UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

July 16, 2021 **Refer to NMFS No:** WCRO-2021-01007

Jim Mazza
Chief, Regulatory Division
U.S Department of Army
San Francisco District, Corps of Engineers
450 Golden Gate Avenue, 4th Floor, Suite 0134
San Francisco, California 94102-3406

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Blue Lake Rancheria's Gravel Operations for the Years 2021-2030

Dear Mr. Mazza:

Thank you for your letter of March 4, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for issuance of individual Clean Water Act Section 404 permits for the Blue Lake Rancheria's gravel mining activities on the Mad River for the years 2021-2030. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR Part 402, as amended; 84 Fed. Reg. 44976, 45016 (August 27, 2019)). NMFS has determined that the proposed action will adversely affect listed species and their critical habitats and has provided an incidental take statement.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action. NMFS has concluded that the action would adversely affect the EFH of Pacific Salmon. Therefore, we have included the results of that review in Section 3 of this document. At this time, NMFS has no EFH conservation recommendations to provide.

Please contact Dan Free, Arcata Office at (707) 825-5164 or Dan.Free@NOAA.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

for Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

ec: Jacob Pounds, Blue Lake Rancheria
Kasey Sirkin, Corps, Eureka
ARN File 151422WCR2021AR00084

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Gravel Mining by the Blue Lake Rancheria for the Years 2021-2030
NMFS Consultation Number: WCRO-2021-01007
Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Southern Oregon/Northern California Coast Coho Salmon (*Oncorhynchus kisutch*)	Threatened	Yes	No	Yes	No
California coastal Chinook (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Northern California Steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern Distinct Population Eulachon (*Thaleichthys pacificus*)	Threatened	No	No	No	No

Essential Fish Habitat and NMFS' Determinations:

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: A. Catherine Marcinkevage

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Date: July 16, 2021

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1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR Part 402, as amended.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at NMFS Arcata Office.

1.2 Consultation History

NMFS previously consulted on Corps permitted gravel extraction by the BLR in the Mad River from 2010-2019. Minor modifications and clarifications regarding the proposed action for this ten-year permit period (2021-2030) are included here and reflect changes that were incorporated based on monitoring of the previous proposed actions, the long-term observations of NMFS scientists, and making the implementation of the project more consistent and repeatable.

The BLR has also agreed to set the annual amount of gravel available to be mined based on a percentage of the estimated annual recruitment of sand and gravel that may be available to be mined on the BLR Bar each year, which is also limited by the bar area. This allows for a variable amount of gravel of gravel to be extracted each year, with maximum and minimum amounts allowed, depending on the recruitment of sand and gravel as estimated by the amount and duration of river flow each year. This technique for managing gravel is intended to reduce the potential for over extraction of sand and gravel and the consequent effects to salmonid habitat and was originally implemented by the other gravel operators in the Mad River (MRO) beginning in 2010 (NMFS 2020). The BLR has agreed to follow the same method for setting the annual extraction amount as the other MRO who mine gravel in the same general area, located both above and below the location of the BLR Bar (NMFS 2020).

NMFS met a number of times with the BLR and the Corps beginning in 2019 to discuss the proposed action. This culminated with a Biological Assessment from Stillwater Sciences

(Stillwater Sciences 2021), which was included in the complete consultation package received by NMFS on March 4, 2021, when consultation was initiated.

On May 19, 2021, NMFS received clarification from Kasey Sirkin with the Corps (Sirkin 2021) that the permit period would be for ten years from 2021-2030.

1.3 Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). The Corps proposes to issue Clean Water Act (CWA) section 404 permit to the BLR for operations for the years 2021-2030.

1.3.1 General Description of Proposed Action

The proposed action is the Corps' renewal of previously authorized individual CWA Section 404 permit that covered the years 2010-2019. The proposed permit period will run for 10 years, from June 30, 2021 through December 31, 2030. The proposed project involves annual gravel extraction, monitoring, restoration, and temporary crossing construction activity on the BLR's gravel bar at river mile 8 on the Mad River, near the City of Blue Lake, California. The BLR's proposed gravel mining for the years 2021-2030 is described and analyzed in a biological assessment (Stillwater Sciences 2021). BLR intends to use the proceeds from gravel mining to fund other restoration projects in the vicinity of the project site. Future restoration activities requiring separate or additional Corps permits, or additional funding sources, are not certain to occur and are not described or analyzed in this biological opinion.

All extraction and reclamation activities would occur between June 1 and October 15 of each year, although work extensions may be granted by the Corps if NMFS approves on a case-by-case basis until October 31. Additional monitoring of rainfall, river stage, and adult salmonid Chinook salmon presence would be necessary to receive an extension. All temporary crossing activities would occur between June 30 and September 15 of each year, although extensions may be granted by the Corps as above on a case-by-case basis until October 31. Extensions would not be granted if 1) significant rainfall has occurred which would make adult salmonid presence likely, or 2) if adults are present and may be affected by the specific mining technique approved that season.

Certain habitat enhancement activities, such as riparian-planting projects, may be conducted outside of the normal extraction operating season. For example, riparian-planting efforts tend to have a higher rate of success when cuttings are collected and installed during the plant's dormant season. In addition, in an effort to keep large woody debris that deposits on gravel bars from being cut by the public for firewood, shake bolts, fence posts, etc., BLR may enter the action area with heavy equipment to pile gravel on individual pieces to deter use of chainsaws (preferred) and/or move logs to a secure stockpile area for future redistribution or use for habitat improvement structures. Any habitat improvement structures would need to go through a separate permitting process.

The proposed action authorized by the individual permit is expected to include certain activities within permitted gravel extraction areas on the BLR bar during extraction seasons to enhance habitat for salmonids and other riverine species. The specific details of such habitat enhancement activities will be determined during the pre-extraction design review process used for gravel extraction operations.

The proposed total annual gravel extraction volume will follow a variable extraction strategy (called FEV- see section 1.3.2.1 below) similar to what has been done at other Mad River gravel extraction sites since 2010 (NMFS 2010). This strategy was developed as a way to vary the annual extraction volume based on the intensity of the water year in terms of the stream discharge and duration and corresponding sediment recruitment volumes. The strategy generally allows an annual extraction volume up to 20,000 cubic yards, but in practice the annual extraction volume will vary with expected recruitment based on area and will typically be less than 20,000 cubic yards. The BLR will not extract if the annual volume allocation is less than 3,000 cubic yards.

1.3.2 Detailed Project Description

The BLR proposes to operate under the project description as described below.

1.3.2.1 Annual Extraction Volume Allocation

The BLR has agreed to use the NMFS annual Fractional Extraction Volume (FEV) strategy (NMFS 2010) to determine extractable gravel volume in conjunction with other planning tools (e.g., cross-sections, Digital Terrain Models [DTM], gravel recruitment, channel alignment, etc.). The goal of setting the annual extraction volume recommendation for the BLR gravel bar is to minimize ecological impacts by maintaining extraction intensity relative to water year intensity, active channel bar area and corresponding rates of sediment recruitment. This approach is like the other gravel operations on the Mad River. To achieve this, the BLR is proposing to extract 3.06 percent of the estimated recruitment on all years when 3.06 percent of the estimated bed material recruitment is greater than 3,000 yd^3. The fraction of the estimated bed material load was calculated following the same logic as used for the other Mad River gravel operators (MRO), as described in NMFS 2010, NMFS 2020, and Stillwater Sciences 2021. These operations are covered under a separate biological opinion (NMFS 2020).

Because BLR is proposing to forgo extraction on years where the estimated extraction rate is less than 3,000 cubic yards, the percent of the recruitment for BLR is increased to maintain the same total volume that is estimated to be extracted in the ten year period as though the extraction occurred every year at the MRO extraction intensity before applying the upper and lower limits. The annual percent of the FEV becomes 3.06 percent of the estimated recruitment when forgoing extraction at volumes less than 3,000 yd^3. A summary of the BLR's annual extraction volume relative to the estimated annual sediment recruitment is provided in Table 1.

Table 1. Annual extraction volume for the BLR Bar relative to estimated annual sediment recruitment for the Mad River.

Water Year Type	Estimated Sediment Recruitment (CY)	Extraction Volume (CY)
Very Low	<90,000	0
Very Low	90,000	3000
Low	150,000	4590
Moderate	200,000	6120
High	275,000	8415
Very High	450,000	13770

In any given year, individual extraction volumes, locations, and methods have been and will continue to be submitted by the BLR for approval or comment by the extraction review team which is composed of the Corps, NMFS and the Environmental Protection Agency (EPA). This planning process is more specifically described below.

1.3.2.2 Conservation Measures

The instream mining activities proposed for the BLR Bar will include a host of conservation measures beginning with the FEV calculations described above, and:

- the pre-extraction planning and approval process,
- an operating season,
- minimum head-of-bar buffers,
- a minimum skim floor elevation,
- rules for the use and maintenance of storage and stockpiles,,
- maintenance of riparian vegetation and wetlands,
- large woody debris retention,
- structure setbacks, and
- post-extraction bar grooming.

The minimum head-of-bar buffer is defined as that portion of the bar that extends from at least the upper third of the bar to the upstream end of the bar that is exposed at summer low flow. The intent of the buffer is to provide protection of the natural stream flow steering effect provided by the height of an undisturbed bar above the thalweg. In other words, the morphology of the bar, including height and sinuosity, steers the stream flow around the bar which creates a diversity of flows and depths which correspond to salmonid habitat diversity (e.g., pools and riffles). An increased or decreased buffer that maintains the steering effect may be further delineated based on the river morphology as observed during the field visit. This process results in extraction plans that are protective of the physical and biological processes within the extraction reach. However, additional annual field reviews are necessary to take into consideration the annual replenishment of previously mined areas, adjustments to extraction designs to avoid or protect sensitive habitat areas, adaptive management, and the siting of bridges.

All equipment used to conduct extractions (e.g., scrapers, excavators, bull dozers, front-end loaders, dump trucks, or any other heavy equipment used for extraction) will be monitored for fuel, oil, or hydraulic fluid leaks. Fueling will not occur within the 100-year floodplain. All equipment will carry a spill prevention and clean-up kit with them when operating within the 100-year floodplain.

1.3.2.3 Annual Extraction Development Process

The proposed action is intended to reduce environmental impacts by site-specific planning of extraction activities that considers river morphology, vegetation patterns, salmonid spawning and rearing habitat, tributary stream location, bedload transport, and other factors. In addition to providing for the BLR's aggregate needs, the proposed activities will preserve riparian vegetation at strategic locations, increase riparian vegetation cover and successional development by using specific extraction techniques, and augment winter rearing habitat at low to high flows.

A comprehensive extraction planning process is key to developing annual mining plans that are protective of riverine function and listed salmonid species and their habitat. This involves annual review of aerial photographs coupled with comparison of recent and historical full-channel cross-sections, which are used during the annual pre-extraction review to identify hydrological and morphological alterations in response to winter flows and previous extractions. Gravel and sand extraction methods are developed in consideration of local and reach-wide geomorphic processes, and protection of bedforms important for sediment transport continuity, changes in local reach hydraulics, sediment transport characteristics, and fish habitat.

Pre-extraction cross-section surveys are typically conducted during May and June or earlier depending on spring flow characteristics. The BLR delineates the 35% exceedance flow line on their gravel bar by conducting site visits as the river approaches 900 cfs at the USGS 11481000 Mad River near Arcata stream gage. At that time, the BLR will mark the water's edge on the substrate. The BLR will calculate 35% exceedance flow water surface elevation at the time of the pre-extraction site visits based on the surveyed marks and adjustments necessary to represent 900 cfs and include flow corrections made by USGS. The BLR and the extraction review team will also use the cross-sections to help identify potential extraction areas containing commercial quantities of aggregate within the project boundaries. The BLR will provide the monitoring data and pre-extraction plans following a reporting format consistent with previous data collection. Several other factors are considered during extraction planning, including:

- site-specific determinations of replenishment since the previous season;
- locations of gravel deposits;
- morphological changes caused by high flows and changes in sediment deposition patterns from the previous season or longer term;
- how the extraction can be tailored to and blend with surrounding natural contours to minimize extraction-induced depressions and initiation of nick-point erosion;
- avoidance of riparian vegetation; and
- the potential use of alternative extraction methods to improve some instream or floodplain habitat features.

The BLR will delineate the proposed extraction plan on aerial photographs, describe in detail the various operational and protective aspects of the extraction, calculate potential harvestable volume that aligns with the FEV, and identify roads and temporary crossing locations, if any. The plan would also include an assessment of how the extraction of selected bar features could potentially affect surrounding morphology when flows increase. Once the proposed extraction plan is developed, it is submitted to the Corps and NMFS, and the EPA. A field review is conducted, at the request of the BLR, to describe the proposed plan, solicit comments or recommendations, and make any final modifications. The plan is then resubmitted to the review team for final review. Once the team agrees with the design of the annual mining plan, the Corps makes the final determination to approve the extraction plan with an annual letter of modification to the BLR.

Extraction designs are implemented by marking mining areas, which may include grade staking or laser levelling, similar to the process used in road construction. The heavy equipment operator is provided with temporary grade stakes that delineate the extraction boundaries and grades determined during the extraction plan review process. Typically, final surfaces are designed to be: (1) free-draining toward the river channel; (2) sloped downstream, parallel to the river; (3) not compacted; and (4) complementary to surrounding natural contours. This extraction planning and implementation strategy is intended to promote low-flow channel confinement and riparian development while reducing the potential for channel shifting, ponding, fish stranding, riffle instability, and nick-point erosion caused by moderate to high-flow inundation.

Following extraction, the review team will also conduct post-extraction field visits, analyze pre- and post-extraction physical monitoring data and aerial photographs to determine compliance with approved extraction plans, and assess effects of gravel operations on the form and function of the river.

1.3.2.4 Extraction Season

The operating season for extraction operations extends from June 1 through October 15, with potential for a Corps and NMFS-approved extension until October 31. Bridge construction and use is limited to June 30 through September 15. Bridge-use extensions can be granted until October 31 with Corps and NMFS approval and is typically dependent upon fish absence and the potential for precipitation events that would result in a rise in river stage.

The intent of the established operating season is to limit the potential for direct impacts and other interactions between extraction activities and various salmonid life-history stages that occupy (seasonally or year-round) the extraction reaches. The adult salmonids are expected to be absent from the river adjacent to the BLR Bar during the operating season. In addition, as reported by Sparkman (2002), most of the downstream smolt migration would be complete by the end of June, with only a few stragglers remaining by the June 30 bridge installation date. Most steelhead fry that occupy edgewater habitats during the first weeks of their lives would be expected to have grown to a larger size, more likely to flee rather than burrow into substrate, and moved into deeper and faster water by June 30.

1.3.2.5 Extraction Descriptions

The primary objective of standard extraction methods is to extract commercial quantities of aggregate. These methods include narrow and wide shoreline skims, offset skims, secondary channel skims, floodplain excavations, trenches and other options developed by the BLR and pre-extraction review team members that will allow for both economical operations and aquatic resource protection (i.e. alcoves). Identification of specific extraction methods will occur during the pre-extraction planning process and will depend on site conditions at that time. The standard impact minimization measures associated with these methods include, but are not limited to, the 35-percent exceedance flow elevation buffer from the low-flow channel, head-of-bar buffer, retaining the natural high points of the bar, avoiding riparian vegetation, avoiding skimming or trenching adjacent to riffles, large woody debris retention, and post-extraction bar surface grooming.

Narrow shoreline skim

Narrow shoreline skims are no more than one-third of the exposed gravel bar width, follow the shape of the bar feature, maintain the point of maximum height of the bar along the length of the skim, and trend in the general direction of stream flow. These skims maintain a vertical offset corresponding to the flow at the calculated 35-percent exceedance level. Finished skims are free-draining and slope either toward the low-flow channel or in a downstream direction. Furthermore, these skims avoid the head of the bar, defined as the upstream one-third of the exposed bar surface. This buffer may be decreased on a case-by-case basis provided that the extraction area narrows, tapering smoothly to a point, and remains below the upstream cross-over riffle. The location of the skim with respect to its orientation to the channel may vary depending on bar morphology.

Offset Skims

Offset skims harvest gravel from the downstream two-thirds of gravel bars. A lateral edge-of-water buffer is maintained along the low-flow channel. The upper one-third of the bar is left in an undisturbed state as an upper bar buffer. The finished grade of the extraction area will have a downstream gradient equal to the river, a flat cross slope, and will be no lower than 1-foot above the low-flow water surface elevation as identified during the pre-extraction review. Cut-slopes are left at a 2:1 (horizontal:vertical) slope except along the upstream side at the head-of-bar buffer where a 6:1 slope will be established. There is at least a 15-foot offset buffer from the bank. The extraction surface daylights along the downstream one-third to one-fifth of the bar to facilitate drainage following high runoff events. The horizontal and vertical offsets are intended to keep the excavation area away from the low-flow channel and minimize effects on listed salmonid species by disconnecting the mined surface from frequent flow inundation. Due to less frequent flow inundation, wide offset skims may take larger flow events to replenish than traditional skim designs, depending on the unaltered bar height between the excavation and the stream.

Secondary channel skims

These extractions are long, linear shallow skims located in dry, overflow channels. These extractions are designed to be free-draining and open at the lower end to prevent any potential fish stranding and maintain existing flow inundation level by preserving the highest portion along the secondary channel. The extraction plan will be designed to be protective of the upstream riffle crest and maintain the existing inundation level and maximum height of the secondary channel. The skim floor of these excavations is set at the 35-percent exceedance flow elevation.

Trench
A trench is generally a long, narrow excavation parallel and adjacent to, but outside of, the wetted perimeter of the channel. This type of extraction may be used to help promote active channel narrowing by concentrating mining adjacent to the channel, thereby allowing for adjacent bar height to continue building. Using a trench along the low flow channel would minimize the area of disturbance and potentially allow the interior to be recolonized with vegetation and build in elevation. Trenches will be typically located adjacent to runs and glides. Standards for trench placement include:

- Not adjacent to eroding banks;
- Upstream end of trench at least 150 ft downstream from riffles;
- 1/3 low flow channel width or less, between 4–15 ft deep;
- Separation by at least 250 feet or the length of the largest trench being planned; and
- Connection to the wetted channel at the upstream and downstream end to prevent fish entrapment.

Floodplain extractions
Opportunities for extracting gravel from floodplain areas include preferred locations that have limited potential for riparian development because of their elevation above the water table and usually only contain invasive species or sparse vegetation that doesn't provide habitat at any flow. Design parameters include excavation down to the dry season capillary fringe to promote riparian vegetation development and, therefore, may also be referred to as "moist pits." Additional design parameters include development of a single connection to secondary or main channels to minimize the potential for fish stranding and avoiding areas where high flow channels exist. The bottom of the excavation shall be ripped to reduce heavy equipment compaction and facilitate seed germination and rooting.

As described above, preferred locations are on un-vegetated floodplains or areas vegetated with shrubs or invasive grasses, such as pampas grass and coyote brush. Locations that present a risk of capturing the main flow would be avoided. Further, areas would be avoided where excavations might interfere with adjacent beneficial habitat or alter the river geomorphology such that habitat is adversely affected or increased instability occurs.

On floodplains with multiple excavations, the total excavation area over the permit period for each site will be limited to minimize the risk of channel avulsion and/or excessive increase in channel braiding. The area of the floodplain excavation will be limited during the permit period at each site based on the following:

> 1) No more than 10% on a frequent floodplain (inundation by 2–5-year flood) unit, accumulated over the 10-year permit period, because of the higher potential for channel avulsion; or

2) No more than 20% on a relatively infrequent floodplain (inundation by 5–10-year flood) unit, accumulated over the 10-year permit period, due to lower chance of channel avulsion.
3) These area restrictions will reset once the areas replenish or are otherwise not relevant if the channel migrates (naturally) into these areas.

