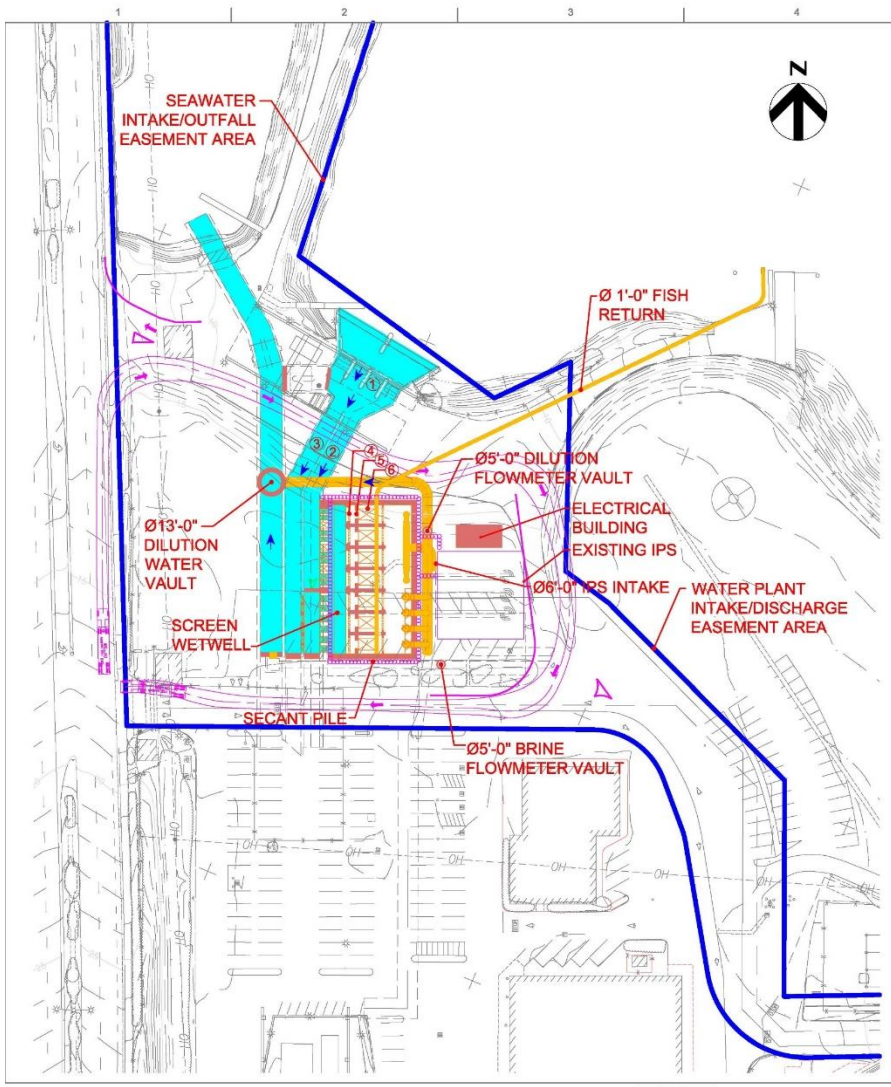
APPENDIX BBB
EVALUATION OF ADDITIONAL INTAKE ALTERNATIVES 1, 15, 16, 17, 18, 19, AND 20

Alternative 1 – Original Proposal



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

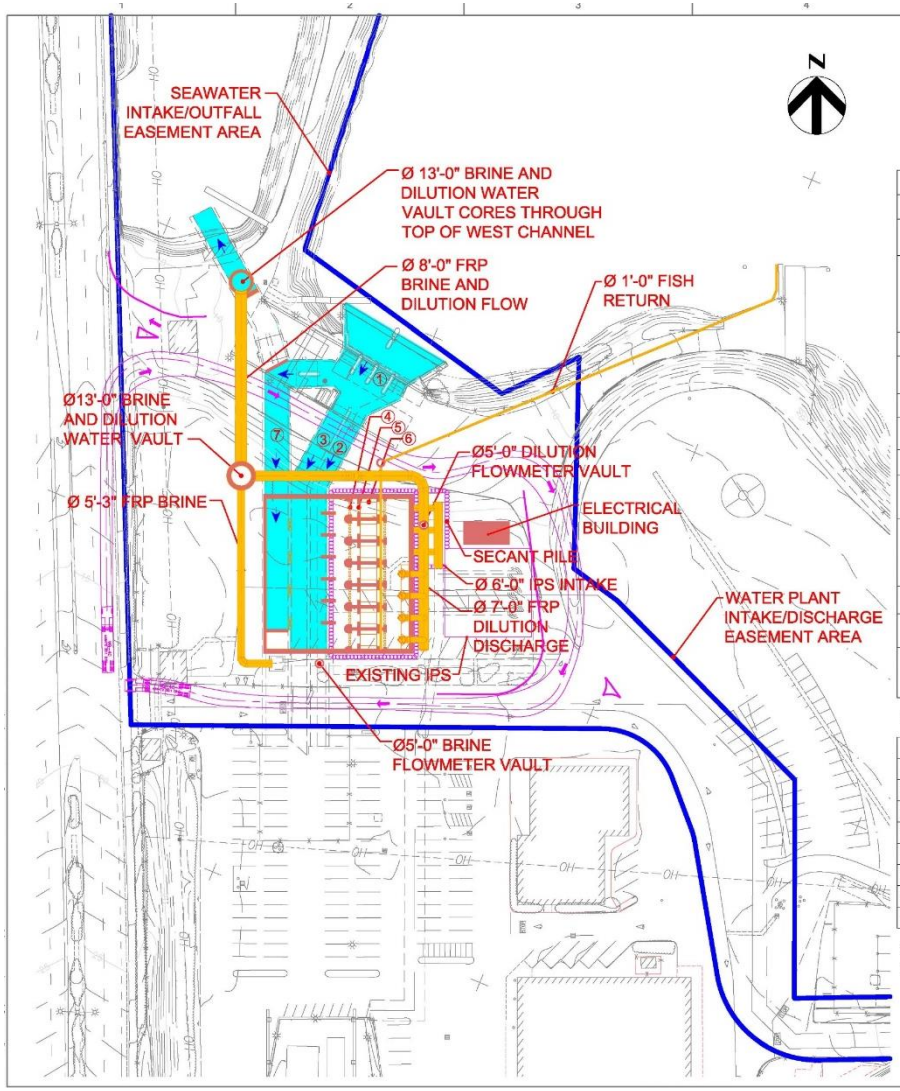
ALTERNATIVE 1

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.

