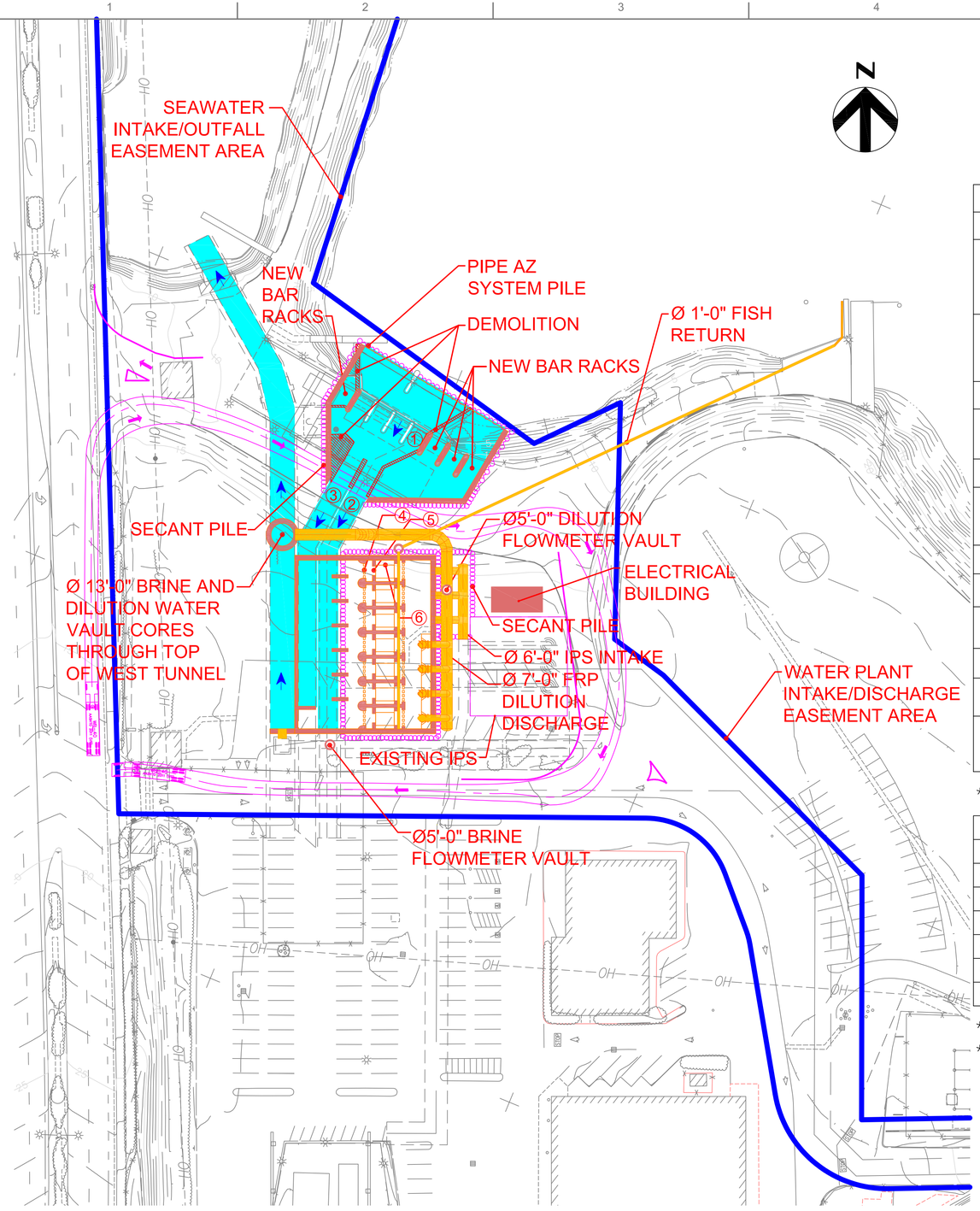

ALTERNATIVE EVALUATION

ITEM	COMMENT
ALTERNATIVE	16
DESCRIPTION	Discharger's proposed project with bar rack inlet structure improved to limit intake velocities to 0.5 fps. Note that this alternative requires two construction phases as identified below. Phase 1 allows for plant operations while applying for USACE permits for lagoon construction. Phase 2 requires shoring around the existing intake to allow construction to occur in dry conditions. See below for plant shutdown durations for each phase.
KEY ELEMENTS	• Additional bar racks at 0.53 fps inlet velocity • 2 east intake channels at 2.63 fps respectively. • 7-1mm center flow screens. • Existing west channel for combined dilution and brine line.
CONSTRUCTION COST	$ 47.2 Million*(Incremental increase from Alt 1 is $ 12.5 Million)
PHASING	Phase 1-Screen intake structure
	Phase 2- Additional bar rack structure
FOOTPRINT	Same as original proposal + Additional bar rack
CONSTRUCTION DURATION	2.1 Years (24.7 Months) (107 Weeks) Phase 1 1.3 Years (15.5 Months) (67 Weeks) Phase 2 Total: 3.3 Years (40.2 Months) (174 Weeks) (Incremental increase from Alt 1 is 67 weeks)
OPERATION & MAINTENANCE	Same as original proposal + Additional 4 bar racks
COMPLEXITY	Phase 2 double width of bar racks
PLANT SHUT DOWN IMPACT	42 days for 1st and 2nd tunnels to screen wet well
	300 days Phase 2 double width of intake and install 40' of new bar rack
PLANT SHUT DOWN COST($182,000/day)	$ 62,244,000*(INCREMENTAL INCREASE FROM ALT 1 is $ 54,600,000)
FISH RETURN MARINE LIFE MORTALITY - JUVENILE AND ADULT FISH (LBS/D)	0.85
SITE INGRESS/EGRESS IMPACT	Fish return line construction Dilution line construction Double width of intake and install 40' of new bar racks

