**Appendix A: Fish Biology**

Fish Biology Report

Stibnite Gold Project

Midas Gold Idaho, Inc.



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**A pair of bull trout spawning in Profile Creek September 2017**

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# Introduction

## Purpose

The purpose of this report is to summarize information related to key fish species in support of stream restoration designs for Midas Gold’s Stibnite Gold Project. The Plan of Restoration and Operations (PRO, Midas Gold 2016) outlines the proposed mitigation plan and identified spring/summer Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), bull trout (*Salvelinus confluentus*), and Westslope cutthroat trout (*O. clarki lewisi)* as species of concern in the project area. As stated in the PRO, the objective of the restoration work is to establish a sustainable fishery with enhanced habitat to support natural populations of salmon, steelhead, and bull trout; improve water quality; establish a productive and sustainable vegetative community; and enhance wildlife habitat, all contributing to a self‐sustaining and productive ecosystem (Midas Gold 2016).

Current status of key fish species is provided in the following:

* Snake River Basin spring/summer Chinook salmon were listed as a threatened species in 1992 (57 FR 14653; April 22, 1992).
* Snake River Basin steelhead were listed as a threatened species in 1997 (62 FR 43937; August 18, 1997).
* Columbia River bull trout were listed as a threatened species in 1998 (63 FR 31647; June 10, 1998).
* Westslope cutthroat trout are considered a species of conservation concern (SOCC) with the United States Forest Service (USFS) Region 4 (USFS 2016) and are assigned a state rank of S4 in Idaho indicating that the species is not rare and apparently secure, but with cause for long-term concern (IDFG 2018).

## Organization of Report

Information in this report is organized on the following topics:

* Section 1, the introduction, explains the purpose of this report and provides the status of key fish species of interest.
* Section 2 contains an overview of fish distribution for spring/summer Chinook salmon, steelhead, bull trout, and Westslope cutthroat trout in the project area and nearby streams.
* Section 3 provides information on periodicity and fish use for key fish species.
* Section 5 covers habitat requirements and physical habitat criteria for key fish species.
* Section 6 assigns reach level biological objectives intended to guide stream restoration and enhancement in the project area.
* Section 7 provides references used throughout this report.

# Fish Distribution

Multiple sources of information were reviewed to describe the presence of spring/summer Chinook salmon, steelhead, bull trout and Westslope cutthroat trout in the project area and nearby streams (IDEQ 2018; IFWIS 2018; Kuzis 1997; MWH 2017, StreamNet 2018; Thurow 1987, Zurstadt and Nelson 2010). The presence of fish within the project area was compiled by stream and enumerated by the reference source (Table 2‑1). MWH (2017) provided baseline fish sampling to document the presence of key fish species within the project area. The Idaho Department of Environmental Quality (IDEQ) maintains a database of fish sampled during their beneficial use reconnaissance program (BURP) (IDEQ 2018; data accessed March 7, 2018). Likewise, Idaho Department of Fish and Game (IDFG) maintains the Idaho Fish and Wildlife Information System (IFWIS 2018; data accessed March 8, 2018) that provides numerous data types (i.e., redd location, fish presence, fish stocking records, trap counts, etc.). StreamNet GIS fish distributions were also reviewed to document the presence of fish within the project area.

Table ‑. Presence of spring/summer Chinook salmon, steelhead, bull trout and Westslope cutthroat trout in project area and nearby streams. Numbers in the table refer to the source of information footnoted below. Dashes indicate no information for the presence of that species within that stream. Passage barriers have been indicated on EFSFSR, West End Creek, Midnight Creek, Fiddle Creek and Hennessy Creek (MWH 2017). An asterisk indicates streams where the presence of that species was detected from eDNA.

| **Stream** | **Steelhead**  **(O. mykiss)** | **Chinook**  **Salmon** | **Bull Trout** | **Westslope**  **Cutthroat Trout** | **Brook Trout** |
| --- | --- | --- | --- | --- | --- |
| No Mans Creek | --- | --- | --- | 2 | --- |
| Profile Creek | 2,3,4 | 2 | 2,3,4 | 2,3,4 | --- |
| Missouri Creek | --- | --- | 2 | 2 | --- |
| Bishop Creek | --- | --- | --- | 2 | --- |
| Tamarack Creek | 1,2,3,4 | 1,2,3,4 | 1,2,3,4 | 1,2,3,4 | --- |
| Salt Creek | 2 | 2 | --- | 2,5 | --- |
| Pepper Creek | --- | --- | --- | 2 | --- |
| Sugar Creek | 1,2,4 | 2,4,5 | 1,2,4,5 | 1,2,4 | --- |
| West End Creek (barrier) | --- | --- | --- | --- | --- |
| EFSFSR below Yellow Pine pit | 1,2,3,4,5 | 2,3,4,6 | 2,3,4 | 1,2,3,4 | --- |
| EFSFSR above Yellow Pine pit (barrier) | 7 | 1,2,6 | 1 | 1,2 | --- |
| Unnamed tributary to Upper EFSFSR | --- | --- | 1\* | --- | --- |
| Fiddle Creek (barrier) | 7 | --- | 1\* | 1 | --- |
| Midnight Creek (barrier) | --- | --- | --- | --- | --- |
| Hennessy Creek (barrier) | --- | --- | --- | --- | --- |
| Garnet Creek (barrier) | --- | --- | --- | 1 | --- |
| Meadow Creek | 7 | 1,2,6 | 1,2 | 1,2,4,5 | --- |
| Unnamed tributary to Meadow Creek | --- | --- | 1\* | 1\* | --- |
| Fern Creek | --- | --- | 1\* | 5 | --- |
| EF Meadow Creek (Blowout Ck.) (barrier) | 1\* | 1 | --- | 1 | --- |
| Reference: **1**. MWH. 2017; **2**. StreamNet Fish Distribution; **3**.Thurow 1987; **4**. Kuzis 1997; **5.** IDEQ 2018; **6.** IFWIS 2018; **7.** Zurstadt and Nelson 2010. | | | | | |

## Spring/summer Chinook Salmon

Adult spring/summer Chinook salmon have been transplanted upstream from the barrier at Yellow Pine pit and successful reproduction has produced juveniles observed in the project area (IFWIS 2018; MWH 2017). Transplanted adult Chinook salmon have constructed redds in the EFSFSR upstream and downstream of Meadow Creek and within Meadow Creek (IFWIS 2018). Juvenile Chinook salmon have been observed in the EFSFSR upstream and downstream of the Meadow Creek confluence and within Meadow Creek (MWH 2017). They have also been observed in the lowermost section on the East Fork Meadow Creek (Blowout Creek) (MWH 2017). Juvenile Chinook salmon observed in lower East Fork Meadow Creek are likely the result of juvenile emigration from Meadow Creek. Chinook salmon occur naturally downstream from the Yellow Pine pit in the EFSFSR, and in the EFSFSR tributaries of Sugar Creek, Tamarack Creek and Profile Creek (Table 2‑1).

## Steelhead

Summer steelhead are known to occur downstream from the Yellow Pine pit in the EFSFSR, Sugar Creek, Tamarack Creek, Profile Creek and Salt Creek (Table 2‑1). Summer steelhead were not detected in aquatic baseline surveys of the upper EFSFSR upstream from the Yellow Pine pit (MWH 2017). However, environmental deoxyribonucleic acid (eDNA) samples collected upstream from the Yellow Pine pit revealed some *O. mykiss* markers in the upper Meadow Creek basin (in Meadow Creek Lake) and in East Fork Meadow Creek (MWH 2017). Detection of *O. mykiss* in the lake is likely Golden trout that are known to have been planted in Meadow Creek Lake (IFWIS 2018; Kuzis 1997). Zurstadt and Nelson (2010) show *O. mykiss* in Fiddle Creek, Meadow Creek and EFSFSR above and below the Meadow Creek confluence. However, the presence of steelhead/redband in these locations was not confirmed by other source information (MWH 2017; IDEQ 2018). The lack of widespread detection of native *O. mykiss* upstream from Yellow Pine pit suggests that their distribution is limited to areas downstream from the Yellow Pine pit passage barrier.

## Bull Trout

Bull trout are known to occur downstream of the Yellow Pine pit in the EFSFSR, Sugar Creek, Tamarack Creek, Profile Creek and Missouri Creek (Table 2‑1). Bull trout have been observed upstream from the Yellow Pine pit in Meadow Creek and EFSFSR. Bull trout were not observed nor did eDNA samples reveal their presence in East Fork Meadow Creek, Midnight Creek and Garnet Creek (MWH 2017). Samples of eDNA in lower Fiddle Creek were positive for bull trout near the confluence with the EFSFSR. However, the presence of bull trout upstream of the barrier on Fiddle Creek was not confirmed during visual surveys or eDNA collections (MWH 2017). Positive detection of bull trout eDNA also occurred in Fern Creek and an unnamed tributary of upper Meadow Creek.