Alternative 15 – Repurpose Discharge Channel to Intake



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

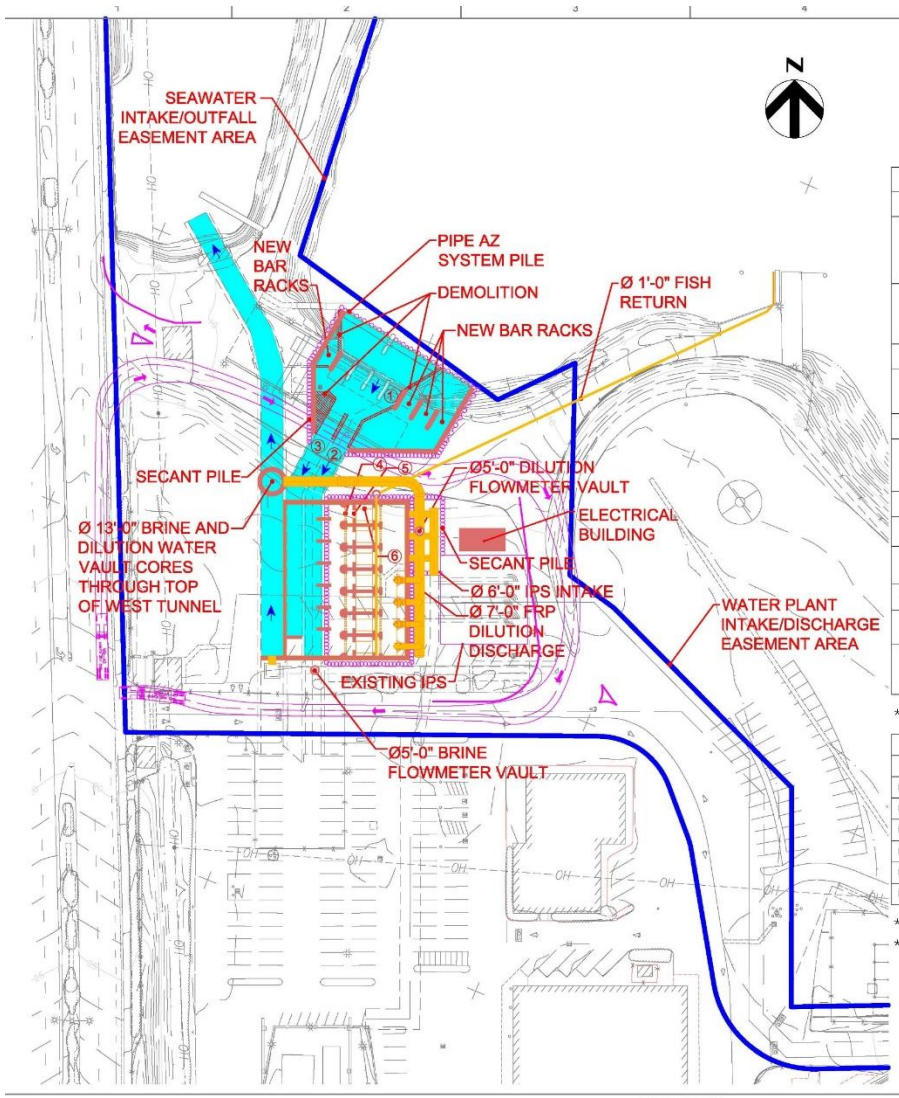
ALTERNATIVE 15

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.

Alternative 16 – Double Width of Bar Rack



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

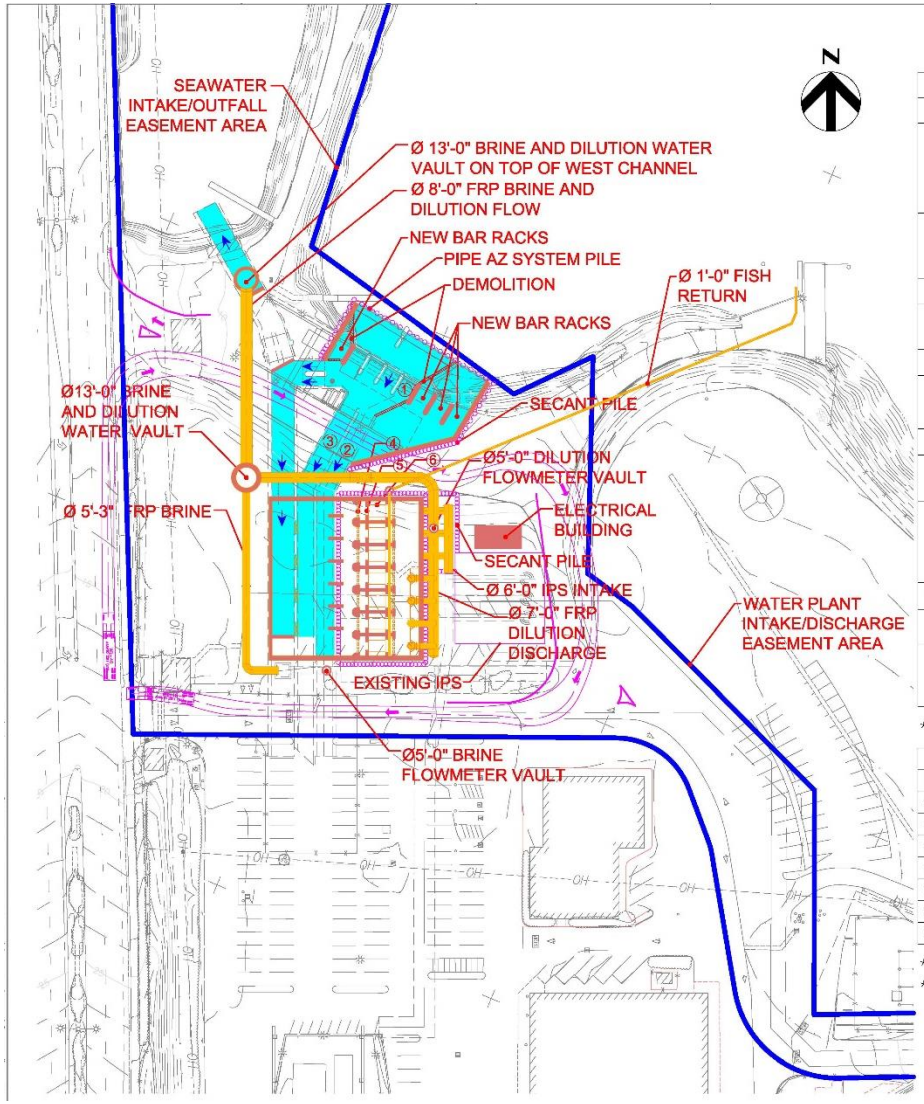
ALTERNATIVE 16

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.

Alternative 17 - Double Width of Bar Rack and Repurpose Discharge Channel as Intake



