Nu-West Industries, Inc.

PROPOSAL FOR SITE-SPECIFIC SELENIUM CRITERIA

Upper Blackfoot River and Georgetown Creek Watersheds

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CONTENTS

TABLES

ACRONYMS AND ABBREVIATIONS

dw	dry weight
EO	egg or ovaries
GMCV	Genus Mean Chronic Value
IDAPA	Idaho Administrative Code
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
mg/kg dw	milligrams per kilogram dry weight
mg Se/kg EO dw	milligrams selenium per kilogram eggs or ovaries, dry weight
Nu-West	Nu-West Industries, Inc.
SMCV	Species Mean Chronic Value
SSC	site-specific criteria
UBR	Upper Blackfoot River
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
µg/L	micrograms per liter

1 INTRODUCTION

This document presents Nu-West Industries, Inc. (Nu-West) proposal for site-specific selenium (Se) criteria for surface waters located in two watersheds in Southeast Idaho: Upper Blackfoot River (UBR) watershed and Georgetown Creek watershed (hereafter referred to as the “Sites”).

In accordance with Idaho Water Quality Standards (Idaho Administrative Code, IDAPA 58.01.02 § 275) site-specific criteria (SSC) may be developed when the resident species of a water body differ in their sensitivity relative to those used to develop a water quality criterion. This is the rationale for developing the SSC for Se: the resident fish species that occur at each Site vary in composition and sensitivity from those used in the development of the United States Environmental Protection Agency (USEPA) 2016 Se criterion (USEPA 2016).

Per the IDAPA, any person may develop SSC in accordance with the rules specified at IDAPA 58.01.02 § 275. One of the acceptable procedures for developing SSC for the protection of aquatic life is the Recalculation Procedure. The SSC for Se proposed herein is based on the Recalculation Procedure in that it is intended to better reflect the assemblage of fish species that reside at each Site. Because USEPA (2016) concludes that fish are the most sensitive group of aquatic organisms to Se effects, the SSC proposed for Se is specific to the most sensitive group of fish species that occur at each Site.

The core steps for developing the proposed SSC include:

a. Geographic definition of each Site (Section 2)

b. Determination of the resident fish species that occur at each Site (Section 3)

c. Recalculation of the Se criterion based on the resident fish species (Section 4)

d. An evaluation of the protectiveness of the SSC to resident fish (Section 5).

The list of resident fish species for each Site is developed from a comprehensive record of fisheries data. Salmonids (i.e., trout) in the genus *Oncorhynchus* are the most sensitive taxonomic group of aquatic organisms that occur at each Site. Consequently, the proposed SSC for Se are based on chronic toxicity values from USEPA (2016) for this genus. The proposed SSC for Se are expected to be protective of other resident fish species based on an evaluation of toxicity data and population information presented in this proposal.

2 DEFINITION OF SITES

According to USEPA (1994, 2013), a “Site” may be a state, region, watershed, waterbody, or segment of a waterbody. The two Sites included for the SSC in this proposal are defined at watershed scales based on existing water body units in IDAPA 58.01.02 § 150.09.

1. UBR – confluence of Lanes and Diamond Creeks to Blackfoot Reservoir (unit US-10), and all tributaries thereof; and

2. Georgetown Creek – source to mouth (unit B-22), and all tributaries thereof.

The mainstems of the Blackfoot River and Georgetown Creek are designated as *Cold Water* and *Salmonid Spawning* for the protection of aquatic life. Cold water refers to water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species. Salmonid spawning refers to waters that provide or could provide a habitat for active self-propagating populations of salmonid fishes. Tributaries of each water way are non-designated, presumed to support cold water aquatic life (IDAPA 58.01.02).

3 RESIDENT FISH SPECIES

The terms “occur at the Site” and “resident” are equivalent in the general context of recalculated SSC, and include life stages and species that:

a. Are usually present at the Site

b. Are present at the Site only seasonally due to migration

c. Are present at the Site intermittently because they periodically return to or extend their ranges into the Site

d. Were present at the Site in the past, are not currently present at the Site due to degraded conditions, but are expected to be present at the site when conditions improve

e. Are present in nearby bodies of water, are not currently present at the Site due to degraded conditions, but are expected to be present at the Site when conditions improve

(*See* IDAPA 58.01.02 § 010.86 - “Resident Species”)

The resident fish species occurring at each Site were determined from comprehensive survey and stocking records. The duration of survey data in conjunction with detailed stocking records provide a high degree of certainty in the list of resident species for each Site, described in the following sections.

