THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Fish and Game
DIVISIONS OF SPORT FISH & COMMERCIAL FISHERIES
351 Research Ct.
Kodiak, AK 99615
Main: 907.486.1825
Fax: 907.486.1841

MEMORANDUM

TO: Sam Rabung, Director
Division of Commercial Fisheries

Dave Rutz, Director
Division of Sport Fish

Through: Nick Sagalkin, Regional Supervisor
Division of Commercial Fisheries, Region IV

Tom Vania, Regional Supervisor
Division of Sport Fish, Region II

From: Kevin Schaberg, Regional Research Supervisor
Division of Commercial Fisheries, Region IV

Timothy McKinley, Regional Research Coordinator
Division of Sport Fish, Region II

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Subject: Chignik and Alaska Peninsula/Aleutian Islands Management Areas Escapement Goal Review

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The purpose of this memorandum is to inform you of the results from the escapement goal analyses for Area L (Chignik Management Area) and Area M (Alaska Peninsula and Aleutian Islands Management Area). The *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223) recognizes the establishment of salmon escapement goals as a joint responsibility of the Alaska Department of Fish and Game (department) and the Alaska Board of Fisheries (board) and describes the concepts, criteria, and procedures for establishing and modifying salmon escapement goals. Under the policy, the board recognizes and describes the department's responsibility for establishing and modifying biological escapement goals (BEG) and sustainable escapement goals (SEG).

Starting in October 2020, an interdivisional team from the Commercial Fisheries and Sport Fish divisions met to review existing Pacific salmon *Oncorhynchus* spp. escapement goals for Area L and Area M. The team met in February 2022 to discuss Area L analyses revisited with the

addition of new data for Chignik sockeye salmon. The team has reached consensus on all revisions outlined below.

Three important terms defined in the *Policy for the Management of Sustainable Salmon Fisheries* are:

- *biological escapement goal* (BEG): the escapement that provides the greatest potential for maximum sustained yield (MSY); and
- *sustainable escapement goal* (SEG): a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5 to 10-year period, used in situations where a BEG cannot be estimated or managed for; and
- *inriver run goal* (IRRG): a specific management objective for salmon stocks that are subject to harvest upstream of the point where escapement is estimated; the inriver run goal will be set in regulation by the board and is comprised of the SEG, or BEG, plus specific allocations to inriver fisheries.

The review team determined the appropriate goal type for each stock with an existing goal, based on the quality and quantity of available data, and then determined the most appropriate methods to evaluate the escapement goal. If a sufficient time series of escapement and total return estimates was available and the data contained sufficient information to provide a scientifically defensible, accurate estimate of the spawning escapement with the greatest potential to produce maximum sustained yield (S_{MSY}), then the data were considered sufficient to attempt to develop a BEG. Methods used to develop BEGs included spawner-recruit, yield, zooplankton biomass and euphotic volume analyses (Munro 2018). If return estimates were not available or the data were not sufficient to estimate S_{MSY}, the data were used to establish an SEG. Methods used to develop SEGs included the percentile approach as described by Clark et al. (2014).

Following these analyses, the team estimated escapement goals for each stock, compared these estimates with the current goal, and agreed to either keep the current goal, change the goal, or eliminate the goal.

The previous escapement goal review for Areas L and M occurred in 2018 (Schaberg et al. 2019a and 2019b). For the 2020 review, 3 additional years (2018–2020) of data (Table 2) were considered. Based on these new data, the team determined if there was enough new information to review existing goals or create new goals for systems that do not have goals. If new information indicated review was necessary, we determined which type of goal was most appropriate and conducted the analysis indicated by the data quality and type of goal. The team did not identify any systems suitable for creating new goals, and only systems with goals currently in place were further considered.

AREA L (CHIGNIK MANAGEMENT AREA)

King Salmon

The team determined the Chignik River king salmon goal did not warrant review as it was investigated in the last cycle and the new data were in the range of previous years. The team found no change was warranted to the current BEG of 1,300 to 2,700 fish (Table 1).