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

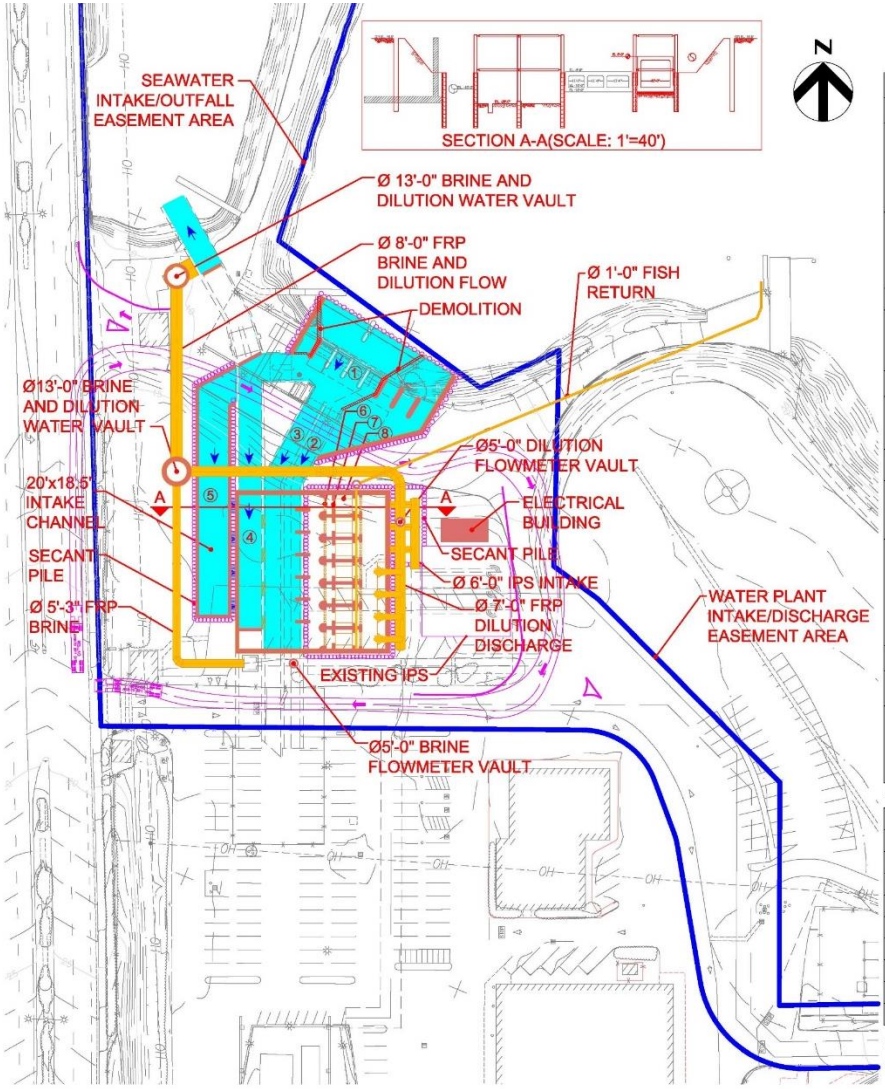
ALTERNATIVE 17

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.

Alternative 18 – Double Width of Bar Rack, Repurpose Discharge Channel as Intake, and Construct New Intake Channel



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

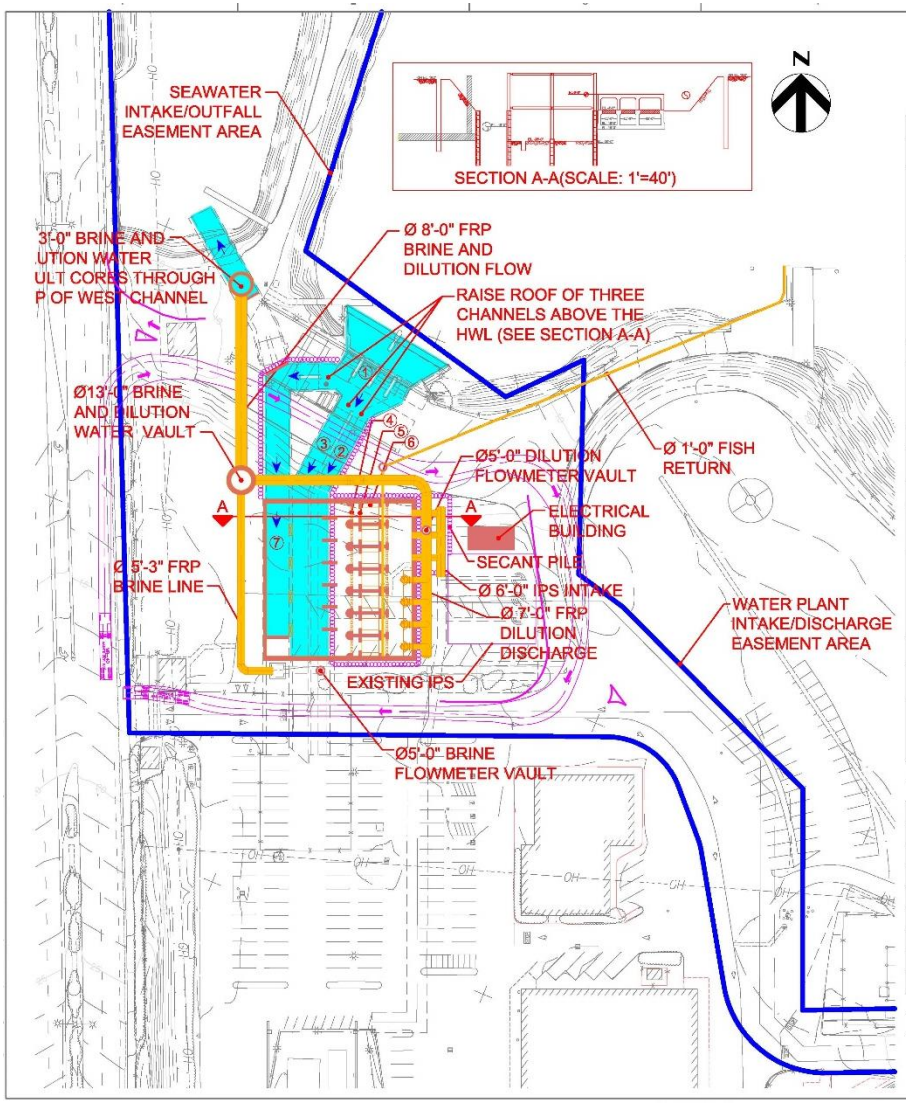
ALTERNATIVE 18

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.

Alternative 19 - Repurpose Discharge Channel to Intake, Raise Height of All Three Intake Channel to Allow Unrestricted Flow at High Water Level