Locally-sourced small to large woody debris can be added into floodplain excavations to improve moisture conditions for natural vegetation recruitment. Additionally, excavations can be planted to enhance vegetation colonization. The type and placement of woody debris will be determined during the pre-extraction field review.

Floodplain excavations may have a narrow connection to the mainstem river or secondary channels at the downstream end at excavation floor elevation, but this connection should not result in an additional flow velocity or flow paths when inundated. The connection will allow for fish that use the excavations as high flow refugia to reenter channels as flows and water surface elevations subside. The excavation will be monitored for fish entrapment once precipitation for the season has ended (typically April or May), instream flows are receding, and the outlet is expected to be dry. NMFS will be contacted if stranding is observed.

Fish access channel
Fish access channels are generally narrow trenches excavated within the Mad River active channel, in areas where the mouths of tributary creeks or rivers go dry, thereby inhibiting fish migration. The channel excavation may extend below the groundwater table or simply remove excess material, which would allow for surface water connection between the tributary and Mad River with relatively small increases in flow. A suitable location for this type of excavation would include the mouth of Powers Creek.

Alcoves
Alcoves occur naturally in alluvial rivers and provide important rearing and holding habitat for salmonids. Alcoves typically form at the downstream end of point bars, downstream end of transverse riffles, against bedrock or large wood obstructions where a bar diverts upstream flow, and at complex meander bends or channel expansions where flow bifurcates around medial or transverse bars or islands become disconnected from upstream surface flow during low flow periods. Alcoves are water filled and maintain a downstream connection, but don't have an upstream connection to the main channel during summer low flow period. They are characterized by having deeper, cooler water than some main channel pools and more cover in the form of woody debris and overhanging trees.

During thermal stress conditions in late summer/early fall, alcoves provide thermal and predation refugia. Cooler subsurface (hyporheic) water flows from the upstream gravel bar into the alcove (Ock and Kondolf 2012). This, along with typically better shading than in the main channel, sustains cooler water throughout the warmer months. During high flow conditions in the winter, alcoves can provide refugia from high flow velocities in the main channel.

Several guidelines for properly locating and designing artificial alcoves will assist gravel operators and their consultants in developing proposals that will meet with approval by regulators. Alcove widths should not exceed approximately one-third of the low flow main channel width. The upstream end of the alcove should be below the upper 1/3 of bar or below the highest point of the bar, whichever is less. Excavated alcoves should include a small channel at the downstream end to ensure low water connection and prevent stranding. Excavation of this connecting channel should be delayed until after extraction of the alcove is complete and after enough time has passed (several days to a week) for suspended sediment to settle out to avoid turbidity impacts to the main channel. The connection should extend no more than a foot below the low flow channel. In addition, alcoves should not present a risk of capturing the main flow through headcutting. As such, they should primarily be located at the downstream end of point bars, but could also include a location at the mouth of Powers Creek which would intercept the cool creek flow.

Adaptive Management
Extractions that deviate from that described above may be considered on a case-by-case basis by the extraction review team and may require additional monitoring and assessment. Deviations will thoroughly describe the expected geomorphic response of the river to the extraction. Additional hydraulic modeling and/or monitoring (e.g., HecRas) may be required of the potential effects of an adaptive management proposal. Requirements for additional monitoring or modeling would be dependent on the proposal being considered.

1.3.2.6 Stream Crossings

Channel alignment and sediment depositional areas may change from year to year throughout Mad River. Changes in morphology may necessitate the installation of temporary crossings to access extraction areas where none were needed previously. Summer crossings typically consist of rail flat car bridges placed across a shallow and narrow portion of channel. Bridges are not installed over pools because of the depth and potential impacts from abutments, nor riffles and others areas where spawning might occur. Installation requires one loader to cross through the active channel to construct the far-side gravel abutment and secure the bridge. K-Rail or large concrete blocks will be placed beneath the ends and sides of the gravel abutment of the bridge to provide an elevated abutment to support the ends of the bridge, provide adequate clearance above the low-flow channel, and contain abutment fill.

Encroachment of bridge abutments into the channel will occur on the sides only and not enter the channel thalweg. Only washed material will be used within the wetted area and extend above the low-flow water surface elevation of the near side approach. Native river bar material will also be used outside of the wetted channel. Heavy equipment will not be used in these wetted channels except for crossing installation and removal activities, each of which require one to two crossings.

Secondary channels with very low flow may be present in some extraction areas. In many cases, such channels may only be a few feet wide and installation of a bridge may be an unreasonable or a more impactive option. In these cases, suitably sized culverts may be used to construct the crossing. The number and size of culverts used will be scaled to fully pass potential increases in flow that may occur with summer and early fall freshets. All crossings will be meet NMFS Fish Passage Guidelines (NMFS 2011).

All crossing activities are restricted to occur between June 30 and September 15 of each year, although work extensions may be granted by the Corps, in consultation with NMFS, on a case-by-case basis until October 31. Monitoring of weather, river flow, and adult Chinook salmon presence in the Mad River will be necessary for granting bridge extensions. Extensions will be granted if rain is not expected that would result in a rise of more than one foot in river stage and adult Chinook salmon are not present. The location, construction, and removal of all temporary channel crossings will be included in the annual pre-extraction plan. The location for channel crossings will be determined during the pre-extraction site review.

1.3.2.7 Monitoring

Monitoring of extraction activities and river morphological changes will be primarily through the annual surveys of long-established cross sections and spring aerial photos at each mining site. Additionally, pre- and post-extraction cross sections and gravel volume calculations are required for each extraction location. Paper copies of the monitoring cross sections and aerial photos are required to be provided to the Corps, NMFS, and EPA on the day of the pre-extraction site visit. Final electronic post-extraction cross section information will be delivered to NMFS by December 31 of each year of extraction.

Physical monitoring will include:

1. identification of the elevation and location of the 35-percent exceedance flow water surface,
2. pre-extraction cross sections,
3. post-extraction cross sections,
4. full-channel monitoring cross sections,
5. high-water elevation and location from the previous winter, and
6. monitoring of floodplain extractions for salmonid stranding and riparian vegetation development.

Alternative physical monitoring methods may be developed by the BLR in discussion with the Corps and NMFS These alternatives may include marking the 35-percent exceedance flow elevation and cross-section monitoring. Any modifications to, or replacement, of the existing 35-percent exceedance flow marking or cross-section monitoring will provide an equal or greater amount of information and protection.

Riparian vegetation monitoring would be conducted toward the end of the 2021–2030 permit period in preparation for the next (2030) permit renewal period. Riparian vegetation monitoring will also be conducted if a 25-year recurrence interval flood occurs. The riparian assessment method will be compatible with those used in the BA (Stillwater Sciences 2021). Other monitoring may be developed as the project proceeds.

1.3.2.8 Pollution Prevention

The BLR, or approved entity mining on behalf of the BLR, will ensure that all fuel and hydraulic lines on heavy equipment are in good working order and not leaking. The BLR will also conduct all fueling and lubrication operations at the processing plant site and use Best Management Practices when doing so. There are no fuel storage facilities at the extraction bar sites. All equipment is serviced on an as-needed basis with the necessary fueling and lubrication conducted at the processing plant on a daily basis prior to the start of work. Accidents, such as a breaking of a hydraulic line, require immediate clean-up of the area and well before the onset of high-flow conditions as per terms and conditions of federal permits.

All tires and auto body debris, or other large metal debris will be removed from the gravel bar and disposed/recycled properly.

1.3.2.9 Maintenance of Riparian Vegetation

All riparian woody vegetation and wetlands will be avoided to the maximum extent possible. Maintenance of a 10-ft minimum buffer between extraction and the canopy edge of mature riparian vegetation. Where riparian vegetation patches are present, a minimum 5-ft buffer is required in up- and downstream directions. Any riparian vegetation or wetland that is to be disturbed must be clearly identified on a map. Impacted areas that must be mapped consist of riparian vegetation that has a dripline within 25 ft of excavation activities (excavation, stockpiling, parking, etc.) or wetlands that are filled, excavated, or drained.

Woody vegetation that is disturbed by extraction operations and is part of a contiguous 1/16-acre complex or is at least 2 inches in diameter will be mitigated. A mitigation plan will be developed and submitted with pre-extraction plans for those instances where unavoidable impacts on woody vegetation are expected to occur. The mitigation plan will consider the size and age of the vegetation removed, identify planting locations, and specify a revegetation survival rate that will be achieved over a three-year period. Failure to achieve the agreed-upon survival rate will require replanting. Impacts on other woody vegetation will be described and submitted with the gravel extraction plans to the Corps and NMFS who will assess the effect to salmonid habitat from these impacts. These other impacts may require mitigation similar to that described above at the discretion of the Corps with input from the extraction review team, but our analysis in this opinion does not assume that this mitigation will occur.

1.3.2.10 Large Woody Debris Retention

Annual high flows may result in the deposition of large woody debris (logs) on gravel bars within the permitted mining area. This woody debris has the potential to provide a number of valuable services within the river, estuary, and ocean. These services include low and high flow cover for salmonids, pool development, nutrient cycling, dune formation, and other functions. However, logs deposited on gravel bars are also subject to wood cutting by people trespassing on the mining areas.

Techniques for protecting woody debris include locked gates, signage at entrance road locations, signs on logs indicating their importance for fish habitat, and pile gravel on the logs to discourage cutting. However, in some cases wood cutters remove logs prior to the allowable gravel operation season when the BLR can legally enter the river with heavy equipment. For the purposes of woody debris protection, the BLR would enter the mining area as early in the year as possible (prior to start of the mining season) to preferably cover logs in gravel (ruins chain saws) or optionally remove them to a safe storage facility within a secure area. The logs moved to the storage area would either be placed back in the river at the end of the season and/or be used in a variety of instream restoration projects. Any woody debris removed for its conservation and its ultimate dissemination shall be documented by the BLR.

1.3.2.11 Powers Creek Fish Passage

The proposed action may include removing gravel at the mouth of Powers Creek to enhance fish passage if gravel deposits impede passage.

1.3.2.12 Other Activities

We considered whether the proposed action would cause any other activities that would have consequences on listed fish species and their critical habitat and determined that it would not.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an Opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This Opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of" a listed species, which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This Opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term “consequences” (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44976, 44977), that definition does not change the scope of our analysis and in this Opinion, we use the terms “effects” and “consequences” interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

We have relied on the BLR’s biological assessment (Stillwater Sciences 2021), peer-reviewed literature regarding the effects of sediment removal on stream geomorphology and how these changes may affect salmonids and their habitat as referenced in this Opinion, other documents regarding sediment extraction in Humboldt County, monitoring information for this ongoing proposed action, past Opinions on similar proposed actions in Humboldt County, status reviews and recovery plans for the potentially affected listed species, and the decades of experience of NMFS staff who help to monitor the effects of activities occurring in aquatic habitat in the NMFS Arcata, California office area.

2.2 Rangewide Status of the Species and Critical Habitat

This Opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species’ likelihood of both survival and recovery. The species status section also helps to inform the description of the species’ current “reproduction, numbers, or distribution” as described in 50 CFR 402.02. The Opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

The following species and their designated critical habitats are likely to be adversely affected by the proposed action:

Threatened Southern Oregon/Northern California Coast coho salmon Evolutionarily Significant Unit (ESU) (*Oncorhynchus kisutch*)
Listing determination (70 FR 37160, June 28, 2005)
Critical habitat designation (64 FR 24049, May 5, 1999);

Threatened California Coastal (CC) Chinook salmon ESU (*O. tshawytscha*)
Listing determination (70 FR 37160, June 28, 2005)
Critical habitat designation (70 FR 52488, September 2, 2005);

Threatened Northern California (NC) steelhead Distinct Population Segment (DPS) (*O. mykiss*)
Listing determination (71 FR 834, January 5, 2006)
Critical habitat designation (70 FR 52488, September 2, 2005).

2.2.1 Life History and Range

2.2.1.1 Coho Salmon

Coho salmon adults migrate to and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Sandercock 1991, Moyle 2002). Adults migrate upstream to spawning grounds from September through late December, peaking in October and November. Spawning occurs mainly November through December, with fry emerging from the gravel in the spring, approximately three to four months after spawning. Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient. Juveniles have been found in streams as small as 1 to 2 meters wide. They may spend one to two years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988). With the onset of fall rains, coho salmon juveniles are also known to redistribute into non-natal rearing streams, lakes, or ponds, where they overwinter (Peterson 1982). At a length of 38–45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Sandercock 1991, Nickelson *et al.* 1992). Emigration from streams to the estuary and ocean generally takes place from March through June.

The SONCC Coho Salmon ESU includes all naturally spawned populations of coho salmon in coastal streams from the Elk River, Oregon, through the Mattole River, California. It also includes three artificial propagation programs: Cole Rivers Hatchery in the Rogue River Basin, and the Trinity and Iron Gate hatcheries in the Klamath-Trinity River Basin.

2.2.1.2 Chinook Salmon

Chinook salmon follow the typical life cycle of Pacific salmon in that they hatch in freshwater, migrate to the ocean, and return to freshwater to spawn. However, diversity within this life cycle exists in the time spent at each stage. Juvenile Chinook salmon are classified into two groups, ocean-type and stream-type, based on the period of freshwater residence (Healey 1991). Ocean-type Chinook salmon spend a short period of time in freshwater after emergence, typically migrating to the ocean within their first year of life. Stream-type Chinook salmon reside in freshwater for a longer period, typically a year or more, before migrating to the ocean. After emigration, Chinook salmon remain in the ocean for two to five years (Healey 1991) tending to stay in the coastal waters of California and Oregon. Chinook salmon are also characterized by the timing of adult returns to freshwater for spawning, with the most common types referred to as fall-run and spring-run fish. Typically, spring-run fish have a protracted adult freshwater residency, sometimes spawning several months after entering freshwater, and produce stream-type progeny. Fall-run fish spawn shortly after entering freshwater and generally produce ocean-type progeny. Historically, both spring-run and fall-run fish existed in the CC Chinook Salmon ESU. At present, only fall-run fish appear to be extant in the ESU.

Fall-run Chinook salmon are decidedly ocean-type (Moyle 2002), specifically adapted for spawning in lowland reaches of big rivers and their tributaries (Moyle 2002, Quinn 2005). Adults move into rivers and streams from the ocean in the fall or early winter in a sexually mature state and spawn within a few weeks or days upon arrival on the spawning grounds (Moyle 2002). Juveniles emerge from the gravel in late winter or early spring and within a matter of months, migrate downstream to the estuary and the ocean (Moyle 2002, Quinn 2005). This life history strategy allows fall-run Chinook salmon to utilize quality spawning and rearing areas in the valley reaches of rivers, which are often too warm to support juvenile salmonid rearing in the summer (Moyle 2002).

The CC Chinook Salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River (exclusive) to the Russian River (inclusive). Seven artificial propagation programs are considered part of the ESU: the Humboldt Fish Action Council (Freshwater Creek), Yager Creek, Redwood Creek, Hollow Tree, Van Arsdale Fish Station, Mattole Salmon Group, and Mad River Hatchery fall-run Chinook hatchery programs, but these programs were discontinued over a decade ago.

2.2.1.3 Steelhead

Steelhead probably have the most diverse life history of any of any salmonid (Quinn 2005). There are two basic steelhead life history patterns: winter-run and summer-run (Quinn 2005, Moyle 2002). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state and spawn in tributaries of mainstem rivers, often ascending long distances (Moyle 2002). Summer steelhead (also known as spring-run steelhead) enter rivers in a sexually immature state during receding flows in spring, and migrate to headwater reaches of tributary streams where they hold in deep pools until spawning the following winter or spring (Moyle 2002). Spawning for all runs generally takes place in the late winter or early spring. Eggs hatch in 3 to 4 weeks and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002). Juveniles spend

1 to 4 years in freshwater before migrating to estuaries and the ocean where they spend 1 to 3 years before returning to freshwater to spawn.

Another expression of the life history diversity of steelhead is the "half pounder" - sexually immature steelhead that spend about 3 months in estuaries or the ocean before returning to lower river reaches on a feeding run (Moyle 2002). Half pounders then return to the ocean where they spend 1 to 3 years before returning to freshwater to spawn. This steelhead life history form has only been observed in the Rogue and Klamath Rivers (of the Klamath Mountain Province Steelhead DPS) and the Mad and Eel Rivers (of the NC Steelhead DPS, Busby *et al.* 1996). Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996). Some steelhead "residualize," as juveniles, becoming resident trout and never adopting the anadromous life history.

The NC Steelhead DPS includes all naturally spawned populations of steelhead in California coastal river basins from Redwood Creek (inclusive) southward to the Russian River (exclusive). Two artificial propagation programs are considered part of the DPS: the Yager Creek Hatchery and the North Fork Gualala River Hatchery (Gualala River Steelhead Project), but these programs were discontinued over a decade ago.

2.2.2 Status of the Species

2.2.2.1 SONCC Coho Salmon

The following summary is from Williams *et al.* 2016, the most recent biological viability report for SONCC coho salmon:

> Although long-term data on coho abundance in the SONCC Coho Salmon ESU are scarce, all available evidence from more recent trends since the 2011 assessment (Williams *et al.* 2011) indicate little change since the 2011 assessment. The two population-unit scale time series for the ESU both have a trend slope not different from zero. The composite estimate for the Rogue Basin populations was not significantly different from zero ($p > 0.05$) over the past 12 years and significantly positive over the 35 years of the data set ($p = 0.01$). The continued lack of appropriate data remains a concern, although the implementation of the Coastal Monitoring Program (CMP) for California populations is an extremely positive step in the correct direction in terms of providing the types of information to assess and evaluate population and ESU viability. The lack of population spatial scale monitoring sites in Oregon is of great concern and increases the uncertainty when assessing viability. Additionally, it is evident that many independent populations are well below low-risk abundance targets, and several are likely below the high-risk depensation (depensation is a decline in growth rate of a population that results from very low populations sizes) thresholds specified by the TRT and the Recovery Plan (NMFS 2014). Though population-level estimates of abundance for most independent populations are lacking, it does not appear that any of the seven diversity strata currently supports a single viable population as defined by the TRT's viability criteria, although all occupied.

> The SONCC Coho Salmon ESU is currently considered likely to become endangered. Of particular concern is the low number of adults counted entering the Shasta River in 2014-15. The lack of increasing abundance trends across the ESU for the populations with adequate data are of concern. Moreover, the loss of population spatial scale estimates from coastal Oregon populations is of great concern. The new information available since the 2011, while cause for concern, does not appear to suggest a change in extinction risk at this time.

2.2.2.2 CC Chinook Salmon

The following summary is from Williams *et al.* 2016, the most recent biological viability report for CC Chinook salmon.