Sockeye Salmon

The team discussed and advised discontinuing separate escapement goals for the early and late runs in favor of a single Chignik River sockeye salmon escapement goal. Analyses of new information indicated notable changes to the rearing habitat and life history strategies of Chignik River sockeye salmon. Specifically, at the Black Lake Workshop hosted by the U.S. Army Corp of Engineers (USACE), November 3-4, 2021, the USACE revealed that the Chignik River watershed had stabilized around the year 2000. Studies initiated in 2011 identified that climate drives rearing early-run juvenile sockeye salmon from Black Lake, to rear throughout the entire watershed (Walsworth et al. 2015, Walsworth et al. 2020), with late-run juveniles outcompeting early-run juveniles when both overlap rearing in Chignik Lake (Griffiths et al. 2013). With watershed morphology stabilized and greater variability in recent climatic conditions, it is unlikely that the utilization of the entire watershed by early-run juvenile sockeye salmon will change. Spawner-recruit relationships indicate increased density dependence and lower productivity for both runs since watershed stabilization, suggesting the adaptive rearing strategies of early-run juveniles may have increased intraspecific competition in Chignik Lake, and possibly throughout lower reaches of the watershed, systemically influencing productivity. The team found a single Chignik River sockeye salmon escapement goal would accurately reflect productivity affected by broadscale freshwater habitat use and increased mixed-stock interactions by Chignik River sockeye salmon. Further, a single escapement goal addresses the limited rearing capacity of Chignik Lake, which supports both early- and late-run juveniles and would simplify management during the traditional "overlap" period.

Bayesian Ricker models were fit in the Pacific Salmon Escapement Goal Analysis (PSEGA) application (Hamazaki 2022). Zooplankton biomass (ZB) and Euphotic Volume (EV) models were also examined. Chignik River sockeye salmon catch, escapement, and age data were recently audited from 1983 to the present; although a longer time series of catch and escapement data exist, daily age composition data are only available for those years. Thus, only data from 1983 to 2013 were used in the analyses. Analyses were initially done using the full data set (1983–2013 brood year data) for each run separately and data from both runs combined. The team also examined a shorter time series of brood year data (1998–2013) to examine stock productivity potentially impacted by watershed stabilization and more recent observations of increased stock interactions.

The team found revising the two separate Chignik River sockeye salmon escapement goals to a single BEG of 450,000 to 800,00 fish was appropriate. Results from both time series of data were used for this escapement goal analysis. The revised lower bound of 450,000 fish is based on the estimate of S_{MSY} of 500,700 fish using the 1998–2013 time series: these lower production years may be more indicative of conditions that will be encountered in the near future. Using the 1998–2013 time series, the lower bound of 450,000 fish is also estimated to provide, on average, a 90% probability of achieving 80% of MSY for the overall run and supported by the ZB model lower bound of 448,096 fish for Chignik Lake where juvenile early- and late-run fish rear together. The revised upper bound of 800,000 aligns with the estimate of S_{MSY} of 789,000 fish using the entire 1983–2013 time series. This level of escapement also is known to provide replacement, where escapements that exceed this value have not consistently provided replacement. These brood years provide better insight into the overall variability of stock production and potential yield in the future. Using the 1983–2013 time series, the upper bound of

800,000 fish was also estimated to provide, on average, a 90% probability of achieving 80% of MSY for the overall run.

Pink and Chum Salmon

Recent escapement data (Table 1) were examined to determine if re-analysis of areawide aggregate escapement goals for pink and chum salmon were necessary. The team determined that the additional years of data were within the range of past observations. These stocks were reviewed and revised in 2015 (Schaberg et al. 2015a) and did not warrant further review because of the recent revision in 2015.

Coho Salmon

There are no coho salmon escapement goals in Area L, as survey conditions often preclude accurate assessment.

AREA M (ALASKA PENINSULA AND ALEUTIAN ISLANDS MANAGEMENT AREA)

King Salmon

The only king salmon escapement goal in Area M is for Nelson River (Table 2). The goal was last updated in 2019 (Schaberg et al. 2019b). There were three years of new stock-recruit data but the new information would not effectively change the stock-recruit relationship, and the team agreed that further analysis was not warranted in 2020.