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

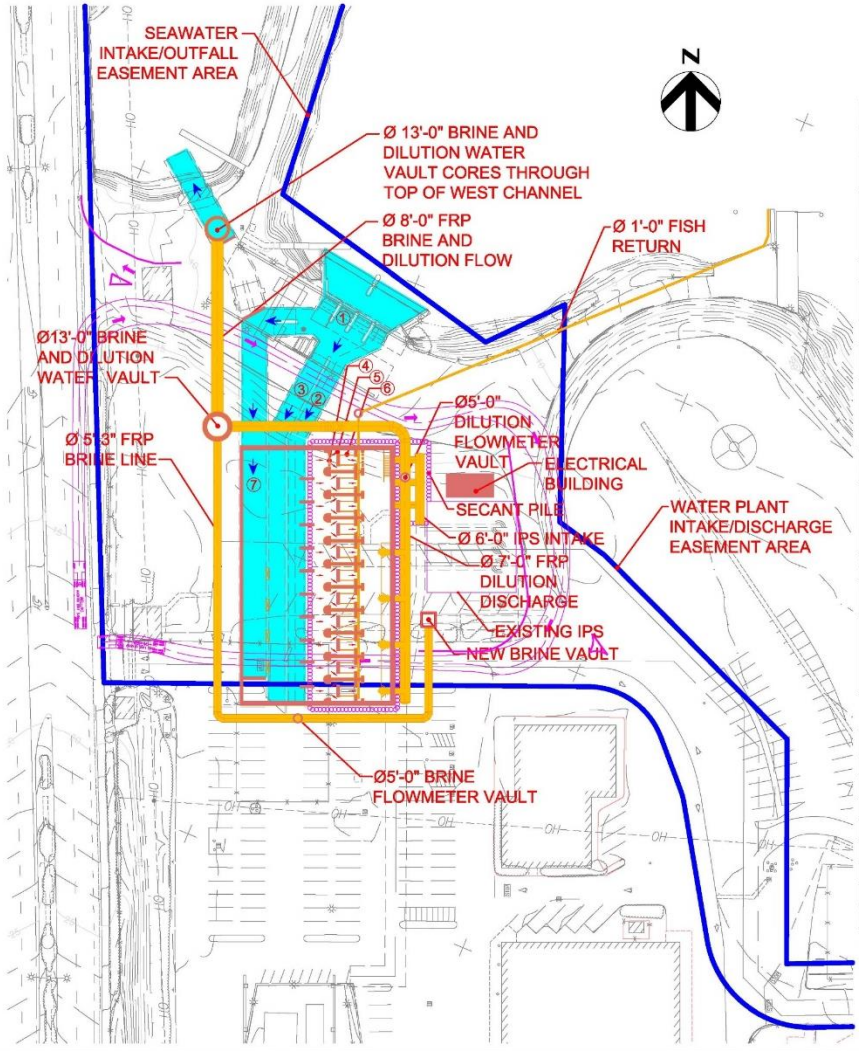
ALTERNATIVE 19

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.

Alternative 20 – Change the Type and Increase the Number of Screens to Reduce Entrance Velocity in Screening Area



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

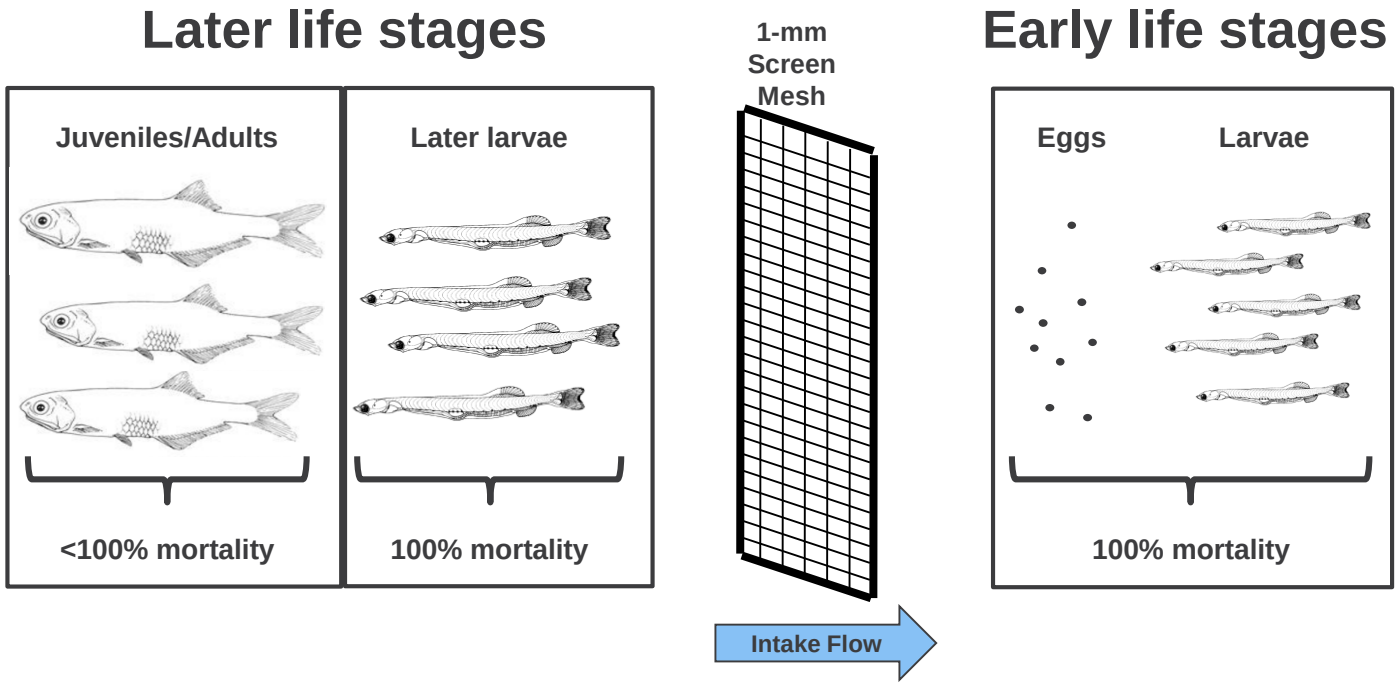
No.	DESCRIPTION	VELOCITY *	COMMENT
①	EXIST. BAR RACK INTAKE	1.06 FPS **	(4)-10 FT BAR RACK
②	EXIST.INTAKE CHANNEL EAST	1.54 FPS	87.5 MGD
③	EXIST.INTAKE CHANNEL WEST	1.54 FPS	87.5 MGD
④	SCREEN UPSTREAM CHANNEL	0.19 FPS	13.5 FT
⑤	SCREEN INFLUENT THROAT	0.47 FPS	5.5 FT
⑥	THROUGH SCREEN VELOCITIES WITH 15% 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.

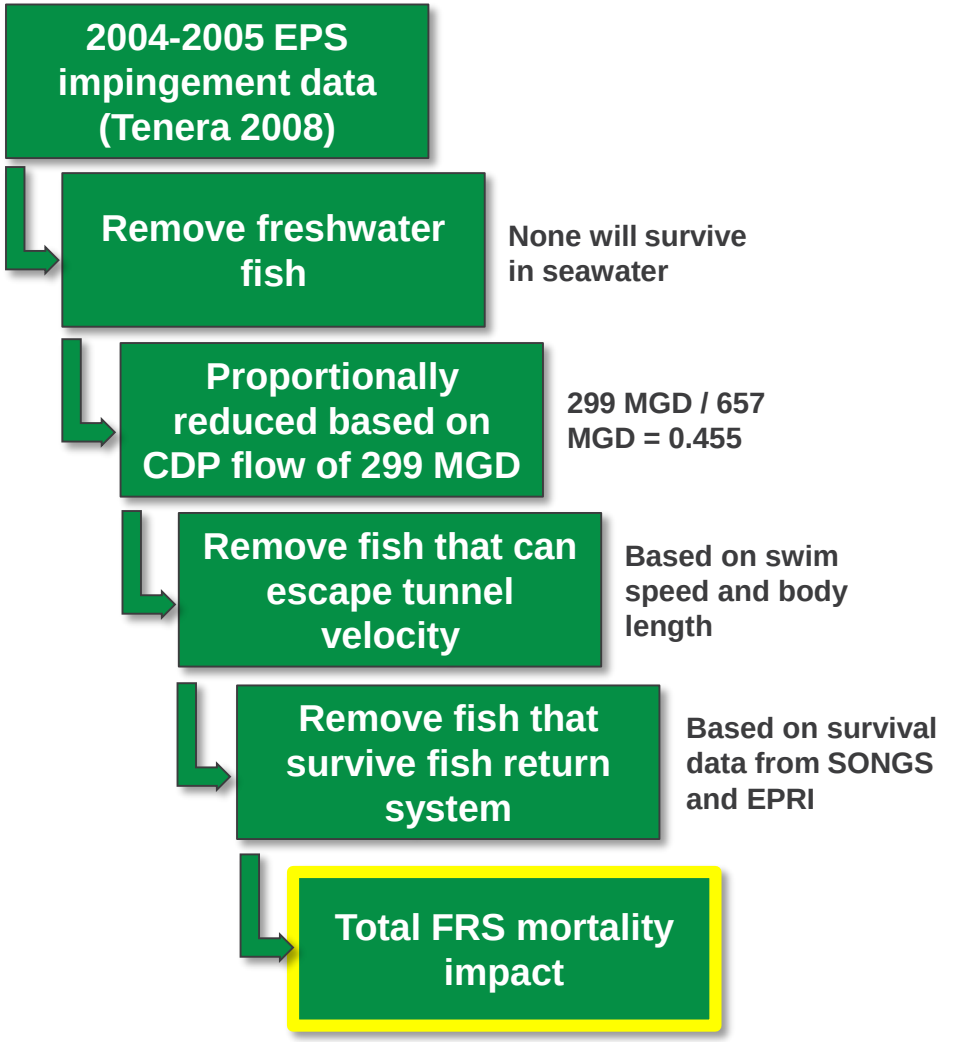
MARINE LIFE MORTALITY ASSESSMENT
INTAKE ALTERNATIVES 1, 15, 16, 17, 18, 19, AND 20