> The lack of long-term population-level estimates of abundance for Chinook salmon populations continues to hinder assessment of status, though the situation has improved with implementation of the CMP in the Mendocino Coast Region and portions of Humboldt County. The available data, a mixture of short-term (6-year or less) population estimates or expanded redd estimates and longer-term partial population estimates and spawner/redd indexes, provide no indication that any of the independent populations (likely to persist in isolation) are approaching viability targets. In addition, there remains high uncertainty regarding key populations, including the Upper and Lower Eel River populations and the Mad River population, due to incomplete monitoring across the spawning habitat of Chinook salmon in these basins (O'Farrell *et al*. 2012). Because of the short duration of most time series for independent populations, little can be concluded from trend information. The longest time series, video counts in the Russian River, indicates the population has remained steady during the 14-year period of record. The longer time series associated with index reaches or partial populations suggest mixed patterns, with some showing significant negative trends (Prairie Creek, Freshwater Creek, Tomki Creek), one showing a significant positive trend (Van Arsdale Station), and the remainder no significant trends.
>
> At the ESU level, the loss of the spring-run life history type represents a significant loss of diversity within the ESU, as has been noted in previous status reviews (Good *et al*. 2005, Williams *et al*. 2011). Concern remains about the extremely low numbers of Chinook salmon in most populations of the North-Central Coast and Central Coast strata, which diminishes connectivity across the ESU. However, the fact that Chinook salmon have regularly been reported in the Ten Mile, Noyo, Big, Navarro, and Garcia rivers represents a significant improvement in our understanding of the status of these populations in watersheds where they were thought to have been extirpated. These observations suggest that spatial gaps between extant populations are not as extensive as previously believed.

In summary, Williams *et al.* (2016) concludes "there is a lack of compelling evidence to suggest that the status of these populations has improved or deteriorated appreciably since the previous status review" and that "the new available information does not appear to suggest there has been a change in the extinction risk of this ESU."

2.2.2.3 NC Steelhead
The following summary is from Williams *et al.* 2016, the most recent biological viability report for NC steelhead.

> The availability of information on steelhead populations in the NC Steelhead DPS has improved considerably in the past 5 years, due to implementation of the CMP across a significant portion of the DPS. Nevertheless, significant information gaps remain, particularly in the Lower Interior and North Mountain Interior diversity strata, where there is very little information from which to assess status. Overall, the available data for winter-run populations—predominately in the North Coastal, North-Central Coastal, and Central Coastal strata— indicate that all populations are well below viability targets, most being between 5% and 13% of these goals…for the two Mendocino Coast populations with the longest time series, Pudding Creek and Noyo River, the 13-year trends have been negative and neutral, respectively (Williams *et al.* 2016). However, the short-term (6-year) trend has been generally positive for all independent populations in the North-Central Coastal and Central Coastal strata, including the Noyo River and Pudding Creek (Williams *et al.* 2016). Data from Van Arsdale Station likewise suggests that, although the long-term trend has been negative, run sizes of natural-origin steelhead have stabilized or are increasing (Williams *et al.* 2016). Thus, we have no strong evidence to indicate conditions for winter-run have worsened appreciably since the last status review.
>
> Summer-run populations continue to be of significant concern because of how few populations currently exist. The Middle Fork Eel River population has remained remarkably stable for nearly five decades and is closer to its viability target than any other population in the DPS (Williams *et al.* 2016). Although the time series is short, the Van Duzen River appears to be supporting a population numbering in the low hundreds. However, the Redwood Creek and Mattole River populations appear small, and little is known about other populations including the Mad River and other tributaries of the Eel River (*i.e.*, Larabee Creek, North Fork Eel, and South Fork Eel).
>
> In summary, the available information for winter-run and summer-run populations of NC steelhead do not suggest an appreciable increase or decrease in extinction risk since publication of the last status reviews…most populations for which there are population estimates available remain well below viability targets; however, the short-term increases observed for many populations, despite the occurrence of a prolonged drought in northern California, suggests this DPS is not at immediate risk of extinction.

2.2.3 Factors for Decline (ESU or DPS Scale)

2.2.3.1 Timber Harvest
Timber harvest and associated activities occur over a large portion of the range of the affected species. Timber harvest has caused widespread increases in sediment delivery to channels

through both increased landsliding and surface erosion from harvest units and log decks. Much of the largest riparian vegetation has been removed, reducing future sources of large woody debris (LWD) needed to form and maintain stream habitat that salmonids depend on during various life stages. In the smaller streams, recruited wood does not usually wash away, so logs remain in place and act as check-dams that store sediment eroded from hillsides (Reid 1998). Sediment storage in smaller streams can persist for decades (Nakamura and Swanson 1993). In fish-bearing streams, LWD originating from mature coniferous forests is important for storing sediment, halting debris flows, and decreasing downstream flood peaks, and its role as a habitat element becomes directly relevant for Pacific salmon species (Reid 1998). LWD alters the longitudinal profile and reduces the local gradient of the channel, especially when log dams create slack pools above or plunge pools below them, or when they are sites of sediment accumulation (Swanston 1991).

Cumulatively, the increased sediment delivery and reduced LWD supply have led to widespread impacts on stream habitats and salmonids. These impacts include reduced spawning habitat quality, loss of pool habitat for adult holding and juvenile rearing, loss of velocity refugia, and increases in the levels and duration of turbidity that reduce the ability of juvenile fish to feed (Reid 1998). These changes in habitat have led to widespread decreases in the carrying capacity of streams that support salmonids.

2.2.3.2 Road Construction

Road construction, whether associated with timber harvest or other activities, has caused widespread impacts on salmonids (Furniss *et al.* 1991). Where roads cross salmonid-bearing streams, improperly placed culverts have blocked access to many stream reaches. Land sliding and chronic surface erosion from road surfaces are large sources of sediment across the affected species' ranges. Roads also have the potential to increase peak flows and reduce summer base flows with consequent effects on the stability of stream substrates and banks. Roads have led to widespread impacts on salmonids by increasing the sediment loads. The consequent impacts on habitat include reductions in spawning, rearing, and holding habitat, and increases in turbidity. The delivery of sediment to streams can be generally considered as either chronic, or episodic. Chronic delivery refers to surface erosion that occurs from rain splash and overland flow. More episodic delivery, on the order of every few years, occurs in the form of mass wasting events, or landslides, that deliver large volumes of sediment during large storm events.

Construction of road networks can also greatly accelerate erosion rates within a watershed (Haupt 1959; Swanson and Dyrness 1975; Swanston and Swanson 1976; Reid and Dunne 1984; Hagans and Weaver 1987). Once constructed, existing road networks are a chronic source of sediment to streams (Swanston 1991) and are generally considered the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Processes initiated or affected by roads include landslides, surface erosion, secondary surface erosion (landslide scars exposed to rain splash), and gullying. Roads and related ditch networks are often connected to streams via surface flow paths, providing a direct conduit for sediment. Where roads and ditches are maintained periodically by blading, the amount of sediment delivered continuously to streams may temporarily increase as bare soil is exposed and ditch roughness features, which store and route sediment and armor the ditch, are removed. Hagans and Weaver (1987) found that fluvial hillslope erosion associated with roads in the lower portions of the

Redwood Creek watershed produced about as much sediment as landslide erosion between 1954 and 1980. In the Mattole River watershed, the Mattole Salmon Group (1997) found that roads, including logging haul roads and skid trails, were the source of 76 percent of all erosion problems mapped in the watershed. This does suggest that, overall, roads are a primary source of sediment in managed watersheds.

Road surface erosion is particularly affected by traffic, which increases sediment yields substantially (Reid and Dunne 1984). Other important factors that affect road surface erosion include condition of the road surface, timing of when the roads are used in relation to rainfall, road prism moisture content, location of the road relative to watercourses, methods used to construct the road, and steepness on which the road is located.

2.2.3.3 Hatcheries

Releasing large numbers of hatchery fish can pose a threat to wild salmon and steelhead stocks through genetic impacts, competition for food and other resources, predation of hatchery fish and wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs are primarily caused by the straying of hatchery fish and the subsequent hybridization of hatchery and wild fish. Artificial propagation threatens the genetic integrity and diversity that protects overall productivity against changes in environment (61 FR 56138, October 31, 1996). The potential adverse impacts of artificial propagation programs are well-documented (Waples 1991; Waples 1999; National Research Council 1995).

2.2.3.4 Water Diversions and Habitat Blockages

Water diversions are common throughout the species' ranges. Unscreened diversions for agricultural, domestic, and industrial uses are a significant factor for salmonid declines in many basins. Reduced stream-flows due to diversions reduce the amount of habitat available to salmonids and can degrade water quality, such as causing elevated water temperatures. Reductions in water quantity can reduce the carrying capacity of the affected stream reach by reducing the amount of available habitat, including by causing discontinuous flow and subsequent disconnected pools. Where warm return flows enter the stream, fish may seek reaches with cooler water, thus increasing competitive pressures in these areas.

Habitat blockages have occurred in relation to road construction as discussed previously. In addition, hydropower, flood control, and water supply dams of different municipal and private entities, have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. The percentage of habitat blocked by dams is likely greatest for steelhead because steelhead were more extensively distributed upstream than Chinook or coho salmon. Because of migration barriers, salmon and steelhead populations have been confined to lower elevation mainstems that historically only were used for migration and rearing. Population abundances have declined in many streams due to decreased quantity, quality, and spatial distribution of spawning and rearing habitat (Lindley *et al*. 2007).

2.2.3.5 Predation

Predation likely did not play a major role in the decline of salmon populations; however, it may have substantial impacts at local levels. For example, Higgins *et al.* (1992) and CDFG (1994) reported that Sacramento pikeminnow (*Ptychocheilus grandis*) accidentally introduced to the Eel River basin are a major competitor and predator of the native salmonids found there.

2.2.3.6 Disease
Disease has not been identified as a major factor in the decline of ESA-listed salmonids. However, disease may have substantial impacts in some areas and may limit recovery of local salmon populations. Although naturally occurring, many of the disease issues salmon and steelhead currently face have been exacerbated by human-induced environmental factors such as water regulation (damming and diverting) and habitat alteration. Natural populations of salmonids have co-evolved with pathogens that are endemic to the areas salmonids inhabit and have developed levels of resistance to them. In general, diseases do not cause significant mortality in native salmonid stocks in natural habitats (Bryant 1994, Shapovalov and Taft 1954). However, when this natural habitat is altered or degraded, outbreaks can occur. For example, ceratomyxosis, which is caused by *Ceratonova shasta*, has been identified as one of the most significant diseases for juvenile salmon in the Klamath Basin due to its prevalence and impacts there (Nichols *et al.* 2007) that are related to reduced flows and increased water temperatures. Ceratomyxosis disease outbreaks occur most years on the Klamath River and may be more prevalent under drought conditions (e.g., 2021).

2.2.3.7 Commercial and Recreational Fisheries
Salmon and steelhead once supported extensive tribal, commercial, and recreational fisheries. NMFS has identified over-utilization as a significant factor in their decline. This harvest strongly affected salmonid populations because, each year, it removed adult fish from the ESU before they spawned, reducing the numbers of offspring in the next generation. In modern times, steelhead are rarely caught in ocean salmon fisheries. Directed and incidental take of Chinook and coho salmon in ocean fisheries are currently managed by NMFS to achieve Federal conservation goals for west coast salmon in the Pacific Coast Salmon Fishery Management Plan (FMP). The goals specify the numbers of adults that must be allowed to spawn annually, or maximum allowable adult harvest rates. In addition to the FMP goals, salmon fisheries must meet requirements developed through NMFS' intra-agency section 7 consultations, including limiting the incidental mortality rate of ESA-listed salmonids.

2.2.3.8 Climate Change
Global climate change presents a potential threat to salmonids and their critical habitats. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir *et al.* 2013). Snowmelt from the Sierra Nevada Mountains has declined (Kadir *et al.* 2013). However, total annual precipitation amounts have shown no discernible change (Kadir *et al.* 2013). Listed salmonids may have already experienced some detrimental impacts from climate change. NMFS believes the impacts on listed salmonids to date are likely fairly minor because natural, and local, climate factors likely still drive most of the climatic conditions steelhead experience, and many of these factors have much less influence on steelhead abundance and distribution than human disturbance across the landscape.

The threat to listed salmonids from global climate change will increase in the future. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley *et al.* 2007, Moser *et al.* 2012). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe *et al.* 2004, Moser *et al.* 2012. Kadir *et al.* 2013). Total precipitation in California may decline; critically dry years may increase (Lindley *et al.* 2007, Schneider 2007, and Moser *et al.* 2012). Wildfires are expected to increase in frequency and magnitude (Westerling *et al.* 2011, Moser *et al.* 2012). Catastrophic wildfires in 2018, 2019, and 2020, coupled with severe drought in Calfiornia seemingly verify the modeling of potential impacts as a result of global climate change.

For Northern California, most models project heavier and warmer precipitation. Extreme wet and dry periods are projected, increasing the risk of both flooding and droughts (DWR 2013). Estimates show that snowmelt contribution to runoff in the Sacramento/San Joaquin Delta may decrease by about 20 percent per decade over the next century (Cloern *et al.* 2011). Many of these changes are likely to further degrade listed salmonid habitat by, for example, reducing stream flow during the summer and raising summer water temperatures. Estuaries may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia *et al.* 2002, Ruggiero *et al.* 2010). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Doney *et al*. 2012). The projections described above are for the mid to late 21st Century. In shorter time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007, Santer *et al.* 2011).

2.2.3.9 Ocean Conditions

Variability in ocean productivity affects fisheries production both positively and negatively (Chavez *et al.* 2003). Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production and marine environmental factors from 1925 to 1989. Beamish *et al.* (1997a) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. Warm ocean regimes are characterized by lower ocean productivity (Behrenfeld *et al.* 2006, Wells *et al.* 2006), which may affect salmon by limiting the availability of nutrients regulating the food supply, thereby increasing competition for food (Beamish and Mahnken 2001). Data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane *et al.* 2008). The Wells Ocean Productivity Index, an accurate measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon and Chinook salmon from the 2004/05 spawn entered the ocean (McFarlane *et al.* 2008). Data gathered by NMFS suggests that strong upwelling in the spring of 2007 may have resulted in better ocean conditions for the 2007 coho salmon cohort (MacFarlane *et al.* 2008). The quick response of salmonid populations to changes in ocean conditions (MacFarlane *et al.* 2008) strongly suggests that density dependent mortality of salmonids is a mechanism at work in the ocean (Beamish *et al.* 1997b, Levin *et al.* 2001, Greene and Beechie 2004).

The poor conditions reflect warmer than average sea surface and deep-sea temperatures associated with a relative lack of lipid-rich species of zooplankton, and krill biomass that was the lowest in the last 20 years (Peterson *et al.* 2015). These warm ocean conditions are attributed to a strengthening El Niños in addition to anomalously warm conditions (the "warm blob") that began in 2013 (Peterson *et al.* 2015) and continued through 2019.

The smolt to adult return rate for coho salmon at Freshwater Creek, a tributary of Humboldt Bay in Northern California, was less than 3 percent from 2011 to 2013 (Anderson *et al.* 2015). Bradford et al. (2000) found that the average coastal coho salmon population would be unable to sustain itself when marine survival rates fall below about 3 percent. Ocean conditions are not necessarily the only influence of marine survival; however, if marine survival is below 3 percent, the SONCC coho salmon ESU will have difficulty sustaining itself. Therefore, poor ocean conditions and low marine survival poses a key threat to the SONCC coho salmon ESU. This is likely the case for other ESUs and DPSs that use the California Current.

2.2.3.10 Drought

The following language is taken from Williams *et al*. 2016, which provides a description of the effects of recent drought conditions on listed salmonids in California, but has been updated to include those similar conditions that have occurred since 2016.

California has experienced well below average precipitation over the last decade (2010-2020). Some paleoclimate reconstructions suggest that the current drought is the most extreme in the past 500 or perhaps more than 1000 years. Anomalously high surface temperatures have amplified the effects of drought on water availability This period 2010-2020 of drought and high air, stream, and upper-ocean temperatures have together likely had negative impacts on the freshwater, estuary, and marine phases for many populations of Chinook salmon, coho salmon, and steelhead.

2.2.3.11 Marine-Derived Nutrients

Marine-derived nutrients (MDN) are nutrients that are accumulated in the biomass of salmonids while they are in the ocean and are then transferred to their freshwater spawning sites where the salmon die. The return of salmonids to rivers makes a significant contribution to the flora and fauna of both terrestrial and riverine ecosystems (Gresh *et al.* 2000), and has been shown to be vital for the growth of juvenile salmonids (Bilby *et al.* 1996, 1998). Evidence of the role of MDN and energy in ecosystems suggests a deficit of MDN may result in an ecosystem failure contributing to the downward spiral of salmonid abundance (Bilby *et al.* 1996). Reduction of MDN to watersheds is a consequence of the past century of decline in salmon abundance (Gresh *et al.* 2000).

2.2.4 Critical Habitat

NMFS is responsible for designating critical habitat for species listed under its jurisdiction. In designating critical habitat, NMFS considers the following requirements of the species: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing offspring; and, generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (see 50 CFR 424.12(b)). In addition to these factors, NMFS focuses on the known PBFs within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. Designated critical habitat for all the species listed below overlaps with the action area.

2.2.4.1 SONCC Coho Salmon Critical Habitat

Description
Designated critical habitat for SONCC coho salmon encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive (May 5, 1999, 64 FR 24049). Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding natural impassible barriers (i.e., natural waterfalls); and (3) tribal lands. The area described in the final rule represented the current freshwater and estuarine range of coho salmon. Land ownership patterns within the coho salmon ESU analyzed in this document and spanning southern Oregon and northern California are 53% private lands, 36% Federal lands, 10% State and local lands, and 1% tribal lands.

The designated critical habitat for SONCC coho salmon is separated into the five PBFs of the species' life cycle. The five PBFs (essential habitat types) include: (1) juvenile summer and winter rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; (4) adult migration corridors; and (5) spawning areas. Within these areas, PBFs (essential features) of SONCC coho salmon critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (64 FR 24049; May 5, 1999).

Current Condition
The condition of SONCC coho salmon critical habitat at the ESU scale, specifically its ability to provide for the species' conservation, has been degraded from conditions known to support viable salmonid populations that contribute to survival and recovery of the species. NMFS determined that present depressed population conditions are, in part, the result of human-induced factors affecting critical habitat, including: intensive timber harvesting, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals for irrigation. All of these factors were identified when SONCC coho salmon were listed as threatened under the ESA, and they continue to affect this ESU (NMFS 2014) and designated critical habitat. However, efforts to improve coho salmon critical habitat have been widespread and are expected to benefit the ESU over time (NMFS 2014).

Within the SONCC coho salmon critical habitat, a large number of habitat restoration actions have been implemented including reducing sediment, creating backwater channels and ponds for juvenile rearing, increasing flows and screening diversions, adding LWD, and fixing fish passage impediments. Therefore, the condition of SONCC coho salmon critical habitat is improved in localized areas where restoration has occurred, but larger scale quality remains impaired.

SONCC coho salmon are dependent upon complex, low gradient habitats for winter rearing, and will express diversity by overwintering in low-gradient, off-channel and estuarine habitats when they are available. The lack of complex aquatic habitat, and much decreased access to floodplains and low gradient tributaries are common features of current critical habitat conditions within the SONCC Coho Salmon ESU (NMFS 2014). The Recovery Plan also describes that land use activities (e.g., timber harvest, road building, etc.) that occur upstream of low gradient streams, still affect the habitat within low gradient streams by reducing the amount of large wood and shade available and by increasing the amount of sediment that routes through the valley bottom habitats.