Sockeye Salmon

Of the 13 escapement goals for sockeye salmon in Area M, six (Ilnik, and Sandy Rivers; Christianson and Mortensens Lagoons; and Orzinski and Thin Point Lakes) were last formally analyzed in 2007 because escapements to these systems generally met their respective goals and past review teams made no changes. The escapement goal review team updated the analysis of these escapement goals using the revised percentile approach by Clark et al. (2014). The remaining seven goals (North Creek, Nelson, Meshik, Bear (early and late runs), and Cinder Rivers; and McLees Lake) were more recently assessed and determined to not have any compelling new information to warrant review in 2020.

Ilnik River

The team evaluated if using the percentile approach (Clark et al. 2014) with the additional weir count data would warrant changing the escapement goal. Applying the Tier 2 percentile ranges (15^{th} and 65^{th} percentiles) to the last 30 years of weir counts (1991–2020; contrast 9.2), team members found increasing the current upper bound, resulting in a revised SEG range of 40,000 to 75,000 fish was warranted.

Sandy River

The team evaluated if using the percentile approach (Clark et al. 2014) with the additional count data would warrant changing the escapement goal. The team decided to use the 25^{th} and 75^{th}

percentiles because the harvest rate of this stock is unknown but likely greater than 0.40 and because these fish are harvested in a mixed-stock fishery. Applying these percentiles to the last 27 years of weir counts (1994–2020; contrast 6.3) the team found a small increase to the lower bound, and a small decrease to the upper bound was warranted, resulting in revising the SEG range to 37,000 to 69,000 fish.

Christianson Lagoon

The team evaluated if using the percentile approach (Clark et al. 2014), with the additional data, would warrant changing the escapement goal. The 25th and 75th percentiles were applied to the past 50 years (1971–2020) of peak aerial survey count data (contrast 101.6) because the harvest rate of this stock is unknown but likely greater than 0.40. Results of the analysis indicated reducing the current lower bound would be appropriate, resulting in revising the SEG to 23,000 to 50,000 fish.

Mortensens Lagoon

The team evaluated if using the percentile approach (Clark et al. 2014) with additional data would warrant changing the escapement goal. Peak aerial survey count data from 1970 to present, with a contrast of 35.0, were assessed with the 25th and 75th percentiles because the harvest rate of this stock is unknown but likely greater than 0.40. The team found reducing the SEG to 1,400 to 5,700 fish was warranted based on results of this analysis.

Orzinski Lake

The team evaluated if using the percentile approach (Clark et al. 2014) with additional data would warrant changing the escapement goal. Weir count data from 1990 to 2020 (contrast 26.8) were applied to a Tier 2 analysis. The team found reducing the lower bound and increasing the upper bound to an SEG of 14,000 to 28,000 fish was warranted based on this analysis.

Thin Point Lake

The team evaluated if using the percentile approach (Clark et al. 2014) with additional data would warrant changing the escapement goal. The past 51 years of peak aerial survey count data (1970–2020; contrast 2,620.0) were assessed using the 25th and 75th percentiles because of the high measurement error inherent in surveying the system, and harvest rates are believed to exceed 0.40. The team found lowering the SEG to 9,000 to 19,000 fish was warranted.

Pink Salmon

The pink salmon escapement goal in Area M was revised in 2016 (Schaberg et al. 2015b). Recent escapement data were evaluated for indications that this goal should be further analyzed. It was observed that recent escapement estimates are within the historic range, and the review team agreed that no further analysis was necessary in 2020.

Chum Salmon

Chum salmon escapement in Area M is observed with aerial surveys. Historically, total indexed escapement estimates calculated using methods described in Fox and Whiteside (2020) have been used. There are five fishing districts in Area M, and escapement is aggregated for each: two

on the North side of the Alaska Peninsula and three on the South side. The three chum salmon escapement goals on the South side of the peninsula were revised in the previous cycle (Schaberg et al. 2019b) and therefore were not reviewed.

Stock-specific chum salmon harvest estimates for the Northwestern and Northern Districts of the North Alaska Peninsula were not available. Recent chum salmon escapements (Table 2) were examined to determine if review of Northern and Northwestern District escapement goals was warranted. The team agreed that further analysis was necessary.