3.1 Resident Fish in the Upper Blackfoot River Watershed

The UBR watershed supports Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*), rainbow trout (*O*. *mykiss*), brook trout (*Salvelinus fontinales*) and various non-game species (minnows, sculpins, and suckers). A compendium of UBR fisheries data is provided in Attachment 1. In total, more than 40,000 survey results (e.g., fish counts) are available for the Blackfoot River and its tributaries between 1959 and 2016. The most comprehensive surveys are summarized below.

a. **Idaho Department of Fish and Game (IDFG) fish surveys.** The IDFG began intensive fishery evaluations and creel surveys in the UBR watershed in 1959 and have continued population and spawning surveys on the UBR and its tributaries through 2007.

b. **IDFG fish stocking records.** IDFG stocks the Blackfoot Reservoir and UBR with hatchery trout on a regular basis. Stocking records are available from 1967 to 2016. Since 1993 and 1995, only rainbow trout have been stocked in the UBR (upstream of the Reservoir) and Blackfoot Reservoir, respectively.

c. **Idaho Department of Environmental Quality (IDEQ) fish surveys.** IDEQ has conducted fish surveys on nearly all tributary streams in the UBR watershed as part of the Beneficial Use Reconnaissance Program between 1993 and 2016.

d. **GEI Consultants, Inc. (GEI) and Arcadis fish surveys.** On behalf of Nu-West, GEI conducted intensive aquatic surveys on ten tributary streams in the UBR watershed between 2013 and 2015. In 2016, GEI and Arcadis continued the surveys on these tributaries. Quantitative electrofishing was conducted during late spring and early fall of each year using multi-pass techniques. All fish collected were identified to species, measured for total length, and weighed.

e. **United States Forest Service (USFS) fish surveys.** The USFS conducted fish surveys on tributaries located through the UBR between 2000 and 2002.

The list of resident species in the UBR watershed is presented in Table 1. This list is comprehensive owing to the extensive record of fisheries data available in the UBR watershed. Fish species listed in Table 1 were consistently confirmed from extensive surveys conducted by various entities. Sturgeon and centrarchids, fish that also are sensitive to Se, are not resident to the UBR watershed.

Table 1. Resident Fish Species that Occur in the Upper Blackfoot River Watershed

Family	Genus	Species	Common Name
Salmonidae	*Oncorhynchus*	*O. mykiss*	Rainbow trout
		O. clarkii bouvieri	Yellowstone cutthroat trout
	Salvelinus	*S. fontinalis*	Brook trout
Cyprinidae	*Rhinichthys*	*R. cataractae*	Longnose dace
		R. osculus	Speckled dace
		R. falcatus	Leopard dace
	Richardsonius	*R. balteatus*	Redside shiner
	Gila	*G. atraria*	Utah chub
	Couesius	*C. plumbeus*	Lake chub
Catostomidae	*Catostomus*	*C. ardens*	Utah sucker
		C. platyrhynchus	Mountain sucker
Cottidae	*Cottus*	*C. bairdii*	Mottled sculpin
		C. beldingii	Paiute sculpin

3.2 Resident Fish in the Georgetown Creek Watershed

Brook trout and rainbow trout currently dominate the fish community in Georgetown Creek. Bonneville cutthroat trout (*O. clarki utah*), a subspecies of cutthroat trout endemic to the Bear River drainage basin, were sampled in Georgetown Creek through the 1990s, but have not been observed in more recent surveys. However, re-establishment of Bonneville cutthroat trout in the Georgetown Creek watershed is a current management objective for IDFG (Teuscher and Capurso 2007). For these reasons, cutthroat trout are considered resident fish to Georgetown Creek in this proposal. A compendium of Georgetown Creek fisheries data is provided in Attachment 2. The most comprehensive surveys are summarized below.

a. **IDFG fish surveys.** The IDFG conducted fish surveys on Georgetown Creek and Left Hand Fork (a tributary to Georgetown Creek) in 1994, 1997, 2003, and 2007.

b. **IDFG fish stocking records.** IDFG stocks Georgetown Creek with hatchery trout during most years. According to stocking records presented by IDFG (Teuscher and Capurso 2007), rainbow trout, brook trout, and cutthroat trout were stocked in Georgetown Creek between 1913 and 2002. According to stocking records currently published by IDFG, only rainbow trout have been stocked in Georgetown Creek since 1995 (https://fishandgame.idaho.gov/ifwis/fishingplanner/).

c. **IDEQ fish surveys.** IDEQ conducted fish surveys in Georgetown Creek watershed between 1997 and 2013 at four locations on Georgetown Creek and one location on Left Hand Fork.

d. **USFS fish surveys.** The USFS conducted fish surveys on Georgetown Creek and Left Hand Fork in 1994, 2000, 2001, and 2007.

e. **GEI and Arcadis fish surveys.** On behalf of Nu-West, GEI conducted fish surveys at four locations on Georgetown Creek and a location on Left Hand Fork in spring and late summer in 2015. GEI and Arcadis continued seasonal fish surveys at these locations in 2016. Quantitative electrofishing was conducted during late spring and early fall of each year using multi-pass techniques. All fish collected were identified to species, measured for total length, and weighed.

