Appendix B

Baseline Conditions and Modeling of Effects of the Anadromous Salmonid Habitat Conservation Plan and Santa Cruz Water Rights Project

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B Baseline Conditions and Modeling of Effects of the ASHCP and SCWRP

B.1 Introduction

Effects of changes in the City of Santa Cruz water supply operations and water rights including new bypass flows at the City's surface water diversions developed within the Anadromous Salmonid Habitat Conservation Plan (ASHCP or Project), have been evaluated in two different existing conditions or baseline contexts within the ASHCP and the Santa Cruz Water Rights Project (SCWRP) Environmental Impact Report (EIR). The new bypass flows included in both the ASHCP and the SCWRP EIR are referred to as Conservation Flows or Agreed Flows.[1] The Project that was the subject of hydrologic, water supply and fisheries habitat modeling provided in both the ASHCP and the SCWRP EIR is the same and consists of the ASHCP Agreed Flows with the implementation of the proposed water rights modifications and related infrastructure improvements that would result from the modifications and provide for water supply augmentation (e.g., aquifer storage and recovery, water transfers).

This appendix explains the differences in the modeling provided in the ASHCP and the SCWRP EIR in terms of the baseline used to compare the effects of the ASHCP, as well as reviews the results of the modeling. Specifically, as further discussed herein, the ASHCP modeling used a baseline that did not account for any additional[2] bypass flows for fisheries habitat at the City's surface water diversions, whereas the SCWRP EIR modeling used a baseline that accounted for interim bypass flows in place in 2018 when the City initiated the EIR and that continue to be in place today.

B.2 Modeling Background

The ASHCP and the SCWRP EIR used three distinct but interrelated models to evaluate the effects of the ASHCP on water supply and fisheries habitat. As described in the ASHCP Appendix 8 these three models include:

- Hydrologic Model - A hydrologic model that develops the available daily flows in the North Coast streams (specifically Laguna, Liddell, and Majors Creeks), the San Lorenzo River, and Newell Creek available for supply once the Agreed Flows are met.
- Water Supply Model - The Confluence® water supply model, which utilizes available streamflows (generated by the Hydrologic Model) in a particular scenario (e.g., with the Agreed Flows) and with many other system operating assumptions, to evaluate potential operations of the City's water system and the resulting water supply reliability and to calculate the resulting flow left instream for fish habitat below each diversion.
- Fisheries Habitat Effects Model - A fisheries habitat effects model that evaluates the fisheries habitat effects of the residual streamflows left instream after municipal supply demands are met in the Water Supply Model, consistent with the minimum streamflows required in a particular scenario, to develop flow-

1 In the City's petitions for changes to water rights, the minimum instream bypass flows, or Conservation Flows, are called "Agreed Flows" in recognition that they were developed through negotiations with NMFS and CDFW. The minimum instream bypass flows, Conservation Flows, and Agreed Flows are identical.

2 Previous agreements did require minimum bypass flows at the Felton Diversion and a 1 cubic foot per second (cfs) continuous release from Loch Lomond Reservoir to Newell Creek.

based metrics of habitat effects. The effects analysis was primarily focused on the influence of the City's water system operations on instream flows and the related habitat effects.

The fisheries model determines the habitat index value for each salmonid life cycle stage (e.g., rearing). The habitat index may be either the weighted usable area (WUA) value for spawning or rearing, or the number of days with suitable conditions for migration of adult or smolt life stages. See ASHCP Appendix 8 for additional information about these three models.

B.3 Modeling Scenarios

B.3.1 ASHCP

The effects of the Project are compared to an existing operations scenario representing City water supply operations with no additional bypass flows for fisheries habitat. This existing operations scenario was based on Confluence model output using a reconstructed hydrologic database for the period 1937-2015 as input (data generated by Balance Hydrologics from the hydrologic model), and assuming unconstrained City diversions using existing facilities, operating procedures, existing flow agreements with the California Department of Fish and Wildlife (CDFW) (circa 2015), and a 3,200 million gallons per year water demand, based on the City's 2015 Urban Water Management Plan.

