SUMMARY OF BDCP MINI-EFFECTS ANALYSIS FOR ESTUARINE FISH

(Last updated 2/10/2010)

This table presents condensed summary results of the BDCP "Mini-Effects" Analysis[1]. The purpose of the Mini-Effects Analysis is to help inform decisions of the BDCP participants related to the development of water operations criteria that will be proposed as part of the BDCP Conservation Strategy. Specifically, the analysis was focused on assessing the potential effects of draft water operations conservation measures and covered activities on seven covered fish species and their habitats, and on providing a basis for refinements to those draft measures.

The information generated through this analysis is intended to help guide the BDCP development process. It does not reflect a decision of any of the BDCP participants. The results are limited in scope and utility, and in no way constitutes the BDCP Effects Analysis that will be conducted for compliance with ESA, NCCPA, NEPA, and CEQA. The draft results of this analysis are the products of SAIC and reflect the outcome of a collaboration with technical experts from DWR, USBR, DFG, USFWS, NMFS, NGOs, and PREs. The information and recommendations summarized in this document, however, should not be attributed to any of the participating state and federal agencies, the state and federal water contractors, or any other member of the BDCP Steering Committee or its Technical Teams.

Estuarine Fish Subgroup Summary Statement

The Estuarine Fish subgroup evaluated the potential beneficial and adverse effects of important stressors to Delta and longfin smelt with implementation of draft BDCP conservation measures. The subgroup made significant progress in evaluating the effects of individual actions to Delta and longfin smelt; however, due to high levels of uncertainty surrounding some input data, a lack of specificity for some conservation measures, and the limited timeframe for the evaluation; it was not possible to evaluate the entire set of conservation measures together and quantify the relative benefits and tradeoffs among the different combinations of conservation measures. Based on the results of the subgroup's analysis, the consultant team has made recommendations for changes to several of the operational measures.

The effect of water operations on entrainment risk compared to the existing conditions [baseline] model run varied depending on the model run option. Entrainment risk of pre-spawning delta smelt adults (Dec-Mar) would be similar to existing conditions under the near-term (NT), and reduced under the Early Long Term (ELT). Relative to existing conditions, entrainment risk of larvae and juveniles in spring (Mar-Jun) in the south Delta would be much higher under NT, moderately higher under ELT-Proposed Ops and ELT-A, but would be lower under ELT-B (i.e. greater benefit compared to existing conditions). The USFWS RPA calls for OMR flows to range between -1250 and -5000 cfs depending on existing conditions. The existing conditions model run included NMFS SJR/export ratio, which generally provides more protection (i.e., less negative OMR flows) than the USFWS RPA might otherwise require. No entrainment was predicted at the proposed North Delta diversion under any ELT model run.

Entrainment risk due to the Mirant power plants was estimated using the frequency of X2 location near the power plants because that generally corresponds to the center of delta smelt distribution during summer. Relative to existing conditions, power plant entrainment risk was similar under NT, but was higher during fall under ELT-Proposed Ops and ELT-A and lower under ELT-B. A red flag was raised concerning the potential for increased entrainment at the power plants

[1] For details on the results and discussion points from the mini-effects analysis, see the detailed stressor-based results tables..

under ELT-Proposed Ops and ELT-A. More information is needed in the future regarding operations (e.g., timing, amount) to better estimate the extent to which entrainment at the power plants is a concern.

In addition to reducing entrainment risks, conservation measures are designed to abate a wide variety of other stressors (e.g., reduce predation and toxic loads) and/or enhance habitat/food resources. The Subgroup's assessment of these conservation measures was largely qualitative because quantitative data and analytical tools were limited and effects on smelt populations are uncertain. Habitat restoration (in particular restoration in Yolo Bypass and Cache Slough) has potential to improve (increase) turbidity and foodweb conditions locally. Food production from Yolo and Cache Slough may or may not be transported downstream towards adult smelt habitat depending on 1) whether there is a net downstream flow from the region, and 2) whether the productivity exits the region as zooplankton (or possibly small aquatic insects) so that it is usable by delta smelt. . Suisun Marsh restoration is expected to increase local food resources for smelt residing in Suisun Bay. However, the Subgroup could not predict the effects of these changes on the smelt populations because other factors may be limiting the populations and there was no quantification available to the group of how Suisun Marsh tidal marsh restoration would increase the timing and quantity of usable food.