The resident list of fish species in the Georgetown Creek watershed is presented in Table 2. This list is comprehensive of species that occur in Georgetown Creek and its tributaries given the extensive record of fisheries and stocking data. Relative to the UBR watershed, the Georgetown Creek watershed comprises a smaller drainage area and thus has fewer fisheries records. The list of resident fish (i.e., salmonids) was consistently confirmed through various comprehensive surveys. From these surveys, sturgeon and centrarchids are not resident to the Georgetown Creek watershed.

Table 2. Resident Fish Species that Occur in the Georgetown Creek Watershed

Family	Genus	Species	Common Name
Salmonidae	*Oncorhynchus*	*O. mykiss*	Rainbow trout
		O. clarkii utah	Bonneville cutthroat trout
		S. fontinalis	Brook trout

4 NU-WEST PROPOSED SITE-SPECIFIC CRITERIA FOR SELENIUM

Table 3 presents aquatic life water quality criteria for Se proposed by IDEQ and the SSC for Se proposed for the two sites herein by Nu-West.

Table 3. IDEQ Proposed Aquatic Life Selenium Criteria (Default) and Nu-West Proposed Site-Specific Criteria

Fish Tissue (mg/kg dw)						Water Column (µg/L)	
Egg-Ovary[1,2]		Whole Body[3,2]		Muscle[3,2]		Water Lotic[4]	
Default	**SSC**	Default	**SSC**	Default	**SSC**	Default	SSC[5,6]
15.1	**25.3**	8.5	**11.6**	11.3	**14.3**	3.1 (30 day)	--

Notes:
1. Egg/ovary supersedes any whole-body, muscle, or water column element when fish egg/ovary concentrations are measured.
2. Frequency: Average not to be exceeded.
3. Fish whole-body or muscle tissue supersedes water column element when both fish tissue and water concentrations are measured.
4. Frequency: Not to be exceeded more than once in three years on average.
5. Site-specific water column values (30-day) are based on dissolved total Se in water and are derived from fish tissue values via mechanistic or bioaccumulation modeling methods in Appendix K from USEPA (2016). In streams or reaches of streams where fish are naturally absent due to low flow conditions, surface water from the fishless stream or reach and fish tissue measured downstream at the first occurrence of a continuous fish population are used for bioaccumulation modeling.
6. Fish tissue supersedes any site-specific water column values when fish are sampled downstream of the fishless stream or reach of fishless stream, at the first occurrence of a continuous fish population.

Bold Values = Nu-West proposed SSC for Se
mg/kg dw – milligrams per kilogram dry weight
SSC – site-specific criteria
µg/L – micrograms per liter

The Nu-West proposed SSC in Table 3 are equivalent to USEPA's (2016) Genus Mean Chronic Value (GMCV) for the genus *Oncorhynchus.* The *Oncorhynchus* value is derived from robust toxicity testing on sensitive reproductive endpoints, and is specific to the most-sensitive resident genus that occurs at each Site. The rationale for this proposed SSC is described below.

Members of the *Salmonidae* family are considered among the most sensitive to Se, along with centrarchids and sturgeon (USEPA 2016). As discussed in Section 3, however, centrarchids and sturgeon do not occur at either Site and thus are not considered resident fish species. Salmonids (cutthroat trout, rainbow trout, and brook trout) are the dominant species of resident game fish at each Site. In the general context of water quality criteria, trout at each Site are considered "critical species" given their commercial and recreational importance. Historical stocking records and current management priorities of salmonids at each Site reflect their local importance.

USEPA (2016) presents toxicity data for three salmonid genera: *Oncorhynchus*, *Salvelinus*, and *Salmo*. Brown trout, in the genus *Salmo,* are not resident to either Site (Section 3). Toxicity data presented by USEPA (2016) clearly show that fish in the genus *Oncorhynchus* are more sensitive to Se than fish in the genus *Salvelinus.* Consequently, Nu-West proposes SSC based on the extensive toxicity data available for members of the *Oncorhynchus* genus, described below.

4.1 Genus *Oncorhynchus*

This section summarizes the available *Oncorhynchus* toxicity data used by USEPA (2016) to develop the *Oncorhynchus* GMCV. In Section 5, toxicity data are presented for other resident fish to establish the protectiveness of the proposed SSC to residents at each Site.

Table 4 presents the toxicity data from USEPA (2016) for two species within the genus *Oncorhynchus*: rainbow trout and Westslope cutthroat trout (*O. clarkii lewisi*).