Accounting for Entrainment and Fish Return Mortality



- Mortality estimates include the following conservative assumptions:
  - 100% mortality of eggs and larvae entrained through the flow augmentation system which includes fish-friendly pumps and a flow conveyance hydraulically optimized to minimize injurious shear, turbulence.
  - Reduced velocities in the intake tunnels under stand-alone operations will allow more fish to escape, though the number of fish that could escape was assumed to be zero for those taxon that could not be estimated because length frequency data were not available.
  - 100% mortality of eggs and larvae returned the lagoon through the fish return system which includes a fish-friendly organism collection system and a flow conveyance hydraulically optimized to minimize shear mortality.

Fish Return Marine Life Mortality Assessment



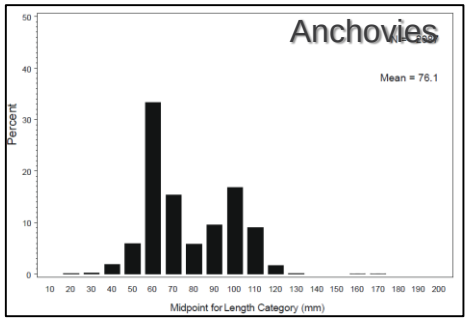
Fish Return Marine Life Mortality Assessment - Assumptions

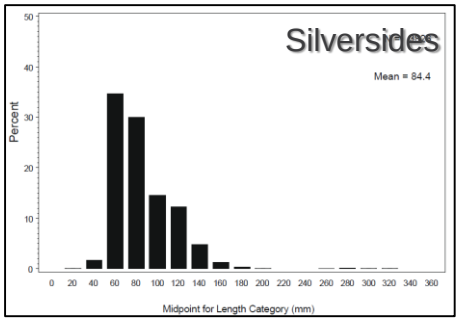
- Swim speed analysis was limited to only taxa for which there were length frequency distribution data reported
  - These taxa represented 81.3% of the total number and 41.6% of the total biomass
  - In the absence of data, the other taxa were not reduced by swim speed capabilities and were assumed to only exit the system via the FRS.
  - This is a conservative assumption as many of the other taxa can likely escape tunnel velocities
- FRS survival was applied to all taxa

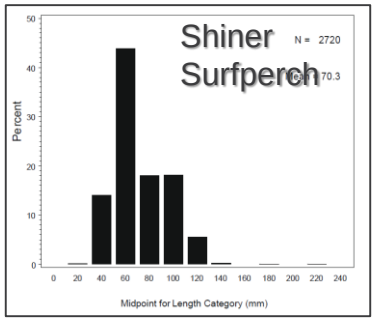
Taxa for which length frequency distribution was available

Common Name	Length Range (mm)	Mean Length (mm)	% of Total # Collected	% of Total Biomass Collected
Anchovies	19-169	76	19.0	4.2
Silversides	18-325	84	32.4	12.9
Shiner Surfperch	11-228	70	14.5	7.6
Queenfish	22-499	74	6.7	2.0
Walleye Surfperch	20-225	113	3.1	6.4
Sand Basses	28-358	81	2.9	1.8
Pacific Sardine	35-242	85	1.4	0.4
Spotfin Croaker	33-555	103	0.9	3.0
White Seabass	36-441	224	0.4	3.3
			81.3	**41.6**

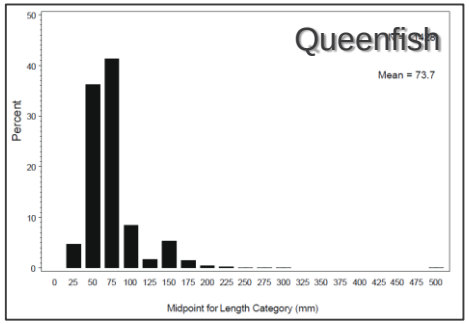
Incremental Increase in Fish Escape

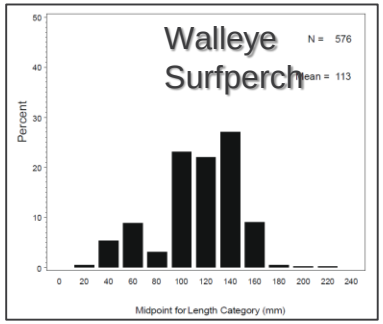


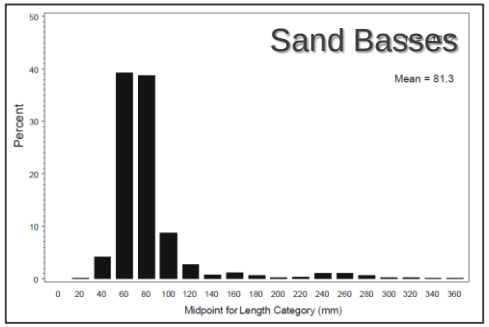


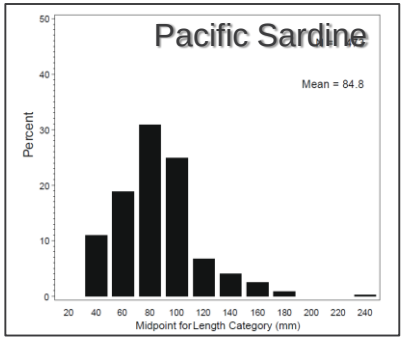


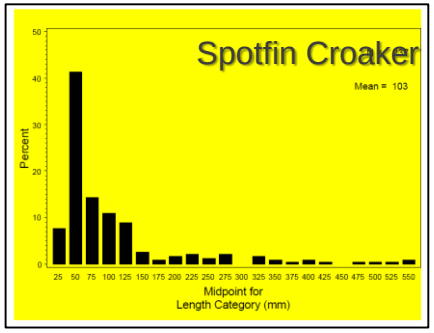
Length frequency distribution for dominant taxa