Northern and Northwestern Districts

Due to the inconsistent nature of aerial surveys throughout these districts, two changes were made to this analysis. One was to shift from the total indexed escapement method (Fox and Whiteside 2020) to the peak aerial survey method (PAS). The second was to review the historical survey data and apply criteria to reduce the number of systems included in the PAS indices. This was done to ensure that the number of systems included in the evaluation and measurement of escapement goals is consistent year to year. In this case, the criteria that determined inclusion were that the system was surveyed a minimum of 32 out of the past 34 years, and that the median peak aerial survey count was 500 fish or greater.

Using the above criteria, the number of streams included in the chum salmon PAS index was reduced from 76 to 18 for the Northern District and 33 to 9 for the Northwestern District. These reductions will increase the ability of the escapement goals to reveal escapement trends and make them less sensitive to unsuccessful surveys. Similar attempts, as in the past, will still be made to survey the other systems. The selected Northern District chum salmon index streams account for a mean of 74% of the total number of fish counted in the 76 systems formerly used to index the escapement. The selected Northwestern District chum salmon index streams account for a mean of 79% of the total number of fish counted in the 33 systems formerly used to index the escapement.

Peak chum salmon counts in each new index system were aggregated to create a PAS index for each district. Contrast, assessment of measurement error, and estimated harvest rates were considered to determine the proper percentile ranges to use to establish SEGs with the percentile approach (Clark et. al 2014). This resulted in the selection of Tier 3 percentile ranges for the Northern and Northwestern Districts. The team found changing the chum salmon aggregate escapement goals to an SEG of 49,000–132,000 fish for the Northern District and an SEG of 49,000–133,000 fish for the Northwestern District was warranted.

Coho Salmon

There are two escapement goals in Area M for coho salmon one each for the Nelson and Ilnik Rivers. These goals have not been reviewed recently and the team agreed that further analysis was warranted in 2020.

Nelson River

The team evaluated if using the percentile approach (Clark et al. 2014) with additional data would warrant changing the escapement goal. Estimated total escapement from 1987–2020, with

a contrast of 3.6, were assessed with the 25th and 75th percentiles (low contrast, high measurement error from aerial survey data, and harvest rate unknown but likely greater than 0.40). The team found revising the lower-bound SEG of 18,000 fish to an SEG range of 19,000 to 29,000 fish was warranted based on this analysis.

Ilnik River

The team evaluated if using the percentile approach (Clark et al. 2014) with additional data would warrant changing the escapement goal. Estimated escapements from 1987–2020, with a contrast of 122.0, were assessed and it was determined that it was appropriate use the Tier 1 percentile ranges (20th and 60th percentiles). The team found changing the lower bound SEG of 9,000 fish to an SEG range of 9,000 to 24,000 fish was warranted based on this analysis.

In summary, this comprehensive review of the 22 existing salmon escapement goals in Area M results in 12 goals remaining unchanged, and the revision of 10 goals (6 sockeye salmon: Ilnik River SEG 40,000–75,000; Sandy River SEG 37,000–69,000; Christianson Lagoon SEG 23,000–50,000; Orzinski Lake SEG 14,000–28,000; Mortensen Lagoon SEG 1,400–5,700; and Thin Point Lake SEG 9,000–19,000; 2 chum salmon: Northern District SEG 49,000–132,000; Northwestern District SEG 49,000–133,000; and 2 coho salmon: Nelson River SEG 19,000–29,000; Ilnik River SEG 9,000–24,000;). Review of the 6 existing salmon escapement goals in Area L resulted in 4 goals remaining unchanged, and the revision of the 2 Chignik River sockeye salmon goals to a single sockeye salmon BEG of 450,000 to 800,000 fish.

There is only one allocative or management plan implication for Area M with the changes, and that is for Orzinski Lake sockeye salmon. Currently in regulation there is an escapement threshold of 25,000 sockeye salmon; achievement of that allows for further liberalization of the gillnet fleet in the Northwest Stepovak section. When that threshold was developed, it was 5,000 fish (25%) above the upper bound of the contemporary SEG. With the changes to the Orzinski Lake sockeye salmon escapement goal, this threshold now would fall within the SEG range (14,000–28,000).