Table 4. Maternal Transfer Reproductive Toxicity Studies for *Oncorhynchus* (from EPA 2016)

Genus	Species	SMCV (mg Se/kg EO dw)	GMCV (mg Se/kg EO dw)
Oncorhynchus	Rainbow Trout[1,2,3]	24.5	25.3[a]
	Cutthroat Trout[4,5]	26.2	

Notes:
[1]Holm (2002)
[2]Holm et al. (2003)
[3]Holm et al. (2005)
[4]Rudolph et al. (2008)
[5]Nautilus Environmental (2011)
[a]Nu-West proposed site-specific Se criterion for Upper Blackfoot River and Georgetown Creek Watersheds
mg Se/kg EO dw - milligrams Se per kilogram eggs or ovaries, dry weight

A rainbow trout EC_{10} of 24.5 milligrams Se per kilogram egg/ovary, dry weight (mg Se/kg EO dw) based on edema is available from Holm (2002) and Holm et al. (2005). Over a three-year study period, eggs were collected from spawning fish at several reference and Se-impacted streams. The eggs were fertilized with milt from wild-caught males and monitored in the laboratory until swim-up stage for percent fertilization, embryonic malformations (craniofacial, fin, and spinal malformations), edema, and mortality. In this study, edema was the most sensitive endpoint (USEPA 2016). The Species Mean Chronic Value (SMCV) for rainbow trout is 24.5 mg Se/kg EO dw and is based on the edema EC_{10} value.

Cutthroat trout EC_{10}s are available from two studies. A cutthroat trout EC_{10} of 24.7 mg Se/kg EO dw based on alevin survival (post hatch to swim-up stage) is available from Rudolph et al. (2008). In this study, eggs from reference and Se-contaminated ponds were fertilized in the field with milt from males collected at each site and transported to the laboratory for rearing. Eggs and alevins were monitored for fertilization, hatching and mortality. After yolk absorption, all viable fry were observed for skeletal, craniofacial, and fin malformations. The most sensitive endpoint was alevin survival (e.g., the EC_{10} of 24.7 mg Se/kg EO dw).

Nautilus Environmental (2011) conducted an extensive follow-up study to Rudolph et al. (2008) and determined a cutthroat trout EC_{10} of 27.7 mg Se/kg EO dw based on larval survival at swim-up stage. Adult fish in spawning condition were collected from Se-impacted streams and ponds and from a reference lake. Fertilized eggs were reared in the laboratory until they reached swim-up stage. Skeletal, craniofacial, and fin malformations were assessed at swim-up and at 28-day post swim-up. The most sensitive endpoint was larval survival at the swim-up stage (e.g., the EC_{10} of 27.7 mg Se/kg EO dw).

USEPA (2016) used these rainbow trout and cutthroat trout EC_{10}s to calculate the *Oncorhynchus* GMCV. When multiple toxicity values are available for a single species, the SMCV equals the geometric mean of the toxicity values. Similarly, when multiple SMCVs are available for a single genus, the GMCV equals the geometric mean of SMCVs (USEPA 1985, 2016). Accordingly, the SMCV for cutthroat trout is 26.2 mg Se/kg EO dw and equals the geometric mean of 24.7 from Rudolph et al. (2008) and 27.7 mg Se/kg EO dw from Nautilus Environmental (2011). The GMCV for the genus *Oncorhynchus* is 25.3 mg Se/kg EO dw and equals the geometric mean of the rainbow trout SMCV (e.g., 24.5 mg Se/kg EO dw) and the cutthroat trout SMCV (e.g., 26.2 mg Se/kg EO dw).

As discussed in USEPA (2016), there is low uncertainty in the *Oncorhynchus* chronic value because the three studies with *Oncorhynchus* span a narrow range of 24.5 to 27.7 mg Se/kg EO dw. In addition, this narrow range incorporates a range of sensitive reproductive endpoints for each species, and thus provides high confidence in the protectiveness of the SSC to resident fish species at both Sites.

In addition to the Se toxicity values used to calculated the *Oncorhynchus* GMCV, USEPA (2016) presents additional toxicity data for *Oncorhynchus* that are briefly summarized below.

1. Kennedy et al. (2000) conducted maternal transfer reproductive toxicity studies on wild-caught cutthroat trout at a reference and an exposed site. The chronic value for mortality and deformity in eggs, larvae, and fry was >21.2 mg Se/kg egg dw (reported as a "greater than" value because no significant effects were observed up to the highest tested).
2. Hardy (2005) evaluated growth, survival, deformity, and hatchability effects in Yellowstone cutthroat trout (*O. clarkii utah*) exposed to dietary Se for 124 weeks. No dose-dependent effects were observed for embryo-larval hatching or survival. The highest dietary Se exposure resulted in a Se concentration of 16.04 mg Se/kg EO dw.