The existing operations (No Bypass) scenario used in the ASHCP was the appropriate basis for comparison in that context because the ASHCP Agreed Flows were compared to a condition that did not have any additional flow requirements beyond those established in the circa 2015 flow agreements with CDFW, so that the full effects of the ASHCP Agreed Flows could be evaluated. For ease of reference in this document, the existing operations (No Bypass) scenario used in the ASHCP is referred to herein as the **"ASHCP baseline"** even though this term is not used in the ASHCP.

B.3.2 SCWRP EIR

The effects analysis of the Project conducted for the SCWRP EIR was also based on Confluence model output using the same hydrologic database (1937-2015) and the same water demand but using a different existing operations scenario than in the ASHCP. The existing operations scenario used in the SCWRP EIR assumed City diversions that would occur under a 2018 agreement with CDFW—the conditions that were in place at the time of the publication of the California Environmental Quality Act (CEQA) Notice of Preparation (NOP) for the SCWRP EIR. The 2018 agreement contains interim bypass flow requirements mirroring portions of the Agreed Flows developed as part of the ASHCP. The 2018 interim bypass flows continue to be representative of existing conditions, as the City and CDFW signed a new agreement in 2023 that has the same interim bypass flows as the 2018 agreement. For ease of reference in this document, the existing operations scenario used in the SCWRP EIR is referred to herein as the **"SCWRP baseline."**

The effects analysis in the SCWRP EIR using the interim bypass flows as the SCWRP baseline was the appropriate basis for comparison in the CEQA document, since that was the existing condition at the time the NOP was released in 2018. This analysis approach was consistent with CEQA Guidelines Section 15125, which requires that an EIR include a description of the physical environmental conditions in the vicinity of the project as they exist at the time the NOP is published. However, that analysis does not represent the full effect of the ASHCP since it contains bypass flow requirements that reflect partial implementation of the ASHCP Agreed Flows. Nonetheless, the different baseline scenarios used in the ASHCP and the SCWRP EIR were appropriate within the context of each of those documents, as explained above.

B.3.3 ASHCP CEQA and NEPA Documents

The National Environmental Policy Act (NEPA) and CEQA require environmental documents to include a description of the affected environment (NEPA) or environmental setting (CEQA) to provide a comprehensive understanding of the baseline existing conditions in the project area so that the potential impacts of the proposed project and alternatives on those conditions can be evaluated. Like the effects analysis in the SCWRP EIR, the existing physical environmental conditions that were in place at the time environmental analysis of the ASHCP was commenced include City diversions occurring under the interim bypass flows described above, as agreed by the City and CDFW in the 2018 agreement and updated 2023 agreement. Therefore, the interim bypass flows continue to be representative of existing conditions and are the appropriate baseline upon which to compare the effects of the ASHCP under CEQA and NEPA.

B.4 Modeling Results

B.4.1 ASHCP Modeling Results

Table B-1 shows the modeled effects of the Project on anadromous species habitat indices, including full implementation of the ASHCP Agreed Flows with water rights modifications, compared with the ASHCP baseline. Table B-1 was developed from the same data presented in graphical form in the ASHCP document, as presented in Figures 5-1 through 5-37 (City of Santa Cruz 2022). Table B-1 was developed to provide greater ability to quantitatively assess the habitat changes that would result with the Project, as well as to compare them to the modeling results presented in the SCWRP EIR.

The results of the modeling presented in Table B-1 show that implementation of ASHCP Agreed Flows with the water rights changes results in habitat improvements for both steelhead and coho that are focused in the North Coast streams, especially Laguna Creek, with benefits in the mainstem San Lorenzo River primarily for adult migration. Implementation of ASHCP Agreed Flows in the Confluence operations model result in increased diversions from Loch Lomond Reservoir storage to offset restrictions at the other diversions to meet the Agreed Flows, particularly in drier years. This results in somewhat greater fluctuation in storage in Loch Lomond Reservoir with slight improvement in some habitat indices in normal years and decreases in habitat indices in dry and critical years due to lower frequency and duration of reservoir spill in drier conditions, as compared to the ASHCP baseline. Negative effects to habitat indices in Newell Creek are more than offset by improvement in habitat indices in North Coast streams and the San Lorenzo River compared to the ASHCP baseline. These effects are described more fully in Chapter 5 of the ASHCP.