The changes to the Chignik River sockeye salmon goals have management implications for the commercial fisheries in Areas K, L, and M. Current regulations (5 AAC 15.357) direct the department to achieve the escapement goals for the early and late runs, not a single sockeye salmon goal, and further define specific management actions that may be taken during the period of transition from predominately early-run sockeye salmon to late-run sockeye salmon. In addition, regulations also provide guidance for the department to allow harvest of surplus early-run sockeye salmon during the transition period while preserving late-run escapement, to meet subsistence needs with late-run fish, to prosecute Eastern District fisheries based on early-run escapement, and to restrict fishing in the Western and Perryville Districts based on late-run run strength. Regulatory language also exists in the Cape Igvak Management Plan (5 AAC 15.360) of Area K and the Southeast District Mainland Salmon Management Plan (5 AAC 09.360) of Area M, which provide guidance for the department to manage fisheries based upon harvestable surpluses in excess of early and late-run Chignik sockeye salmon.

Staff are preparing separate reports for each management area that will document these escapement goal reviews in more detail, including all current and revised escapement goals, as

well as detailed descriptions of the analyses performed. These reports will be published prior to the 2023 board meeting. In addition, an oral escapement goal report will be presented at the board meeting.

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Table 1. Escapements from 2012 to 2020, escapement goals, and 2023 revisions for salmon stocks in the Chignik Management Area (CMA).

	2020 Goal Range			Initial	Escapement[a]									2023 EG Revisions
	Lower	Upper	Type	Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	
KING SALMON														
Chignik River[b]	1,300	2,700	BEG	2002	1,349	1,153	2,795	1,954	1,743	1,137	825	1,517	1,278	No Change
CHUM SALMON														
Entire Chignik Area	45,000	110,000	SEG	2016	93,800	109,900	46,720	123,400	69,900	96,900	33,400	98,000	39,675	No Change
COHO SALMON														
There are no coho salmon stocks with escapement goals in Chignik Area														No Change
PINK SALMON														
Entire Chignik Area (odd year)	260,000	450,000	SEG	2016		231,800		404,000		586,000		415,300		No Change
Entire Chignik Area (even year)	170,000	280,000	SEG	2016	111,000		87,240		68,100		41,900		118,496	No Change
SOCKEYE SALMON														
Chignik River Early Run	350,000	450,000	BEG	2014	353,441	386,782	360,381	534,088	418,290	453,257	263,979	345,918	137,213	Single system wide BEG of
Chignik River Late Run[c]	200,000	400,000	SEG	2008	358,948	369,319	291,228	589,809	348,023	339,303	275,718	336,077	193,765	450,000-800,000

[a] Shaded cells indicate the escapement did not meet the lower end of the current escapement goal.

[b] King salmon escapement estimated for Chignik include an estimated 100 kings harvested above the weir as harvest estimates are typically not available for Chignik sport harvest.

[c] The Chignik River late-run sockeye escapement objective includes the late-run sockeye salmon SEG (200,000 – 400,000) plus an additional 10,000 fish in August and 10,000 fish in September to ensure inriver harvest opportunities above the weir.

Table 2.– Escapements from 2011 to 2020, escapement goals, and 2023 revisions for salmon stocks in the Alaska Peninsula and Aleutian Islands Management Area.