2.2.4.2 CC Chinook Salmon Critical Habitat

Description
Designated critical habitat for CC Chinook salmon includes the stream channels up to the ordinary high-water line (50 CFR Part 226.211). In areas where the ordinary high-water line has not been defined pursuant to 50 CFR Part 226.211, the lateral extent is defined by the bankfull elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

Critical habitat for CC Chinook salmon was designated as occupied watersheds from the Redwood Creek watershed, south to and including the Russian River watershed (70 FR 52488, September 2, 2005). Humboldt Bay and the Eel River estuary are designated as critical habitat for the CC Chinook Salmon ESU. Some areas within the geographic range were excluded due to economic considerations. Critical habitat was not designated on Indian lands. Designated critical habitat for CC Chinook salmon overlaps the action area. In designating critical habitat for CC Chinook salmon, NMFS focused on areas that are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. The critical habitat designation for these species identifies the known PBFs that are necessary to support one or more Chinook salmon life stages, including: (1) freshwater spawning, (2) freshwater rearing, (3) freshwater migration, (4) estuarine areas, (5) nearshore marine areas, and (6) offshore marine areas. Within the PBFs, essential elements of CC Chinook salmon critical habitats include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, (10) safe passage conditions, and (11) salinity conditions (70 FR 52488, September 2, 2005).

Current Condition
The condition of CC Chinook salmon critical habitat, specifically its ability to provide for their conservation, is degraded from conditions known to support viable salmonid populations. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when CC Chinook salmon were listed as threatened under the ESA, and they all continue to affect this ESU. Therefore, the condition of CC Chinook salmon critical habitat is improved in localized areas where restoration has occurred, but larger scale quality remains impaired.

2.2.4.3 NC Steelhead Critical Habitat

Description
NMFS designated critical habitat for NC steelhead in September 2005 (70 FR 52488, September 2, 2005). Designated critical habitat for NC steelhead includes the stream channels up to the ordinary high-water line (50 CFR 226.211). In areas where the ordinary high-water line has not been defined pursuant to 50 CFR 226.211, the lateral extent is defined by the bankfull elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater. Critical habitat for NC steelhead was designated as occupied watersheds from the Redwood Creek watershed, south to and including the Gualala River watershed. Humboldt Bay and the Eel River estuary are designated as critical habitat for the NC Steelhead DPS. In general, the extent of critical habitat conforms to the known distribution of NC steelhead in streams, rivers, lagoons and estuaries (NMFS 2005). Some areas within the geographic range were excluded due to economic considerations. Native American lands and U.S. Department of Defense lands were also excluded.

Specific PBFs, that are essential for the conservation of each species, were identified as: freshwater spawning sites; freshwater rearing sites; freshwater migration corridors; estuarine areas; nearshore marine areas; and offshore marine areas. Within the PBFs, essential elements of NC steelhead critical habitats include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, (10) safe passage conditions, and (11) salinity conditions (70 FR 52488, September 2, 2005).

Designated critical habitat for NC steelhead overlaps the action area. In designating critical habitat for NC steelhead, NMFS focused on areas that are important for the species' overall conservation by protecting quality growth, reproduction, and feeding.

Current Condition
Similar to the current condition of SONCC coho salmon and CC Chinook salmon critical habitat, the current condition of NC steelhead critical habitat is degraded throughout most of the range of this species. Estuaries and lower river habitats are greatly reduced, in both area and condition, as the valley bottoms near the mouths of rivers are where most of the agricultural and urban development is concentrated. Levees constrain most estuaries and lower rivers in this DPS and prevent access to important off-channel rearing habitat. Upstream land uses increase the amount of sediment and warm water that enters low gradient streams and decreases the availability of large wood in these habitats.

The condition of NC steelhead critical habitat, specifically its ability to provide for their conservation, is degraded from conditions known to support viable salmonid populations. NMFS determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when NC steelhead were listed as threatened under the ESA, and they all continue to affect this DPS. Therefore, the condition of

NC steelhead critical habitat is improved in localized areas where restoration has occurred, but larger scale quality remains impaired.

2.2.4.4 Conservation Value of Critical Habitat
The PBFs of designated critical habitat for SONCC coho salmon, NC steelhead, and CC Chinook salmon are those accessible freshwater habitat areas that support spawning, incubation and rearing, migratory corridors free of obstruction or excessive predation, and estuarine areas with good water quality and that are free of excessive predation. Timber harvest and associated activities, road construction, urbanization and increased impervious surfaces, migration barriers, water diversions, and large dams throughout a large portion of the freshwater range of the ESUs and DPSs continue to result in habitat degradation, reduction of spawning and rearing habitats, and reduction of stream flows. The result of these continuing land management practices in many locations has limited reproductive success, reduced rearing habitat quality and quantity, and caused migration barriers to both juveniles and adults. These factors likely limit the conservation value (*i.e.*, limiting the numbers of salmonids that can be supported) of designated critical habitat within freshwater habitats at the ESU/DPS scale.

Although watershed restoration activities have improved freshwater critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability continue because the same land management practices persist in many locations.

2.2.4.5 Summary
Although watershed restoration activities have improved freshwater and estuarine critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability that resulted from historical and ongoing land management practices persist in many locations, and are limiting the conservation value of designated critical habitat within these freshwater and estuarine habitats at the ESU and DPS scales.

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area for this consultation includes the Mad River from the upstream extent of the BLR property near the City of Blue Lake, Humboldt County, California, downstream approximately 8 miles to the mouth of the Mad River at the Pacific Ocean. This includes the mouth of Powers Creek. Gravel mining at the BLR bar and associated activities are expected to affect the bed and banks of the Mad River in this location as described below in the effects of the action section (section 2.5). The location of the BLR Bar is shown in Figure 1.

This section of the Mad River is in a partially unconfined, alluvial reach that allows for gravel deposition. The lateral extent of the action area for BLR's proposed action includes the river channel, the floodplain (100-year), and the associated roads and gravel processing facilities that are outside the 100-year floodplain. The action area includes tributary mouths that enter the river in this section and downstream habitat that may be affected by gravel mining and associated activities.

Figure 1. Photographic Image of the BLR Bar and its relationship with Powers Creek and the City of Blue Lake. Photo courtesy of Google Earth.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

2.4.1 Status of Listed Species in the Action Area

The Mad River is part of the Central Coast diversity stratum for SONCC coho salmon, and the North Coastal diversity stratum for CC Chinook salmon and NC winter steelhead (Spence *et al.* 2008, Williams *et al.* 2008). In addition, the Mad River is part of the Northern Coastal/North Mountain Interior diversity stratum for NC summer steelhead. For coho salmon, CC Chinook salmon, and NC steelhead, the Mad River is identified as an area that should ultimately support a viable population (one at low risk of extinction) because these populations are expected to play a key role in recovery of the ESU or DPS. In order for an ESU or DPS to be viable and eligible for delisting, all diversity strata that make up that ESU or DPS must be viable (Spence *et al.* 2008, Williams *et al.* 2008). Given the current expected roles of each population in recovery, the Mad River must support a viable population in order for the Central Coastal and Northern Coastal diversity strata of coho salmon and Chinook salmon and NC steelhead, respectively, to be viable.

Table 2 provides a summary of the status of coho salmon, Chinook salmon, and steelhead in the action area.

Table 2. Status of the three ESA-listed salmonid species' populations found within the action area as outlined in each species recovery plans.

	SONCC Coho Salmon	**CC Chinook Salmon Fall-Run**	**NC Steelhead (Winter-Run)**	**NC Steelhead (Summer-run)**
Population within the Action Area	Mad River	Mad River	Mad River	Mad River
Diversity Stratum	Central Coastal	North Coastal	North Coastal/North Mountain Interior	North Coastal/North Mountain Interior
Role within ESU/DPS	Functionally Independent	Functionally Independent	Functionally Independent	Functionally Independent
Extinction Risk	High	Low*	Low*	High*
Depensation Threshold	Likely below	Above*	Above*	Below*
Spawner Abundance Target	9,300 adults	3,000 adults	Lower Mad River=3,200 adults Upper Mad River=6,100 adults	Effective populations size N_e>=500
Watershed Size/Potential Habitat	494 square miles 135 IP-km	494 Square miles 94 IP-km	494 Square miles Lower Mad River= 146 IP-km; Upper Mad River= 304 IP-km	494 Square miles Lower Mad River= 146 IP-km; Upper Mad River= 304 IP-km
Limiting Stresses	Altered Sediment Supply; Lack of Floodplain and Channel Structure	Estuary: Quality and Extent; Water Quality: Turbidity; Habitat Complexity: Large Wood, Shelter and Pools	Water Quality: Temperature and turbidity; Riparian Vegetation: Canopy Cover and Tree Diameter; Habitat Complexity: Large Wood	Water Quality: Temperature and turbidity; Riparian Vegetation: Canopy Cover and Tree Diameter; Habitat Complexity: Large Wood
Limiting Threats	Roads, Mining/gravel extraction	Channel Modification; roads	Channel Modification; Logging and Wood harvesting; Roads	Channel Modification; Logging and Wood harvesting; Roads

*The Multispecies Recovery Plan did not assign extinction risk categories or address depensation levels, so professional judgement was used to assign these categories to be consistent with the SONCC Coho Salmon Recovery Plan.

Actual population estimates for coho salmon, summer-and winter- steelhead, and Chinook salmon are limited to what has been collected in recent years. CDFW has been operating sonar and apportioning results to species in the Lower Mad River since 2013 using an ARIS (Adaptive Resolution Imaging Sonar) system. From August 28, 2017 to January 2, 2018, the abundance estimate for adult coho salmon was 1,575 (95% CI = 1,482 – 1,668; CV = 3.0%) (Sparkman and Holt 2020). The Mad River estimate of adult CC Chinook salmon populations using sonar for the years 2014-2018 ranged from 4,100 to 9,606 (Sparkman and Holt 2020). The number of adult winter steelhead (natural and hatchery-origin) detected per year ranged from 712 to 7,761 between fall 2014 and winter of 2018. The number of adult summer steelhead from 2014-2018 ranged between 191 and 558 (Sparkman and Holt 2020). The CDFW also differentiated fall steelhead from either summer steelhead or winter steelhead, which reduces the summer-and winter-run estimates.

2.4.2 Overview of the Mad River Watershed

The Mad River is designated critical habitat for SONCC coho salmon, CC Chinook salmon, and NC steelhead. The key limiting stresses for each species are identified above in Table 2. Timber harvest, road building, gravel mining, grazing and water diversion/impoundment are the land and water uses that have had the most pronounced effect on salmon and steelhead habitat in the Mad River basin. Much of the North Fork watershed and the lower and middle portions of the Mad River basin are owned by Green Diamond Resource Company (GDRC) and are used for timber production. Grazing occurs on large ranches throughout the Mad River basin, as well as more concentrated grazing along the reaches of the lower river and its tributaries. Most of the upper basin is part of the Six Rivers National Forest and is managed using an ecosystem-based approach that provides for resource protection under the Northwest Forest Plan (Forest Ecosystem Management Assessment Team 1993). Water quality (sediment and temperature) in the downstream action area may be affected by these activities.

The Humboldt Bay Municipal Water District (HBMWD) constructed Matthews Dam in 1961 at river mile (RM) 84 in the upper basin which created Ruth Reservoir, well upstream of historic coho salmon and Chinook salmon habitat, but it did block some steelhead habitat. The reservoir is used by HBMWD to store storm flows for release down the river and withdrawal near the Essex facility in Arcata, California for municipal and industrial use. The withdrawals are accomplished using Ranney wells approximately 50 feet below the river bottom and from a screened surface water diversion. The release of water from Ruth Reservoir provides a higher summer low flow than what occurred prior to dam construction because HBMWD needs to deliver adequate water downstream for diversion at the Essex facility. The HBMWD operations primarily impact flows during the fall and early winter when they begin capturing flows from the first storm events in the watershed above Ruth Reservoir. These lower flows may have some influence on Chinook salmon migration timing during some years when this decreased flow would result in impaired adult migration cures or reduce the depth of water for migration in the action area. Additionally, during some years, the flow hydrograph recession in the spring may result in lower flows during a short period of time when mandated river flows are less than what the natural flows would be which may influence Chinook salmon smolt outmigration timing.

Extensive instream gravel mining occurs throughout the lower Mad River; mining practices have greatly improved since the 1970s. The majority of large gravel bars on the lower mainstem Mad River between Blue Lake and Highway 299 are mined each year, and annual mining typically removes the estimated mean annual recruitment of gravel coming into the mining reach. Since gravel extraction is the focus of this Opinion, more information will be provided below.
The communities of Arcata, Blue Lake, and McKinleyville are located along the lowermost reach of the Mad River, near the mouth. Many of the impacts of urbanization are in the form of

development and associated road construction and land clearing, resulting in increased run-off, increased fine sediment, increased chemical contamination from run-off of roads and other surfaces, intrusion into the Mad River floodplain with development (*e.g*., roads, bridges, houses, and other infrastructure) that reduces the floodplain, water diversions from tributaries for agriculture and domestic uses, and establishment of homeless encampments.

The land uses described above have reduced available salmon and steelhead habitat throughout the basin. Increased sediment production from logged hill slopes and roads, especially as occurred during the 1955 and 1964 flood events, have filled the Mad River with sediment, creating chronically high turbidity levels. Although the Mad River basin has naturally high rates of sediment delivery due to unstable hill slopes prone to landslides and high rates of surface erosion, the U.S. Environmental Protection Agency (USEPA) estimated that 64 percent of total sediment delivered to streams was attributed to human and land management related activities, with roads being the dominant sediment source (USEPA 2007). In the lower Mad River and North Fork areas, total sediment loading is currently five times greater than natural sediment loading (USEPA 2007).

Compounding the increase in sediment delivery, loss of riparian vegetation has reduced shading and created a lack of instream large wood. These land uses have resulted in warm, shallow and wide instream habitat conditions that have severely impacted salmonids. Most of the basin now has forest stands of smaller diameter trees, with a greater percentage of hardwoods that provide different ecological functions than those found historically (GDRC 2006). This affects water quality (sediment and temperature) and recruitment of LWD in the action area.

Water impoundment and release for municipal diversion and hydroelectric operations has resulted in greater than naturally occurring summer flows in the action area, potentially increasing habitat availability during summer and early fall months. Screened water diversions at Essex in the lower river create minor fluctuations in the rate of flows in the summer and early fall. The impacts of this diversion are negligible in most instances. However, peak flows in the fall are dampened and this may make adult migration more difficult or may dampen the flow cues salmonids use for upstream migration.

The Mad River is listed as "Impaired" for sediment and temperature under section 303(d) of the Clean Water Act (USEPA 2007). NMFS (2014) describes stresses to the Mad River salmonid populations as: lack of floodplain and channel structure, impaired water quality, altered sediment supply, degraded riparian conditions, and altered hydrologic function. Salmonid habitat in the Mad River is generally degraded. There is excessive sediment supply coming from roads and other land disturbances, which fills pools and interferes with spawning success. Suitable instream structure, as well as off-channel habitat, is extremely limited. These habitat features are essential to rearing juveniles. Insufficient riparian cover means there is not enough large wood falling into the stream to create this structure. Degraded riparian condition also leads to impaired water temperatures due to a lack of shade. Water temperatures in the lethal to stressful range have been observed Mad River (NMFS 2014). Tributary stream flows have been adversely affected by diversion of streams and springs for rural domestic and marijuana farming (NMFS 2014).

2.4.3 Factors affecting species environment within the action area

The key limiting threats, those that most affect the viability of the population by influencing stresses, are roads and mining/gravel extraction, and timber harvest. Several other threats with somewhat lower potential to affect survival and recovery are also present in the action area, as summarized below.

Roads

Road density is very high throughout the basin, ranging from 4.4 to 6.3 miles of road per square mile in the lower Mad River and North Fork areas (USEPA 2007). Roads are a substantial source of both chronic and catastrophic sediment input to streams in the basin, affecting the quality and quantity of available salmon and steelhead habitat in the Mad River and its tributaries, including the action area. In 2007, the USEPA developed the TMDL for sediment and turbidity for the Mad River (USEPA 2007). An estimated 64 percent of the total sediment delivered to streams was attributed to human and land management-related activities, and road-related sediment contributes approximately 62 to 73 percent of the anthropogenic sediment in the basin (USEPA 2007). Additionally, roads and associated infrastructure can impinge on the floodplains reducing availability for salmonids and riparian development.

Mining/Gravel Extraction

Historic gravel extraction was very damaging to the habitat in the lower Mad River, including the action area. In response to habitat concerns, Humboldt County initiated the County of Humboldt Extraction Review Team (CHERT) in 1994. Current instream mining practices are much improved over past practices and extraction volumes have been significantly reduced. However, even with minimization measures, gravel extraction may reduce overall habitat complexity, but the magnitude of this effect is highly variable depending on the location, type, and volume of the extraction. Additionally, some appropriately placed and sized extractions (e.g., alcoves) have provided short-term enhancement of habitat complexity and value. Previously, channel enlargement has occurred in the action area (CHERT 2005, NMFS 2004, CHERT 2009, NMFS 2010) with the most pronounced and persistent enlargement at the Christie and the Johnson gravel mining sites (Figure 1). This is most likely a result of extraction exceeding replenishment rates. However, in 2010, NMFS developed and provided a strategy to manage extraction volumes to minimize and avoid damage to aquatic habitat. The strategy is based on the area of the extraction and a percentage of the recruitment that varies from year to year depending on the flow levels and duration (i.e., higher flow levels and higher duration of high flow events increases recruitment) (NMFS 2010). After discussions with stakeholders, NMFS's strategy is now used for gravel mining in the lower Mad River, including the action area. The NMFS 2020 biological opinion analyzed the effects of that mining, reaching conclusions of no jeopardy to listed species, and no adverse modification or destruction of critical habitat.

An assessment of the channel enlargement through cross section analysis for the recent 2010-2018 extraction period suggests channel enlargement has been reduced in some locations and reversed on Christie Bar during this period (Figure 2) (NMFS 2020). Johnson Bar showed continued enlargement, though this enlargement may not be directly related to mining given the reduction in mining on the Christie Bar (immediately upstream) and the Johnson Bar. Christie

Bar has aggraded where the extraction intensity is the lowest in the upper reach[1] and significantly less than the previous permit period. Cross section enlargement has been observed at the BLR Bar on the Mad River where extraction was not based on variability in estimated annual recruitment (Figure 2) (NMFS 2020). Enlargement of bars upstream of the action area in relation to higher mining intensity is indicated in Figure 2 to provide more evidence of this intensity/enlargement relationship.