B.4.2 SCWRP EIR Modeling Results

Table B-2 shows the modeled effects of the Project including full implementation of the ASHCP Agreed Flows with water rights modifications, compared with the SCWRP baseline. As discussed previously, the 2018 interim bypass flows were established as the SCWRP baseline for the SCWRP EIR and reflected portions of the Agreed Flows that were included in the 2018 agreement with CDFW. See Section B.3, Modeling Scenarios, above for additional information.

The major differences between the interim bypass flows and full implementation of Agreed Flows under the ASHCP are as follows.

- The Agreed Flows have a bypass during adult migration in Laguna Creek, Liddell Creek, and Majors Creek in April of 0% to 60% hydrologic conditions; the interim bypass flows do not have bypass flows for adult migration during April in those locations.
- The Agreed Flows have a bypass for adult spawning in Liddell Creek and Majors Creek in December of 0% to 60% hydrologic conditions and in Laguna Creek in December of all hydrologic conditions; the interim bypass flows have no bypass for spawning during December.
- The Agreed Flows have a 1 cfs minimum release to Newell Creek with a 0.25 cfs release during low Loch Lomond Reservoir storage levels; the interim bypass flows have a 1 cfs minimum release to Newell Creek at all times.
- The Agreed Flows have a 40 cfs minimum flow below the Felton Diversion during migration and spawning periods; the interim bypass flows have a 20 cfs minimum during migration and spawning periods below the Felton Diversion.
- The interim bypass flows have an exception year reduced bypass for rearing downstream of the Tait Street Diversion; the Agreed Flows do not have a reduced exception year rearing flow.
- The Agreed Flows have a bypass for adult migration in April of 0% to 60% hydrologic conditions in the San Lorenzo River downstream of the Tait Street Diversion; the interim bypass flows have no bypass for adult migration in April at this location.

Additional migration flows in December and April under the Project result in modest habitat improvement in the North Coast streams in normal and wet years compared to the SCWRP baseline, particularly in Laguna Creek (Table B-2). Higher flows for migration in December and April result in higher than optimum flows for coho rearing and result in a slight decline in the rearing habitat index for coho in wet years (Table B-2). The Project-related increase in minimum flow below the Felton Diversion (from 20 cfs previously to 40 cfs) during steelhead and coho adult migration periods results in improved migration and spawning habitat compared to the SCWRP baseline, particularly in drier year types (Table B-2). Differences in habitat index values in Newell Creek downstream of Newell Creek Dam/Loch Lomond Reservoir are the result of differing reservoir operations between the SCWRP baseline and the Project. Bypass requirements for habitat are the same under the SCWRP baseline and Project in this location, but habitat provided by reservoir spill is altered by operation of the Project. Specifically, the increased capacity of the Graham Hill Water Treatment Plant (GHWTP), (described in Appendix D-2 of the SCWRP EIR), results in the ability to take more water at the Tait Street Diversion, offsetting water that would otherwise be withdrawn from Loch Lomond Reservoir. The effect is most pronounced in dry and critical year types, although, while the differences are large in percentage terms, they are not necessarily large in overall magnitude and biological significance. For example, the 50.5% increase in the steelhead adult migration index in dry years amounts to 3 additional days (from 7 days to 10 days) and therefore the improvement may not be biologically significant (SCWRP EIR Appendix D-3). Habitat index values are low in dry and critical years even with no City diversion (i.e., Loch Lomond Reservoir operations and diversion not present). These effects are more fully detailed in Appendix D-3 of the SCWRP EIR.