System	2020 Goal Range Lower	2020 Goal Range Upper	Type	Initial Year	Escapement[a] 2011	2012	2013	2014	2015	2016	2017	2018	2019	2020[b]	2023 EG Revisions
KING SALMON															
Nelson River	2,400	5,000	BEG	2019	1,704	1,092	1,221	3,801	2,890	4,618	1,852	5,022	12,163	2,498	No Change
CHUM SALMON															
Northern District[c]	119,600	239,200	SEG	2007	96,952	140,418	137,251	191,586	189,194	277,674	234,440	236,109	208,397	118,815	SEG 49,000–132,000
Northwestern District[c]	100,000	215,000	SEG	2007	151,400	140,000	92,800	54,525	89,800	113,250	195,700	90,705	173,600	62,100	SEG 49,000–133,000
Southeastern District[d]	62,500	151,900	SEG	2019	137,500	30,152	NA	74,300	NA	NA	416,845	55,510	111,800	107,600	No Change
South Central District[d]	68,900	99,200	SEG	2019	68,800	NA	101,400	91,600	182,000	166,000	566,213	NA	224,000	93,500	No Change
Southwestern District[d]	86,900	159,500	SEG	2019	NA	NA	NA	NA	NA	146,200	NA	NA	12,800	84,550	No Change
COHO SALMON															
Nelson River	18,000		LB SEG	2004	21,000	19,160	22,000	25,000	45,000	45,000	19,000	44,000	23,000	23,000	SEG 19,000–29,000
Ilnik River	9,000		LB SEG	2010	18,000	11,800	17,000	33,000	14,000	28,000	6,000	122,000	24,000	45,000	SEG 9,000–24,000
PINK SALMON															
South Peninsula Total	1,750,000	4,000,000	SEG	2016	2,494,950	478,910	2,320,790	1,340,380	7,820,800	1,038,160	5,663,637	732,422	4,236,700	3,209,750	No Change
SOCKEYE SALMON															
Cinder River[e]	36,000	94,000	SEG	2016	105,500	73,000	90,000	96,000	118,000	200,500	222,600	189,000	95,025	106,800	No Change
Ilnik River[f]	40,000	60,000	SEG	1991	43,000	61,000	51,000	59,000	26,000	124,000	238,000	81,000	75,000	41,000	SEG 40,000–75,000
Meshik River[g]	48,000	86,000	SEG	2016	101,900	50,900	123,600	114,700	171,700	131,800	191,525	133,700	103,200	64,550	No Change
Sandy River	34,000	74,000	SEG	2007	37,500	27,100	42,000	59,000	116,000	170,000	145,000	35,000	71,000	60,000	SEG 37,000–69,000
Bear River Early Run	176,000	293,000	SEG	2004	207,451	173,158	219,074	259,046	304,356	293,280	570,840	324,093	205,273	299,198	No Change
Bear River Late Run	117,000	195,000	SEG	2004	132,549	116,442	196,926	206,954	210,644	139,720	229,160	232,907	294,727	200,802	No Change
Nelson River	97,000	219,000	BEG	2004	89,000	103,300	248,000	250,000	257,000	300,000	381,000	221,000	115,000	185,000	No Change
Christianson Lagoon	25,000	50,000	SEG	1980s	35,200	40,000	16,500	32,600	6,700	111,700	290,600	26,100	39,300	22,800	SEG 23,000–50,000
North Creek	7,500	10,000	SEG	2019	10,200	18,000	8,500	7,500	18,000	21,000	5,800	8,300	11,000	8,200	No Change
Orzinski Lake	15,000	20,000	SEG	1992	16,764	17,243	17,386	13,600	26,534	21,019	20,989	2,817	4,367	6,819	SEG 14,000–28,000
Mortensen Lagoon	3,200	6,400	SEG	late 1980s	500	5,000	4,000	500	NA	13,000	15,500	1,200	800	800	SEG 1,400–5,700
Thin Point Lake	14,000	28,000	SEG	late 1980s	14,500	19,000	5,700	8,600	19,900	36,400	44,300	1,000	9,600	10,450	SEG 9,000–19,000
McLees Lake[h]	10,000		LB SEG	2019	36,602	15,111	15,687	12,424	20,284	39,892	13,195	No Weir	No Weir	5,037	No Change

Note: NA = data not available; LB SEG = lower-bound SEG.

[a] Shaded cells indicate the escapement did not meet the lower end of the current escapement goal.

[b] Data from 2020 were preliminary at the time of analysis.

[c] The recommended goals were calculated with a reduced number of index streams. Escapement values in this table are from the prior escapement enumeration method for comparison with the current escapement goals, not the 2021 recommendations.

[d] Southern AK peninsula chum salmon escapement goals were revised in 2019, and a new aggregation/index approach was used (Schaberg et al. 2019b). All values have been updated to the new aggregate index values.

[e] Cinder River sockeye salmon escapement includes Mud Creek.

[f] Ilnik River sockeye salmon counts in 2012, 2013, and 2016 include Ocean River aerial surveys added as a separate component. In all other years Ocean River flows into Ilnik Lagoon and is counted at the Ilnik River weir.

[g] Meshik escapement includes Meshik River, Red Bluff Creek, and Yellow Bluff Creek. It does not include Highland or Charles creeks.

[h] McLees Lake sockeye salmon SEG will be in effect if a weir is in place; there will be no goal if a weir is not operated.