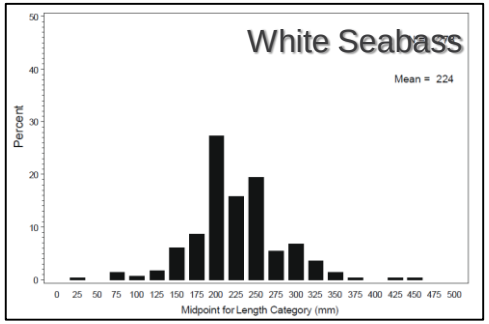












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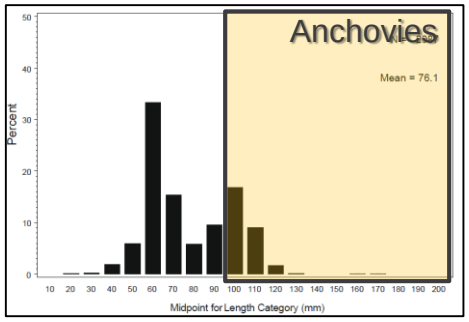
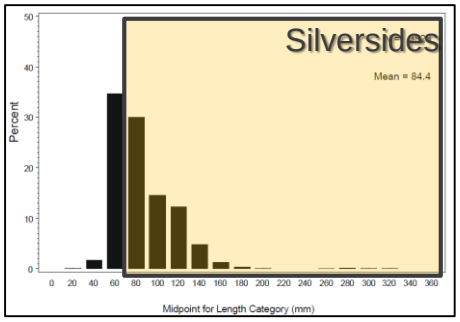
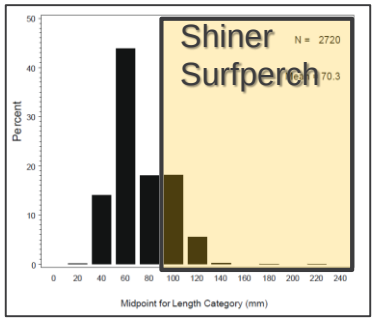
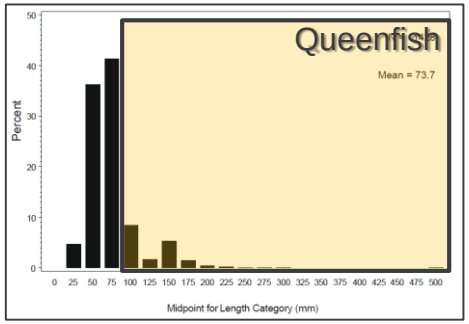
Incremental Increase in Fish Escape

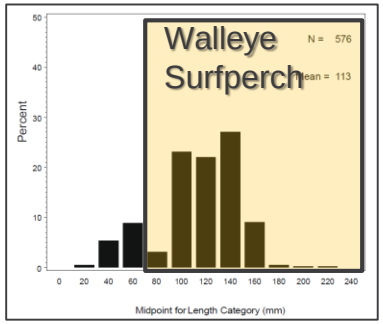


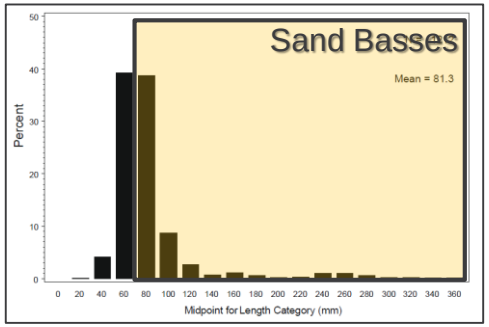


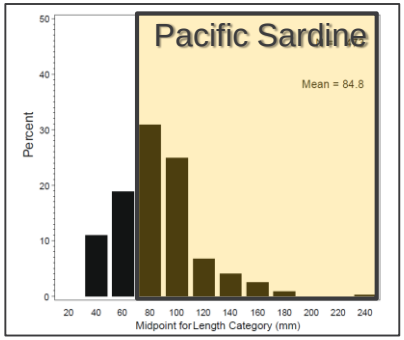


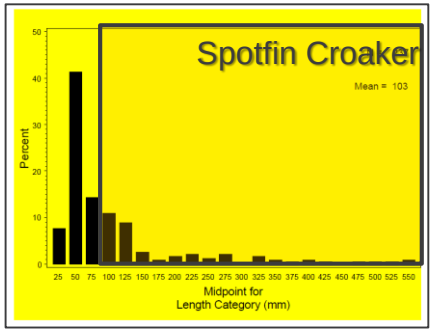
Fish that can escape
<u>2.6 ft/sec</u>

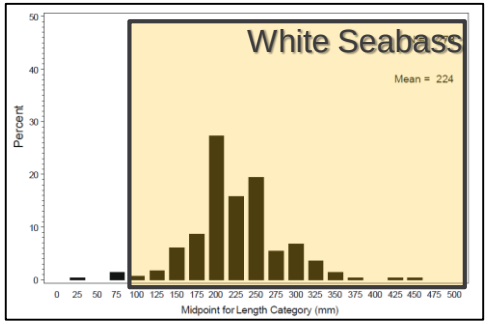












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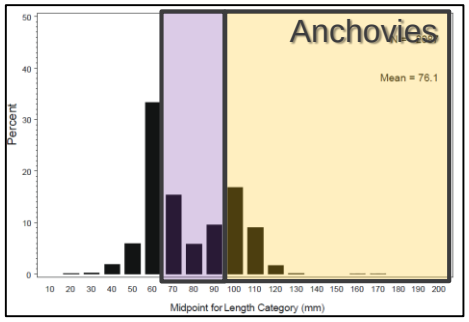
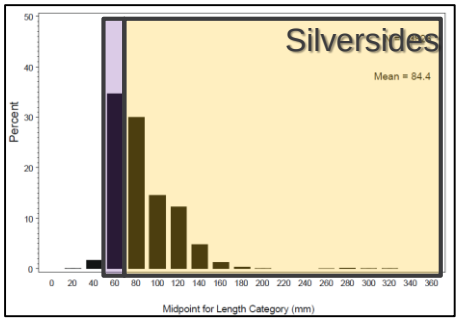
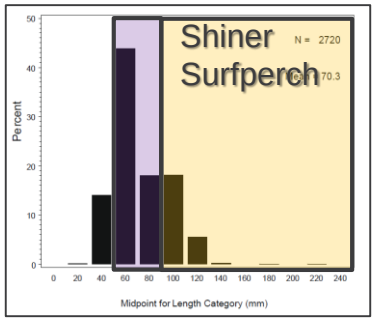
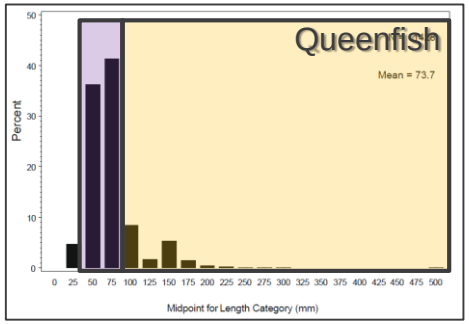
Incremental Increase in Fish Escape