B.4.3 Comparison of Modeling Results

Differences between Tables B-1 and B-2 result from comparing the Project to different baselines (ASHCP baseline and SCWRP baseline), as described previously. The differences in North Coast streams are fairly straightforward and have to do primarily with increased bypass flows with the Project relative to both baselines. In Table B-1 the Project includes the full range of bypass flows in the Agreed Flows so improvements relative to the ASHCP baseline are large. In Table B-2 the SCWRP baseline already includes most of the Agreed Flows but December and April

bypass flows are included with the Project and the operations are changed through implementation of the SCWRP. All of the changes in habitat indices in North Coast streams reflected in Table B-2 are the result of addition of the December and April bypass flows in the SCWRP baseline, so the Project improvement in the habitat indices is not as great as that shown in Table B-1.

Differences between B-1 and B-2 in Newell Creek and the San Lorenzo River are a little more complex and primarily involve differences in operation of Loch Lomond Reservoir. In the ASHCP baseline for Table B-1, which has no requirements for bypass flows in the North Coast streams or at the Tait Street Diversion, the City's operational strategy was to keep Loch Lomond Reservoir storage as high as possible at all times by drawing as much as possible from other sources. As a result, the reservoir tended to enter spill conditions earlier in the winter and spill later in the spring or after runoff events. This difference in spill frequency is most notable in drier type years. With the Agreed Flows included in the Project, the reservoir is drawn on during periods when bypass flow requirements preclude diversion from other sources. This results in more frequent occurrence of lower reservoir stage with the Project, which can delay the onset of spill conditions in the winter and end spill conditions earlier in the spring and after runoff events. As a result, habitat indices in Newell Creek for spawning, steelhead rearing, and smolt migration are slightly lower with the Project than under the ASHCP baseline in Table B-1. Change in Reservoir spill is also reflected in flows and habitat conditions in the San Lorenzo River; however increased bypass flows at both the Felton and Tait Street diversions with the Project result in increased habitat indices at these locations with the Project compared to both baselines, neither of which has these bypass flow requirements.

In Table B-2, habitat indices show improvement in Newell Creek with the Project compared to the SCWRP baseline. This is because the SCWRP baseline includes the interim bypass flows and would therefore have similar effects on Loch Lomond Reservoir operations (i.e., reduced spill frequency) as the Project. However, in this case, the Project has components that conserve storage and increase spill frequency relative to the interim bypass flows in the SCWRP baseline (though not to the levels seen in the ASHCP baseline used for Table B-1). The increase in spill frequency with the Project results in increases in habitat indices in Newell Creek relative to the SCWRP baseline. Project components that influence Loch Lomond Reservoir storage and increase spill frequency include taking more water at the Tait Street Diversion, offsetting water that would otherwise be withdrawn from Loch Lomond; and decrease to a 0.25 cfs bypass during low Loch Lomond Reservoir storage conditions.

In Table B-1, increases in the adult migration and spawning indices at Felton Diversion are related to the increased bypass flow from 20 cfs under the ASHCP baseline to 40 cfs with the Project. Under the ASHCP baseline more flow was diverted at the Tait Street Diversion so the 40 cfs bypass had relatively small effect, primarily in dry and critically dry years. The SCWRP baseline included a new bypass requirement at the Tait Street Diversion but kept the old 20 cfs bypass at Felton Diversion. Under the SCWRP baseline more diversion from Felton Diversion to Loch Lomond Reservoir was possible relative to the ASHCP baseline. Inclusion of the new 40 cfs Felton Diversion bypass with the Project therefore results in a greater improvement in migration and spawning indices at Felton Diversion in Table B-2 than the same Project improvements in Table B-1.