* 2017 Dollar Value

ALTERNATIVE 16			
No.	DESCRIPTION	VELOCITY *	COMMENT
①	UPGRADED BAR RACK INTAKE	0.53 FPS **	(8)-10 FT BAR RACK
②	EXIST.INTAKE CHANNEL EAST	2.63 FPS	149.5 MGD
③	EXIST.INTAKE CHANNEL WEST	2.63 FPS	149.5 MGD
④	SCREEN UPSTREAM CHANNEL	0.33 FPS	4.0 METER
⑤	SCREEN INFLUENT THROAT	0.73 FPS	1.82 METER
⑥	THROUGH SCREEN VELOCITIES WITH 15% FOULING	0.44 FPS	3.5 METER CENTER FLOW

* ALL VELOCITY SHOWN ARE AT MLLW UNLESS OTHERWISE NOTED.

** VELOCITY THROUGH BAR RACK.

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ALTERNATIVE-16

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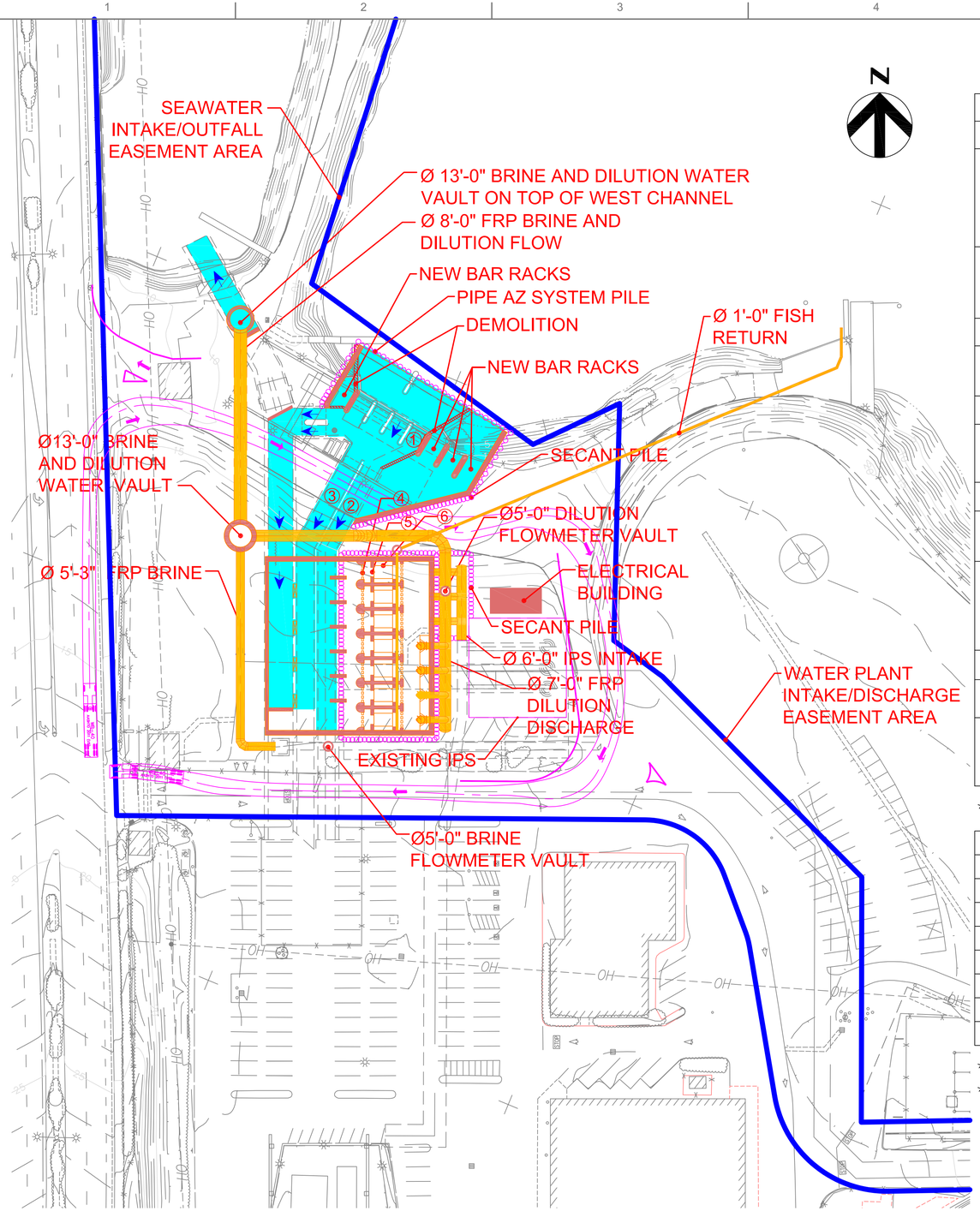