## Westslope Cutthroat Trout

Cutthroat trout are widespread occurring upstream and downstream from the Yellow Pine pit (Table 2‑1). Upstream from the Yellow Pine pit, they have been observed in the EFSFSR, Meadow Creek, East Fork Meadow Creek and Fiddle Creek (MWH 2017). Westslope cutthroat trout were not observed nor did eDNA samples detect their presence in Midnight Creek, upper Garnet Creek or upper Fiddle Creek.

## Brook Trout

Brook trout were not observed in streams upstream from the Yellow Pine pit and eDNA samples did not indicate the presence of brook trout in the upper EFSFSR watershed (MWH 2017). Brook trout have been observed in the Johnson Creek (Thurow 1987).

# Periodicity

The following information was assembled to provide guidance on periodicity and potential fish use for spring/summer Chinook salmon, summer steelhead, bull trout, and Westslope cutthroat trout. Potential fish use and periodicity is key to understanding the life history of native species and their potential reintroduction/colonization through elimination of passage barriers and stream restoration. When possible, the information presented has been drawn from reference data within the South Fork Salmon River subbasin. Indeed, recolonization of the currently inaccessible habitats would likely occur from local fish populations and hatchery sources. Detailed life history information is lacking on resident forms of bull trout and Westslope cutthroat trout. Moreover, specific life history information on spring spawning species (i.e., steelhead and Westslope cutthroat trout) is scarce.

PIT tag data from a station (ESS) on the EFSFSR (RM 13.0) was used to describe adult migrations of Chinook salmon and steelhead to the EFSFSR watershed but falls short of describing arrival distribution to the project area. Currently, there are no active[[1]](#footnote-1) PIT tag stations near the confluence of Sugar Creek and EFSFSR that would describe the arrival distribution for Chinook salmon and steelhead to the project area. Thus, it is important to acknowledge that periodicity is from a much larger geographic scale than the current project area. Periodicity for different life stages has been displayed in two week intervals reflecting the general level of detail that is noted in the literature and stream surveys.

## Spring/summer Chinook Salmon

Chinook salmon entering the South Fork Salmon River are a spring/summer-run salmon. Juveniles of spring/summer Chinook salmon in the South Fork Salmon River exhibit a stream-type life history. That is, juveniles spend a full year in freshwater before they migrate to the ocean. Table 3‑1 and the following sections present information on potential fish use and periodicity expected for spring/summer Chinook salmon near the project area.

Table ‑. Periodicity and fish use for different life stages of spring/summer Chinook salmon.

| **Species** | **Life Stage** | **Jan** | | **Feb** | | **Mar** | | **Apr** | | **May** | | **Jun** | | **Jul** | | **Aug** | | **Sep** | | **Oct** | | **Nov** | | **Dec** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Spring/  Summer Chinook Salmon | Adult Migration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Adult Spawning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Incubation/Emergence |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Rearing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Emigration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Adult Migration-**In the Columbia River, the South Fork Salmon River adult migration to Bonneville (50th percentile) for summer Chinook salmon was June 1 based on PIT tagged adult salmon (Crozier 2016). PIT tag data from the EFSFSR near Parks Creek showed that the 50th percentile for spring/summer Chinook salmon was about July 8 over the period 2009-2017 (Table 3‑1). However, in Johnson Creek, a tributary to the EFSFSR, Rabe et al. (2017) noted that adult run timing assessed at the adult weir was bimodal for adult spring/summer Chinook salmon with peaks occurring in both late June and again in mid-August. Adult run time typically initiated in June and is complete by mid-September (Rabe et al. 2017). PIT tag data suggest that adult Chinook salmon enter the EFSFSR sporadically in May with peak occurrence in early July with migration ending mid-September.

Figure ‑. Arrival distribution of PIT tagged Chinook salmon at the PIT tag array located on the EFSFSR (RM 13) near Parks Creek.

**Adult Spawning-**Rabe et al. (2006) have observed that spawning in Johnson Creek typically starts in early August and peaks during the third week of August. Spawning is typically complete by mid-September. By comparison, in the South Fork Salmon River, spawning typically occurred from mid-August to mid-September with some spawning noted in late September (Young and Blenden 2011). Peak spawning for spring/summer Chinook salmon in the South Fork Salmon River occurred within the first two weeks of September. Redd surveys conducted in Sugar Creek (2008-2016) show that spawning begins in August and ends mid-September (Nez Perce Tribe data, Jan. 2018). The earliest known spawning occurred on 13 August 2010 and the latest occurred on 10 September 2009. It should be noted that spawning surveys in Sugar Creek may have occurred as much as 14 days apart, which could bias counts of new redds toward later spawning dates. Regardless, there is considerable agreement among the spawning areas (i.e., SF Salmon, Johnson Creek and Sugar Creek) which indicates that spawning is likely to occur from August through mid-September in the project area (Table 3‑1).

**Incubation/Emergence-**For spring/summer Chinook salmon, the incubation/emergence period extends from the time of spawning to emergence from the streambed. The term alevin describes yolk sac fry after hatching. Emergence is the time at which the alevin has absorbed the yolk sac and emerges from the substrate, and is termed a fry. For Chinook salmon, the incubation/emergence period extends from early August (spawning) to end of April (emergence) the following year (Rabe et al. 2006; Nez Perce Tribe data, Jan. 2018; Miller et al. 2014, USBWP 2005) (Table 3‑1).

**Juvenile Rearing-**Juvenile Chinook salmon fry emerge from the streambed in the spring and spend a full year rearing in freshwater until they emigrate as parr and smolts. After emergence, fry may be displaced downstream by stream flow seeking refuge in low velocity habitats with abundant cover (i.e., wood, undercut banks, vegetative overhang, etc.) along the stream margins. As fry grow and stream temperatures increase, they transition into parr selecting habitats suitable for their needs. For Chinook salmon parr, this is typically expressed as pool habitat in the summer that provides adequate food and cover (Bjornn and Reiser 1991). As stream temperatures decline parr seek suitable habitats for winter refuge. These habitats provide resting and hiding areas (i.e., wood, undercut banks, streambed interstitial spaces). Juvenile Chinook salmon rearing would occur year-round within the project area (Table 3‑1).

**Juvenile Emigration-**In Johnson Creek, the juvenile emigration period occurs from March into November (Rabe et al. 2006). Rabe et al. (2006) noted that smolts in Johnson Creek typically emigrated during the early spring months of March-May, while parr emigrated throughout the summer, and presmolts emigrated in the fall. Juvenile Chinook salmon emigration would occur throughout most of the year with peaks likely observed in the spring, summer and fall. Juvenile emigration during winter months would be minimal in project area (Table 3‑1).

## Summer Steelhead

South Fork Salmon River steelhead are summer-run fish which appear to be predominately B-run steelhead that pass Bonneville Dam after August 25 (Thurow 1987). A portion of the steelhead destined for the SFSR ascend the Salmon River in fall, overwintering in the mainstem Salmon River or South Fork Salmon River, while the remainder overwinter in the Snake River (Mallet 1970). Steelhead stage in these areas before migrating to SFSR spawning areas in the spring. Table 3‑2 and the following sections present information on periodicity and potential fish use for steelhead.

Table ‑. Periodicity and fish use for different life stages of summer steelhead.

| **Species** | **Life Stage** | **Jan** | | **Feb** | | **Mar** | | **Apr** | | **May** | | **Jun** | | **Jul** | | **Aug** | | **Sep** | | **Oct** | | **Nov** | | **Dec** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Steelhead | Adult Migration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Adult Spawning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Incubation/Emergence |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Rearing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Emigration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Adult Migration-**Information suggests that South Fork Salmon River steelhead ascend the Columbia River in late summer and overwinter in the Snake and Salmon rivers before entering the South Fork Salmon River (SFSR) in spring (Mallet 1970; Thurow 1987). In the Columbia River, the South Fork Salmon River adult steelhead migration to Bonneville (50th percentile) for wild steelhead (n=312; 2001-2016) was September 16 based on PIT tagged adult steelhead (PTAGIS September 19, 2017; query Bonneville Dam detections of SFSR steelhead). Thurow (1987) noted that wild steelhead are in the vicinity of the SFSR around mid-September with steelhead staging at the mouth of the SFSR in the fall and spring. Adult steelhead then ascend the SFSR in the spring and proceed to spawning streams (Thurow 1987). Spawning ground surveys on the SFSR indicate that steelhead arrived at Poverty Flat (RM 56) by April 16. PIT tag data from the EFSFSR near Parks Creek showed an adult migration period from late March to end of May with the 50th percentile occurring on 23 April for the period 2009-2017.

Figure ‑. Arrival distribution of PIT tagged steelhead at the PIT tag array located on the EFSFSR (RM 13) near Parks Creek.

**Adult Spawning-**Holubetz (1995) speculated that spawn time may be related to elevation. In high elevation tributaries, steelhead typically spawned in a narrow time frame from April 15 to May 15 (Thurow 1983; Orcutt et al. 1968). In the mainstem South Fork Salmon River, Thurow (1987) observed steelhead spawning from mid-April to end of May. Tributary spawning areas included sections of Burntlog, Johnson, and Lick creeks, and East Fork of the South Fork Salmon and Secesh rivers. Steelhead began spawning in tributaries about one week later than steelhead in mainstem areas. In the project area, spawning is likely to occur from late April to end of May (Table 3‑2).