Table B-1. Listed Fish Habitat Effects of the Proposed Project Compared to ASHCP Baseline

Stream Reach	Year Type	Steelhead				Coho			
		Adult migration (m)	Spawning/incubation (i)	Rearing (r)	Smolt migration (s)	Adult migration (m)	Spawning/incubation (i)	Rearing (r)	Smolt migration (s)
Laguna Anadromous	Wet	49.7%	24.2%	17.6%	37.1%	28.2%	14.5%	–	37.1%
	Normal	61.9%	39.6%	59.9%	174.2%	58.3%	25.1%	4.8%	174.2
	Dry	38.0%	44.4%	49.5%	180.6%	○	34.8%	8.0%	180.6
	Critically dry	39.5%	43.4%	44.5%	171.1%	○	41.3%	12.0%	171.1
Liddell Anadromous	Wet	18.0%	14.1%	5.7%	3.1%				
	Normal	57.1%	24.6%	10.8%	14.5%				
	Dry	15.0%	10.3%	+	42.2%				
	Critically dry	○	18.2%	3.3%	155.7%				
Majors Anadromous	Wet	2.2%	3.0%	+	13.5%				
	Normal	○	16.8%	25.4%	35.3%				
	Dry	○	24.8%	41.0%	○				
	Critically dry	○	34.1%	41.8%	○				
San Lorenzo below Tait St	Wet	+		–	○	2.8%			○
	Normal	2.5%		–	○	6.2%			○
	Dry	4.5%		–	+	11.2%			+
	Critically dry	4.6%		10.8%	6.6%	14.5%			6.6%
San Lorenzo below Felton	Wet	+	+	–	○	2.5%	–	–	○
	Normal	+	+	–	○	3.5%	–	–	○
	Dry	3.8%	+	–	○	12.5%	–	–	○
	Critically dry	14.0%	5.8%	–	○	19.3%	–	–	○
Newell Anadromous	Wet	○	–	+	○	○	–	–	○
	Normal	3.4%	2.7%	○	3.4%	○	+	–	3.4%
	Dry	○	−4.0%	○	−8.5%	○	−6.2%	–	−8.5%
	Critically dry	○	−13.2%	−3.3%	○	○	−18.7%	–	○

Notes: – = <2% decrease in habitat index; + = <2% increase in habitat index; ○ = no change in habitat index, or change of 1 day or less in migration periods.
Values for coho spawning and rearing below Felton are based on change in flow rather than habitat indices.

Table B-2. Listed Fish Habitat Effects of the Proposed Project Compared to SCWRP Baseline

Stream Reach	Year Type	Steelhead				Coho			
		Adult migration (m)	Spawning/incubation (i)	Rearing (r)	Smolt migration (s)	Adult migration (m)	Spawning/incubation (i)	Rearing (r)	Smolt migration (s)
Laguna Anadromous	Wet	8.5%	5.9%	○	○	○	+	−2.7%	○
	Normal	○	3.3%	○	○	○	+	–	○
	Dry	○	+	○	○	○	+	–	○
	Critically dry	○	+	○	○	○	+	○	○
Liddell Anadromous	Wet	4.1%	3.4%	○	○				
	Normal	5.0%	3.4%	○	○				
	Dry	○	–	–	○				
	Critically dry	○	–	–	○				
Majors Anadromous	Wet	○	+	○	○				
	Normal	○	+	○	○				
	Dry	○	–	–	○				
	Critically dry	○	○	○	○				
San Lorenzo below Tait St	Wet	○		–	○	○			○
	Normal	○		–	○	○			○
	Dry	○		–	○	○			○
	Critically dry	○		–	○	○			○
San Lorenzo below Felton	Wet	+	+	–	○	4.9%	–	–	○
	Normal	+	+	–	○	4.6%	–	–	○
	Dry	8.0%	2.6%	○	○	15.8%	+	○	○
	Critically dry	22.0%	6.4%	○	○	15.3%	–	○	○
Newell Anadromous	Wet	6.3%	4.5%	+	3.4%	15.9%	5.1%	–	3.4%
	Normal	19.9%	10.1%	○	14.0%	19.8%	9.2%	–	14.0%
	Dry	50.5%	27.1%	+	44.5%	○	29.6%	+	44.5%
	Critically dry	○	26.3%	8.6%	○	○	50.0%	2.0%	○

Notes: – = <2% decrease in habitat index; + = <2% increase in habitat index; ○ = no change in habitat index, or change of 1 day or less in migration periods.
Values for coho spawning and rearing below Felton are based on change in flow rather than habitat indices.

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