ALTERNATIVE EVALUATION

ITEM	COMMENT
ALTERNATIVE	17
DESCRIPTION	Discharger's proposed project with bar rack inlet structure improved to limit intake velocities to 0.5 fps and with discharge tunnel repurposed as an intake (combination of Alternatives 15 and 16). Note that this alternative requires two construction phases as identified below. Phase 1 allows for plant operations while applying for USACE permits for lagoon construction. Phase 2 requires shoring around the existing intake to allow construction to occur in dry conditions. See below for plant shutdown durations for each phase.
KEY ELEMENTS	• Additional bar racks at 0.53 fps inlet velocity. • 3 intake channel at 1.54, 1.54 and 1.60 fps inlet velocity respectively. • 7-1mm center flow screens. • Additional brine discharge and combined dilution and brine line.
CONSTRUCTION COST	$ 50.2 Million*(Incremental increase from Alt 1 is $ 15.5 Million)
PHASING	Phase 1A-Screen intake structure Phase 1B-Dilution and brine line
	Phase 2- Additional bar rack structure
FOOTPRINT	Same as original proposal + Additional bar rack
CONSTRUCTION DURATION	2.2 Years (26.1 Months) (113 weeks) for Phase 1 1.3 Years (15.5 Months) (67 Weeks) Phase 2 Total: 3.5 Years 41.5 Months) (180 Weeks) (Incremental increase from Alt 1 is 73 weeks)
OPERATION & MAINTENANCE	Same as original proposal + Additional 4 bar racks
COMPLEXITY	3rd tunnel connection Phase 2 double width of intake, install new bar racks New combined dilution and brine discharge
PLANT SHUT DOWN IMPACT	42 days to connect 1st and 2nd tunnels to screen wet well 28 days for blocking existing channel and cutting roof and connect to 3rd tunnel 14 days for pipeline connection. Total of 84 days
	300 days Phase 2 double width of intake and install 40' of new bar rack
PLANT SHUT DOWN COST($182,000/day)	$ 69,888,000*(INCREMENTAL INCREASE FROM ALT 1 $ 62,244,000)
FISH RETURN MARINE LIFE MORTALITY - JUVENILE AND ADULT FISH (LBS/D)	0.78
SITE INGRESS/EGRESS IMPACT	Fish return line construction Dilution line construction Double width of intake and install 40' of new bar racks Combined dilution and brine line construction

* 2017 Dollar Value

ALTERNATIVE 17			
No.	DESCRIPTION	VELOCITY *	COMMENT
①	UPGRADED BAR RACK INTAKE	0.53 FPS **	(8)-10 FT BAR RACK
②	EXIST.INTAKE CHANNEL EAST	1.54 FPS	87.5 MGD
③	EXIST.INTAKE CHANNEL WEST	1.54 FPS	87.5 MGD
④	SCREEN UPSTREAM CHANNEL	0.33 FPS	4.0 METER
⑤	SCREEN INFLUENT THROAT	0.73 FPS	1.82 METER
⑥	THROUGH SCREEN VELOCITIES WITH 15% FOULING	0.44 FPS	3.5 METER CENTER FLOW
⑦	EXIST.DISCH. CHANNEL REPURPOSED	1.60 FPS	124 MGD

* ALL VELOCITY SHOWN ARE AT MLLW UNLESS OTHERWISE NOTED.