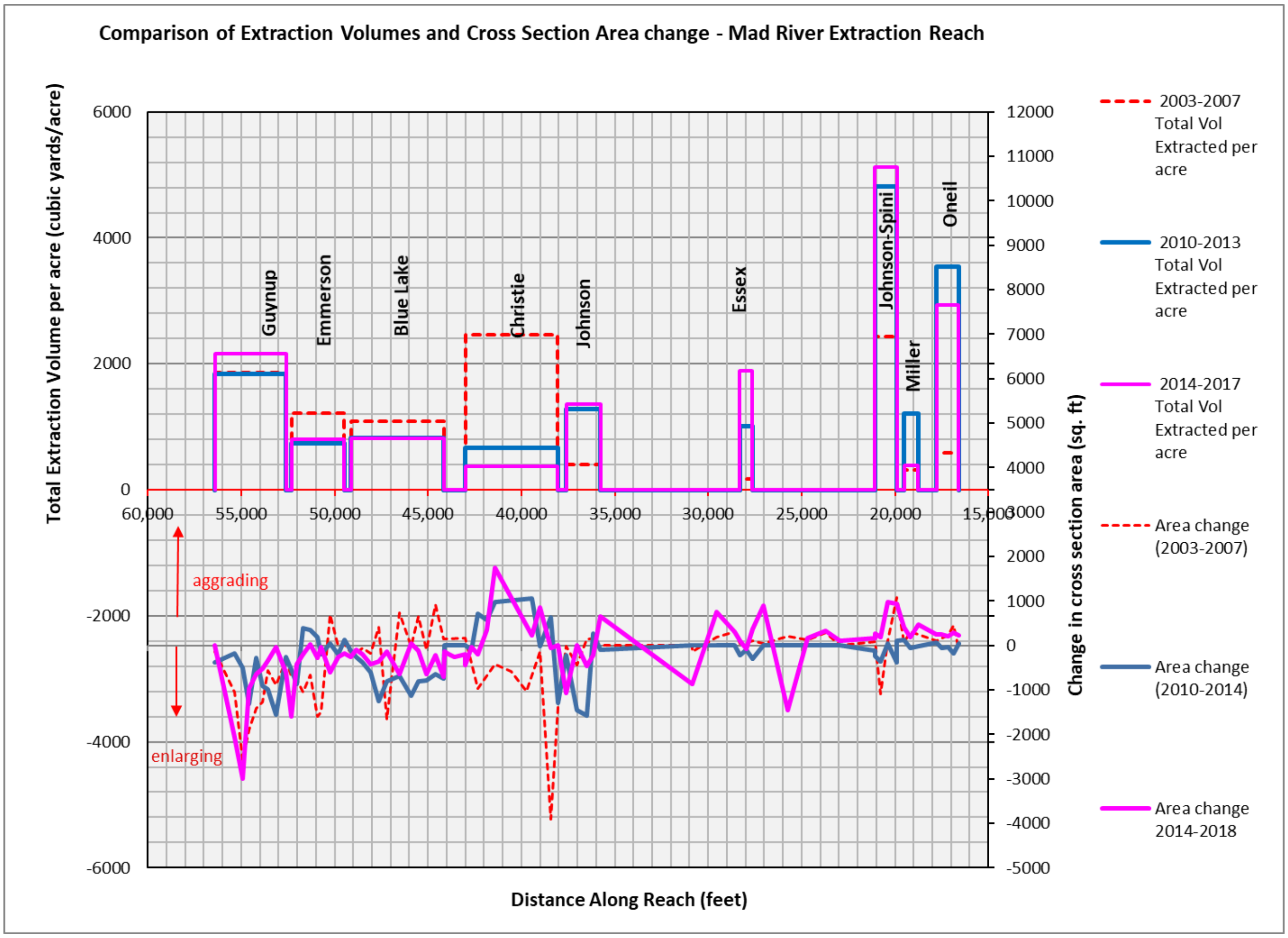

Figure 2. Comparisons of cross-section area change in the Mad River mining reach from upstream on the left to downstream on the right. The portion of the action area shown on this graph begins just below the Blue Lake Bar. The Ranceria (BLR) bar that is proposed for gravel mining is between the Blue Lake Bar and the Christie Bar. The action area extends from the Blue Lake Bar downstream past the Onell bar.

The channel enlargement observed in the past resulted in reduced channel confinement over a range of flows with less stream power to create and maintain pools and riffles, decrease in secondary, lateral flows required for efficient bar building, increased lateral channel instability (NMFS 2010), and increased riffle instability (NMFS 2004, 2010), which reduced the quality and quantity of juvenile salmonid rearing habitat and adult holding and Chinook salmon

[1] The upper reach starts at the Guynup Bar and extends downstream to just upstream of the Essex bar (see Figure 2).

spawning habitat. The implementation of the FEV strategy for managing gravel volumes and changes in extraction techniques (e.g., narrower and fewer skims) during 2010-2019 has reduced the channel instability and resulted in a more stable dynamic equilibrium in the channel. There is still some potential for enlargement at sites that may be over-extracted, or where extractions lead to channel capture or with extractions when multiple low flow years occur in succession. However, the amount of enlargement and the time for recovery is reduced under the FEV strategy.

Given the sensitivity of the channel to disturbance caused by extractions, and the use of the gravel extraction reach by salmon and steelhead, gravel extraction is a high threat to salmon and steelhead in the Mad River as described in the recovery plans for Chinook salmon, steelhead, and coho salmon (NMFS 2014, 2016). However, there is a recent trend in the recovery of habitat in the mining reach that may be attributed to some extraction techniques (Stillwater Science 2020) as a result of increased riparian growth that has resulted from implementation of floodplain extractions, reducing skimming and skim widths, short-term improvements from alcove extractions, varying the annual extraction volume based on estimated gravel recruitment in the extraction volume, and a reduction in the annual volume extracted. Stillwater Sciences (2020) compared riparian and habitat classifications from 1994, 2007, and 2018 and observed a 1.5x decrease in open bar area and a concomitant 2.3x increase in palustrine woodland acreage. Notably, most of the decrease in open bar area and increase in palustrine woodland acreage occurred between 2007 and 2018 (Stillwater Sciences 2020), which coincided with a greater focus on riparian restoration through gravel extraction, a narrowing of skim widths, and better managing gravel extraction volumes scaled to annual recruitment estimates.

Channelization/Diking

Channelization and diking presents a high threat to the Mad River population. Levees confine some the Mad River in the action area and disconnect the channel from its floodplain and wetlands, reducing the availability of off-channel winter rearing habitat and reducing the ability of the channel to meander and create new habitats.

Timber Harvest

Timber harvest is a medium to high threat to the salmon and steelhead populations in the Mad River. Many of the changes that have occurred to instream and riparian conditions in the basin reflect legacy effects of more intensive harvest from previous decades. Although current timber harvest practices are more protective of salmonid habitat than before, timber harvest likely threatens the persistence of the salmonid populations by increasing sediment yield and reducing streamside shading (and increasing water temperatures) and potential large wood recruitment. The majority of the private timberland in the Mad River basin is owned by Green Diamond and will continue to be harvested for timber. Within Green Diamond property, harvest occurs at a moderate level and under the direction of the company’s Aquatic Habitat Conservation Plan (AHCP; GDRC 2006). This plan lays out goals and objectives to minimize and mitigate effects from timber harvest through measures related to road and riparian management, slope stability, and harvesting activities. Although the private timberland is managed under an AHCP that reduces the effects of timber harvest, increased sediment yield, decreased sources of instream wood, and decreased stream shading are still expected to occur and affect conditions in the action area by increasing fine sediment, increasing water temperature, and reducing LWD recruitment.

Dams/Diversions
Dams and diversions pose a substantial threat to the Mad River salmonid populations. Dams do not block much habitat for salmonids, but they do alter river hydrology in the action area. Diversions and groundwater pumping at the HBMWD Essex facility (RM 9 to 10) cause daily flow fluctuations during summer and fall months; however, observations by NMFS staff and analysis of gage data (NMFS 2005) show negligible impacts on juvenile salmonids, with water level generally dropping no more than 0.2 feet. Due to riffle grade control, it is unlikely that the amount of available habitat is decreased for rearing coho salmon and stranding has never been documented (HBMWD and Trinity Associates 2004). Changes in flows, however, may affect migration of adults during the fall. The impoundment of the Mad River at Matthews Dam has also increased summer and fall flows throughout most of the mainstem Mad River and increased habitat availability in the action area.

Agricultural Practices
Agricultural practices pose an overall medium threat to salmonids in the Mad River watershed, including the action area. Grazing occurs throughout the basin and may contribute to increased fine sediment and to decreased riparian vegetation which affects water quality in the action area. Other agriculture, such as the cultivation of hay and irrigation of pastures and dairy operations also occurs in the lower basin. Cannabis cultivation in the Mad River watershed may also affect water quality and quantity in the action area.

High Severity Fire
Altered vegetation characteristics throughout the basin pose a moderate threat to salmonids from high severity fires. Most of the basin contains forests of small diameter trees that are close together. These types of previously logged forests burn with greater intensity than late seral forest stands, and high severity forest fires create an erosion hazard. The increased sediment yield from high severity fires would likely deliver sediment to salmonid habitat in the basin, including the action area, filling pools and reducing habitat complexity. Riparian vegetation would also be reduced or eliminated, and issues associated with inadequate riparian cover, including increased water temperatures and decreased macroinvertebrate abundance in the watershed (including the action area) would be aggravated.

Climate Change
Climate change poses a threat to salmonid populations in northern California. Although the current climate is generally cool, modeled regional average temperature shows a relatively large increase over the next 50 years (the period to which the model applies) (PRBO Conservation Science 2011). Average air temperature could increase by up to 2°C in the summer and by 1°C in winter. Annual precipitation in this area is predicted to change little over the next century. The vulnerability of the estuary and coast to sea level rise is moderate in this population. Juvenile and smolt rearing are most at risk due to increasing temperatures and changes in the amount and timing of precipitation, which will affect water quality and hydrologic function in the summer. However, some degree of protection for mainstem flows is provided by the flow augmentation from Ruth Dam. The range and degree of temperature and precipitation is likely to increase in all populations in the Mad River. Ocean acidification (Feely et al. 2008) will also likely negatively affect adult salmonids along with changes in ocean conditions and prey availability.

Urban/Residential/Industrial Development
Population growth and development, especially in the Arcata and McKinleyville area, will continue to present a medium threat to salmonids in the Mad River because it results in removal of vegetation, increased sediment delivery, introduction of exotic species, and increased landscape coverage with impervious surfaces that alters water transport on land and subsequently affects instream flows. Most of the growth within Humboldt County is in the Arcata and McKinleyville area (projected at 0.6 percent annually), resulting in more water diverted from the lower Mad River. All of these activities are expected to result in a degradation of habitat for salmonids in the action area.

Fishing and Collecting
Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any monitoring-related scientific collection, these activities pose a medium threat to adult salmonids which means that the populations will be reduced. A significant recreational fishery occurs in the lower Mad River primarily because the presence of the Mad River Hatchery, which produces winter steelhead for angler harvest. Additionally, the Mad River is very accessible by bank fishers. Chinook salmon, coho salmon, and winter and summer steelhead are all vulnerable to impacts from recreational fishing during seasons that overlap with adult presence in the Mad River. The actual impacts to these populations is currently not known because no monitoring of harvest currently occurs.

Road-Stream Crossing Barriers
Road-stream crossing barriers impede juvenile and adult salmonid migration and are considered a low threat to the population. Many of the road-stream crossing barriers in the lower Mad River and its tributaries have been addressed through culvert upgrades or other improvements (e.g., Powers Creek and Quarry Creek.

Habitat and Species Trends
The current status of habitat in the action area is improving relative to past conditions that lead to the listing of coho salmon, steelhead, and Chinook salmon in the Mad River. Timber harvest practices and road building have changed to reduce sediment inputs and increase future LWD recruitment to the stream channel. Some road systems on private timber land have been upgraded to reduce sediment. Gravel extraction practices have been changed to better control the volume of gravel extracted based on annual sediment recruitment estimates and protect the natural morphology of the stream. The lower Mad River is still influenced by levees and some sections of the river are restricted from occupying floodplains. However, localized restoration efforts including culvert replacement and other barrier removal activities, LWD enhancement, and creation of off-channel habitats will further improve conditions for listed salmon and steelhead in the Mad River.

Population monitoring of salmon and steelhead in the Mad River has been limited until recently. However, this limited monitoring suggests Chinook salmon and steelhead populations are likely increasing over previous estimates with the Chinook salmon being at or above the recovery goal of 3,000 adults and the natural steelhead population near the 9,300 escapement goal. The steelhead population has measurably improved since 2001. The abundance of the coho salmon population is still relatively unknown, but considered at high risk of extinction. However, the single population estimate in 2017 was 1,575 adult coho salmon which is significantly higher than previous estimates (Sparkman and Holt 2020).

2.4.4 Salmonid use of the Action Area

Coho salmon, Chinook salmon, and steelhead have different life history requirements and use the action area in temporally and physiologically variable ways. For example, Chinook salmon may use the action area for spawning, but steelhead and coho salmon do not, primarily because they have access to tributaries during upstream migration and they prefer the smaller substrates and lower gradients found in tributary streams. Chinook salmon fry are particularly dependent on the action area because they spawn there and finding suitable slow velocity edgewater habitat immediately upon emergence (within minutes to hours) is especially critical to their survival. Therefore, Chinook salmon fry are more dependent on the action area for rearing, but NC steelhead and coho salmon fry may also use these areas shortly (within days) after spawning after migrating out of tributaries for density dependent or other reasons. For example, some portion of the coho salmon population that exhibit a "nomads" life history strategy may rely on the action area, especially the slow-moving, inundated portions of the BLR Bar for winter rearing (Koski 2009). Most Chinook salmon juveniles outmigrate by June 30th and summer water temperatures are typically too warm in the summer to support juvenile coho salmon rearing. Steelhead juveniles may rear in the action area year around. This variability in different species and life history use of the action area is important to understand the potential effects of the action and is summarized in Table 3, below.

Table 3. Life history periodicity table for Chinook salmon, steelhead, and coho salmon in the action area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Fry/Juv				X	X	X						
Chinook Adult	X								X	X	X	X
Chinook Spawning	X									X	X	X
Steelhead Fry/Juv	X	X	X	X	X	X	X	X	X	X	X	X
Steelhead Adult	X	X	X	X	X	X				X	X	X
Steelhead Spawning	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coho Fry/Juv	X	X	X	X							X	X
Coho Adult	X	X								X	X	X
Coho Spawning	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

2.5.1 Potential Effects from Gravel Mining

Potential impacts from various types of gravel mining on fish habitat are well documented (*e.g.,* Pauley *et al.*1989, Brown *et al.* 1998). Gravel mining modifies the geomorphic features and flow hydraulics at a bar-unit scale, and impacts cascade to larger reach scales. This changes local salmonid habitat quality and quantity, potentially affecting individual NC steelhead, CC Chinook salmon, and SONCC coho salmon. For example, Brown *et al.* (1998) compared mined sites to reference reaches in gravel bed streams and found that total fish densities in pools were higher in reference reaches than in mined sites and reaches farther downstream. They also found bankfull channel widths were significantly increased at mined sites, and distance between riffles increased, resulting in fewer pools in reaches downstream of mined sites. Biomass and densities of invertebrates were higher in reference reaches. In addition, Pauley *et al.* (1989) observed changes in channel form and resultant impacts to habitat function from skimming, including: (1) decreased channel confinement, with widening and shallowing of the low flow channel and decreased water depths over riffles, which created migration barriers; (2) obliteration of side channels, resulting in reduced habitat for salmonids; and (3) channel instability at the top of skimmed bars, with an increase in the probability of redd scour.

However, the mining examined in the above studies (Pauley *et al.*1989, Brown *et al.* 1998) did not include all of the elements of the proposed action that are intended to reduce effects. In addition to information from literature, NMFS also uses studies of gravel mining in the Mad River, such as CHERT reports, and sediment recruitment estimates (*e.g.,* Knuuti 2003), and our own analysis of gravel mining in the Mad River. NMFS (2002, 2004, 2010, 2020) analyzed the Mad River gravel mining effects through: (1) cross-section area change, (2) longitudinal profile change, (3) habitat trends, 4) channel stability, (5) gravel bar disturbance and replenishment, (6) instream hydraulics, (7) water year intensity, (8) sediment recruitment, and (9) mining intensity. From these analyses, we determine the likely effects to channel morphology, salmonid habitat and salmonid individuals from the proposed action.

The likely impacts of the proposed action are discussed in detail in the sections below. The proposed in-channel gravel extraction operations and habitat improvement activities result in the following effects to listed salmonids and their habitats:

(1) Noise, motion, and vibration disturbance from equipment operation;
(2) Chemical contamination from equipment fluids;
(3) Water heating due to less streamside vegetation and shade;
(4) Spawning attraction to temporary channel crossings;

(5) Reduced passage of adults and juveniles through temporary culverts and reduced passage from riffle instability;
(6) Turbidity and sediment from connection of trenches and alcoves;
(7) Crushing during temporary channel crossing installation and removal activities;
(8) Increased stranding due to extraction;
(9) Elevated turbidity and suspended sediment from temporary and permanent road use and construction, gravel extraction, and channel crossing construction and removal:
10) Channel enlargement, channel instability, riffle instability;
(11) Reduced refuge from high water velocity and predation; and
(12) Beneficial effects to survival from habitat improvement.

2.5.1.1 Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation
Noise, motion, and vibration produced by heavy equipment operation within the vicinity of the wetted channel may disrupt migrating, spawning, or rearing salmonids at gravel mining sites. Reports from Halligan (1997, 1998, 1999) and Jensen (2000) indicate that gravel mining operations did not result in avoidance behaviors during extraction operations which occurred as close as 45 feet to the stream and on temporary bridges. However, CDFW recently observed a negative behavioral response of holding, adult Chinook salmon to adjacent extraction operations at the Essex Bar (Sparkman 2019). CDFW observed movement of holding adult Chinook salmon out of a holding pool seemingly as a result of nearby excavation activities. This disturbance could force adult Chinook salmon to crowd into other pools that may be less suitable or expose fish to increased predation risk.

In most years, the location of the channel in the action area is adjacent to a rip-rap wall with overhanging vegetation, which creates high quality adult holding habitat. This also means that a bridge would be needed to access bar deposits for mining. However, since bridge construction and use is restricted to June 30th to September 15th, we do not expect adults to be in the action area during gravel extraction when a bridge is required. If extraction (including bridge use) occurs past September 15th due to an extension, the location of the gravel mining is not expected to disturb holding or migrating adult Chinook salmon because it would be either located inland of the river or the pool would no longer be present because the Mad River wouldn't flow along the rip-rap resulting in the scour hole. Based on the lack of avoidance behaviors observed in the studies noted above, any exposed listed juvenile salmonids are likely able to hold and migrate near active gravel extraction operations, despite noise, motion, and vibration, without a negative response. Therefore, any effects from noise, motion, or vibration are expected to be negligible.

2.5.1.2 Chemical Contamination from Equipment Fluids
All operations use equipment powered by diesel fuel and lubricated by other petroleum products that are hazardous to listed salmonids. The potential for hazardous fluid spills or leaks exists, both within and outside of the wetted channel. However, given the provisions for spill response kits to be included with equipment, only small amounts of hazardous fluids are likely to leak, or be delivered to the wetted channel. Due to the small amount, coupled with dilution factors and the ability of juvenile salmonids in the action area to swim away, any effects to individuals from chemical leaks are expected to be negligible.

2.5.1.3 Water Heating Due to Less Streamside Vegetation and Shade

Shade-providing vegetation is not expected to be removed due to proposed woody riparian vegetation protection measures. Some vegetation suppression may occur where roads and extractions occur, but the amount of shade that this future vegetation would provide is limited due to the location of most extraction activities within the annually inundated channel where annual scour and deposition already affect the ability of woody vegetation to grow to sufficient size to provide shade to the low flow stream channel. Increases in riparian vegetation due to extractions intended to promote vegetation are not expected to provide shade such that river temperatures are significantly decreased. However, siting alcoves or wetted overflow extractions where localized shading occurs may provide localized reductions in solar radiation and temperature which could extend the function of these areas for salmonid rearing. Therefore, we expect that increases in water temperature due to streamside vegetation suppression will be negligible.

2.5.1.4 Spawning Attraction to Temporary Channel Crossings

Temporary channel crossings will be removed prior to September 15 each year, but may be extended to October 31 with appropriate monitoring of weather, stream flow, and adult Chinook salmon presence. Bridges will not be extended if rain is expected to result in a stage rise of 1-foot or more or if Chinook salmon are present near the bridge location. Chinook salmon typically enter the Mad River in September each year. Based on Chinook spawning timing and known spawning locations (Halligan 2003), the project timing restriction of September 15th will avoid the attraction to redd building at or near temporary bridge sites. Therefore, the risk of adverse effects to redds or adults from temporary channel crossings is negligible.