Although significant dose-response relationships were not observed, the additional data support the protectiveness of the *Oncorhynchus* GMCV because Se concentrations in each study approached the *Oncorhynchus* GMCV and no significant effects were observed. This suggest the *Oncorhynchus* GMCV appropriately captures the low-end effect range.

4.1.1 Tissue Elements for the Genus *Oncorhynchus*

Toxicity endpoints in USEPA's Se criterion document are expressed as EC_{10} values on a dry weight (dw) tissue basis and comprise EO, whole-body, or muscle tissues. Because organisms in aquatic environments exposed to Se accumulate it primarily through their diets, and not directly through water, the most relevant Se toxicity studies involve extended duration dietary exposure and measurement of total Se fish tissue. Selenium in the EO of exposed adult females in pre-spawning condition and effects occurring in offspring through maternal transfer of Se produce the strongest dose-response relationships. Therefore, Se EC_{10} concentrations are commonly reported on an EO basis, as described above. The EO tissue element of the proposed SSC (Table 3) is specific to the genus *Oncorhynchus.* Similarly, the whole-body and muscle SSC values in Table 3 are specific to the genus *Oncorhynchus* and are consistent with the final chronic values presented by USEPA (2016) for these tissues.

5 PROTECTIVENESS OF SITE-SPECIFIC SELENIUM CRITERION

This section describes the protectiveness of the proposed SSC to other resident fish species inhabiting each Site. Similar to the *Oncorhynchus* evaluation presented in Section 4, Se toxicity data and information on species sensitivity from USEPA (2016) are the primary source of information used to characterize the sensitivity of fish species and the protectiveness of the proposed SSC. The following sections present toxicity data for other resident fish, to establish the protectiveness of the proposed SSC for each Site.

5.1 Family *Salmonidae*

5.1.1 Genus *Salvelinus*

Brook trout are resident species that occur at each Site. USEPA (2016) presents toxicity studies for two species in the genus *Salvelinus*: Dolly Varden (*S. malma*) and brook trout (Table 5).

Golder (2009) tested wild-caught Dolly Varden from reference and exposed sites (Table 5). Increases in larval deformity rates were associated with relatively high EO Se concentrations and the EC_{10} value presented in USEPA (2016) is 56.22 mg Se/kg EO dw.

In addition to testing rainbow trout, Holm et al. (2005) also tested wild-caught brook trout from reference and exposed sites over three years. No effects on fertilization, deformities, edema, or mortality were observed up to the maximum egg concentration of 48.7 mg Se/kg dw egg. Because an EC_{10} is available for Dolly Varden (a related species in the *Salvelinus* genus), USEPA (2016) did not use the brook trout chronic value of >48.7 mg Se/kg EO dw to calculate the *Salvelinus* GMCV (Table 5). These brook trout data indicate this species is less sensitive to Se than species in the genus *Oncorhynchus*, and therefore will be protected by the proposed SSC.

Table 5. Maternal Transfer Reproductive Toxicity Studies for *Salvelinus* (from USEPA 2016)

Genus	Species	SMCV (mg Se/kg EO dw)	GMCV (mg Se/kg EO dw)
Salvelinus	Dolly Varden[1]	56.2	56.2
	Brook Trout[2]	>48.7	

Notes:
[1] Golder (2009)
[2] Holm et al. (2005)
mg Se/kg EO dw - milligrams Se per kilogram eggs or ovaries, dry weight

5.2 Family *Cyprinidae*

Cyprinids (dace, chubs, and shiners) are resident fish species in the UBR watershed but they do not occur in the Georgetown Creek watershed (Tables 1 and 2). USEPA (2016) presents several sources of data to conclude cyprinids are not among the most sensitive families to Se effects. Toxicity data (EC_{10}s) were presented in USEPA (2016) for the fathead minnow (*Pimephales promelas*) from two studies.

In the Schultz and Hermanutz (1990) study, an EC_{10} could not be calculated due to high response variability among treatments. Consequently, the Schultz and Hermanutz (1990) fathead minnow chronic value (Table 6) was not used directly by USEPA (2016) to calculate the national Se criterion. However, the data from this study was considered an additional insensitive genus by USEPA that was included in the total number of taxa (i.e., genera) used to calculate the Se criteria. USEPA (2016) presents two other fathead minnow studies to support their conclusion that cyprinids are relatively insensitive to Se.