** VELOCITY THROUGH BAR RACK.

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ALTERNATIVE-17

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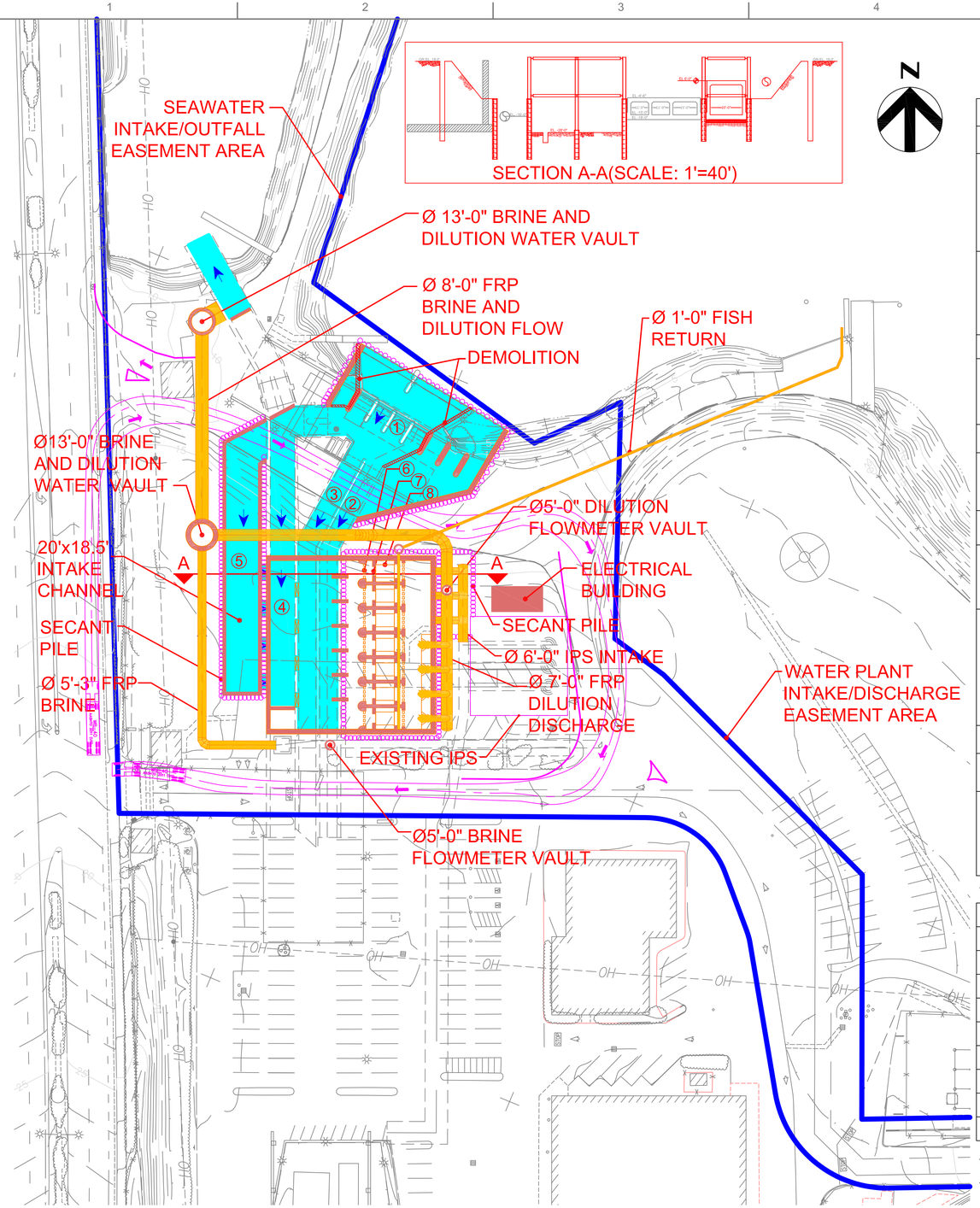

ALTERNATIVE EVALUATION

ITEM	COMMENT
ALTERNATIVE	18
DESCRIPTION	Discharger's proposed project with bar rack inlet structure improved to limit intake velocities to 0.5 fps, discharge tunnel repurposed as an intake, and a fourth intake tunnel added to reduce intake velocities (combination of Alternatives 16 and 17 with a new tunnel). Note that this alternative requires two construction phases as identified below. Phase 1 allows for plant operations while applying for USACE permits for lagoon construction. Phase 2 requires shoring around the existing intake to allow construction to occur in dry conditions. See below for plant shutdown durations for each phase.
KEY ELEMENTS	• Additional bar racks at 0.53 fps inlet velocity • 4 intake channels at 0.68, 0.66, 0.67 and 1.04 fps inlet velocity respectively. • 7-1mm center flow screens. • Additional brine discharge and combined dilution and brine line.
CONSTRUCTION COST	$ 56.3 Million* (Incremental increase from Alt 1 is $ 21.6 Million)
PHASING	Phase 1A-Screen intake structure Phase 1B-New 4th intake channel Phase 1C-Dilution and brine line
	Phase 2- Additional bar rack structure
FOOTPRINT	Same as original proposal + Additional 4 bar racks+Additional 4 th tunnel
CONSTRUCTION DURATION	2.7 Years (32.5 Months) (141 weeks) for Phase 1 1.3 Years (15.5 Months) (67 Weeks) Phase 2 Total: 4 Years (48.0 Months) (208 Weeks) (Incremental increase from Alt 1 is 201 weeks)
OPERATION & MAINTENANCE	Same as original proposal + Additional 4 bar racks + Additional removal of mussels and other fouling organisms in the new tunnel.
COMPLEXITY	3rd tunnel connection Phase 2 double width of intake, install new bar racks Construct 4th intake channel New combined dilution and brine discharge
PLANT SHUT DOWN IMPACT	42 days to connect 1st and 2nd tunnels to screen wet well 28 days for blocking existing channel and cutting roof and connect to 3rd tunnel 14 days for pipeline connection. 28 days for new tunnel connection. Total of 112 days for plant shut down.
	300 days Phase 2 double width of intake and install 40' of new bar rack
PLANT SHUT DOWN COST($182,000/day)	$ 74,984,000* (INCREMENTAL INCREASE FROM ALT 1 is $ 67,340,000)
FISH RETURN MARINE LIFE MORTALITY - JUVENILE AND ADULT FISH (LBS/D)	0.75
SITE INGRESS/EGRESS IMPACT	Fish return line construction Dilution line construction Double width of intake, install 40' of new bar racks Construct 4th intake channel Combined dilution and brine line construction