Turbidity is important for smelt and could be managed by decreasing Fall X2 (i.e., shifting X2 downstream of 79 km to areas with open water and wind-driven mixing that would resuspend sediment) and/or restoring tidal marsh habitat in the west Delta that would be shallow and well mixed due to high winds in the region. Physical modeling indicates that Fall X2 would be higher in the NT and ELT and ELT-A than in existing conditions and ELT-B, both of which have Fall X2 requirements. However, Subgroup members disagreed on the influence of Fall X2 on the Delta smelt population. The subgroup will gather additional information and conduct additional analysis for the full effects analysis

Effects of various toxic load reduction control measures are expected to be positive, but small. Likewise, the effects of predator control measures are expected to be positive, but small and localized. There was not agreement among subgroup members that predation could be reduced to a level that would have a population-level benefit on delta or longfin smelt. There are potential food supply benefits of habitat restoration in NT and ELT and changed water operations in ELT, according to the Foodweb Subgroup, such as increased residence time (more time for phytoplankton bloom) and nutrient adjustments (ammonia/nitrogen reduction) that could facilitate primary production, especially of diatoms which provide a more efficient pathway for carbon transfer up the foodweb. The Subgroup recommended that the BDCP address potential conflicts between cold water storage use for salmon upstream and Delta flow requirements for delta smelt (e.g., X2) (especially for ELT-B).

Species: Delta smelt

	Near Term (NT)	**Early Long Term (ELT)**		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
Red Flags	Increased entrainment risk into Contra Costa (92 km) and Pittsburg (77 km) power plants based on modeled changes in X2 (proxy for location of smelt) relative to existing conditions (but need operations and hydrodynamic "footprint" of power plants to analyze).	Same as NT	Same as NT	None identified.

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	Entrainment of larvae and juveniles	Fall X2 location and lower habitat quantity/quality during Sept, Oct, Nov. Entrainment of larvae and juveniles	Fall X2 location and lower habitat quantity/quality during Sept, Oct, Nov. Entrainment of larvae and juveniles	
Overall Effects of Proposed Action(s)	Average (within the 20-80th percentiles) of Mar-Jun X2 position is greater by 1.6 km (i.e. is located further upstream) in ELT-A compared to existing conditions. This indicates a possibly biologically meaningful difference in freshwater flows for Delta smelt between the NT and existing conditions. Winter-spring turbidity is largely controlled by stormwater runoff, over which BDCP actions would have little effect. Therefore, the net effect of BDCP actions on winter-spring turbidity is uncertain, but would likely be too small to significantly affect the Delta smelt population, although letting the first pulse in the Sacramento River pass without diverting could increase turbidity. Average Fall (September – December) X2 location was very similar between the NT and existing conditions. The relationship of Fall X2 vs. Delta smelt habitat, as defined by broad parameters of salinity and	Average (within the 20-80th percentiles) of Dec-May X2 position is greater by 2.3 km (i.e. is located further upstream) in ELT-A compared to existing conditions. This indicates a possibly biologically meaningful difference in freshwater flows for Delta smelt between the ELT-A and existing conditions. Same as Near-Term Average Fall X2 location in ELT-A was up to 20% greater (i.e., is located farther upstream) than existing conditions. The relationship of Fall X2 vs. Delta smelt habitat, as defined by broad parameters of salinity and turbidity, indicated a reduction up to 80% of Delta smelt habitat. However, there was no agreement about the population	Average (within the 20-80th percentiles) of Dec-May X2 position is greater by 3.1 km (i.e. is located further upstream) in ELT-Proposed compared to existing conditions. This indicates a possibly biologically meaningful difference in freshwater flows for Delta smelt between the ELT-Proposed and existing conditions. Same as Near-Term Average Fall X2 location in ELT-Proposed was up to 20% greater than (i.e., is located farther upstream) existing conditions. The relationship of Fall X2 vs. Delta smelt habitat, as defined by broad parameters of salinity and turbidity, indicated a reduction up to 80% of Delta smelt habitat. However,	Average (within the 20-80th percentiles) of Dec-May X2 position in ELT-B is identical to existing conditions. This indicates no difference in freshwater flows for Delta smelt between the ELT-B and existing conditions. Same as Near-Term Average Fall X2 location in ELT-B was up to 5% lower (i.e., is located farther downstream) than existing conditions. The relationship of Fall X2 vs. Delta smelt habitat, as defined by broad parameters of salinity and turbidity, indicated an increase up to 60% of Delta smelt habitat.