1. Fathead minnow populations persisted in Belews Lake, NC after Se contamination had eliminated most other fish species (Young et al. 2010).
2. GEI (2008) conducted maternal transfer reproductive studies with gravid adult fathead minnows collected near Denver, CO and estimated EC_{10}s for larval survival and deformities between 35 and 65 mg Se/kg whole body dw (Table 6).

Table 6. Maternal Transfer Reproductive Toxicity Studies for *Pimephales* (from USEPA 2016)

Genus	Species	SMCV (mg Se/kg dw)	GMCV (mg Se/kg dw)
Pimephales	Fathead Minnow	<25.6 (EO)[1] 35-65 (WB)[2]	--

Notes:
[1] Schultz and Hermanutz (1990). Value not used in EPA's 5th percentile calculation due to high uncertainty; but counted towards N=15.
[2] GEI (2008)
-- Not calculated due to high uncertainty in final chronic value. However, USEPA (2016) determined that cyprinids are less sensitive than salmonids.
mg Se/kg dw – milligrams Se per kilogram dry weight

In addition to these fathead minnow toxicity studies, USEPA (2016) analyzed cyprinid population data from several Se-contaminated field sites. The available studies and analyses (Appendix E, USEPA [2016]) indicate that native cyprinid taxa such as chubs, shiners, and dace (the resident cyprinids in the UBR watershed) are not sensitive to Se when compared with other families of freshwater fish. Taken together, USEPA (2016) concludes native cyprinids are more tolerant of Se than salmonids. The proposed SSC based on salmonids is therefore expected to be protective of cyprinids resident to the UBR watershed.

5.3 Family *Catostomidae*

Suckers are the only resident fish within the *Catostomidae* family that occur in the UBR watershed. They are not resident in Georgetown Creek based on available fisheries data (Section 3.2).

USEPA (2016) evaluates the sensitivity of suckers to Se based on available toxicity studies and population data from field studies, similar to their evaluation of cyprinid sensitivity.

5.3.1 Genus *Catostomus*

de Rosemond et al. (2005) evaluated reproductive effects on wild-caught white suckers (*Catostomus commersonii*) at an exposed Se site (Table 7). Although a reference site was not sampled, EO Se concentrations at the exposed site were grouped into low (8.4 to 9.4 mg Se/kg EO dw) and high (33.6 to 48.3 mg Se/kg EO dw) exposures. Embryo or larval effects were not observed up to the high Se exposure (geometric mean = 40.3 mg Se/kg EO dw).

Table 7. Maternal Transfer Reproductive Toxicity Studies for *Catostomidae* (from USEPA 2016)

Genus	Species	SMCV (mg Se/kg EO dw)	GMCV (mg Se/kg EO dw)
Catostomus	White Sucker[1]	>40.3	--

Notes:
[1]de Rosemound et al. (2005)
-- Not calculated by USEPA (2016) because no fish or eggs were collected from a reference site.
mg Se/kg EO dw – milligrams Se per kilogram eggs or ovaries dry weight

USEPA (2016) also summarizes additional toxicity studies for sucker species based on non-maternal transfer studies (Table 8).

Table 8. Other chronic toxicity data for the family *Catostomidae* (from USEPA 2016)

<table>
<tr><th>Genus</th><th>Species</th><th>SMCV (mg Se/kg WB dw)</th><th>GMCV (mg Se/kg WB dw)</th></tr>
<tr><td>Catostomus</td><td>Flannelmouth Sucker[1]</td><td>>10.2</td><td>--</td></tr>
<tr><td>Xyrauchen</td><td>Razorback Sucker[1]</td><td>>12.9</td><td rowspan="2">--</td></tr>
<tr><td>Xyrauchen</td><td>Razorback Sucker[2]</td><td>>42</td></tr>
</table>

Notes:
[1]Beyers and Sodergren (2001a)
[2]Beyers and Sodergren (2001b)
-- Not calculated by USEPA (2016) because parental females not exposed; used as a line of evidence to evaluate catostomid sensitivity.
mg Se/kg WB dw – milligrams Se per kilogram dry weight whole body

The additional Se toxicity values for sucker species are unbounded no-effect levels and provide additional information on the relative insensitivity of different species of suckers. In an evaluation of field population data, USEPA concludes suckers are more tolerant of Se compared to other fishes (Appendix K, USEPA 2016).

5.4 Family *Cottidae*

Sculpin in the genus *Cottus* are the only resident species in the family *Cottidae* that occur in the UBR watershed. They have not been documented in Georgetown Creek (Section 3.2).

Cottid toxicity data are not presented in USEPA (2016). However, Lo et al. (2014) evaluated the effects of dietary Se on slimy sculpin (*Cottus cognatus*) and presented the results at a Society of Environmental Toxicology and Chemistry conference (Lo et al. 2014). Field-collected sculpin were exposed to dietary Se in the laboratory for seven months and spawned for effects determination. No adverse effects were observed on hatching success, fry survival, deformities, fry length, or fry weight up to 19.4 mg Se/kg EO dw.