* 2017 Dollar Value

ALTERNATIVE 18

No.	DESCRIPTION	VELOCITY *	COMMENT
1	EXIST. BAR RACK INTAKE	0.53 FPS **	(8)-10 FT BAR RACK
2	EXIST.INTAKE CHANNEL EAST	0.68 FPS	39 MGD
3	EXIST.INTAKE CHANNEL WEST	0.66 FPS	37 MGD
4	EXIST.DISCH. CHANNEL REPURPOSED	0.67 FPS	52 MGD
5	NEW INTAKE CHANNEL	1.04 FPS	171 MGD OPEN CHANNEL
6	SCREEN UPSTREAM CHANNEL	0.33 FPS	4.0 METER
7	SCREEN INFLUENT THROAT	0.73 FPS	1.82 METER
8	THROUGH SCREEN VELOCITIES WITH 15% FOULING	0.44 FPS	3.5 METER CENTER FLOW

* ALL VELOCITY SHOWN ARE AT MLLW UNLESS OTHERWISE NOTED.

** VELOCITY THROUGH BAR RACK.

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PROJECT MANAGER

PROJECT NUMBER

PRELIMANRY NOT FOR CONSTRUCTION OR RECORDING

POSEIDON CHANNELSIDE
a Poseidon Water company

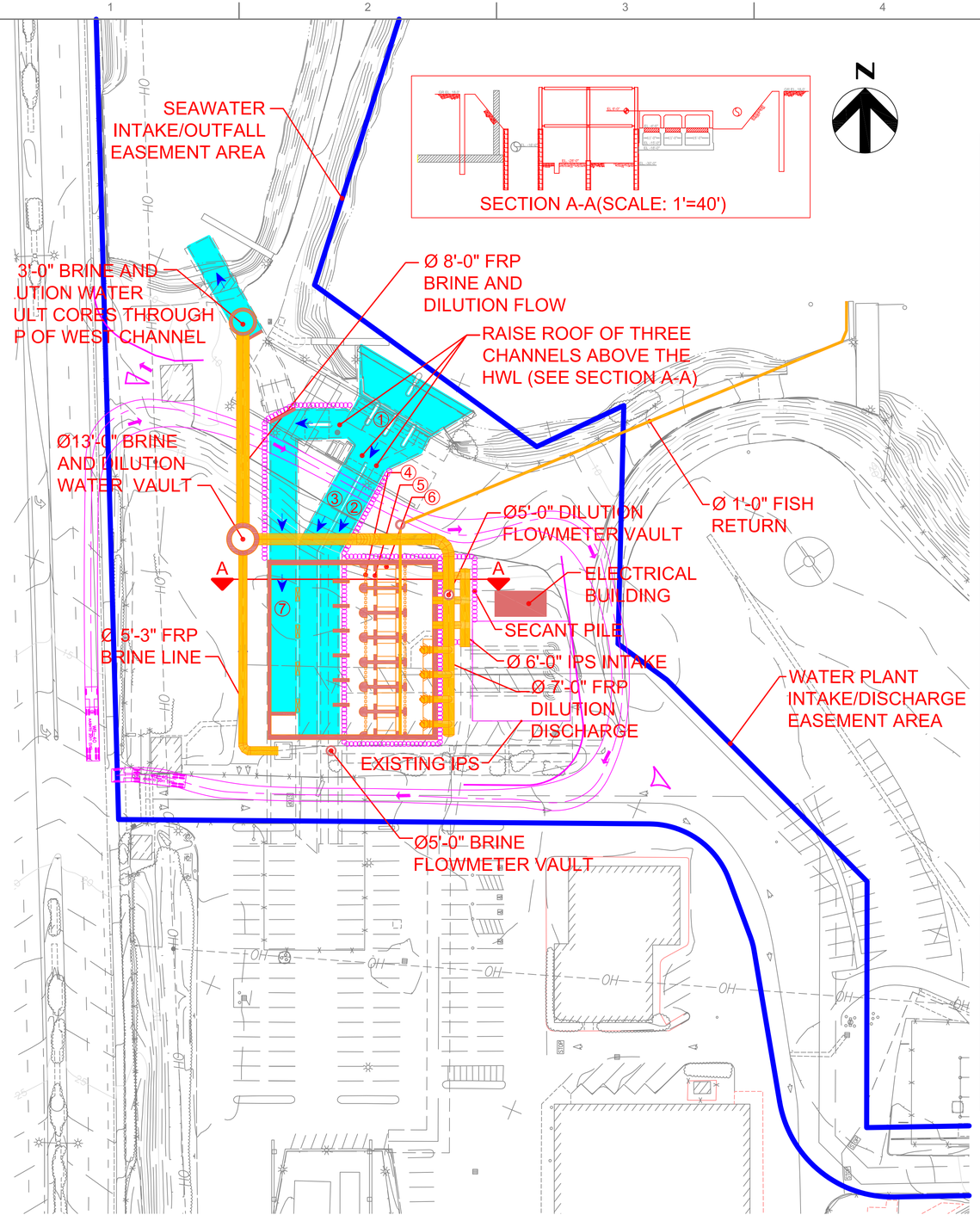
ALTERNATIVE-18

0 1" 2"