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	turbidity, indicates the same result. However, there was no agreement about the significance of changes in Fall X2 for Delta smelt population. Frequency at which average X2 location was less than (farther west of) 79 km, as a proxy for Summer-Fall turbidity, would not be different in NT relative to existing conditions. However, there was disagreement about the use of Fall X2 as a proxy for turbidity. Not applicable – no north Delta diversions in NT	level effect of changes in Fall X2 to Delta smelt. Frequency at which average X2 location was less than 79 km, as a proxy for Summer-Fall turbidity, would be up to 33% lower in ELT-A relative to existing conditions. However, there was disagreement about the use of Fall X2 as a proxy for turbidity. Particle tracking model results indicate that there would be no entrainment of particles inserted at the Cache Slough at Miner Slough and Hood under ELT_Proposed. Likewise, PTM runs do not show upstream movement of particles towards the north Delta diversions. Therefore, there is no evidence that the delta smelt population would have significant population level vulnerability to entrainment, impingement, or predation at the proposed ND diversion facility because few individuals are thought to spawn upstream of Isleton. Larval/juvenile entrainment risk	there was no agreement about the significance of changes in Fall X2 for Delta smelt population. Frequency at which average X2 location was less than 79 km, as a proxy for Summer-Fall turbidity, would be up to 33% lower in ELT-Proposed relative to existing conditions. However, there was disagreement about the use of Fall X2 as a proxy for turbidity. Same as Range A	However, there was no agreement about the significance of changes in Fall X2 for Delta smelt population. Frequency at which average X2 location was less than (farther west of) 79 km, as a proxy for Summer-Fall turbidity, would not be different in ELT-B relative to existing conditions in all months but July, in which frequency was 20% greater than existing conditions. However, there was disagreement about the use of Fall X2 as a proxy turbidity. Same as Range A