**Incubation/Emergence-**For steelhead the incubation/emergence period extends from the time of spawning to emergence from the streambed. Thurow (1987) noted that variability in environmental conditions can be seen in steelhead emergence in the South Fork Salmon River. In 1984, 98 percent of the steelhead fry emerged by August 10 and in 1985, 98 percent emergence occurred by July 17. Thurow (1987) pointed out that lower stream discharge and warmer water temperatures accelerated emergence in 1985 as compared to 1984. Given the observed variability in time of emergence, the incubation/emergence period is likely to extend from mid-April to mid-August (Table 3‑2).

**Juvenile Rearing-**Juvenile steelhead emerge from the streambed in the late spring and summer and may spend several years rearing in streams before migrating to the ocean. Thurow (1987) observed multiple age classes of juvenile steelhead within tributaries of the South Fork Salmon River basin. Juvenile steelhead rearing would occur year-round (Table 3‑2).

**Juvenile Emigration-**Juvenile emigration for steelhead can occur throughout the year (USBWP 2005). Smolt trapping on the lower SFSR from March through November indicates that juvenile steelhead emigrate throughout the season with definite peaks in July and August (Albee and Orme 2011). Juvenile emigration within the project area would likely occur year-round with peak emigration occurring in summer months (Table 3‑2).

## **Bull** **Trout**

In the SFSR, Thurow (1986) documented the presence of both resident and fluvial stocks in all reaches and 18 tributaries that were surveyed. Watry and Scarnecchia (2008) also noted adfluvial life histories in the Secesh watershed. MWH (2017) observed different size classes of bull trout in project area streams which suggest year-round residence and production from area streams. Table 3‑3 and the following sections present information on periodicity and potential fish use expected for bull trout.

Table ‑. Periodicity and fish use for different life stages of bull trout.

| **Species** | **Life Stage** | **Jan** | | **Feb** | | **Mar** | | **Apr** | | **May** | | **Jun** | | **Jul** | | **Aug** | | **Sep** | | **Oct** | | **Nov** | | **Dec** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bull Trout | Adult Migration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Adult Spawning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Incubation/Emergence |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Rearing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Emigration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Adult Migrations-**Life history strategies and migratory patterns of bull trout were studied in the Secesh River and EFSFSR watersheds (Hogen and Scarnecchia 2006; Watry and Scarnecchia 2008). In the Secesh River watershed, Watry and Scarnecchia (2008) found that upstream migrations occurred during late June and early July with migrations into two spawning tributaries during late July and early August. Primary over-wintering areas were Loon Lake, the lower Secesh River, and the lower SFSR. For the EFSFSR, Hogen and Scarnecchia (2006) found that bull trout overwintered in the large rivers downstream from the EFSFSR (SFSR and the Salmon River further downstream). Upon return, bull trout migrated upstream to the EFSFSR in June and July and further upriver into small tributaries to spawn in August and September (Hogen and Scarnecchia 2006). In both studies, upstream migrations occurred in late June and early July with migrations for some bull trout into spawning tributaries during late July and August. Movements of resident bull trout related to spawning are not well documented, but given their resident life history likely fall within the range noted for fluvial bull trout in the EFSFSR. The information suggests that adult bull trout return to the EFSFSR in late June through early July with some adults staging near spawning tributaries in August (Table 3‑3).

**Adult Spawning-**Adult spawning periods reported for the SFSR subbasin occur from late August to mid-October (Burns et al. 2005). However, biotelemetry studies on bull trout in both the Secesh and EFSFSR watersheds indicate spawning likely occurs from late August through mid-September (Hogen and Scarnecchia 2006; Watry and Scarnecchia 2008). In both studies, bull trout typically left spawning tributaries by end of September. In the EFSFSR, spawning areas included Tamarack, Profile and Sugar creeks and some tributaries to those streams (Burns et al. 2005). As reported by Hogen (2002) cited in (Burns et al. 2005) spawning occurred over a short, definite time period, from September 1 –15 with all spawning completed by September 20. Bull trout redd surveys conducted in Sugar Creek (2009-2014, 2016) show that spawning begins in late August and ends near mid-September (Nez Perce Tribe data, Jan. 2018). The earliest redd reported in Sugar Creek was observed on 28 August and the last redds were observed on 16 September. Recent observations by Midas Gold contractors of bull trout redds and spawning activity in Sugar (Sep 13, 2017) and Profile (Sep 14, 2017) creeks comport well with the end of the spawning period noted in the EFSFSR radio tag study (Hogen and Scarnecchia 2006). The information presented in the EFSFSR telemetry study and redd surveys in Sugar Creek suggest that the spawning period for bull trout likely occurs from mid-August to mid-September (Table 3‑3).

**Incubation/Emergence-**As cited by Batt (1996), the incubation period for bull trout is about 100 to 145 days, with hatching occurring in late January requiring an additional 65 to 90 days for yolk sac absorption (Heimer 1965, McPhail and Murray 1979, Allan 1980, Weaver and White 1984; Shepard et al. 1984). Fry normally emerge from early April through May depending upon water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992). The incubation/emergence period for bull trout would extend from mid-August through end of May the following year (Table 3‑3).

**Juvenile Rearing-**MWH (2017) observed different size classes of bull trout in a baseline study of streams in the aquatic resource study area. This suggests multiple age classes and extended rearing in tributary streams. Thurow (1987) noted that bull trout displayed increased growth rates after age three which reflects movements of fluvial stocks from tributaries to mainstem areas. Mainstem areas likely serve primarily as overwintering, adult migration and rearing habitat for bull trout while tributaries are principally for juvenile rearing and adult spawning. Juvenile rearing would occur year-round in streams of the project area (Table 3‑3).

**Juvenile Emigration-**Juvenile bull trout emigration is not well documented in the SFSR subbasin. However, emigrant behavior might be approximated from other sources. Downs et al. (2006) observed that juvenile bull trout emigrated in pulses with one occurring in the spring and another in fall. Following the large pulse of age one and older juveniles emigrating in spring, they observed a second peak in downstream movement in fall (Downs et al. 2006). Lower emigration rates were noted in late July and August. Bellerud et al. (1997) also identified two emigration peaks of juvenile bull trout separated by a period of low movement in July in Oregon’s Grand Ronde River system. Juvenile emigration in the project area would probably follow similar patterns as noted. Therefore, juvenile emigration is likely to occur from April to end of November with little emigration occurring during winter months (Table 3‑3).

## Westslope Cutthroat Trout

MWH (2017) observed different size classes of Westslope cutthroat trout in aquatic resource study area streams which suggest year-round residence and production from area streams. IDFG (2013) reported that densities of Westslope cutthroat trout in the South Fork Salmon River subbasin were highest in the EFSFSR watershed. Table 3‑4 and the following sections present information on periodicity and potential fish use expected for westslope cutthroat trout.

Table ‑. Periodicity and fish use for different life stages of Westslope cutthroat trout.

| **Species** | **Life Stage** | **Jan** | | **Feb** | | **Mar** | | **Apr** | | **May** | | **Jun** | | **Jul** | | **Aug** | | **Sep** | | **Oct** | | **Nov** | | **Dec** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Westslope Cutthroat  Trout | Adult Migration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Adult Spawning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Incubation/Emergence |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Rearing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile Emigration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Adult Migrations-**Adult migrations of fluvial Westslope cutthroat trout are not well documented in the SFSR. However, adult migration might be approximated from other studies of Westslope cutthroat trout. In the Upper Salmon River basin, Schoby and Curet (2007) noted that Westslope cutthroat trout entered spawning tributaries between mid-April and early June. Schmetterling (2003) found that cutthroat tagged in April-June sometimes migrated extensive distances (62 miles) to ascend tributaries of the Clark Fork River to spawn. In the Coeur d’Alene River basin, Dupont (2008) found that movement patterns were generally the most extensive in the months of April-June with less movement occurring during summer and winter. In the Middle Fork Salmon River, Zurstadt and Stephan (2004) observed that upstream movements started in late March with peak movement in May. In that study, they found that extensive downstream movements occurred from May through July (Zurstadt and Stephan 2004). The pattern of movement observed in these studies is probably related to both spawning and cold water refuge and suggests that adult migrations within the project area are likely to occur from late March through June (Table 3‑4).

**Adult Spawning-**USBWP (2005) indicated a spawning period for cutthroat trout that extends from May to the end of the first week of July for most tributaries of the Upper Salmon River basin. The information comports well with the movement studies previously noted for adult migrations (Schoby and Curet 2007; Zurstadt and Stephan 2004). The information suggests that the spawning period for Westslope cutthroat trout likely extends from mid-April through mid-July (Table 3‑4).

**Incubation/Emergence-**As noted by Miller et al. (2014), the incubation/emergence period for salmonids is quite variable and dependent on stream temperature. The incubation/emergence period for Westslope cutthroat trout likely extends from mid-April through July with the possibility that resident cutthroat in smaller streams at higher elevations may emerge as late as August. Observations by Midas Gold contractors of very small (<25mm) trout in mid-September (Sep 14, 2017) in Fiddle Creek suggest that an emergence period ending in August would encompass fish in small streams (Table 3‑4).