FILENAME FILENAME

SCALE SCALE

SHEET



ALTERNATIVE EVALUATION

ITEM	COMMENT
ALTERNATIVE	19
DESCRIPTION	Discharger's proposed project with discharge tunnel repurposed as an intake and all intake tunnel roofs raised to accommodate HWL without restriction. Note that this alternative requires three construction phases as identified below. Phase 1 allows for plant operations while applying for USACE permits for lagoon construction. Phase 2 requires shoring around the existing intake to allow tunnel modifications to occur in dry conditions. Phase 3 allows for construction of dilution and brine lines. See below for plant shutdown durations for each phase.
KEY ELEMENTS	• Existing bar rack at 1.06 fps inlet velocity. • 3 intake channels at 0.94, 0.94 and 1.05 fps inlet velocity respectively. • Raise roof of three intake channels 10.5 ft • 7-1mm center flow screens. • Additional brine discharge and combined dilution and brine line.
CONSTRUCTION COST	$ 43.6 Million*(Incremental increase from Alt 1 is $ 8.9 Million)
PHASING	Phase 1A-Screen intake structure Phase 1B-Raising existing channel walls and adding new roof Phase 1C- Dilution and brine line
FOOTPRINT	Raise roof on intake channels 10.5 ft
CONSTRUCTION DURATION	2.4 Years (29 Months) (124 Weeks) (Incremental increase from Alt 1 is 17 weeks)
OPERATION & MAINTENANCE	Same as original proposal
COMPLEXITY	3rd tunnel connection Raising all three tunnel walls and adding new roof New combined dilution and brine discharge
PLANT SHUT DOWN IMPACT	224 days for raising all three tunnel roofs (to include 42 days to connect 1st and 2nd tunnels to screen wet well and 28 days for blocking existing channel and cutting roof and connect to 3rd tunnel); 84 days for pipeline construction. 14 days for pipeline tie-in. Total of 322 days plant shut down.
PLANT SHUT DOWN COST($182,000/day)	$ 58,604,000*(INCREMENTAL INCREASE FROM ALT 1 is $ 50,960,000)
FISH RETURN MARINE LIFE MORTALITY - JUVENILE AND ADULT FISH (LBS/D)	0.75
SITE INGRESS/EGRESS IMPACT	Fish return line construction Dilution line construction Combined dilution and brine line construciton Raise roof on intake channels 10.5 ft

* 2017 Dollar Value

ALTERNATIVE 19			
No.	DESCRIPTION	VELOCITY *	COMMENT
①	EXIST. BAR RACK INTAKE	1.06 FPS **	(4)-10 FT BAR RACK
②	EXIST.INTAKE CHANNEL EAST	0.94 FPS	85 MGD
③	EXIST.INTAKE CHANNEL WEST	0.94 FPS	85 MGD
④	SCREEN UPSTREAM CHANNEL	0.33 FPS	4.0 METER
⑤	SCREEN INFLUENT THROAT	0.73 FPS	1.82 METER
⑥	THROUGH SCREEN VELOCITIES WITH 15% FOULING	0.44 FPS	3.5 METER CENTER FLOW
⑦	EXIST.DISCH. CHANNEL REPURPOSED	1.05 FPS	129 MGD

* ALL VELOCITY SHOWN ARE AT MLLW UNLESS OTHERWISE NOTED.

** VELOCITY THROUGH BAR RACK.

This Margin Reserved for Notes
Avoid Drawing in This Area

0 40 80 120
SCALE 1"=40'