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	Larval/juvenile entrainment risk (percent change from existing conditions) in the south Delta during spring based on USFWS BO regressions (using X2 position and OMR flows) is predicted to be 40-100% higher under NT than existing conditions (spring OMR flows more negative and X2 greater). The USFWS RPA calls for OMR flows to range between -1250 and -5000 cfs depending on existing conditions. The existing conditions model run included the NMFS SJR inflow/export ratio, which generally provides more protection (i.e., less negative OMR flows) than the USFWS RPA might otherwise require. Pre-spawn adult entrainment risk during Dec-Mar (based on OMR flows) is similar to existing conditions. Frequency of X2 at 76-93 km (defined by the subgroup as the zone of entrainment by power plants) in Summer-Fall is similar between NT and existing conditions. Additional	(percent change from existing conditions) in the south Delta during spring based on USFWS BO regressions is predicted to be 20-70% higher than existing conditions (spring OMR flows similar, but X2 higher). The USFWS RPA calls for OMR flows to range between -1250 and -5000 cfs depending on existing conditions. The existing conditions model run included the NMFS SJR inflow/export ratio, which generally provides more protection (i.e., less negative OMR flows) than the USFWS RPA might otherwise require. Pre-spawn adult entrainment risk during Dec-Mar (based on OMR flows) is lower than existing conditions and NT. Frequency of X2 at 76-93 km in the Summer-Fall is higher in ELT-A compared to existing conditions. This may be important during some years. Entrainment at the power plants is a potential red flag issue under ELT; however, additional operational information is needed before more definitive	Larval/juvenile entrainment risk (percent change from existing conditions) in the south Delta during spring based on USFWS BO regressions is predicted to be 10-70% higher than existing conditions (spring OMR flows similar, but X2 higher). The USFWS RPA calls for OMR flows to range between -1250 and -5000 cfs depending on existing conditions. The existing conditions model run included the NMFS SJR inflow/export ratio, which generally provides more protection (i.e., less negative OMR flows) than the USFWS RPA might otherwise require. Similar to Range A. Same as Range A.	Larval/juvenile entrainment risk (percent change from existing conditions) in the south Delta during spring based on USFWS BO regressions is predicted to be 20-30% lower than existing conditions (spring OMR flows less negative and X2 lower). The USFWS RPA calls for OMR flows to range between -1250 and -5000 cfs depending on existing conditions. The existing conditions model run included the NMFS SJR inflow/export ratio, which generally provides more protection (i.e., less negative OMR flows) than the USFWS RPA might otherwise require. Pre-spawn adult entrainment risk during Dec-Mar (based on OMR flows) is lower than existing conditions, ELT-Range A and ELT Proposed Operations. Frequency of X2 locations in the vicinity of the power plants under ELT-B in the fall is the same or lower when compared to existing conditions. This would be expected to reduce potential effects on Delta smelt.

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	operational information is needed before more definitive conclusions can be offered. A number of predator reduction actions were considered. None of these actions were considered to have a significant regional effect on predators of Delta smelt. Pumping water preferentially at the CVP rather than the SWP facilities was expected to have the potential for a small incremental increase in the overall survival of entrained fish. Although beneficial, it would not likely have a population-level effect on Delta smelt. The other actions were considered to have localized effects with no population level impacts. In general, the foodweb subgroup expects that, provided the right phytoplankton are produced, habitat restoration will increase secondary productivity. There is low certainty regarding whether an increase in the right phytoplankton would result in increased food available for Delta smelt, how far the food resources for Delta smelt will be transported downstream, and whether clams will consume all	conclusions can be offered. Same as NT Same as NT.	Same as NT Same as NT.	Same as NT Same as NT.

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	the additional production. There is higher certainty that food produced locally will have localized benefits to fish. Reductions in toxic loads are expected to be beneficial to Delta smelt, but effects are predicted to be small. Two-gates in the NT will increase structure-related predation on delta smelt. This additional predation is not expected to have a large population-level effect due to limited spatial extent.	Same as NT, but larger reductions. Not applicable – no two-gates proposed for long-term.	Same as NT, but larger reductions. Not applicable – no two-gates proposed for long-term.	Same as NT, but larger reductions. Not applicable – no two-gates proposed for long-term.
Recommended Refinements or Revisions to Operations	Determine current and proposed future operations of Contra Costa and Pittsburg power plants to allow better evaluation of their impacts; provide 3-D modeling estimates of their hydrodynamic influence at various levels of water diversion. N/A – no diversions from north Delta in NT	Same as NT. To increase winter suspended sediment/turbidity into the Delta, do not export water from the Sacramento River during the first major pulse flow.	Same as NT. Same as Range A.	Same as NT. Same as Range A.
Major Points of Disagreement/ Challenges within the group.	Disagreement: Importance of Delta ouflow/X2 during fall for population level effects on Delta smelt. Disagreement: Feasibility and effectiveness of local predator	Same as NT.	Same as NT.	Same as NT. In addition: Challenge: Potential conflict between X2 upstream coldwater pool management

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	control. Challenge: Insufficient information to evaluate some actions. Challenge: The degree to which benefits of conservation strategy would offset adverse effects could not be quantified.			and fall for Delta smelt.