**Juvenile Rearing-**Westslope cutthroat trout inhabit streams that are cold and nutrient-poor (IDFG 2013). In the Management Plan for the Conservation of Westslope Cutthroat Trout in Idaho, IDFG (2013) note that the distribution and abundance of larger WCT is strongly associated with pool habitat and suggest that stream reaches with numerous pools support the highest densities of fish. Moreover, habitats that provide some form of cover also seem to be preferred. MWH (2017) observed several different sizes classes of Westslope cutthroat trout in the upper EFSFSR suggesting that juvenile rearing occurs year-round (Table 3‑4).

**Juvenile Emigration-**Juvenile Westslope cutthroat trout emigration from tributary streams is not well documented and complicates our understanding of their early life history. As noted in IDFG (2013) Westslope cutthroat trout may spend 1-4 years in tributary streams depending on their life history. As resident cutthroat trout, they can remain in tributary streams completing their entire life cycle. Like bull trout, age one and older Westslope cutthroat trout likely make up the majority of spring emigrants while summer and fall periods may show an increase in young-of-the-year migrants. Therefore, juvenile emigration is likely to occur from April through the end of November in aquatic area resource streams with little emigration occurring during winter months (Table 3‑4).

# Salmonid Habitat Requirements

Physical habitat criteria are often used to help describe complex salmonid habitat requirements that support different species and life stages. In this section, habitat requirements are outlined for spawning, incubation and rearing of key fish species. References are provided in the tables.

## **Spring**/summer Chinook Salmon

Chinook salmon in the South Fork Salmon River basin exhibit a stream-type life history rearing a full year in freshwater before they migrate downstream to the ocean. Therefore, it is important to identify the aquatic habitats used by juvenile spring/summer Chinook salmon in their first year of life. In freshwater, juvenile rearing requirements begin early as fry seek low velocity shallow water habitats along the stream margins. Along these stream margins, overhanging vegetation and woody debris provide important cover (Table 5‑1). As they grow and become larger (parr), juvenile Chinook salmon move into deeper water preferring pool and run type habitats over fast water habitat types such as riffles. Juvenile Chinook salmon would make good use of cover seeking woody debris, undercut banks, depth and large substrate as cover. As stream temperatures decline in winter, juvenile Chinook salmon hide in coarse substrate emerging at night and resting in low velocity areas. In spring, with increasing stream temperature and discharge juvenile Chinook salmon begin their downstream migration to the ocean.

Upon return, adults mostly 3 to 5 years old migrate upstream and spawn during late summer. Adult spring/summer Chinook salmon typically rest in large deep pools before spawning. Adequate stream temperatures (42-57°F) allow adult to rest and mature before they spawn. Adult Chinook salmon select low gradient riffle type habitat with water depths greater than 11.8 inches for spawning. Chinook salmon generally spawn in stream channels that are less than 4 percent with the highest potential noted between 0.0 and 1.5 percent. Redds are typically constructed in substrate that varies from large gravel to moderate sized cobble. They prefer to have pools with cover in close proximity to spawning. Redd size varies from about 55-101 ft2 with a recommended area of about 216 ft2 per spawning pair. Females bury their eggs in substrate that is about 7.9-11.8 inches deep. Recommended temperatures during spawning vary from 42.1-57.0 °F. During incubation stream temperature between 41.0-57.9 °F displayed the highest survival. Low stream temperatures (<39.9 °F) may be experienced during the incubation period as long as initial development occurs within a suitable range for normal egg development.

Table ‑. Habitat requirements and physical habitat criteria for different life stages of Chinook salmon.

| **Life Stage** | **Parameter** | **Criteria** | **Reference** |
| --- | --- | --- | --- |
| **Spawning** | Substrate (in) | 0.51-3.58; D50 Range (0.43-2.70) | Bjornn and Reiser 1991 (summer Chinook); Kondolf and Wolman 1993 (D50 Range Idaho Chinook) |
| Water Velocity (ft/s) | 1.05-3.58 | Bjornn and Reiser 1991 (summer Chinook) |
| Water Depth (in) | ≥11.8 | Bjornn and Reiser 1991 (summer Chinook) |
| Stream Temperature (°F) | 42.1-57.0 | Bjornn and Reiser 1991  (summer Chinook); Kuzis 1997 |
| Redd Size (ft2) | 54.9-101.2 | Bjornn and Reiser 1991  (summer Chinook) |
| Channel Type | 1. Forced pool-riffle 2. Pool-riffle 3. Plane bed | Roni, Pess, Beechie and Hillman Presentation 2012 (Chinook and Steelhead Habitat Requirements) |
| Gradients (%)  with Bankfull widths  (12.1-164 ft.) | 0.0-0.5% medium to high spawning potential | Cooney and Holzer 2006 |
| 0.5-1.5% low to high spawning potential |
| 1-4% low to medium spawning potential |
| 4-7% low potential |
| >7%-No potential |
| Spawning area/spawning pair (ft2) | 216.4 | Bjornn and Reiser 1991  (summer Chinook salmon) |
| Migration Barrier | 20% gradient 656+feet | Cooney and Holzer 2006 |
| Cover | Large woody debris, deep water (pools & runs), turbulence, and undercut banks in close proximity to spawning. | Bjornn and Reiser 1991 |
| **Incubation** | Egg Pocket Depth (in) | 7.9-11.8 (mean) | DeVries 1997; Bjornn Reiser 1991 (Columbia R.) |
| Intragravel DO (ppm) | 8.0 | Bjornn and Reiser 1991  (Steelhead & Coho) |
| Temperature (°F) | 35.6-57.9; 41.0-57.9; 42.8-53.6 | Velsen 1987; Bjornn and Reiser 1991; Kuzis 1997;Myrick and Cech 2001 (42.8-53.6°F best range) |
| Fines (<0.25 in) | <30% | Kuzis 1997 |
| Stream Icing & Scouring | Anchor and frazil ice as well as scouring can reduce intragravel survival. | Bjornn and Reiser 1991 |
| **Rearing** | Post-emergent | Post-emergent Chinook salmon cluster at stream margins in slow (0-0.33 ft/s) and shallow water (<1.97 ft). Chinook salmon fry typically station over fine substrates with abundant vegetation cover (brush, grasses, and woody debris). Chinook salmon select shallow, quiet (<0.03 ft/s) water at night. | Roni, Pess, Beechie and Hillman Presentation 2012 (Chinook salmon and Steelhead Habitat Requirements) |
| Summer | As Chinook salmon grow, they use faster (0.07-1.44 ft/s) and deeper (0.82-9.84 ft) water, and select brush, woody debris, or cobble/boulder cover. Chinook salmon select shallow, quiet (<0.03 ft/s) water at night. | Roni, Pess, Beechie and Hillman Presentation 2012 (Chinook salmon and Steelhead Habitat Requirements) |
| Winter | Select slow water habitat types in winter with coarse substrates for concealment. At temperatures are less than 50°F, Chinook salmon remain concealed in cover (woody debris or coarse substrate). Chinook salmon emerge at night and reside near the stream bed over sand, bedrock, or boulders in depths that range from 1.64-6.56 ft. Juvenile Chinook salmon use velocities less than 0.07 ft/s at night. | Roni, Pess, Beechie and Hillman Presentation 2012 (Chinook salmon and Steelhead Habitat Requirements) |
| Channel Type | Chinook salmon preferred channel types that contained pool and run habitat types over pocket water and riffles. | Bjornn and Reiser 1991 |
| Gradient | >4%-Limited | Cooney and Holzer 2006 |

## **Summer** **Steelhead**

South Fork Salmon River steelhead are summer-run fish which appear to be predominately B-run steelhead that pass Bonneville Dam after August 25 (Thurow 1987). Post-emergent steelhead seek shallow, low velocity habitats along the stream margins (Table 5‑2). As steelhead grow and become larger, juvenile fish move into deeper, faster water and can be found in a variety of habitat types. Juvenile steelhead prefer pocket water but can also be found in pools, runs and riffles. As stream temperatures decline in winter, most juvenile steelhead hide in coarse substrate emerging at night and resting in low velocity areas. In spring, with increasing stream temperature and discharge some juvenile steelhead may begin their downstream migration to the ocean or remain for another year.

South Fork Salmon River steelhead have a diverse life history, spending 1-5 years in freshwater and 1-3 years in the ocean with adults returning predominantly as 5 year old fish (Copeland et al. 2017). Adult steelhead ascend the SFSR in the spring and proceed to spawning streams by mid-April (Thurow 1987). Adult steelhead spawn in riffle habitat at water depths greater than 9.45 inches. In general, steelhead spawn in stream channels of less than 4 percent gradient with the highest potential noted between 0.5-4.0 percent. Redds are typically built in streambed material that varies from large gravel to moderate sized cobble. Redd size varies from about 47.4-58.1 ft2 with egg pocket depths between 5.9 and 11.8 inches. Recommended temperatures during spawning vary from 39.0-48.9°F with temperatures between 41-50 °F during incubation displaying the highest survival.