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ISSUE	DATE	DESCRIPTION	PROJECT MANAGER / PROJECT NUMBER

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ALTERNATIVE-19

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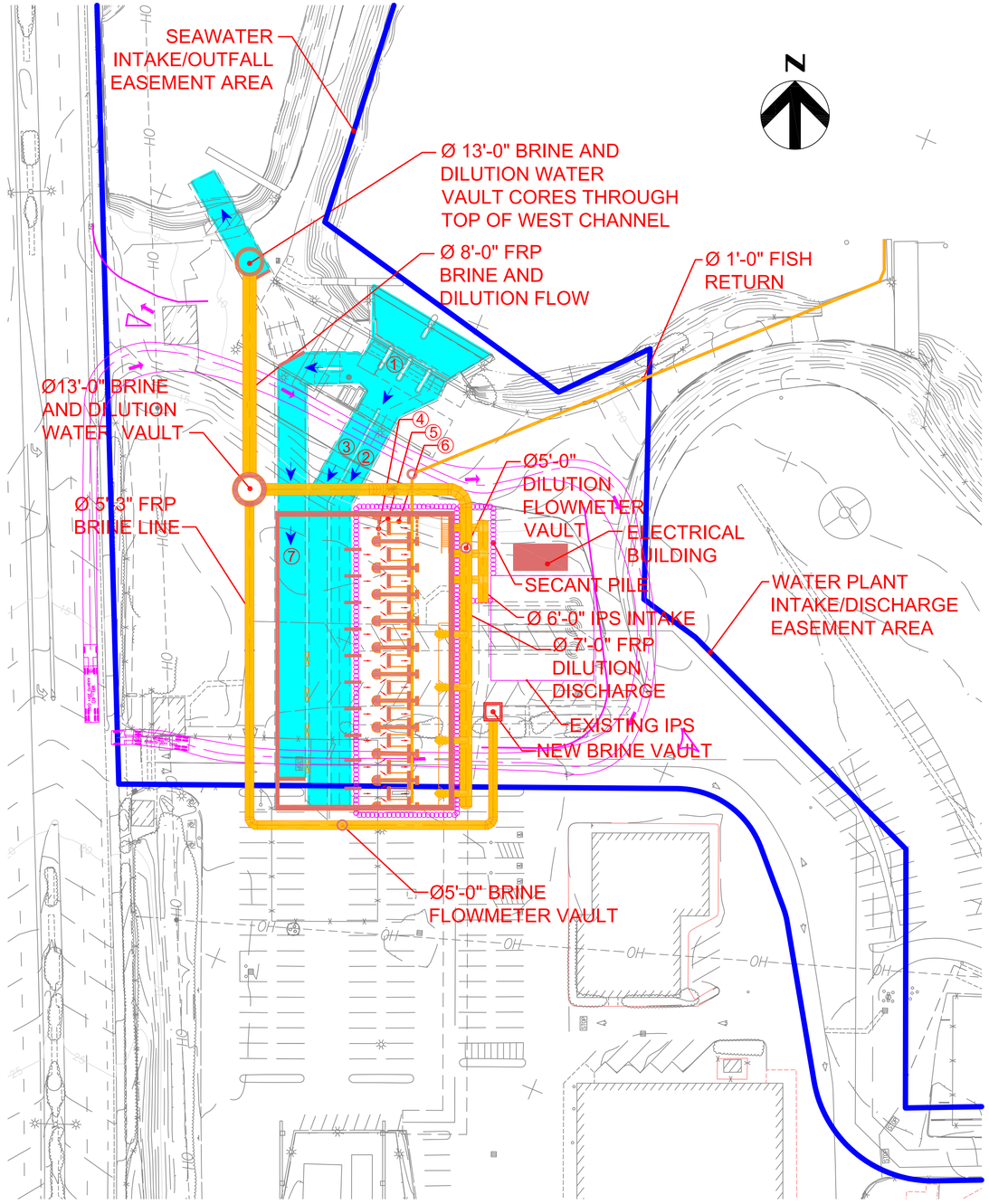

ALTERNATIVE EVALUATION

ITEM	COMMENT
ALTERNATIVE	20
DESCRIPTION	Discharger's proposed project with change in screen type from a single entry (inside-out) to a double entry (outside-in) type screen to achieve 0.5 fps screen entry velocity. This increases the number of screens required from 7 to 11, resulting in a structure length increase of 64 feet.
KEY ELEMENTS	• Existing bar rack at 1.06 fps inlet velocity. • 3 intake channels at 1.54, 1.54 and 1.60 fps inlet velocity respectively. •11-1mm dual flow screens (through screen velocity at 0.49 ft/sec,inlet throat velocity at 0.47 fps) • Additional brine discharge and combined dilution and brine line.
CONSTRUCTION COST	$ 54.3 Million* (Incremental increase from Alt 1 is $ 19.6 Million)
PHASING	Phase 1A-Screen intake structure Phase 1B-Dilution and brine line
FOOTPRINT	Larger intake structure to accommodate additional fish screens
CONSTRUCTION DURATION	2.2 Years (26.1 Months) (113 weeks) (Incremental increase from Alt 1 is 6 weeks)
OPERATION & MAINTENANCE	Same as original proposal + Additional 4 screen Dual Flow screen is primarily used for retrofit. Dual Flow screen (double entry single exit outside in) has O&M issue on sediment removal compared with Center Flow screen (single entry double exit inside out) as the sediment will be accumulated prior to entering the screen from outside.
COMPLEXITY	3rd tunnel connection New combined dilution and brine discharge
PLANT SHUT DOWN IMPACT	42 days to connect 1st and 2nd tunnels to screen wet well 28 days for blocking existing channel and cutting roof and connect to 3rd tunnel 14 days for pipeline connection. Total of 84 days
PLANT SHUT DOWN COST($182,000/day)	$ 15,288,000* (INCREMENTAL INCREASE FROM ALT 1 IS $ 7,644,000)
FISH RETURN MARINE LIFE MORTALITY - JUVENILE AND ADULT FISH (LBS/D)	0.78
SITE INGRESS/EGRESS IMPACT	Intake screen structure Fish return line construction Dilution line construction Combined dilution and brine line construciton Brine line construction

* 2017 Dollar Value

ALTERNATIVE 20			
No.	DESCRIPTION	VELOCITY *	COMMENT
(1)	EXIST. BAR RACK INTAKE	1.06 FPS **	(4)-10 FT BAR RACK
(2)	EXIST.INTAKE CHANNEL EAST	1.54 FPS	87.5 MGD
(3)	EXIST.INTAKE CHANNEL WEST	1.54 FPS	87.5 MGD
(4)	SCREEN UPSTREAM CHANNEL	0.19 FPS	13.5 FT
(5)	SCREEN INFLUENT THROAT	0.47 FPS	5.5 FT
(6)	THROUGH SCREEN VELOCITIES WITH 15% FOULING	0.49 FPS	10 FT DUAL FLOW
(7)	EXIST.DISCH. CHANNEL REPURPOSED	1.60 FPS	124 MGD

* ALL VELOCITY SHOWN ARE AT MLLW UNLESS OTHERWISE NOTED.