In addition to this study, available field data indicate sculpins are generally insensitive to Se. In NAMC (2008), shorthead sculpin (*C. confusus*) population densities were not significantly correlated to dietary Se or sculpin-tissue Se (up to >18 mg Se/kg whole body dw).

Local sculpin population data collected in the UBR watershed and the adjacent Salt River watershed (Formation and HabiTech, 2012) also suggest sculpins are not particularly sensitive to Se. Formation and HabiTech (2012) sampled sculpin populations across a range of reference and Se-impacted sites. Population densities were not statistically related to surface water or sculpin-tissue Se up to >39 µg/L or >25 mg Se/kg whole-body dw, respectively.

6 RECOMMENDATION

Nu-West proposes SSC for Se (Table 3) for application to the two “Sites” described in Section 2. The proposed SSC for Se are developed from USEPA’s (2016) Se criterion, are specific to the most sensitive resident fish taxa, and are protective of other resident fish taxa. The proposed SSC consist of an EO element (25.3 mg Se/kg EO dw), a whole-body element (11.6 mg Se/kg whole-body dw), and a muscle element (14.3 mg Se/kg muscle dw).

The proposed SSC values are applicable to each Site according to the well-documented resident fishes that occur at each Site (Section 3). A SSC established from the most sensitive resident follows USEPA guidance for Sites containing few resident families. In agreement with USEPA (2016) recommendations, this proposal expresses the SSC for Se as a single criterion composed of multiple elements in a manner that explicitly affirms the primacy of the whole-body or muscle element over the water-column element, and the EO element over the other elements. The hierarchy of each element corresponds directly to the level of certainty associated with each element. For example, the water column element has the highest uncertainty and is applied last. In contrast, the tissue elements override water column values because they provide a more direct measure of exposure and effects.

Adoption into IDAPA of the SSC for Se at the two Sites could occur at 58.01.02 § 275.02 to reflect water quality criteria for specific waters, consistent with the current structure of the administrative code, or other sections of IDAPA 58.01.02 following IDEQ recommendations.

7 REFERENCES

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Attachment 1. Compendium of Fish Surveys in the Upper Blackfoot River Watershed

Surveys	Dates	Data Source	Streams	Total Fish Count	Fish Species
Idaho Department of Fish and Game - Fish Srveys[1]	1959 - 1961	Culpin (1963)	Blackfoot River and tributaries: Angus Creek, Bacon Creek, Chippy Creek, Diamond Creek, Lanes Creek, Sheep Creek, Timothy Creek	1,467	Yellowstone cutthroat trout
	1970-1971	Heimer (1972)	Diamond Creek, Angus Creek, Lanes Creek, Sheep Creek, Spring Creek, Timothy Creek, Trail Creek, Slug Creek	624	Blackfoot reservoir: chubs and suckers. Tributaries: Yellowstone cutthroat trout
	1978-1981	Thurow (1980, 1981)	Blackfoot Reservoir and Blackfoot River	1,611	Yellowstone cutthroat trout, hatchery and wild rainbow trout
	1960-1980	Thurow (1981)	Blackfoot River	7,670	Cutthroat trout
	1981	Thurow (1980, 1981)	Diamond Creek, Sheep Creek, Spring Creek, Bacon Creek, Browns Canyon Creek, Diamond Creek, Kendall Creek, Lanes Creek, Sheep Creek, Slug Creek Spring Creek, Timothy Creek, Trail Creek	5,049	Brook trout, Yellowstone cutthroat trout
	1981	Mariah (1981)	Timber Creek, Diamond Creek, Slug Creek, Trail Creek	1,299	Brook trout, cutthroat trout, longnose dace, speckled dace, Paiute sculpin, Utah chub
	1978-1986	Schill and Heimer (1988); Heimer (1987)	Spring Creek, Timothy Creek, Bacon Creek, Browns Canyon Creek, Sheep Creek	1,728 Spawners; 1,513 Redds	Yellowstone cutthroat trout
	1987	Schill and Heimer (1988)	Diamond Creek	183	Trout > 90 mm
	1999-2001	Meyer and Lamansky (2002)	Angus Creek, Bacon Creek, Bear Canyon Creek, Browns Canyon Creek,Chippy Creek, Cold Spring Creek, Coyote Creek, Diamond Creek, Dry Canyon Creek, Kendal Creek, Lanes Creek, Maybe Creek, Sheep Creek, Slug Creek, Stewart Canyon, Timber Creek, Trail Creek	1,699	Brook trout, hybrid trout, rainbow trout, Yellowstone cutthroat trout, mottled sculpin, Paiute sculpin, longnose dace, speckled dace, leatherside chub, Utah chub, mountain sucker, Utah sucker, redside shiner
	2001	Maxim (2001)	Middle Sheep Creek	190	Cutthroat trout, mottled sculpin
	2001-2007	Teuscher (2009)	Blackfoot River	8,752	Yellowstone cutthroat trout
Idaho Department of Fish and Game - stock records	1967-2016	IDFG (2017)	Blackfoot River	36,052,232	Coho salmon (pre-1977), cutthroat trout, rainbow trout, hybrid (rainbow x cutthroat)
Beneficial Use Reconnaissance Program Data	1993 - 2016	IDEQ (2017)	Blackfoot River and tributaries: Angus Creek, Bacon Creek, Browns Canyon, Chicken Creek, Chippy Creek, Corrailsen Creek, Corral Creek, Coyote Creek, Daves Creek, Diamond Creek, Dry Valley Creek, Johnson Creek, Kendall Canyon Creek, Lanes Creek, Little Blackfoot River, Mill Canyon, Olsen Creek, Sheep Creek, Slug Creek, Spring Creek, State Land Creek, Timothy Creek, Trail Creek.Timothy Creek,	1,744	Utah sucker, mountain sucker, mottled sculpin, Paiute sculpin, lake chub, cutthroat trout, rainbow trout, brook trout, mountain whitefish, longnose dace, leopard dace, speckled dace, redside shiner