Table ‑. Habitat requirements and physical habitat criteria for different life stages of steelhead.

| **Life Stage** | **Parameter** | **Criteria** | **Reference** |
| --- | --- | --- | --- |
| **Spawning** | Substrate (in) | 0.24-4.02; D50 Range (0.41-1.81) | Bjornn and Reiser 1991 (Steelhead); Kondolf and Wolman 1993 (D50 Range all steelhead) |
| Water Velocity (ft/s) | 1.31-2.99 | Bjornn and Reiser 1991 (Steelhead) |
| Water Depth (in) | ≥9.45 | Bjornn and Reiser 1991 (Steelhead) |
| Stream Temperature (°F) | 39.0-48.9 | Bjornn 1991 (Steelhead) |
| Redd Size (ft2) | 47.4-58.1 | Bjornn and Reiser 1991 (Steelhead) |
| Spawning area/spawning pair (ft2) | No data |  |
| Channel Type | 1. Forced pool-riffle 2. Pool-riffle  3. Plane bed | Roni, Pess, Beechie and Hillman 2012 |
| Bankfull Width (ft) Intrinsic Potential | <12.5 - None | Cooney and Holzer 2006 |
| 12.5-164 - Low to High |
| >164 - Low |
| Gradient (%) | 0.0-0.5% low spawning potential | Cooney and Holzer 2006 |
| 0.5-4.0% low to High spawning potential |
| 4-7% Low spawning potential |
| >7%-No spawning potential |
| Migration Barrier | 20% gradient 656+feet | Cooney and Holzer 2006 |
| Cover | Large woody debris, deep water (pools & runs), turbulence, and undercut banks in close proximity to spawning. | Bjornn and Reiser 1991 |
| **Incubation** | Egg Pocket Depth (in) | 5.9-11.8 (mean) | DeVries 1997 |
| Intragravel DO (ppm) | 8.0 | Bjornn and Reiser 1991 (Steelhead & Coho) |
| Temperature (°F) | >35.6; 41-50 | Velsen 1987; Myrick and Cech 2001 (41-50 °F best survival) |
| Fines (<0.25 in) | <25% | Kuzis 1997 |
| Stream Icing & Scouring | Anchor and frazil ice as well as scouring can reduce intragravel survival. | Bjornn and Reiser 1991 |
| **Rearing** | Post-emergent | Post-emergent steelhead cluster at stream margins in slow (0-0.33 ft/s) and shallow water (<23.6 in). Steelhead fry typically station over cobble and small boulder substrates. Steelhead select shallow, quiet (<0.03 ft/s) water at night. | Roni, Pess, Beechie and Hillman 2012 |
| Summer | As steelhead grow, they use faster (0.06-1.12 ft/s) and deeper (7.5-74.8 in) water use cobble and boulders as cover. Steelhead select shallow, quiet (<0.03 ft/s) water at night. They use areas with fine sediments, bedrock, or coarse substrate at night. At night, larger fish use deeper (15.8-35.4 in) water than smaller fish (5.9-23.6 inches) | Roni, Pess, Beechie and Hillman 2012 |
| Winter | During periods when temperatures are less than 50°F, steelhead remain concealed in cover (woody debris or coarse substrate). Steelhead emerge from cover at night and reside near the stream bed over sand, bedrock, or boulders in depths that range from 19.7-78.7 in. Steelhead use low velocity (0.06 ft/s) areas at night. | Roni, Pess, Beechie and Hillman 2012 |
| Channel Type | Steelhead densities (fish/area) were highest in pocket water but were also found in decreasing order in pools, runs and riffles. | Bjornn and Reiser 1991 |
| Gradient | >10%-Limited | Cooney and Holzer 2006 |

## **Bull** **Trout**

Life history characteristics of bull trout are quite diverse with resident, fluvial and adfluvial forms often occurring within the same basin. Newly emerged fry are secretive and hide in the gravel along stream margins and in side channels (Table 5‑3). Early rearing habitat is characterized by low velocity, shallow water with substrate that provides adequate interstitial spaces as cover. As they grow and become larger they can be found mostly in pool habitat and maintain focal areas near the stream bottom. Bull trout occur most often in A (entrenched, step-pool, 4-10 percent gradient) and C (meandering, riffle-pool, <2 percent gradient) channel types. In winter, bull trout use concealment cover of large woody debris and boulder substrate crevices in deep pools during the day. At night, fish emerge from cover and select low velocity habitat as they maintain their position near the stream bottom.

Bull trout may live in tributary streams their entire lives as resident forms and some may emigrate from their natal streams at about age 3 and become migratory which is reflected in their increased growth as they get older (Thurow 1987). Bull trout can reach maturity in 4-7 years and individuals have been known to live as long as 20+ years (USFSW 2015). Bull trout typically spawn in low gradient riffle habitat with water depths greater than 9.4 inches. They have been noted to spawn in higher gradient channels where hydraulic controls allow accumulations of spawning gravels. Redds are typically constructed in gravel sized substrate that varies from 0.3-2.5 inches. Resident forms of bull trout build smaller (2.6-16.2 ft2) redds than migratory forms (1.4-26.9 ft2) with egg pocket depths occurring between 3.9 and 7.9 inches. Recommended temperatures during spawning vary from 39.2-48.2 °F.

Table ‑. Habitat requirements and physical habitat criteria for different life stages of bull trout.

| **Life Stage** | **Parameter** | **Criteria** | **References** |
| --- | --- | --- | --- |
| **Spawning** | Substrate (in) | 87% of the dominant substrate sizes measured at bull trout redd sites were in the pebble (0.26-1.00) and small gravel (1.00-2.00) categories. Pea gravel (0.08 to < 0.31) and gravel (0.31-2.52) were dominant substrates (> 60%) in redds. | Anglin et al. 2008; Guzevich and Thurow 2017 |
| Water Velocity (ft/s) | 0.66-1.97 (0.82 mean); 0.06-2.13 (0.70 mean) | Anglin et al. 2008; Anglin et al. 2008; Guzevich and Thurow. 2017 |
| Water Depth (in) | 7.9-23.6 Range (10.6 mean); 1.9-20.9 range (7.8-mean) | Anglin et al. 2008; Guzevich and Thurow. 2017 |
| Stream Temperature (°F) | Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed. Watershed conditions indicators (WCI) 7-Day Average Maximum Temperature for bull trout spawning period 39.2-48.2 °F. | USFWS 2015; Baxter and Hauer 2000; USFS 2003 Appendix B |
| Redd Size (ft2) | Resident (range 2.58-16.2); Fluvial (range 4.3-26.9); Fluvial (range1.40-25.6, mean 7.3) | Anglin et al. 2008; Guzevich and Thurow. 2017 |
| Channel Type | Sites where bull trout spawn are characterized by relatively low gradients, a predominance of small gravel, low velocities and proximity to cover (cutbanks, log jams, pools, overhanging bush, etc.). In larger streams redds are often sited downstream of aggrading areas and are associated with ground water sources; whereas, in smaller streams redds are associated with pockets of suitable gravel. Redds occur in patches of sorted gravels along the margins of runs, in high gradient riffles, and downstream from boulders or large woody debris. In higher gradient channels, redds have been observed either downstream from boulders or upstream from natural hydraulic controls where gravels accumulate. Hydraulic controls often result from accumulations of large woody debris and sediment. Pool-riffle and forced pool-riffle channel types would fit this habitat description and comport with redds observed in Sugar and Profile creeks in 2017. | McPhail and Baxter 1996; Guzevich and Thurow. 2017; Miller personal communication 2017 |
| Gradient (%) | <3% | Fraley and Shepard 1989 |
| Migration Barrier | Bull trout have been observed in presence absence surveys in gradients up to 23%. This is very close to the 20% defined for anadromous steelhead and Chinook salmon | Watson and Hillman 1997 |
| Cover | Large woody debris, deep water (pools & runs), boulders, and turbulence. | Wissmar and Craig 2004 |
| **Incubation** | Egg Pocket Depth (in) | 3.94-7.87 | DeVries 1997 |
| Intragravel DO (ppm) | 8.0 | Bjornn and Reiser 1991  (Steelhead & Coho) |
| Temperature (°F) | success increases with temperatures <50°F, optimum 35.6 to 39.2 °F | Kuzis 1997 (Bull Trout) |
| Fines (<0.03 in) | <12% fines (0.03 inches) in gravel; Surface fines (≤0.24 in) ≤20% | Same as WCI, USFS 2003 Appendix B |
| Stream Icing & Scouring | Anchor and frazil ice as well as scouring can reduce intragravel survival. | Bjornn and Reiser 1991 |
| **Rearing** | Post-emergent | Newly emerged fry are secretive and hide in the gravel along stream edges and in side channels. Early rearing habitat is characterized as low velocity, shallow habitat along stream margins with adequate interstitial spaces in the substrate to provide cover. | McPhail and Baxter 1996 |
| Summer | As juveniles grow, they select deeper habitats found mainly in pools, but also in riffles and runs. They maintain focal sites near the bottom and are strongly associated with instream cover, especially overhead cover. | McPhail and Baxter 1996 |
| Winter | Bull trout used concealment cover of large woody debris and boulder substrate crevices in deep pools during the day. At night, fish emerged from cover and habitat use shifted to shallow water with low cover. Microhabitat partitioning among species (bull trout and cutthroat) and size classes occurred at night, cutthroat trout moving into shallower, faster water that was farther from cover compared to bull trout. Smaller fish of both species occupied focal positions in slower, shallower water closer to the substrate than larger fish. | Jakober et al. 2000 |
| Channel Type | Bull trout occurred more often in A (entrenched, step-pool, 4-10% gradient) and C (meandering, riffle-pool, <2% gradient) channel types. Bull trout most often occupied slow-water habitats (scour and dam pools) within alluvial lowlands and valleys. The dominant riparian vegetation in these sites consisted of trees and shrubs. | Watson and Hillman 1997 |
| Bankfull Width (ft) | 0.98-86.0 | Watson and Hillman 1997 |
| Gradient | >23%-None  A (entrenched, step-pool, 4-10% gradient) and C (meandering, riffle-pool, <2% gradient) | Watson and Hillman 1997 |