2.5.1.5 Reduced Passage of Adults and Juveniles through Temporary Culverts

Use of temporary culverts rather than temporary bridges may reduce the quality of migratory habitat by hampering or eliminating fish passage through a culvert. The Corps seldom approved culverts associated with gravel mining during the period from 1996 to 2019. Based on previous monitoring results and discussions with the Corps and BLR, NMFS anticipates that during the life of the proposed action, few, if any, culverts will be needed as temporary channel crossings, and that they would be used in secondary channels, and not in the main river channel. Because culverts will allow upstream and downstream fish passage for all life stages, impacts caused by temporary channel crossings to migratory habitat will be negligible.

We expect the minimum skim floor elevation corresponding to the 35 percent exceedance flow to provide for adequate migration depth adjacent to skim extractions. Additionally, we expect that other extraction designs will have sufficient vertical and horizontal offset from the low flow water surface elevation to provide for adequate migration depth. NMFS does not expect that the proposed action will result in migration blockages due to riffle instability.

2.5.1.6 Sediment and Turbidity from the Connection of Alcoves and Trenches

Increased turbidity would also result from the connection of a dry trench or alcove to the wetted channel. Berms are used to separate the trench or alcove from the low flow channel, and suspended sediment is allowed to settle prior to connection to the wetted channel. However, during connection of the dry trench or alcove, a small pulse of turbidity is released to the otherwise clear, low-flow river. Based on past observations of NMFS and others (Stillwater

2020, 2021) of the magnitude and duration of the pulse of turbidity associated with dry trenches and alcoves, NMFS anticipates that the turbidity will not result in temporary displacement of individual salmonids and will not result in a decrease in food for salmonids or feeding of individuals salmonids.

2.5.1.7 Crushing During Instream Temporary Crossing Installation and Removal

Temporary channel crossings and limited in-stream equipment operation are proposed between July 1 and September 15 each year, at one location per year between 2021 and 2030. Most young-of-year (YOY) Chinook salmon will avoid exposure because equipment will only operate near the end of their outmigration period. In addition, YOY Chinook salmon and YOY coho salmon typically reside in pools or deeper habitat where bridges are not constructed. Also, juvenile coho salmon and Chinook salmon and adult listed salmonids will be of sufficient size and maturity to successfully flee and avoid death or injury. Therefore, no juvenile coho salmon or Chinook salmon, or adult listed salmonids are expected to be crushed, buried, or otherwise injured by equipment. However, a small number (e.g., less than 10) YOY steelhead, based on the size of the footprint of the bridge abutments, the habitat where bridges are constructed (not in riffles or pools where most steelhead are found) would likely be injured or killed at the one temporary channel crossing location, per year for the next 10 years because they may occupy shallow areas where bridges are constructed. Redds will not be affected because redds will not be present when heavy equipment will enter the low flow wetted channel.

2.5.1.8 Increased Stranding

Gravel extraction surfaces (*i.e.*, skimmed bars, alcoves, floodplain extractions) all have an increased potential for juvenile salmonid stranding after inundation and subsequent receding flows where extracted gravel bars are left with closed undulations or depressions. The risk of stranding on extracted bars is low due to post-extraction free draining grade; any type of skimmed gravel bar must be final graded to provide a free draining surface as a way to avoid or minimize stranding.

The risk of stranding in floodplain extractions is dependent on the location and whether outlets or connections to the channel, if constructed, remain open. All floodplain excavations will have a connection to the main channel or an overflow channel, but sometimes sediment replenishment and channel morphology changes can reduce the effectiveness of drainage features of these extractions, which may result in juvenile salmonid stranding. Once trapped, the fate of juvenile salmonids likely ends in death unless adequate hyporheic flow exists to support survival. Numbers of individual juvenile Chinook salmon, coho salmon or steelhead that become trapped in floodplain excavations will depend on the percent of area disturbed by these extractions, the maintenance of the connections to watered channels, and the frequency of inundation.

Because the proposed action will not disturb more than about 10 percent of the surface area at or above the 2-5 year and 20% of the 5-10 year floodplain at any given time, we expect that low numbers of coho salmon, Chinook salmon and steelhead juveniles will be stranded and die in any given extraction at or above the 2-year floodplain. Beyond our expectation of low numbers, we cannot precisely estimate the number of juveniles that may be stranded in any given year because this number depends on the frequency of inundation of these extractions, the ability of fish to leave these extractions will vary, and the number of juveniles exposed will vary depending on the adult spawning population and reproductive success. As noted, the area restriction for these extractions will limit the number of areas that would potentially strand juveniles.

We expect that the stranding potential in floodplain extractions would be similar to stranding that would naturally occur in an unmodified river floodplain, which would contain stranding areas that are created by high flows scouring around LWD and multiple high- to moderate-flow channel development across the floodplain. There may be multiple extractions in any given year that are located at or above the 2-year floodplain, but opportunities for their construction will be limited by the areal disturbance, and by the presence of mature, woody vegetation that will be protected from extractions on floodplain surfaces. Adult salmonids are not expected to be stranded in floodplain excavations, as adult salmonids of all three species are more likely to stay within the annually inundated channel and are expected to be able to flee these areas upon detection of receding flows.

2.5.1.9 Elevated Turbidity and Sediment from Gravel Extraction Related Activities

Gravel extraction, and temporary channel crossing construction and removal loosens surface material, reduces surface particle size, and changes channel form, which will likely result in increased erosion of bars and banks and elevated turbidity and sedimentation when disturbed areas become inundated and loosened sediment is available for transport by river flow.

2.5.1.9.1 In-stream Equipment Use

In-stream equipment operations located within the wetted channel are likely to cause short-term increases in turbidity during periods of low flow in otherwise clear water. NMFS expects a maximum of one temporary channel crossing will be constructed and removed per year, for the next 10 years. Increased turbidity and sedimentation from heavy equipment entry to the wetted channel will likely interfere with respiration, reduce feeding success, and displace any listed juvenile salmonids present during the pulse of turbid water. Increased sedimentation also reduces the interstitial spaces of substrate, and decreases the habitable area for aquatic invertebrates, an important food source for juvenile salmonids (Bjornn *et al.* 1977). In addition, increased turbidity makes salmonid prey and predator detection difficult.

Temporary channel crossing construction and removal methods and instream equipment use associated with habitat improvement activities employ measures aimed to minimize the amount of fine sediment delivery and associated turbidity. Even with minimization measures, in-stream equipment use will result in short-term increases (up to 8 hours at a time) in turbidity and suspended sediment up to 500 meters downstream of the location of the activity, based on our observations of similar activities in the past, at the same or similar locations. This will result in short-term behavioral changes of primarily juvenile coho salmon and steelhead, but also including the small numbers of juvenile Chinook salmon that have not yet out-migrated or that may over-summer.

Behavioral changes include changes in feeding, predator detection, and avoidance of sediment plumes up to 100 meters downstream of the disturbance, such that the juvenile salmonids will be displaced into different habitat. Juvenile salmonids will experience these short-term behavioral changes at one crossing location per year, for the next 10 years. However, small area of disturbance and the measures for limiting fine sediment delivery will also limit exposure to individuals, and we expect that many individuals will be able to relocate to nearby areas for feeding. However, this relocation of individuals may slightly increase competition among individuals. NMFS anticipates only very small numbers of juveniles would be adversely affected.

In addition to the behavioral changes to individuals discussed above, there will be decreases in the salmonid prey base up to 500 meters downstream of the equipment disturbance due to settling of fine sediment on substrates. Settling of fine sediment on substrates reduces benthic macro-invertebrate (food) by reducing primary productivity, thereby hindering feeding opportunity for exposed juvenile listed salmonids. NMFS anticipates only very small numbers of juveniles would be adversely affected.

2.5.1.9.2 Gravel Extraction and Road Use

Chinook salmon typically spawn in the Mad River from October through January. The first winter storm events that wash over mined bars are likely to occur at the peak of the Chinook salmon spawning. Increases in turbidity and suspended sediment can also result in deposition of suspended sediment on redds, suffocating incubating eggs or embryos. Wickett (1954) showed that sediment intrusion is most damaging to young embryos in the first 30 days of incubation because this stage is less efficient at oxygen uptake. Besides inhibiting the emergence of alevins, one of the principal means by which fine sediment reduces survival of salmonid embryos is by reducing intra-gravel water flow, thereby reducing the amount of dissolved oxygen available for respiration (Bjornn and Reiser 1991).

A minimum skim floor elevation at the 35 percent exceedance flow will provide confinement of the low flow channel until the stream is transporting high levels of suspended sediment such that additional sediment coming off extraction or road surfaces is relatively minor in comparison (NMFS 2002). Therefore, listed salmonids are already responding to high suspended sediment and turbidity levels when the extraction and road surfaces are overtopped by river flow. The relatively small contribution of sediment coming off of extraction and road surfaces during the initial inundation is unlikely to result in an additional response. Therefore, exposure to increased turbidity and sedimentation as a result of extraction activities and road use above the water surface elevation of the 35 percent flow will have only minor effects to respiration and feeding success of juvenile salmonids, will not result in displacement of listed salmonids in the action area, and will not suffocate incubating eggs.

In summary, the number of juvenile salmonids that experience reduced growth and survival or otherwise injured or killed (e.g., from competition and from displacement largely due to equipment use) from increased turbidity and sedimentation is expected to be low. However, these low losses will fluctuate in number or will sometimes not occur over the ten-year permit period because of changes in volumes and extraction techniques, the single stream crossing constructed, and the variability in precipitation, ocean conditions, and the size and timing of increased sediment and turbidity. Therefore, we are using the area disturbed, a maximum of one bridge per season, and the extraction techniques as a surrogate for the number of salmonids affected by increased sediment and turbidity.

2.5.1.10 Channel enlargement, channel instability, riffle instability

As previously described, a channel enlarged by sediment removal that has outpaced sediment deposition results in decreased channel stability, with subsequent deceases in salmonid habitat quality and quantity (*e.g.,* Newport and Moyer 1974, Behnke 1990, Kanehl and Lyons 1992, Hartfield 1993, Brown *et al.* 1998, NMFS 2010), and the associated riparian habitat can deteriorate (Rivier and Seguier 1985, Sandecki 1989). Potential effects on salmonid habitat include reduced pool depth and complexity and decreased riffle quality. Localized impacts to pool and riffle habitat will likely result in decreased growth of salmonid juveniles by decreases in feeding opportunities, and increased competition between individuals of different species (Harvey and Nakamoto 1996), which can both affect size of smolts and subsequent smolt-to-adult survival (Ward and Slaney 1988, Holtby *et al.* 1990).

2.5.1.10.1 Channel Enlargement and Increased Channel Instability

As described in detail in the *Environmental Baseline* section, channel enlargement has occurred in the action area, and there is still some potential for enlargement from gravel extraction, particularly if multiple low flow years occurs. However, the amount of enlargement and the time for channel recovery will be reduced under the FEV strategy because it limits extraction amounts and the area disturbed. Several other protective measures will further reduce the potential effects to habitat and individual salmonids from channel enlargement and increased channel instability. These measures include: (1) head-of-bar buffer, (2) maximum width of skims, (3) preservation of the bar shape by avoidance of the highest portions of the gravel bar (both longitudinally and across the bar), (4) avoidance of mining adjacent to spawning riffles, and (5) limited extraction in areas above the 2-year flow level for riparian enhancement purposes. Additionally, most of the right bank adjacent to the BLR extraction area is currently armored with rip rap and unlikely to move.

A head-of-bar buffer will reduce the potential for geomorphic changes to the river from sediment extraction, as the head-of-bar buffer will remain undisturbed. With a head-of-bar buffer, we expect that channel shifting and potential widening will be reduced, but not completely eliminated. For example, in the absence of a buffer, the channel would be free to shift position across a completely mined bar feature and possibly assume a braided or very wide and shallow configuration. However, even with the undisturbed head-of-bar buffer, the channel may shift downstream of the head-of-bar into the skimmed surface or into deeper extractions like alcoves. We expect that this response will decrease with the FEV strategy and implementation of the head-of-bar buffer. In addition, avoiding the higher portions of the bar will retain the larger scale topographic features that provide hydraulic control during larger storm flows, providing additional assurance that the channel will not be subject to increased lateral instability and channel widening.

Limiting the extent of the skim width is expected to serve two purposes. First, it reduces the area over which extraction may occur and therefore lessens the immediate changes in channel width. Second, the proposed narrow skims will better conform to the overall river planform and more readily replenish during high river flows, reducing the size and duration of immediate channel enlargement caused by gravel removal. Avoiding mining adjacent to spawning riffles will also reduce the area over which extraction may occur and reduce overall disturbance.

In addition, although we expect short-duration, localized, low-flow channel enlargement to occur when low flow years occur back to back or more often, we also expect that a limited amount of extractions in the areas above the 2-year flow elevation and judicious implementation of alcove extractions and other alternative extraction techniques will help the lower active bar area to replenish and recover function. This will decrease the negative effects of temporary, low-flow channel enlargement on habitat.

As discussed in the *Environmental Baseline*, the 2010-2019 implementation of the FEV at the other mined Mad River bars is what we expect to be implemented on the BLR Bar for the 2021-2030 period. The channel cross section analysis (NMFS 2020) that showed widening at the BLR Bar (Figure 2, NMFS 2020) may not reflect the implementation of this proposed action because the FEV is expected to reduce potential extraction when recruitment is low. Therefore, we expect that implementing the FEV on the BLR Bar will reduce the potential for degradation and channel widening there and, , downstream as natural aggradation and degradation processes are more likely preserved.

Since the proposed action is designed to protect existing morphology, we do not expect that the proposed action will measurably increase channel enlargement in the action area. However, limited adverse impacts to pools and riffles from channel enlargement and an associated increase in channel instability may still occur at smaller scales, i.e. at the sites of mining activities. Only localized and short-duration channel enlargement is expected to occur; habitat will not significantly deteriorate downstream because larger channel enlargement is not anticipated. Localized impacts to pool and riffle habitat will likely result in decreased growth of salmonid juveniles by decreases in feeding opportunities, and increased competition between individuals of different species (Harvey and Nakamoto 1996), which can both affect size of smolts and subsequent smolt-to-adult survival (Ward and Slaney 1988, Holtby *et al.* 1990). We cannot precisely estimate the number of juveniles that would be injured or killed from habitat changes that result from localized channel widening because of the highly variable physical environment and highly variable fish populations. However, we expect very few juveniles will be injured or killed during the winter after skim extractions are implemented and no juveniles will be injured or killed when mining does not occur or other mining strategies are implemented (e.g., alcove extrcations). Overall, we expect that the proposed action will promote the existing channel morphology and channel stability and promote the maintenance of functioning salmonid habitat in the action area which will minimize the number of juveniles injured or killed in a localized area.

2.5.1.10.2 Increased Riffle Instability

Riffle instability from gravel mining affects spawning, migrating, and rearing habitat for listed salmonids.

Impacts to Spawning Habitat

Sediment removal can initiate channel instability that has consequence on the stability and quality of riffle habitats. There is greatest potential for riffle instability to occur if sediment removal causes channel enlargement that reduces channel confinement, or with bar skimming or instream trenching as the extraction technique. Sediment removal, particularly instream trenching, can cause bed lowering to propagate both upstream and downstream, thereby scouring spawning substrate or redds. Decreased channel stability, either through degradation or lateral migration, increases the probability of salmonid redd scour or de-watering, or decreases fry emergence by altering the channel hydraulics at redds. Bar skimming reduces bar heights, reducing channel confinement and increasing shear stress over riffles that can scour redds (NMFS 2004), until the skimmed surface is replenished.

At a stable riffle, where flow diverges, the water depth and velocity become more uniform, providing conditions conducive to the formation of well sorted patches of gravel. It is these gravel patches, combined with the gradient of the hyporheic flow field (subsurface water) that provides optimal substrates for spawning salmonids (Groot and Margolis 1991). In a disturbed river channel, where habitat is simplified and the pool-riffle sequence is less pronounced, as noted by Collins and Dunne (1990), spawning habitat quantity and quality will be reduced. Also, sediment extraction has been demonstrated to reduce the overall substrate size by removal of the armor layer. Therefore, where larger particles are in short supply, gravel extraction would likely reduce the quality of spawning habitat by reducing the size of spawning substrate needed for Chinook salmon. Also, decreased particle size due to sediment removal activities would lead to increased bed mobility and a higher likelihood of redd scour.

The BLR action area provides spawning habitat for Chinook salmon (see Table 3 above). A number of protective measures have been included in the proposed action to reduce the effects of gravel extraction on spawning habitat: (1) the FEV strategy will maximize extraction downstream of spawning habitat and will minimize channel enlargement and channel instability in the upper reach, (2) extraction will be avoided adjacent to spawning riffles in the upper reach, (3) alcoves and riparian enhancement excavations will occur, and (4) traditional, wide skimming will not be used in the upper reach. The combination of these protective measures will likely reduce impacts to spawning habitat to instances of where localized channel enlargement decreases channel confinement and alters channel hydraulics, causing a decrease in channel stability.

We expect that the quality of spawning habitat will be affected during some years in the riffle immediately below the BLR Bar, if it exists morphologically, extraction has occurred on the BLR Bar, and the proceeding winter is below average in terms of high flows and duration. Additionally, the river may move into the extraction area thereby increasing channel instability on a short-term, localized scale. In these instances, gravel extraction will increase the frequency of channel migration, thereby reducing the quality of spawning habitat. Bar skimming, in particular, promotes lateral instability and increases scour as the flow path is shortened over the skimmed bar. When bar skimming is used as the extraction technique, we expect a general decrease in substrate size over time in areas with high mining intensity. However, the removal of gravel from the BLR Bar will not likely influence the availability of suitable substrate for spawning because the supply from upstream should be adequate to maintain spawning sites and past mining has not reduced the availability of spawning habitat in the action area (Stillwater 2021). Additionally, much of the bar will remain untouched each mining season and mining will not occur when recruitment and replenishment is low.

Narrow skimming is expected to be used at the BLR Bar during times of high sediment recruitment. In years when bar skimming is used, we anticipate up to one Chinook redd will be scoured or experience reduced fry emergence each year mining occurs as a result of extraction and consequent changes in the scour and depositional environment due to changes in channel location. We assume this because only one riffle is expected to experience scour and this scour is not expected to completely destroy the riffle. Additionally, this portion of the river is not heavily used for spawning such that we expect more than a couple of redds to occur at each riffle (Stillwater 2020, 2021). The extent or probability of redds being destroyed by scour depends on the timing of hydrologic events relative to spawning and incubation timing. It also depends on the presence of redds which varies depending on flow conditions during adult migration. However, given the past timing of storms that affect the hydrology of the Mad River, there is a high likelihood that a hydrologic event with the potential to result in scour will occur during the incubation period.

Also, given the past hydrologic record, we anticipate a multiple-year low flow cycle to occur during the 10-year permit period. We also think that the proposed limits on extraction volumes will reduce the probability of channel enlargement due to over-extraction during low flows because gravel will not be extracted when estimated sediment recruitment for the river is low (<90,000 cubic yards). Therefore, we do not expect that extraction during consecutive low flow years will occur, so effects to scour potential would be minimal or nonexistent during these times

Impacts to Rearing Habitat
The shallow, swift flows over riffles are important habitats for numerous species of invertebrates, many of which are food sources for salmonids. Reductions in the quality of riffles occur by a decrease in substrate size by chronic sediment removal (especially in locations with a high density of mining and where mining out-paces sediment deposition), resulting in changes and overall reductions in macro-invertebrates, thereby decreasing food availability for rearing juvenile salmonids. Decreased food availability will result in smaller juveniles. Decreased smolt size at the time of ocean entry has been shown to decrease ocean survival, and thus reduce the abundance of returning adults (Ward and Slaney 1988, Holtby *et al.* 1990).