Attachment 1. Compendium of Fish Surveys in the Upper Blackfoot River Watershed

US Forest Service Surveys[1]	2000-2002	USFS (2009); Formation (2011)	Angus Creek, Bacon Creek, Bear Canyon Creek, Browns Canyon Creek, Cabin Creek, Campbell Creek, Corrailsen Creek, Coyote Creek, Daves Creek, Diamond Creek, Goodheart Creek, Hornet Creek, Johnson Creek, Kendall Creek, Lander Creek, Lanes Creek, Mill Creek, Mill Canyon Creek, Olsen Creek, S. Stewart Canyon Creek, Timber Creek, Trail Creek, Yellow Jacket Creek	Not Reported	Cutthroat trout, rainbow trout, brook trout, speckled dace, longnose dace, redside shiner, sculpin spp., sucker spp.
GEI and Arcadis	2013-2016	GEI (2014, 2015, 2016a,b); Arcadis (2017)	Angus Creek, Bear Canyon Creek, Coyote Creek, Sheep Creek, South Fork Sheep Creek, Slug Creek, South Fork Timber Creek.	6,623	Brook trout, cutthroat trout, sculpin spp., mountain sucker, Utah sucker, longnose dace, speckled dace, redside shiner

Notes:

[1]Survey data requested from Agencies

Acronyms and Abbreviations:

IDFG = Idaho Department of Fish and Game
IDEQ = Idaho Departmetn of Environmental Quality
USFS = United States Forest Service

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Attachment 2. Compendium of Fish Surveys in the Georgetown Creek Watershed

Surveys	Dates	Data Source	Streams	Total Fish Count	Fish Species
Idaho Department of Fish and Game - Surveys[1]	1994, 1997, 2003, 2007	Teuscher and Capurso (2007)	Left Hand Fork, Georgetown Creek	Not Reported	Brook trout, cutthroat trout, cutthroat/rainbow hybrids, rainbow trout.
Idaho Department of Fish and Game - Stocking Records	1968-2011	IDFG (2017)	Left Hand Fork, Georgetown Creek	81,923	Brook trout, cutthroat trout, rainbow trout.
Idaho Department of Environmental Quality Surveys	1997, 2012, 2013	IDEQ (2017)	Left Hand Fork, Georgetown Creek	58	Brook trout, cutthroat trout, rainbow trout.
US Forest Service Surveys[1]	1994	Cowley (1994)	Georgetown Creek	Upper: 9 Lower: Not Reported	Brook trout, cutthroat trout, cutthroat/rainbow hybrids, rainbow trout.
	2000, 2001, 2007	USFS (2003); Teuscher and Capurso (2007)	Left Hand Fork, Georgetown Creek	Not Reported	Brook trout, cutthroat/rainbow hybrids, rainbow trout.
GEI and Arcadis	2015-2016	GEI (2016); Arcadis (2017)	Left Hand Fork, Georgetown Creek	661	Brook trout, Cutthroat trout, Cutthroat/Rainbow hybrids, Rainbow trout.

Notes:

[1]Survey data requested from Agencies

Acronyms and Abbreviations:

IDFG = Idaho Department of Fish and Game

IDEQ = Idaho Departmetn of Environmental Quality

USFS = United States Forest Service

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