## **Westslope Cutthroat Trout**

As noted previously, Westslope cutthroat trout have a widespread distribution and may exhibit resident or migratory life histories. Resident forms remain in their natal streams while migratory forms move downstream occupying habitats in larger streams. The status review for Westslope cutthroat trout characterized spawning habitat as low-gradient stream reaches that have gravel substrate ranging from 0.09-2.95 inches in diameter. Several researchers confirm that Westslope cutthroat trout spawn in low gradient stream reaches between 0.5-4.4 percent. Spawning occurs in riffle habitat in water less than 9 inches deep with velocities ranging between 0.8-2.6 ft/s. Females construct redds that vary in size from 0.97-9.69 ft2 and bury their eggs in substrate about 3.9-7.9 inches deep.

Temperature during the incubation period may range from 43-63 °F but 50 °F is optimal. Fry typically emerge from the gravel 45 to 75 days after egg fertilization depending on water temperature (Calhoun 1944; Lea 1968; Scott and Crossman 1973). Post-emergent fry seek low velocity lateral habitats with cover and larger growth increments occurring after age 3 suggest that emigration occurs at this age to more productive downstream habitats (Thurow 1987). Idaho Department of Fish and Game (2013) note that the distribution and abundance of larger cutthroat trout is strongly associated with pool habitat and suggest that stream reaches with numerous pools support the highest densities of fish.

Table ‑. Habitat requirements and physical habitat criteria for different life stages of Westslope cutthroat trout.

| **Life Stage** | **Parameter** | **Criteria** | **Reference** |
| --- | --- | --- | --- |
| **Spawning** | Substrate (in) | 0.03-1.4; 0.12-3.15 average; 0.08-2.95 | Kuzis 1997; Hickman and Raleigh 1982; (average size); USFWS 1999 |
| Water Velocity (ft/s) | 0.98-1.97; Average 1.84 (0.82-2.56) | Hickman and Raleigh 1982; Schmetterling 2000 |
| Water Depth (in) | 1.7–9.0; average 5.1 | Schmetterling 2000 |
| Stream Temperature (°F) | 43.0 to 63.0 | Kuzis 1997 |
| Redd Size (ft2) | 0.97-9.69 | Kuzis 1997 |
| Channel Type | Cutthroat trout prefer channel types that contain pools, pool tailouts, and riffles. | Hickman and Raleigh 1982 |
| Gradient (%) | 0.5- 4.4 | Magee et al. 1996; Zurstadt and Stephan 2004; Schmetterling 2000; Marotz and Fraley 1986 |
| Migration Barrier | >17 | Peterson et al. 2014-excluded as potentially unsuitable habitat for Westslope cutthroat trout |
| **Incubation** | Egg Pocket Depth (in) | 3.9-7.9 | DeVries 1997 |
| Intragravel DO (ppm) | 7-8 | Hickman and Raleigh 1982; Bjornn and Reiser 1991 (Steelhead & Coho) |
| Temperature (°F) | 43-63 range; 50 optimal | Hickman and Raleigh 1982 |
| Fines (<0.25 in) | Decreased survival >10% fines | Kuzis 1997 |
| Stream Icing & Scouring | Anchor and frazil ice as well as scouring can reduce intragravel survival. | Bjornn and Reiser 1991 |
| **Rearing** | Post-emergent | Fry selected lateral habitats with low velocities (<0.07 ft/sec). Lateral habitats were along the stream margin, backwaters and side channels. | Moore and Gregory 1988; |
| Summer | As cutthroat grow (>2.2 in) they can select deeper and faster velocities away from the stream margin (>0.16 ft/sec). Juvenile cutthroat are most often found in stream pools and runs and a diversity of cover. Adult cutthroat trout are strongly associated with pools and cover. | Moore and Gregory 1988; USFWS 1999;  IDFG 2013 |
| Winter | Cutthroat trout used concealment cover of large woody debris and boulder substrate crevices in deep pools during the day. At night, fish emerged from cover and habitat use shifted to shallow water with low cover. Microhabitat partitioning among species (bull trout and cutthroat) and size classes occurred at night, cutthroat trout moving into shallower, faster water that was farther from cover compared to bull trout. Smaller fish of both species occupied focal positions in slower, shallower water closer to the substrate than larger fish. | Jakober et al. 2000 |
| Channel Type | Variable-mostly pools and runs | Kuzis 1997;Moore and Gregory 1988;  USFWS 1999 |
| Gradient | >17 | Peterson et al. 2014-excluded as potentially unsuitable habitat for Westslope cutthroat trout |

# Biological Objectives

Biological objectives were assessed for reaches of the EFSFSR (EF1-EF4) and Meadow Creek (MC4-MC6) based on intrinsic potential for Chinook salmon and steelhead (Cooney and Holzer 2006). For others reaches the current distributions and barriers were used to determine appropriate biological objectives. This is an initial coarse scale assessment that will be refined and replaced when intrinsic potential is applied globally using GIS techniques to all accessible (< 20 percent gradient) stream reaches in the upper EFSFSR. Developing intrinsic potential for all stream reaches will help identify net benefits associated with the Stibnite Gold Project Conceptual Mitigation Plan.

## Anadromous Salmonids

Cooney and Holzer (2006) used channel slope (gradient), bankfull width (BFW) and the ratio of valley width to bankfull width to assess intrinsic potential for anadromous spring/summer Chinook salmon and steelhead (see Table 6‑1 and Table 6‑2).

Table ‑. Intrinsic potential for Interior Columbia basin Spring/Summer Chinook salmon spawning and initial rearing.

| Chinook salmon relative potential for spawning and initial rearing | | | | |
| --- | --- | --- | --- | --- |
| Stream width / Gradient Categories | | Valley Width Ratio  (ratio of valley width to bankfull stream width) | | |
| Bankfull Width  (ft) | Gradient  (%) | Confined  (≤4 x BFW) | Moderately Confined  (4 to 20 x BFW) | Unconfined  (> 20 x BFW) |
| BFW <12.1 | ≥ 0.0 | None | None | None |
| BFW 12.1 to 82 | 0.0 - 0.5 | Medium | High | High |
| 0.5 - 1.5 | Low | Medium | High |
| 1.5 - 4.0 | Low | Low | Medium |
| 4.0 - 7.0 | Negligible | Low | Low |
| >7.0 | None | None | None |
| BFW 82-164 | 0.0 - 0.5 | None | Medium | Medium |
| 0.5 -10.0 | None | None | None |
| ≥ 10.0 | None | None | None |
| BFW > 164 | ≥ 0.0 | None | None | None |
| Note: Intrinsic potential categories (i.e., none - high) were assessed for potential anadromous reaches in Meadow Creek and EFSFSR. Intrinsic potential categories were based on proposed bankfull width (BFW), gradient (%), and the ratio of floodplain width (FPW) to bankfull width (FPW/BFW). For example, streams with a BFW from 12.1 to 82 feet, a gradient from 0.0%-0.5% and confinement ratio greater than 20 (i.e., unconfined) were considered to have a high intrinsic potential for Chinook salmon (Cooney and Holzer 2006). | | | | |

Table ‑. Intrinsic potential for interior Columbia basin summer steelhead spawning and initial rearing.