Species: Longfin smelt

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The information generated through this analysis is intended to help guide the BDCP development process. It does not reflect a decision of any of the BDCP participants. The results are limited in scope and utility, and in no way constitutes the BDCP Effects Analysis that will be conducted for compliance with ESA, NCCPA, NEPA, and CEQA. The draft results of this analysis are the products of SAIC and reflect the outcome of a collaboration with technical experts from DWR, USBR, DFG, USFWS, NMFS, NGOs, and PREs. The information and recommendations summarized in this document, however, should not be attributed to any of the participating state and federal agencies, the state and federal water contractors, or any other member of the BDCP Steering Committee or its Technical Teams.

	Near Term (NT)	**Early Long Term (ELT)**		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
Red Flags	None identified	Increased entrainment risk into Contra Costa (92 km) and Pittsburg (77 km) power plants based on modeled changes in X2 location (proxy for location of smelt) relative to existing conditions (but need operations of power plants to analyze).	Same as Range A	None identified
Overall Effects of Proposed Action(s)	Average (within the 20-80th percentiles) of Dec-May X2 position is greater by 1.6 km (i.e., is located further upstream) in ELT-A compared to existing conditions. This indicates a small and possibly biologically meaningful decrease in freshwater flows for longfin smelt between the NT and existing conditions.	Average (within the 20-80th percentiles) of Dec-May X2 position is greater by 2.3 km (i.e., is located further upstream) in ELT-A compared to existing conditions. This indicates a small and possibly biologically meaningful decrease in freshwater flows for longfin smelt between the ELT-A and existing conditions.	Average (within the 20-80th percentiles) of Dec-May X2 position is greater by 3.1 km (i.e., is located further upstream) in ELT-Proposed compared to existing conditions. This indicates a small and possibly biologically meaningful decrease in freshwater flows for longfin smelt between the ELT-Proposed and existing	Average (within the 20-80th percentiles) of Dec-May X2 position in ELT-B is identical to existing conditions. This indicates no difference in freshwater flows for longfin smelt between the ELT-B and existing conditions.

[2] For details on the results and discussion points from the mini-effects analysis, see the detailed stressor-based results tables..

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
			conditions.	
	Habitat restoration would contribute to local increases in food supply and winter/spring turbidity.	Habitat restoration would contribute to local increases in food supply and winter/spring turbidity – benefits in ELT would be greater than NT due to higher acreages assumed to be restored.	Same as Range A	Same as Range A
	The relatively small acreage in which SAV would be treated and rapid recolonization by SAV indicates this offers at most, a small localized benefit to predation and turbidity. This benefit is independent of water operations.	Same as NT but larger effect with increased restoration area	Same as ELT A	Same as ELT A
	Entrainment of particles in the south Delta export facilities released at Station 815 in March and April is consistently higher in the NT compared to existing conditions by ~1-5% (average difference is 2.5%). It is doubtful that this difference is biologically meaningful to longfin smelt. X2/OMR relationships for longfin smelt have not been developed and were not utilized in the analysis.	Entrainment of particles in the south Delta export facilities released at Station 815 in March and April in drier years is 4-19% greater in ELT_A than existing conditions (longfin smelt would be expected this far into the Delta only during dry years). X2/OMR relationships for longfin smelt have not been developed and were not utilized in the analysis.	Entrainment of particles in the south Delta export facilities released at Station 815 in March and April in drier years is 1-6% greater in ELT_proposed than existing conditions (longfin smelt would be expected this far into the Delta only during dry years). X2/OMR relationships for longfin smelt have not been developed and were not utilized in the analysis.	Entrainment of particles in the south Delta export facilities released at Station 815 in March and April is 30.5% lower on average than existing conditions. This pattern is consistent among water year types. X2/OMR relationships for longfin smelt have not been developed and were not utilized in the analysis.
	Not applicable – no north Delta diversions in NT	Particle tracking model results indicate that there would be no entrainment of particles inserted at the Cache Slough at Miner Slough and Hood under	Same as ELT A	Same as ELT A