NMFS expects that the following measures will reduce the likelihood of riffle instability and the associated fining of riffle particle size, thus reducing impacts to rearing habitat and individual juveniles of all species: (1) the FEV strategy will reduce channel enlargement and over-extraction in the upper reach, thereby allowing particle size at riffles to coarsen; (2) the head-of-bar buffer will preserve channel confinement at riffles adjacent to the upstream end of the bar which will promote riffle stability; (3) the avoidance of mining adjacent to riffles will also promote channel confinement; (4) the minimum skim floor elevation will confine the low flow channel and promote riffle stability, and (5) extraction techniques with a habitat improvement component, such as alcoves and off-channel riparian enhancement extractions, will provide additional habitat value, such as thermal and velocity refuge, for rearing juveniles in the upper reach.

We expect up to one riffle may be affected by gravel mining at the BLR Bar, but this would not be every year and would be dependent on the morphology of the river both as a result of mining, but also as a result of natural morphological change. We expect this change to riffle habitat to primarily occur immediately downstream of the BLR Bar. This change would result in the reduction in survival of some juvenile Chinook salmon and steelhead as a result of the degradation of riffle habitat below the mined BLR Bar. Coho salmon juveniles prefer pool habitat for rearing and are unlikely to be affected by the riffle loss.

Impacts to Migration Habitat
Calculations of water surface elevation using cross sections in mined areas indicate that the 35 percent exceedance flow provides for a water depth sufficient to allow for adult salmonid migration (Mosley 1982). In an undisturbed river, 10 inches of water over the riffle crest should be sufficient to provide unimpeded fish passage because fish are observed migrating over shallower riffles with their backs above the water and few, if any Chinook salmon in the Mad River will be larger in body size such that they would be impeded. Coho salmon and steelhead in the Mad River typically migrate during higher stream flows and they are smaller than Chinook salmon. However, in disturbed channels with increased riffle instability, fish expend additional energy to migrate through simplified and reduced pool-riffle structures. Frequently disturbed rivers are often missing some of the important attributes of a natural river that allow unimpeded migration or spawning. Those attributes include channel margin complexity, bed roughness, and vegetative cover. Additional flow depth beyond the cited minimums can help offset the lack of habitat complexity.

Adult migration may be impeded through longer-term increases in channel width due to repeated sediment removal and incomplete replenishment at a site. This occurs as bars are lowered or portions of bars are removed, and stream habitat becomes less complex. The habitat simplification that occurs, as a result of sediment removal out-pacing sediment deposition, increases flat water habitat. Adult migration may be impeded if long stretches of flat water habitat occur without holding cover (Thompson 1972). As discussed previously, channel enlargement, including increases in channel width, and associated increases in flat water habitat are expected to be minimized by the FEV strategy and other protective measures.

The action area immediately adjacent to the BLR Bar typically flows along a rip-rap bank and includes high quality adult holding/migratory habitat. Thus, NMFS does not expect more than negligible delays or impacts to migrating adults as a result of the proposed action.

2.5.1.11 Reduced Refuge from High Water Velocity
Gravel extraction can alter the distribution of velocity refugia in extraction reaches. These impacts can occur through: (1) pool and channel complexity reduction, (2) decreased channel bed roughness, and (3) increased velocity at high flow.

In addition to reducing stream depths over riffles (as a result of increasing channel width), gravel removal operations increase water velocities and reduces hydraulic complexity, thereby forcing migrating salmonids to expend additional energy from their finite energy reserves used for migration and spawning. Reduced flow-field complexity and increased migratory velocities, particularly reduced edge-water eddies and low velocity zones, result from reduced sinuosity, increased channel width at bars, and reduced topographic complexity of geomorphic features, which all affect adult salmonids during their upstream migrations across riffles by increasing their energy expenditure. Juvenile salmonids, especially newly emergent fry, will also face challenges finding and using velocity refuges during high flows in simplified, hydraulically smoother channels. Based on the FEV approach, NMFS expects that suitable low velocity areas will be available in nearby areas such that most of the juvenile salmonids will be able to relocate to these areas. However, a small number of Chinook salmon fry and juveniles may perish because they are unable to locate suitable velocity refugia. Fry are particularly vulnerable within a hours of emergence from the gravel and need to find suitable low velocity areas to acclimate to river conditions outside of interstitial spaces where they resided as eggs and alevins. Steelhead and coho salmon do not use the action area for spawning so this post-emergent velocity refugia in the action area is not critical for their survival. Coho salmon and steelhead fry will use the action area when slightly older, but critical edgewater areas that are necessary for survival immediately upon emergence are not found in the action area for these species. Therefore, we do not expect a loss of steelhead or coho salmon fry or juveniles as a result of a lack of immediately-available suitable velocity refugia near extraction areas from the proposed action.

Pool and Channel Complexity Loss
Pools should provide a complex of deep, low water velocity areas, backwater eddies, and submerged structural elements that provide cover, winter holding, and flood refuge for fish (Brown and Moyle 1991). During their upstream migration, adult salmonids typically move quickly through rapids and pause for varying duration in deep holding pools (Briggs 1953, Ellis 1962, Hinch *et al.* 1996, Hinch and Bratty 2000). Holding pools provide listed salmonids with safe areas in which to rest when low flows or fatigue suppress migration. Pools are also preferred by juvenile coho salmon (Hartman 1965, McMahon 1983, Fausch 1986), the subset of Chinook salmon that over-summer, and steelhead. Steelhead also utilize riffle habitat for rearing if it is complex with velocity refuge behind cobble and small boulders (Hartman 1965, Raleigh *et al.* 1984, Hearn and Kynard 1986, Shirvell 1994). Pools with sufficient depth and size can also moderate elevated water temperatures stressful to salmonids (Matthews *et al.* 1994). Deep, thermally stratified pools with low water velocities, or connection to cool groundwater, provide important cold water refugia for cold water fish such as salmonids (Shirvell 1994.).

Most of the BLR Bar currently is adjacent to high quality holding habitat that adult salmonids use during their upstream migration. The rip-rap wall adjacent to the river channel and parallel to the bar constricts the channel and provides the scour for pool maintenance. We expect that implementing the FEV strategy will reduce the potential for over-extraction and consequent channel enlargement and the trend toward flatwater habitat. Additionally, providing a head-of-bar buffer and restricting the skim to 1/3rd of the bar width should also help maintain the necessary bar structure to maintain this important adult salmonid holding habitat. Thus, we expect little if any pool or channel complexity loss in the action area resulting from the proposed action.

Changes in Channel Bed Roughness and Increased Velocities at High flows
Reductions in exposed particle size result from the removal of overlying coarse sediments and abrasion and particle breakage caused by the passage of heavy equipment. Coastal watersheds in the action area are composed of sedimentary and low-grade metamorphic rocks. Particles that easily break into smaller particles when moving downstream and when heavy equipment crushes them dominate the coarse sediment load in these coastal streams, such as the Mad River Stillwater 2021). As a result of disrupting the natural armoring process and mechanical crushing, disturbed bar surfaces are typically finer-grained than undisturbed bar surfaces.

Areas of heavy bed armor can provide valuable fish habitat during high flows (Church *et al.* 2001) because of low near-bed velocity and productive benthic habitat whenever inundated (Bjornn *et al.* 1977). Also, riffles with coarse substrate such as cobbles provide velocity refuges for juvenile salmonids (Hartman 1965, Raleigh *et al.* 1984, Hearn and Kynard 1986, Shirvel 1994). As described previously, sediment removal, especially when large areas of gravel bars are disturbed by repeated skimming without full replenishment, results in finer substrate sizes. Finer substrate sizes results in increased bed mobility, which will result in less stable velocity refugia provided by the channel bed. The characteristic particle size distribution in the action area is largely dominated by gravel and cobble. Gravel extraction, particularly bar skimming, reduces the presence of coarse armor layer, translating to localized reductions in high-flow velocity refugia.

Gravel bars are typically inundated during most storm flows in the late fall, winter, and early spring. If a skimmed surface does not completely replenish quickly during the first storm flows above the 35% exceedance flow, then more uniform water velocity occurs over the lower, skimmed surfaces, reducing the transverse flow responsible for building the bar shape and sediment sorting. These skimmed areas would otherwise provide particle roughness and areas of low edge water velocity which are beneficial to newly emergent juvenile salmonids. Although velocity refuge is important for juveniles of all species in the action area, it is especially important near redds as newly emergent fry must find suitable rearing habitat or else they are likely to be swept downstream with consequent increases in injury and mortality. Since most of the BLR Bar is adjacent to an existing pool and the head of bar buffer and other riffle protection measures will be implemented to reduce effects and 2/3rds of the width of the bar will be protected from skimming, we only expect a small reduction in Chinook salmon fry survival (<10 fry) because of gravel mining on the BLR Bar, but most fry from any individual redd will be able to find suitable refugia.

2.5.1.12 Beneficial Effects to Habitat

We anticipate there will be benecifical effects to the environmental baseline and consequent survival of individual coho salmon, Chinook salmon, and steelhead fry and juveniles from some of the mining-related activities on the BLR Bar. We expect these improvements to the habitat to primarily occur on the BLR Bar where the mining is occurring and not extend significantly downstream to other portions of the action area. We expect that alcove construction will improve the availability and quality of low velocity fry rearing habitat. We expect that improved passage into Powers Creek will be implemented if passage is impeded by gravel depsoits which will improve fish passage conditions for steelhead and salmon and increase their survival. Finally, we believe implementation of the FEV will reduce channel widening and annual mining disturbance such that habitat conditions and consequent survival of individual salmon and steelhead fry will improve.

2.5.2 Effects to Critical Habitat

As previously described in detail in this *Effects of the Action* section, the majority of effects from the proposed action will be in the form of effects to PBFs, such that the effects to critical habitat will occur from: (1) localized instances of channel enlargement that results in reduced channel confinement and increased channel instability near the BLR Bar affecting hydraulic conditions at

Chinook salmon spawning sites and reproductive success; (2) localized instances of channel enlargement that results in fining of riffle particle size affecting food sources and feeding, and (3) increases in turbidity affecting water quality, feeding and sheltering.

We also anticipate there will be limited improvements in habitat conditions for salmon and steelhead when alcoves are constructed and fish passage into Powers Creek is maintained through extracting gravel in the Powers Creek delta. Additionally, we expect that the channel widening observed under the previous mining activities (Figure 2) as well as the level of bar disturbance will be reduced under this proposed action which will allow some recovery of functioning habitat conditions at the BLR bar.

In summary, for CC Chinook salmon and NC steelhead, and SONCC coho salmon critical habitat, the PBFs: (1) substrate, (2) water quality, (3) water velocity, (4) cover/shelter, and (5) food will only experience localized decreases in conservation value at the BLR Bar scale or immediately downstream at the first riffle during the 10 year proposed action. Also, the decrease in conservation value of the 5 PBFs is not expected to propagate to the reach scale, nor occur every year of the 10 year period because the action is limited to a single gravel bar, the volume is limited to what would be expected to replenish during variable recruitment years, and extraction is avoided during low years. We expect that there will be PBFs, such as water quantity, water temperature, safe passage conditions and salinity, within the action area that will not experience decreases in conservation value.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

We anticipate that ongoing activities related to urbanization, agriculture, forestry, and recreation (e.g., fishing) will continue to affect habitat and listed Chinook salmon, coho salmon, and steelhead survival, as described in the environmental baseline.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5), including the minimal effects identified under section 2.5.3, to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

2.7.1 Effects on SONCC Coho Salmon

2.7.1.1 Population Size

Tributaries outside of the action area are used for coho salmon spawning, but the action area provides rearing and migratory habitat for both fry and juvenile coho salmon, primarily in the winter and spring when temperatures in the action area are suitable for coho salmon. Juvenile rearing capacity is limited in tributaries, especially in years with below average precipitation when many of the tributaries have extensive reaches that lack surface flow. None of the minimal effects as described in section 2.5 are expected to add additional stress or cumulatively injure or kill coho salmon in the action area. The proposed action will result in the death or injury of a small number of fry that do not access suitable winter sheltering habitat (less than 10 fry as described in section 2.5.1.11). However, sheltering areas (*e.g.*, alcoves) will also be created under the proposed action, so any decreases in survival from the proposed action will be offset by improvements in survival for other individuals. Additionally, fry typically have high natural mortality rates so a minimal reduction in fry survival is likely to be compensated in slightly higher survival of remaining individuals such that the smolt population and adult population is unlikely to be reduced.

We also expect a small number of smolts may be smaller at ocean entry because of reduced feeding and sheltering opportunities at the juvenile life stage as a result of the proposed action. The effects of climate change, including increases in temperature, changes in precipitation patterns and amounts, and ocean conditions that result in poor survival may enhance the adverse effects of the proposed action and result in increased mortality of coho salmon. For example, reductions in growth may be more impactful to survival in the ocean when ocean conditions are poor. Additionally, the effects of sediment from the proposed action on juvenile coho salmon survival is likely increased because of sediment conditions as discussed in the environmental baseline. However, given that the smolt to adult survival rate in the ocean is less than 10 percent during the best of conditions, the small number of smolts that would have reduced survival because of reduced fitness at ocean entry will result in a negligible reduction in the number of adults that will return when factoring in all the effects of the proposed action. Therefore, the reduction in the size of the Mad River coho salmon population will be negligible.

2.7.1.2

As discussed above, the small reduction in abundance of coho salmon in the Mad River is expected to be negligible under the proposed action. The effects to habitat from the proposed action that reduce rearing success of non-natal coho salmon fry and juveniles will not result in a decrease in the number of coho salmon that return to spawn. In addition, although we expect decreases in juvenile rearing success, we expect that these reductions will be localized and will not occur every year during the 10-year permit, such that returning adults will be able to successfully reproduce and replace themselves during the 10-year permit. Therefore, the reduction in productivity of the Mad River coho salmon population is expected to be negligible.

2.7.1.3 Spatial Structure

As described above in the effects section, the proposed action will not impede the ability of coho salmon to access habitat within or outside of, the action area. Therefore, the spatial structure of the Mad River coho salmon population is not expected to be reduced. The spatial structure of the Mad River coho salmon population will slightly improve under the proposed action if access to Powers Creek is improved through extraction, which may occur under the proposed action because it occurred under the previous ten-year permit period and is a focus of restoration efforts by the BLR., We did not consider this potential enhancement action when reaching our conclusion about impacts on spatial structure or other population parameters.

2.7.1.4 Diversity

The diversity of coho salmon within the Mad River is expected to be slightly reduced by reductions in juvenile feeding and sheltering opportunities which will result in a very few injured or killed individuals that rely on over-wintering habitat in the action area. However, since these losses are minimal, phenotypic or genotypic changes are not expected, and we do not expect the small reduction in diversity to appreciably reduce the diversity of the Mad River coho salmon population.

2.7.1.5 Summary

The numbers, distribution, and reproduction of the Mad River coho salmon population are not expected to be appreciably affected by the proposed action. As noted above, any fry, juveniles, or smolts lost will likely be replaced by future spawning events and numbers in the action area are likely to increase based on the proposed action's enhancement of aquatic habitat complexity (e.g. the creation of alcoves) during the 10 year period. Thus, the viability of the Mad River population of SONCC coho salmon will not be affected to the extent that the ESU's ability to survive and recover will be appreciably reduced.

2.7.2 Effects on CC Chinook Salmon

2.7.2.1 Population Size

Our analysis of the effects indicates that the proposed action will decrease the quality of riffles, velocity refugia, and food production in the action area over the 10-year period. Additionally, some fry are expected to be stranded in extraction areas. The effects to winter rearing habitat and velocity refugia near spawning areas will result in a slight decrease in survival of fry from: 1) one redd in the action area, and 2) fry that migrate into the action area from redds in the mainstem and tributaries upstream. In some years, a small number of fry will be stranded in extraction areas and will be injured or die. However, sheltering areas (*e.g.*, alcoves) will also be created under the proposed action, so any decreases in survival from the proposed action will be offset by improvements in survival for other individuals.

NMFS expects that there will be reduction in egg-to-fry success for CC Chinook salmon during some years primarily because of hydraulic changes at one riffle immediately downstream of the BLR Bar because of redd scour, changes in the lateral course of the river, and sedimentation. We expect that the reduction in the number of juvenile Chinook salmon that eventually migrate to the ocean will be negligible as the reduction in egg-to-fry success will be small, localized to the one redd, and will not occur every year of the 10-year period. We also expect a small number of smolts may be smaller at ocean entry because of reduced juvenile feeding and sheltering opportunities as a result of the proposed action which will reduce their survival to adult (Zabel and Achord 2004).

The effects of climate change, including increases in temperature, changes in precipitation patterns and amounts, and ocean conditions that result in poor survival may enhance the adverse effects of the proposed action and result in increased mortality of Chinook salmon. For example, reductions in growth may be more impactful to survival in the ocean when ocean conditions are poor. Additionally, the effects of turbidity and sediment from the proposed action on juvenile Chinook salmon survival is likely increased because of high turbidity and suspended sediment conditions as discussed in the environmental baseline. However, given that the smolt to adult survival rate in the ocean is less than 10 percent during the best of conditions, the small number of smolts that would have reduced survival because of reduced fitness at ocean entry will result in a negligible reduction in the number of adults that will return. For example, if 90 smolts enter the ocean under the proposed action with high fitness, but 100 smolts with high fitness would have entered absent the proposed action, at a 10% return rate that would equate to the loss of 1 adult return. This example assumes a 10% reduction in the fitness, and thus survival, of the Chinook salmon population, which is much higher than what we would expect from the proposed action, which affects the fitness of less than 1% of the population (due to the very small and localized project-related disturbance area compared to the rest of the spawning habitat in the watershed). Therefore, although we expect a slight reduction in the number of fry and juveniles that will survive as a result of the action, we do not expect an appreciable reduction in the number of returning adults in the CC Chinook salmon population.

2.7.2.2 Population Productivity

As discussed above, the proposed action is expected to primarily reduce the survival of eggs and fry and affect juvenile feeding, sheltering and ocean survival. However, the reduction in the number of smolts that survive and enter the ocean is expected to be small and not appreciably reduce the number of returning adults. In addition, although we expect a small reduction in the survival of eggs and fry and decreases in juvenile feeding and sheltering opportunities, we expect that these reductions will be localized and will not occur every year during the 10-year permit, such that returning adults will be able to successfully reproduce and replace themselves during the 10-year permit. Under the previous ten-year mining period and a more impactful (i.e., no FEV strategy) proposed action, the Mad River Chinook salmon population was able to respond to improved ocean, river, and tributary habitat conditions such that the population exceeded recovery targets. We believe this shows that Chinook salmon productivity is not affected by the proposed action such that the Mad River population cannot survive and recover if the baseline continues to improve as a result of regulation of other activities and implementation of habitat restoration actions. Climate change and ocean productivity declines will continue to affect the productivity of Chinook salmon in the Mad River and the ESU regardless of implementation of the proposed action. Therefore, we do not expect the slight reduction in productivity from the proposed action will measurably affect the productivity of the Mad River Chinook salmon population.

2.7.2.3 Spatial Structure
The proposed action will not reduce access to Powers Creek or other areas currently available to the Mad River Chinook salmon population. Therefore, the spatial structure of the Chinook salmon population is not expected to be reduced. As noted, the proposed action may increase access to Powers creek if this enhancement action is implemented. We did not consider this potential enhancement action when reaching our conclusion about impacts on spatial structure or other population parameters.