| Steelhead relative potential for spawning and initial rearing | | | | |
| --- | --- | --- | --- | --- |
| Stream width / Gradient Categories | | Valley Width Ratio  (ratio of valley width to bankfull stream width) | | |
| Bankfull Width  (ft) | Gradient  (%) | Confined  (≤4 x BFW) | Moderately Confined  (4 to 20 x BFW) | Unconfined  (> 20 x BFW) |
| BFW <12.5 | ≥ 0.0 | None | None | None |
| BFW 12.5 - 82 | 0.0 - 0.5 | None | Medium | Medium |
| 0.5 - 4.0 | Low | High | High |
| 4.0 - 7.0 | None | Low | Low |
| > 7.0 | None | None | None |
| BFW 82 - 164 | 0.0 - 4.0 | Low | Medium | Medium |
| >4.0 | None | None | None |
| BFW > 164 | ≥ 0.0 | None | Low | Low |
| Note: Intrinsic potential categories (i.e., none - high) were assessed for potential anadromous reaches. Intrinsic potential categories were based on bankfull width (BFW), gradient (%), and the ratio of floodplain width (FPW) to bankfull width (FPW/BFW). For example, streams with a BFW from 12.5 to 82 feet, a gradient from 0.0%-0.5% and confinement ratio greater than 20 (i.e., unconfined) were considered to have a medium intrinsic potential for steelhead (Cooney and Holzer 2006). | | | | |

Intrinsic potential helped identify potential biological objectives for restoration and enhancement reaches of the EFSFSR and Meadow Creek (Table 6‑3 and Table 6‑4). Intrinsic potential for spring/summer Chinook salmon in the EFSFSR is considered low largely because of stream gradient. However, for steelhead intrinsic potential varied from low to high in different reaches of the EFSFSR. In Meadow Creek, intrinsic potential for spring/summer Chinook salmon varied from low to high but remained high for steelhead. This suggests that multiple biological objectives could be achieved with stream restoration/enhancement and elimination of the passage barrier at the Yellow Pine pit. Successful reproduction for spring/summer Chinook salmon has been demonstrated by observations of juvenile Chinook salmon following translocation of adult spawners the year before (MWH 2017). This assessment also suggests that successful steelhead production is probable given the high intrinsic potential noted. However, the rate of recolonization would be influenced by habitat quality and size of the nearby steelhead population.

Table ‑. Coarse scale assessment of intrinsic potential for spring/summer Chinook salmon and steelhead in reach EF1 to EF4 of the EFSFSR.

| **Stream** | **Reach Designation** | **Valley & Channel Characteristics** | | | | | | **Intrinsic Potential2** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Channel Slope** | **Bankfull Width (ft)** | **FP/BF ratio (min)** | **FP/BF ratio (max)** | **Floodplain Width ft (min)** | **Floodplain Width ft (max)** | **Chinook**  **salmon** | **Steelhead** |
| East Fork South Fork  Salmon River (EFSFSR) | EF1 | 6.48 | 15 | 4.8 | 9.7 | 72 | 145 | Low | Low |
| EF2a | 3.07 | 25 | 5.4 | 10.8 | 135 | 269 | Low | High |
| EF2b | 2.85 | 25 | 5.4 | 10.8 | 135 | 269 | Low | High |
| EF2c | 6.61 | 25 | 5.4 | 10.8 | 135 | 269 | Low | Low |
| EF3a | 3.76 | 25 | 3.8 | 7.6 | 96 | 191 | Low | Low & High |
| EF3b | 3.76 | 22 | 5.4 | 10.7 | 118 | 236 | Low | High |
| EF3c | 3.76 | 26 | 4.5 | 9.0 | 117 | 234 | Low | High |
| EF3d | 3.76 | 22 | 5.7 | 11.5 | 126 | 252 | Low | High |
| EF3e | 3.76 | 26 | 5.2 | 10.5 | 136 | 272 | Low | High |
| EF4 | 2.62 | 26 | 3.2 | 6.2 | 84 | 161 | Low | Low & High |
| 2. In EF3a and EF4 the variation in floodplain width produced FP/BF ratios where intrinsic potential would vary from low to high for steelhead. | | | | | | | | | |

Table ‑. Coarse scale assessment of intrinsic potential for spring/summer Chinook salmon and steelhead in reaches MC4 to MC6 of Meadow Creek.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Stream** | **Designation** | **Valley & Channel Characteristics** | | | | | | **Intrinsic Potential3** | |
| **Channel Slope** | **Bankfull Width (ft)** | **FP/BF ratio (min)** | **FP/BF ratio (max)** | **Floodplain Width ft (min)** | **Floodplain Width ft (max)** | **Chinook Salmon** | **Steelhead** |
| Meadow  Creek | MC4 | 0.98 | 16 | 11.5 | 23.0 | 184 | 368 | Med-High | High |
| MC5 | 1.39 | 17 | 10.9 | 21.9 | 186 | 372 | Med-High | High |
| MC6 | 2.29 | 17 | 6.1 | 12.1 | 103 | 206 | Low | High |
| 3. In MC4 and MC5 the variation in floodplain width produced FP/BF ratios where intrinsic potential would vary from medium to high for spring/summer Chinook salmon. | | | | | | | | | |

These reaches of Meadow Creek and the EFSFSR would also provide potential spawning, rearing and migratory corridors for bull trout and westslope cutthroat trout. Some overlap in spawning distributions of bull trout and spring/summer Chinook salmon observed in Sugar Creek is encouraging and suggests that multiple biological objectives could be achieved (Figure 6‑1, Figure 6‑2, Figure ). In addition, the lowermost sections of some tributaries streams (i.e., East Fork Meadow Creek, Garnet Creek, and Midnight Creek) may provide some limited juvenile rearing habitat for steelhead and spring/summer Chinook salmon. However, for other streams like Fiddle Creek and West End Creek the steep gradient at the confluence preclude that potential.

## Migratory or resident salmonids

With stream connectivity restored across the current Yellow Pine pit, migratory forms of westslope cutthroat trout and bull trout are likely to migrate to the upper EFSFSR. The biological objective for Fiddle Creek and East Fork Meadow Creek is westslope cutthroat trout based on current distribution (Figure 3‑1). Stream restoration atop the tailing storage facility in upper Meadow Creek would encourage continued occupancy for both westslope cutthroat trout and bull trout. West End Creek would remain non-fish bearing. The majority of Garnet Creek, Midnight Creek, and Hennessy Creek would also be non-fish bearing except near their confluence with the EFSFSR.

With stream restoration and enhancement focused on developing high quality habitat, multiple biological objectives may be addressed for spring/summer Chinook salmon, steelhead, bull trout, and westslope cutthroat trout within the Stibnite Gold Project.

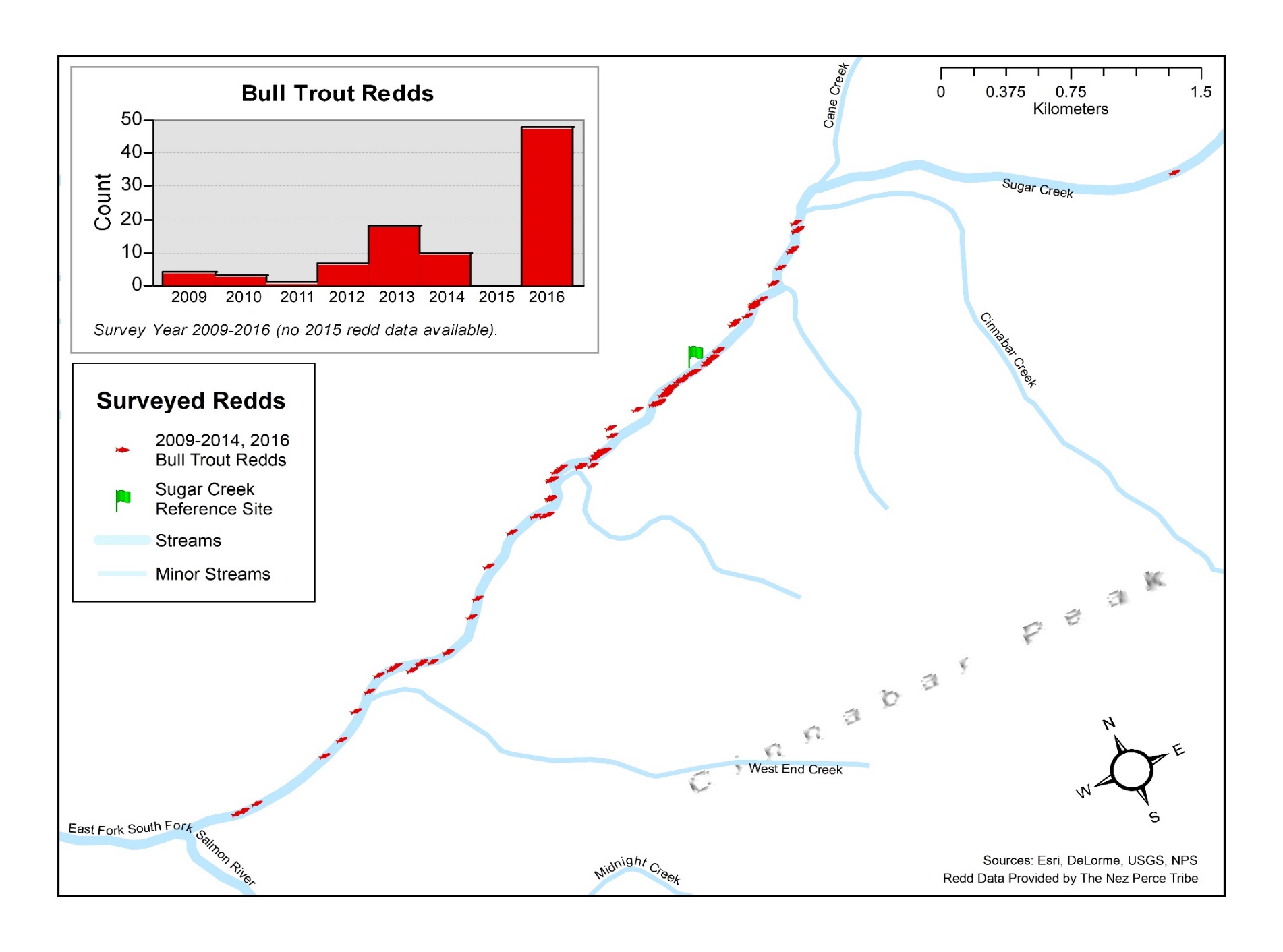


Figure ‑. **Bull trout redds observed in Sugar Creek (2009-2014, 2016). Information provided by the Nez Perce Tribe (2018).**