** VELOCITY THROUGH BAR RACK.

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Carlsbad Desalination Project Intake Alternatives Capital Cost Analysis ($)							
Construction Cost	**Alternatives**						
Alternative	**#1**	**#15**	**#16**	**#17**	**#18**	**#19**	**#20**
Construction Duration (yrs)	2.06	2.17	3.35	3.46	4.00	2.38	2.17
Construction Costs							
Additional Permitting	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000	3,150,000
Intake/Outfall Construction	34,675,000	38,311,000	47,178,000	50,157,000	56,300,000	43,642,000	54,274,000
Construction Management	2,373,529	2,500,271	3,859,866	3,986,607	4,608,795	2,742,233	2,500,271
Construction Insurance	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Construction Rent	309,000	325,500	502,500	519,000	600,000	357,000	325,500
Post Construction Entrainment Study	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Subtotal	**42,707,529**	**46,486,771**	**56,890,366**	**60,012,607**	**66,858,795**	**52,091,233**	**62,449,771**
Transaction Costs, legal	972,401	1,059,917	1,326,843	1,402,852	1,580,316	1,191,057	1,423,576
Capitalized Interest	2,554,752	2,849,808	4,536,491	4,895,628	6,019,721	3,319,639	3,880,079
Additional 6 Mo Debt Service Reserve	1,362,806	1,488,401	1,905,007	2,018,490	2,298,609	1,678,953	1,999,074
Debt Underwriting	398,684	434,566	544,006	575,169	647,929	488,333	583,666
Additional 1 month O&M Reserve	237,229	244,426	251,815	258,464	267,750	248,868	261,895
Outstanding Equity Fee	386,509	431,826	830,374	908,318	1,251,610	534,576	580,530
Total Project Cost	**48,619,910**	**52,995,714**	**66,284,901**	**70,071,529**	**78,924,730**	**59,552,659**	**71,178,591**
Incremental Increase		**4,375,804**	**17,664,991**	**21,451,619**	**30,304,819**	**10,932,749**	**22,558,681**

Carlsbad Desalination Project Intake Alternatives Annualized Cost Analysis ($/yr)							
Annualized Cost	**Alternatives**						
Alternative	**#1**	**#15**	**#16**	**#17**	**#18**	**#19**	**#20**
Construction Debt Charge	2,725,612	2,976,802	3,810,014	4,036,980	4,597,218	3,357,907	3,998,148
Construction Equity Charge	1,343,851	1,465,336	1,833,513	1,937,774	2,186,179	1,647,814	1,968,089
Additional O&M Charge	2,846,750	2,933,110	3,021,780	3,101,570	3,213,000	2,986,420	3,142,740
Total Annual Costs	**6,916,213**	**7,375,248**	**8,665,307**	**9,076,324**	**9,996,398**	**7,992,141**	**9,108,976**
Incremental Increase		**459,034**	**1,749,094**	**2,160,111**	**3,080,184**	**1,075,928**	**2,192,763**

Carlsbad Desalination Project Intake Alternatives Cost/Benefit Analysis							
Cost/Benefit Analysis	**Alternatives**						
Alternative	**#1**	**#15**	**#16**	**#17**	**#18**	**#19**	**#20**
Net Productivity Loss Proposed Intake (lbs/d)	0.85	0.78	0.85	0.78	0.75	0.75	0.75
Reduced Mortality (lbs/d)		0.07	0.00	0.07	0.10	0.10	0.10
Reduced Mortality (lbs/yr)		25.55	0.00	25.55	36.50	36.50	36.50
Incremental Cost increase ($/yr)		$459,034	$1,749,094	$2,160,111	$3,080,184	$1,075,928	$2,192,763
Unit Cost of Reduced Mortality ($/lb)		**$17,966**	**n/a**	**$84,544**	**$84,389**	**$29,477**	**$60,076**

Carlsbad Desalination Project Plant Shutdown Cost ($)							
Alternative	**#1**	**#15**	**#16**	**#17**	**#18**	**#19**	**#20**
Length of Shutdown (d)	42	84	342	384	412	322	84
Unit Cost of Shutdown ($/d)	$182,000	$182,000	$182,000	$182,000	$182,000	$182,000	$182,000
Plant Shutdown Cost	**$7,644,000**	**$15,288,000**	**$62,244,000**	**$69,888,000**	**$74,984,000**	**$58,604,000**	**$15,288,000**