2.7.2.4 Diversity
The diversity of Chinook salmon within the Mad River is expected to be slightly reduced by the reduction in egg and fry survival and reductions in juvenile feeding and sheltering opportunities. However, since phenotypic or genotypic changes are not expected, we do not expect the small reduction in diversity to appreciably reduce the diversity of the Mad River Chinook salmon population.

2.7.2.5 Summary
The Mad River CC Chinook salmon population is an independent population in the CC Chinook salmon ESU. Although we expect a decrease in the survival of eggs and fry, and reduced juvenile feeding and sheltering, we do not expect that these reductions will result in an appreciable reduction to the likelihood of survival and recovery of the Mad River CC Chinook salmon population. Under a similar proposed action over the previous ten years, adult Chinook salmon numbers have increased in some years such that recovery targets have been exceeded. We believe this shows that Chinook salmon productivity is not affected by the proposed action such that the Mad River population and ESU cannot survive and recover if the baseline continues to improve as a result of regulation of other activities, and the proposed action which will assist with the recovery of salmonid habitat at and near the BLR, including the bar creation of alcoves. Climate change and ocean productivity declines will continue to affect the productivity of Chinook salmon in the Mad River and the ESU in some years regardless of the proposed action. Therefore, the viability of the Mad River population of CC Chinook salmon will not be affected to the extent that the ESU's ability to survive and recover will be appreciably reduced.

2.7.3 Effects on NC Steelhead
The Mad River includes two populations of NC steelhead that will be affected by the proposed action; summer-run and winter-run steelhead. However, NMFS assumes that individuals from each population will have the same response to the proposed action. Therefore, the assessment below is for each population.

2.7.3.1 Population Size
The proposed action will primarily affect juveniles of all age classes (age 0+, 1+, and 2+) by reducing the quality of rearing habitat which reduces the number of individuals that the habitat can support (*i.e.,*., feeding, sheltering which would increase competition) and also reduces the function of the habitat which will reduce the fitness and consequent survival of individuals. We expect this to result in injury or death of only a small number of the 0+ age class because older, and larger fish in 1+ and 2+ age classes will be able to effectively compete and survive under the affected habitat conditions. In addition, the proposed single bridge construction is expected to result in the death or injury of a small number of age 0+ steelhead each year. This small loss of

age 0+ steelhead translates into a negligible decrease in the number of smolts that enter the ocean, and no reduction in returning spawning adults. Natural-origin smolts are typically 2+ years old, so a loss of a few 0+ steelhead is unlikely to translate into a reduction in the number of returning adult steelhead. The effects of climate change, including increases in temperature, changes in precipitation patterns and amounts, and ocean conditions that result in poor survival may enhance the adverse effects of the proposed action and result in increased mortality of juvenile steelhead. For example, reductions in growth may be more impactful to survival in the ocean when ocean conditions are poor. Additionally, the effects of turbidity and sediment from the proposed action on juvenile steelhead survival is likely increased because of high turbidity and suspended sediment conditions as discussed in the environmental baseline.

However, given the availability of adequate rearing habitat in other portions of the Mad River watershed and the juvenile steelhead production that occurs in the watershed, it is unlikely that the small reduction in the numbers of juvenile steelhead as a result of implementing the proposed action would appreciably reduce the size of the Mad River steelhead population. Sheltering areas (*e.g.*, alcoves) will also be created under the proposed action, so any decreases in survival from the proposed action will be offset by improvements in survival for other individuals. In addition, the size of the adult steelhead population seems to be able to respond to improved ocean and freshwater conditions under a similar proposed action that occurred the last ten years (2009-2019). Therefore, NMFS expects that proposed action will not appreciably reduce the NC steelhead population size in the Mad River, diversity stratum, or DPS.

2.7.3.2 Population Productivity

The productivity of the populations is not expected to be reduced because the number of adult steelhead returning is not expected to be appreciably reduced. The negligible reduction in population productivity is expected to be spread among both of the affected steelhead populations in the Mad River and not translate into discernible reductions in adult numbers. Summer and winter steelhead rely on the action area for the same life history requirements and, therefore, are also affected by the proposed action in similar ways. Under the previous ten-year mining period and a slightly more impactful proposed action, the Mad River winter steelhead population was able to respond to improved ocean, river, and tributary habitat conditions such that the population approached recovery targets. This suggests a limited affect from gravel mining on steelhead populations.

The summer steelhead population is significantly below depensation levels so its ability to respond to positive, natural environmental conditions in the ocean and Mad River watershed is limited regardless of the effects of the proposed action. We believe this shows that summer or winter steelhead productivity is not affected by the proposed action such that the Mad River population cannot survive and recover if the baseline continues to improve as a result of regulation of other activities and implementation of habitat restoration actions that benefit both winter and summer steelhead populations. Climate change and ocean productivity declines will continue to affect the productivity of steelhead in the Mad River regardless of implementation of the proposed action. Therefore, the productivity of the DPS is not expected to be reduced to the extent that the DPS's ability to survive and recover will be appreciably reduced.

2.7.3.3 Spatial Structure

Although two NC steelhead populations are affected, it is unlikely that both populations will be affected to the extent that adult escapement is reduced during every year of the 10-year permit. In addition, the proposed action will not reduce access to habitats currently available to the Mad River steelhead populations (e.g., Powers Creek). Therefore, the spatial structure of the steelhead populations is not expected to be reduced. As noted, the proposed action may increase access to Powers creek if this enhancement action is implemented. We did not consider this potential enhancement action when reaching our conclusion about impacts on spatial structure or other population parameters.

2.7.3.4 Diversity

Recent genetic analysis of summer steelhead suggests that the genes for expression of this phenotype exist in all steelhead, but its expression is dependent on other unknown factors that may have changed such that expression of the winter-run type dominates (Arciniega et al. 2016). We do not think that the effects of gravel mining will affect expression of the summer-run phenotype. Since phenotypic or genotypic changes are not expected, the diversity of affected steelhead populations is not expected to be reduced by the loss of a negligible number of adult steelhead during the 10-year permit.

2.7.3.5 Summary

The viability of the winter and summer populations of steelhead that use the action area will not be diminished because we do not expect a decrease in adults as a result of gravel mining and its reduction in the 0+ juvenile steelhead population of a few individuals. We also expect any decrease in 0+ juveniles will be ameliorated by the increased productivity of the winter-run steelhead population because of continual improvements to the baseline from changes in forestry practices, increased regulation of stream diversions and cannabis production, improvements in fish passage, habitat restoration actions, and consistent and higher mainstem flows from operations of Mathews Dam in coordination with the HBMWD, which results in increases in summer flows upstream of the HBMWD diversion point in Arcata, California.

Under a similar proposed action over the previous ten years, adult winter-run steelhead numbers have increased significantly in some years. We believe this shows that steelhead productivity is not affected by the proposed action such that the Mad River population and ESU cannot survive and recover if the baseline continues to improve as a result of regulation of other activities and construction of alcoves and recovery of the BLR Bar from previous mining. Climate change and ocean productivity declines will continue to affect the productivity of steelhead, especially summer steelhead, in the Mad River and the ESU. However, climate change and ocean productivity will continue to influence the productivity of Mad River steelhead populations regardless of the implementation of the proposed action. Therefore, a decrease in the viability of the NC steelhead DPS is not expected as a result of the proposed action. Overall, the numbers of spawners are not expected to be appreciably reduced to the extent that reductions in the populations' likelihood of survival and recovery would be expected to reduce the likelihood of survival and recovery of the species at the DPS level.

2.7.4 Effects on Critical Habitat

NMFS approaches its "destruction and adverse modification determinations" by examining the effects of actions on the *conservation value* of the designated critical habitat; that is, the value of the critical habitat for the conservation of threatened or endangered species. We expect the effects of the action to include: (1) localized instances of channel enlargement that results in reduced channel confinement and increased channel instability near the BLR Bar affecting hydraulic conditions at Chinook salmon spawning sites and reproductive success; (2) localized instances of channel enlargement that results in fining of riffle particle size affecting food sources and feeding, and (3) increases in turbidity affecting water quality, feeding and sheltering.

2.7.4.1 SONCC Coho Salmon Critical Habitat

The action area is critical for the conservation of the Mad River population of SONCC coho salmon because all juveniles must use the action area during a portion of their freshwater life stage.

The localized decreases in conservation value of PBFs within the action area will not limit the ability of the Mad River SONCC coho salmon population to respond to favorable ocean conditions and/or improved PBFs outside of the action area. NMFS believes that the proposed action will result in overall habitat conditions in the action area that will support an increase in the population of SONCC coho salmon because the population has positively responded to improvements in the habitat baseline and other regulatory actions. Additionally, habitat in the action area improved under implementation the 2010-2019 opinion, and we expect more improvement to occur with the change to managing gravel volumes using the FEV. Therefore, NMFS believes that the proposed action, after factoring in the baseline, status, and cumulative effects, will not appreciably reduce the conservation value of SONCC coho salmon critical habitat in the action area or for the entire designation for the species.

2.7.4.2 CC Chinook Salmon Critical Habitat

The action area includes approximately 2 miles of spawning habitat for CC Chinook salmon. This area is important for the early spawning component of the Mad River Chinook salmon population because spawning typically commences prior to the onset of fall rains, but is especially important during years when fall and early winter rainfall is low, which impedes access to spawning habitat in tributaries and farther upstream on the Mad River. We expect later arriving and spawning Chinook salmon to move into tributaries and upstream mainstem areas after significant rainfall occurs. In addition, all juvenile and adult Chinook salmon must migrate and rear within the action area during significant portions of their freshwater life stages. Therefore, the Mad River action area is essential for the conservation of the Mad River population of CC Chinook salmon.

NMFS expects that implementation of the proposed action will result in a decrease in Chinook salmon spawning habitat quality and quantity. However, this decrease is not expected to result in a significant decrease in the conservation value of the action area because the effects are limited spatially to a single riffle, it will not affect every redd that may be constructed in that riffle, and it will not occur each year. Low velocity refugia during critical winter and spring rearing periods are expected to be reduced, but this habitat is not currently limiting in the action area, so this reduction is not expected to significantly decrease the conservation value of the action area.

Additionally, construction of alcoves and increases in riparian habitat will increase low velocity habitat.

In addition, the localized decreases in conservation value of PBFs within the action area will not limit the ability of the Mad River CC Chinook salmon population to respond to favorable ocean conditions and/or improved PBFs outside of the action area. NMFS believes that the proposed action will result overall in habitat conditions in the action area that will support an increase in the populations of CC Chinook salmon because the population has positively responded to improvements in the habitat baseline and other regulatory actions. Additionally, habitat in the action area improved under implementation of a similar proposed action from 2010-2019. Therefore, NMFS believes that the proposed action, after factoring in the baseline, status, and cumulative effects, will not appreciably reduce the conservation value of CC Chinook salmon critical habitat in the action area or for the entire designation for the species.

2.7.4.3 NC Steelhead Critical Habitat

The action area is critical to the conservation of Mad River steelhead populations because many individuals of these populations must pass and spend time feeding and sheltering in the action area prior to ocean entry. The proposed action is expected to decrease the conservation value of some of the PBFs in a limited portion of the action area. However, the decrease in conservation value is expected to be localized to the individual site scale, not expected to propagate to the reach scale, and not expected to occur every year of the 10-year proposed action. We expect that there will be critical habitat within the action area that will not experience decreases in conservation value and will increase with increases in riparian vegetation and the creation of alcoves. Additionally, the proposed action may increase access to Powers creek if this enhancement action is implemented. We did not consider this potential enhancement action when reaching our conclusion about impacts on spatial structure or other population parameters.

In addition, the localized decreases in conservation value of PBFs within the action area will not limit the ability of the Mad River NC steelhead populations to respond to favorable ocean conditions and/or improved PBFs outside of the action area. NMFS believes that the proposed action will result in overall habitat conditions in the action area that will support an increase in the populations of NC steelhead because populations have positively responded to improvements in the habitat baseline and other regulatory actions. Additionally, habitat in the action area improved under implementation of a similar proposed action from 2010-2019. Therefore, NMFS believes that the proposed action, after factoring in the baseline, status, and cumulative effects, will not appreciably reduce the conservation value of NC steelhead critical habitat in the action area or for the entire designation for the species.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of SONCC coho salmon, CC Chinook salmon, or NC Steelhead and is not likely to destroy or adversely modify their designated critical habitats.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur from crushing resulting in injury or death during temporary channel crossing construction, channel enlargement and instability which reduces the survival of eggs and fry, increased stranding in extraction areas which results in death, elevated sediment, and reduced winter refugia which results in lower growth and survival. NMFS expects that up to 10 NC steelhead juveniles each year may be killed during heavy equipment use while constructing and removing the single stream crossing. All eggs and/or fry in up to one Chinook salmon redd near the BLR Bar may be killed by scour from increased channel enlargement and instability each year. Approximately 10 steelhead, Chinook, and coho fry each year that mining occurs may be killed because of a reduction in winter refugia habitat.

It is not possible to quantify the amount of individual juvenile coho salmon, Chinook salmon, and steelhead injured or killed as a result of stranding in extraction areas, elevated turbidity, and channel enlargement and instability because it is not possible to meaningfully measure the number of juvenile coho salmon, Chinook salmon, and steelhead that use the action area during the winter when effects would occur and locating small, dead fish is practically impossible due to predation, decomposition, and poor water visibility. In addition, juvenile distribution is not even across the action area, making it difficult to estimate the number of fish. When NMFS cannot quantify the amount or extent of incidental take in terms of the numbers of individuals, NMFS uses surrogates to estimate the amount or extent of incidental take.

Therefore, we use the FEV allocation for a particular year as an overall surrogate for take from increased stranding in extraction areas, elevated turbidity, and channel enlargement and instability. For example, we expect that the annual FEV amount will be equal or less than 3.06% of the total annual recruitment volume. If this amount is exceeded, reinitiation of consultation would likely be needed. Additional surrogates are used as well. The take surrogates for stranding are the limits to the floodplain extraction locations and total areal percent of extractions in the floodplain as described in the Proposed Action. Specifically, the take surrogates for stranding of coho salmon, Chinook salmon, and steelhead juveniles would be exceeded if more than one floodplain extraction of up to 10% of the 2 to 5 year floodplain and up to 20% of the 5 to 10 year floodplain are extracted in the BLR property until the applicable floodplain area replenishes or if the channel migrates into the applicable 2 to 5 year and/or 5 to 10 year floodplain area. If these surrogates are exceeded, reinitiation of consultation would likely be needed.

2.9.2 Effect of the Take

In the biological Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). In order to be exempt from the prohibitions of section 9 of the ESA, the federal agency and applicant must comply with the terms and conditions necessary for carry out the reasonable and prudent measures.

NMFS considers that the following reasonable and prudent measures are necessary and appropriate to minimize take of SONCC coho salmon, CC Chinook salmon and NC steelhead. The Corps shall:

1. Report updates on the annual FEV.
2. Ensure that extractions minimize the stranding of fish.
3. Ensure that the monitoring necessary to track channel enlargement and instability, and stranding in the action area resulting from the proposed action is completed in a timely manner so that future changes to implementation under adaptive management to reduce effects can be quickly evaluated to ensure impacts are as expected.

2.9.4 Terms and Conditions

The Corps or any applicant must comply with the terms and conditions described below in order to implement the RPMs (50 CFR 402.14). The Corps or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

The following terms and conditions implement reasonable and prudent measure 1:

The Corps shall require the BLR to annually update the FEV volume calculator with the current water year daily flow information, with input from NMFS, by May 15 of each year and provide the resultant gravel volume allocation to NMFS. Adjustments to the FEV sediment volume can be made if high flows occur after May 15. The results of the FEV update will be provided to NMFS by May 31 of each year.

The following terms and conditions implement reasonable and prudent measure 2:

The Corps shall require BLR or their consultants to assess extractions that may strand fish (e.g., alcoves and floodplain extractions) for stranding in the spring of each year following extraction. NMFS shall be contacted if stranded fish are observed.

The following terms and conditions implement reasonable and prudent measure 3:

A. The Corps shall ensure that the BLR categorizes the appropriate floodplain zone of any proposed floodplain extractions (e.g., using either hydraulic modeling or direct observation and marking of each flow level representing the 2-5 year and 5-10 year flood zones) prior to approving those floodplain extractions.
B. The Corps shall ensure that all required monitoring cross section data for the previous year is be provided to NMFS prior to the Corps approving the annual extraction.
C. The Corps shall ensure that spring aerial photos and monitoring cross sections that include the previous year's extractions and the 35% exceedance flow elevation are provided at least one day prior to the pre-extraction field review. Monitoring cross sections for the field review shall span the 100-year flow channel and include the wetted channel unless the river is too high for safe surveying.
D. Ensure that annual extraction monitoring reports follow data format and standards in the Gravel Extraction Monitoring Guidelines and are provided to NMFS each year by December 31. Reports shall be submitted to:

North Coast Branch Supervisor
National Marine Fisheries Service
1655 Heindon Road
Arcata, California 95521

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1) The Corps should work with NMFS and the BLR to develop a rapid method for documenting changes in habitat in the action area.
2) The Corps should work NMFS and the BLR to develop new sediment recruitment estimates for the Mad River.
3) The Corps should work with the BLR to provide NMFS a running list of extractions for the site with annual notes on the river changes at the site until full replenishment.
4) The Corps should work with NMFS and the BLR to analyze cross sections every year to assess the change in area comparable to the previous cross-section analysis (NMFS 2020).

2.11 Reinitiation of Consultation

This concludes formal consultation for the BLR gravel mining permit for the 2021-2030, period. As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.12 "Not Likely to Adversely Affect" Determination for Southern DPS Eulachon

Threatened Southern DPS of Eulachon (*Thaleichthys pacificus*)

Listing determination (75 FR 13012, March 18, 2010)

Critical Habitat Designation (76 FR 65323, October 20, 2011).

NMFS concurs with the Corps' determination that the proposed action is not likely to adversely affect Southern DPS eulachon due to their extremely unlikely, and therefore discountable, occurrence in the action area during in-water project activities. Southern DPS eulachon complete their freshwater life history during winter and early spring when project activities will not impact them. Additionally, critical habitat for Southern DPS eulachon is not expected to be adversely affected because any fine sediment increases are likely to be gone by the time eulachon migrate into the action area to spawn. Eulachon are broadcast spawners so they don't require stable riffles or an absence of scour to protect eggs. Therefore, local geomorphological changes as a result of the BLR's mining proposal are not expected to reduce the spawning success of eulachon if they spawn near the BLR Bar on the Mad River.

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

HAPCs for salmon affected by the Project are: complex channel and floodplain habitat, as described in the Pacific Salmon FMP.

3.2 Adverse Effects on Essential Fish Habitat

The adverse effects to EFH from the proposed action are included in the effects of the action section of this Opinion. These include localized decreases in substrate size, changes in the geomorphology of the river from gravel extraction, and localized increases in fine sediment and turbidity.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS has no additional conservation recommendations for EFH. NMFS believes that the proposed action contains appropriate measures that would minimize the adverse effects to Pacific Coast salmon EFH. Thus NMFS has no EFH Conservation Recommendations at this time.

3.4 Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that effects the basis for NMFS' EFH Conservation Recommendations (50 CFR600.920(1)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this Opinion is the Corps. Other interested users could include the County of Humboldt and the gravel miners. Individual copies of this Opinion were provided to the Corps. The format and naming the document adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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