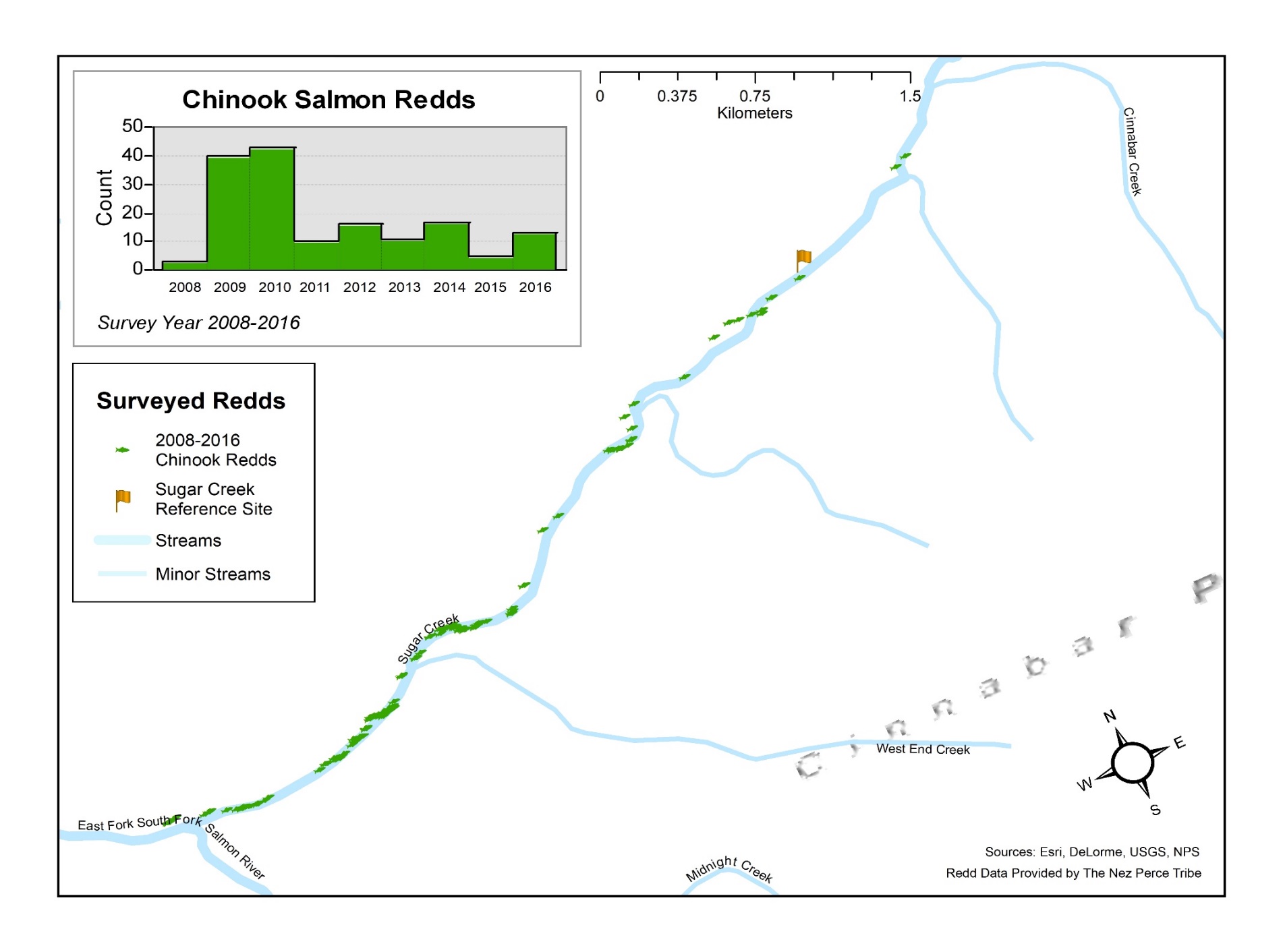


Figure ‑. Chinook Salmon Redds observed in Sugar Creek (2008 – 2016). Information provided by the Nez Perce Tribe (2018).

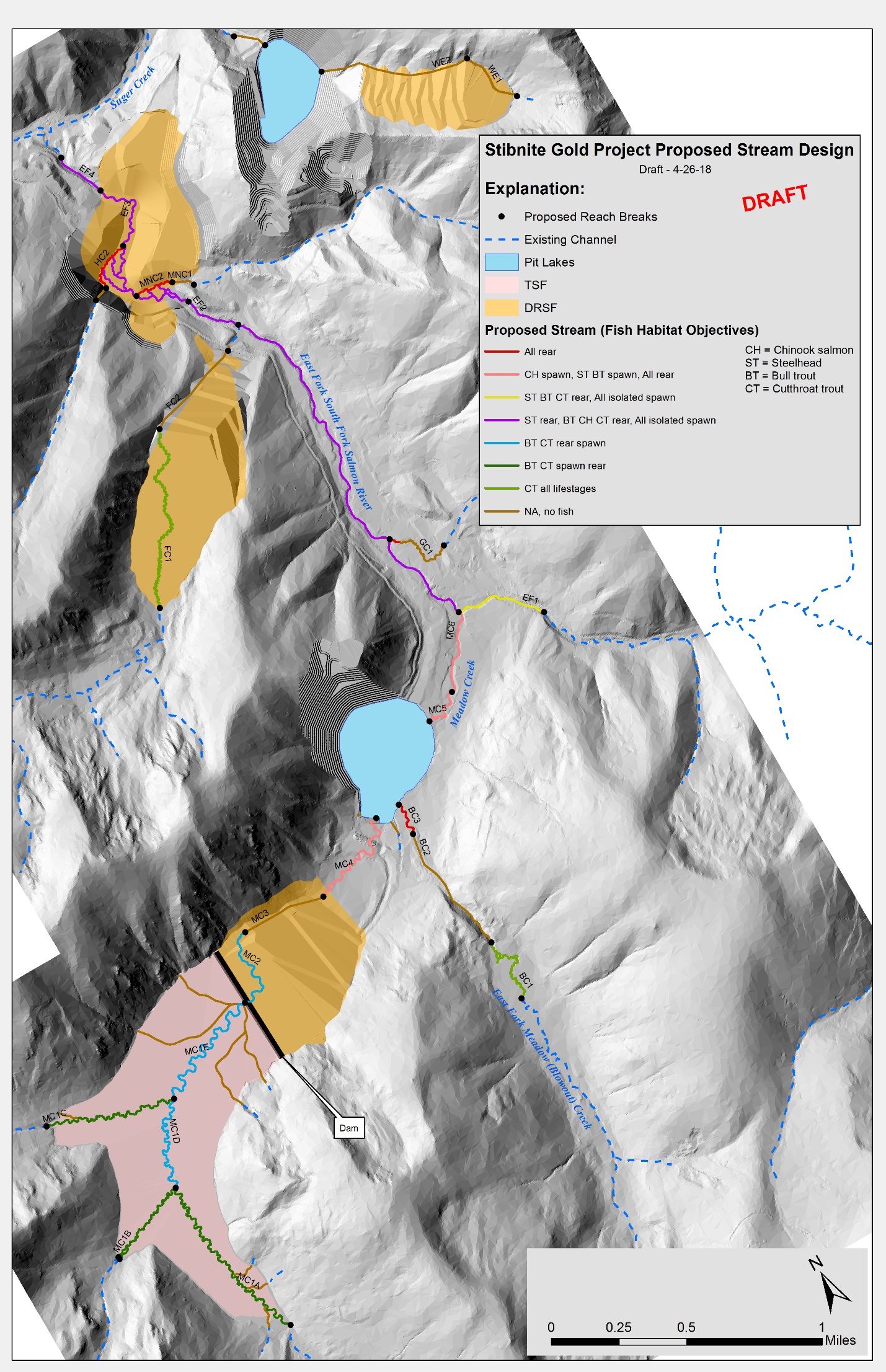


Figure ‑. Proposed biological objectives for streams of the upper EFSFSR.

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1. . A PIT tag array has been installed downstream from the YPP Lake and will be operated in 2018. [↑](#footnote-ref-1)