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
		ELT_Proposed. Likewise, PTM runs do not show upstream movement of particles towards the north Delta diversions. Therefore, there is no evidence that the longfin smelt population would have significant population level vulnerability to entrainment, impingement, or predation at the proposed ND diversion facility because few individuals are thought to spawn upstream of Rio Vista.		
	Frequency of X2 at 76-93 km (defined by the subgroup as the zone of entrainment by power plants) in Summer-Fall is similar between NT and existing conditions, although few longfin smelt are present this far upstream during summer when most power plant operations are expected. Additional operational information is needed before more definitive conclusions can be offered.	Frequency of X2 at 76-93 km in the Summer-Fall is higher in ELT-A compared to existing conditions. This may be important during some years. Entrainment risk of longfin smelt at the power plants is a potential red flag issue in the ELT-A, although few are present this far upstream during summer when most power plant operations are expected. Entrainment at the power plants is a potential red flag issue under ELT; however, additional operational information is needed before more definitive conclusions can be offered.	Same as Range A	Frequency of X2 locations in the vicinity of the power plants under ELT-B in the fall is the same or lower when compared to existing conditions. This would be expected to reduce potential effects on longfin smelt, although few are present this far upstream during summer when most power plant operations are expected.
	Preferential export operations from the CVP during the NT have the potential to result in a small incremental increase in the overall survival of entrained fish	Benefits of preferential operations from the CVP during ELT-A will be lower, but overall exports are lower, indicating an overall larger benefit of changed	Same as ELT A	Same as NT

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	in the south Delta. Although beneficial, it would not likely have a population-level effect on longfin smelt.	operations.		
	A number of predator reduction actions were considered. None of these actions were considered to have a significant regional effect on predators of longfin smelt. Pumping water preferentially at the CVP rather than the SWP facilities was expected to have the potential for a small incremental increase in the overall survival of entrained fish. Although beneficial, it would not likely have a population-level effect on longfin smelt. The other actions were considered to have localized effects with no population level impacts.	Same as NT	Same as NT	Same as NT
	Two-gates in the NT will increase structure-related predation on longfin smelt. This additional predation is not expected to have a large population-level effect due to limited spatial extent.	Not applicable – no two-gates proposed for long-term.	Not applicable – no two-gates proposed for long-term.	Not applicable – no two-gates proposed for long-term.
	In general, the foodweb subgroup expects that, provided the right phytoplankton are produced, habitat restoration will increase secondary productivity. There is low certainty regarding	Same as NT.	Same as NT.	Same as NT.

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	whether an increase in the right phytoplankton would result in increased food available for longfin smelt, how far the food resources for longfin smelt will be transported downstream, and whether clams will consume all the additional production. There is higher certainty that food produced locally will have localized benefits to fish. Reductions in toxic loads will are expected to be beneficial to longfin smelt, but effects are predicted to be small.	Same as NT, but larger reductions.	Same as NT, but larger reductions.	Same as NT, but larger reductions.
Recommended Refinements or Revisions to Operations	Determine current and proposed future operations of Contra Costa and Pittsburg power plants to allow better evaluation of their impacts; provide 3-D modeling estimates of their hydrodynamic influence at various levels of water diversion. N/A – no diversions from north Delta in NT	Same as NT. To increase winter suspended sediment/turbidity into the Delta, do not export water from the Sacramento River during the first major pulse flow.	Same as NT. Same as Range A.	Same as NT. Same as Range A.
Major Points of Disagreement within the group/Challenges	Disagreement: Feasibility and effectiveness of local predator control. Disagreement Appropriateness of using PTM results for Station 815 alone vs. including a broader geographic distribution	Same as NT	Same as NT	Same as NT

	Near Term (NT)	Early Long Term (ELT)		
	Proposed Operations	**Range A**	**Proposed Operations**	**Range B**
	of longfin smelt in the analysis. Challenge: Insufficient information to evaluate some actions. Challenge: The degree to which benefits of conservation strategy would offset adverse effects could not be quantified with existing data.			