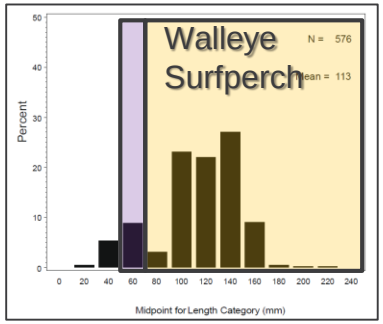


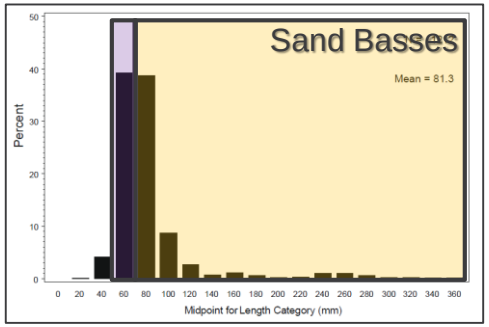


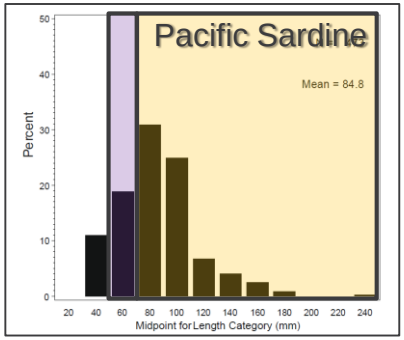


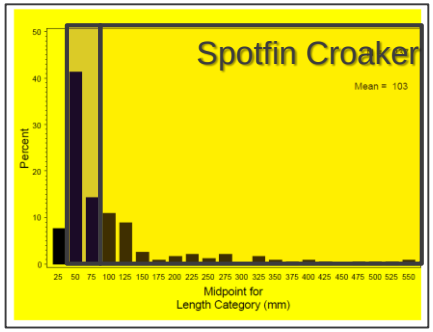
Fish that can escape
<u>1.6 ft/sec</u>

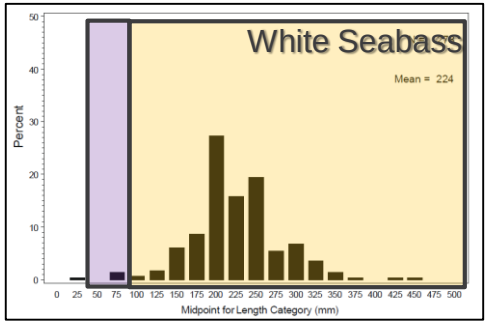












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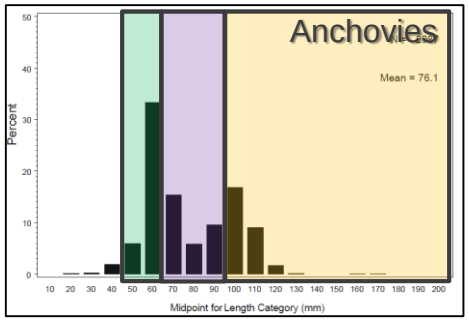
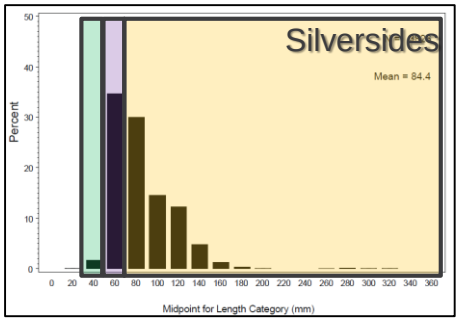
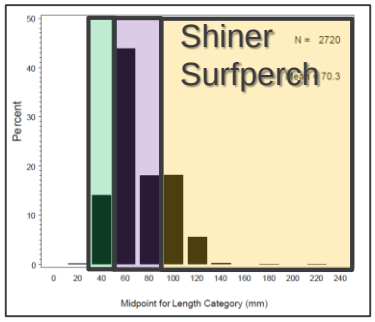
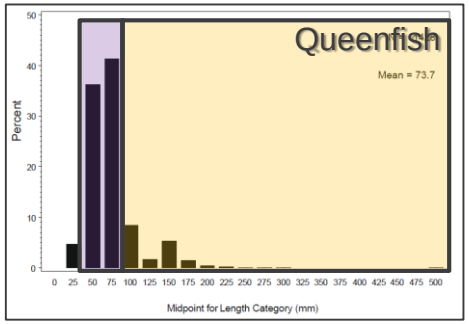
Incremental Increase in Fish Escape

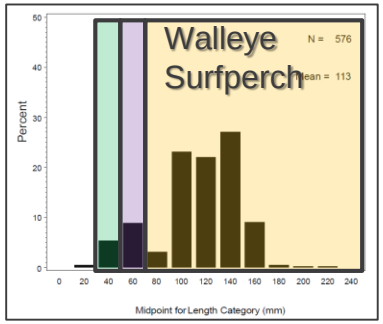


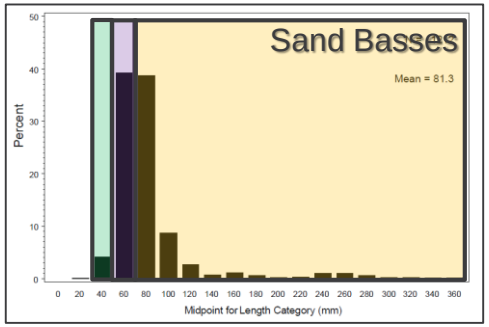


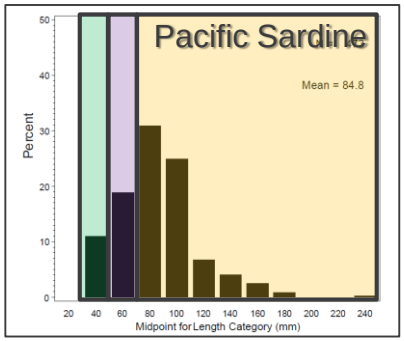


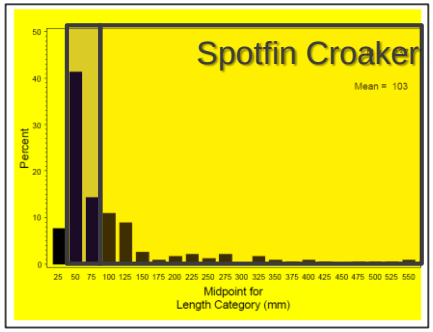
Fish that can escape
<u>1.0 ft/sec</u>

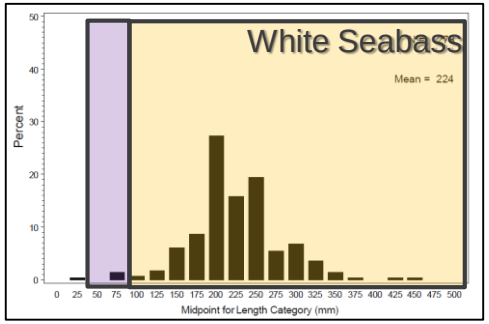












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Comparison of Alternative Intake Velocity and Environmental Benefits

Alternative	Description	Velocity at Bar Rack at MLLW (ft/sec)	Mean Velocity in Tunnels at MLLW (ft/sec)	Reduction in Fish Return Mortality (lbs/day)[1]	Fish Return Mortality (lbs/day)[1]	Incremental Mortality Reduction (lbs/day)	Incremental Survival Increase (fish/day)
1	Original Proposal	1.06	2.63	6.21	0.85	NA	NA
15	Alternative 1 plus: • Convert discharge tunnel to intake	1.06	1.54	6.28	0.78	0.07	4
16	Alternative 1 plus: • Widen bar rack	0.53	2.63	6.21	0.85	0	0
17	Alternative 1 plus: • Convert discharge tunnel to intake • Widen bar rack	0.53	1.54	6.28	0.78	0.07	4
18	Alternative 1 plus: • Convert discharge tunnel to intake • Widen bar rack • New 20-ft wide open intake channel	0.53	0.85	6.31	0.75	0.10	8
19	Alternative 1 plus: • Convert discharge tunnel to intake • Raise intake/discharge tunnel roof to flow as open channel	1.06	1.01	6.31	0.75	0.10	8
20	Alternative 1 plus: • Convert discharge tunnel to intake • Dual flow screens	1.06	1.54	6.28	0.78	0.07	4

[1] FRS mortality estimate includes juveniles and adults which are likely to interact with the CDP intake.

SCHEDULE CONSIDERATIONS
INTAKE ALTERNATIVES 1, 15, 16, 17, 18, 19, AND 20

Construction Schedule and Plant Shutdown Cost

Alternative	1	15	16	17	18	19	20
Construction Duration (years)	2.06	2.17	3.35	3.46	4.00	2.38	2.17
Length of Shutdown (days)	42	84	342	384	412	322	84
Unit Cost of Shutdown (2017 $/day)	$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**

COST ANALYSIS
INTAKE ALTERNATIVES 1, 15, 16, 17, 18, 19, AND 20

Capital Cost (2017 $)

Alternative	1	15	16	17	18	19	20
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**

Annual Cost (2017 $)

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**

ENVIRONMENTAL COST BENEFIT ANALYSIS INTAKE ALTERNATIVES 1, 15, 16, 17, 18, 19, AND 20

Environmental Cost Benefit Analysis – Incremental Cost of Marine Life Mortality Reduction ($ Per Fish)

Alternative	1	15	16	17	18	19	20
Marine Life Potentially at Risk of Mortality (fish per day)	168	168	168	168	168	168	168
Reduction in Marine Life Mortality (fish per day)	145	149	145	149	153	153	149
Net Productivity Loss Proposed Intake (fish per day)	23	19	23	19	15	15	19
Reduced Mortality (fish per day)		4	0	4	8	8	4
Reduced Mortality (fish per year)		1460	0	1460	2920	2920	1460
Annual Cost increase (2017 $)		$459,034	$1,749,094	$2,160,111	$3,080,184	$1,075,928	$2,192,763
Unit Cost of Reduced Mortality ($ per fish)[1]		**$314**	**No Reduction**	**$1,480**	**$1,055**	**$368**	**$1,502**

1. Annual capital cost increase ($/year) divided by reduced mortality (number of fish per year). Cost is incurred starting in the year the intake improvements go into service and continue through 2045.

Environmental Cost Benefit Analysis – Incremental Cost of Marine Life Mortality Reduction ($ Per Pound of Fish)

Alternative	1	15	16	17	18	19	20
Marine Life Potentially at Risk of Mortality (lbs/d)	7.06	7.06	7.06	7.06	7.06	7.06	7.06
Reduction in Marine Life Mortality (lbs/d)	6.21	6.28	6.21	6.28	6.31	6.31	6.28
Net Productivity Loss Proposed Intake (lbs/d)	0.85	0.78	0.85	0.78	0.75	0.75	0.78
Reduced Mortality (lbs/d)		0.07	0.00	0.07	0.10	0.10	0.07
Reduced Mortality (lbs/yr)		25.55	0.00	25.55	36.50	36.50	25.55
Annual Cost increase (2017 $/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**	**No Reduction**	**$84,544**	**$84,389**	**$29,477**	**$85,822**

1. Annual capital cost increase ($/year) divided by reduced mortality (lbs/year). Cost is incurred starting in the year the intake improvements go into service and continue through 2045.

FEASIBILITY DETERMINATION
INTAKE ALTERNATIVES 1, 15, 16, 17, 18, 19, AND 20

Feasibility Determination
Alternatives 1, 15, 16, 17, 18, 19, and 20

Comparison of Cost, Schedule, and Environmental Benefits												
Intake Alternatives 1, 15, 16, 17, 18, 19, and 20												
	Cost (2017 $)			Schedule		Environmental Cost/Benefit						
Alternative	Capital Cost	Annual Cost ($/Year)	Annual Cost Increase ($/Year)	Construction Schedule (Years)	Plant Shutdown Cost	Reduction in marine Life Mortality (lbs per day)	Additional Mortality Reduction (lbs per day)	Benefit Cost Ratio ($/lb)[1,3]	Additional Mortality Reduction (Number of Fish per day)	Benefit Cost Ratio ($/Fish)[2,3]	Feasibility Determination
1	$ 48,619,910	$ 6,916,213	NA	2.1	$ 7,644,000	6.21	NA	NA	NA	NA	Feasible
15	$ 52,995,714	$ 7,375,248	$ 459,034	2.2	$ 15,288,000	6.28	0.07	$ 17,966	4	$ 314	Infeasible - unfavorable B/C ratio, increased plant shutdown.
16	$ 66,284,901	$ 8,665,307	$ 1,749,094	3.3	$ 62,244,000	6.21	0.00	NA	0	NA	Infeasible - added cost with no additional environmental benefit, schedule constraints, significant plant shutdown costs.
17	$ 70,071,529	$ 9,076,324	$ 2,160,111	3.5	$ 69,888,000	6.28	0.07	$ 84,544	4	$ 1,480	Infeasible - significant additional cost, unfavorable B/C ratio, schedule constraints, significant plant shutdown costs.
18	$ 78,924,730	$ 9,996,398	$ 3,080,184	4.0	$ 74,984,000	6.31	0.10	$ 84,389	8	$ 1,055	Infeasible - significant additional cost, unfavorable B/C ratio, schedule constraints, significant plant shutdown costs.
19	$ 59,552,659	$ 7,992,141	$ 1,075,928	2.4	$ 58,604,000	6.31	0.10	$ 29,477	8	$ 368	Infeasible - significant additional cost, unfavorable B/C ratio, schedule constraints, significant plant shutdown costs.
20	$ 71,178,591	$ 9,108,976	$ 2,192,763	2.2	$ 15,288,000	6.28	0.07	$ 60,076	4	$ 1,502	Infeasible - significant additional cost, unfavorable B/C ratio, schedule constraints, significant plant shutdown costs, site layout extends outside available property

1. Annual capital cost increase ($/year) divided by additional mortality reduction (lbs/year).
2. Annual capital cost increase ($/year) divided by additional mortality reduction (number of fish per year).
3. These costs are incurred starting in the year the intake improvements are completed and continue through 2045.