APPENDIX K

Fish Resources

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Acronyms and Abbreviations

µm	micrometers
AES	aquatic ecological system
cfs	cubic feet per second
EIS	environmental impact statement
GIS	geographic information system
LTRMP	Long Term Resource Monitoring Program
LWD	Large woody debris
Montana FWP	Montana Fish, Wildlife & Parks
NTU	nephelometric turbidity unit

Appendix K
Fish Resources

This appendix provides detailed technical information related to survey and analytical methods used to assess fish habitat potential in the study area, and the results of the effort.[1]

OEA used five sources of information to assess the likelihood of fish presence and fish habitat potential.

- Physical surveys of aquatic habitat composition and condition at accessible sites in the study area.
- Fish presence surveys in study area streams conducted by Montana Fish, Wildlife & Parks (Montana FWP).
- A predictive fish species assemblage and aquatic ecosystem classification scheme developed by the State of Montana for assessing environmental impacts in prairie ecosystem river systems.
- Species-specific habitat preferences and requirements obtained from a regional database of monitoring studies in the Missouri River ecosystem.
- A geographic information system (GIS)-based drainage area analysis as a basis for predicting aquatic ecosystem type.

OEA conducted physical habitat surveys at 38 sites in accessible streams and rivers in the study area in the spring and summer of 2013. Sites were selected to characterize the extent and composition of habitat types available to fish. Habitat survey results are summarized in site-level reports provided in Attachment K-1, *Valley Segment Reports*. OEA used the results to characterize fish habitat suitability based on known or likely species presence as determined by aquatic ecosystem type and species-specific habitat requirements. The information sources and methods used to complete this assessment are described in detail in the following sections.

K.1 Physical Survey Results (Tongue River)

OEA conducted physical surveys in the Tongue River and Moon, Otter, and Canyon Creeks. Attachment K-1 provides a summary of survey site data for the valley segments of the Tongue River and for survey sites at Moon, Otter, and Canyon Creeks. During the physical surveys, OEA visited segments of each water body and recorded the following data.

[1] This appendix provides supporting information for Chapter 8, Section 8.4, *Fish*, of this *Draft Environmental Impact Statement for the Tongue River Railroad*. This information should not be interpreted as stand-alone information and must be read in combination with the associated chapter.

- Number and type of habitat units (pool, riffle, glide, and run).
- Habitat unit length.
- Habitat unit wetted width (average per each habitat unit).
- Habitat unit water depth (average and thalweg).
- Habitat unit ordinary high water line or bankfull (average width and depth).
- Water temperature.
- Weather.
- Survey start and end times.
- Survey crew members.
- Habitat unit substrate composition (visual estimate of the dominant, secondary and minor).
- Bank stability/erosion (estimate of percent of bank actively eroding at survey site).
- Channel confinement (estimate of natural and human-made confinement at survey site).
- Geomorphic features (beaver dams, avulsion, woody debris).
- Physical barriers (culverts, waterfalls, diversion dams).
- Other observations, such as livestock access, water intakes, return water discharge locations, riparian habitat conditions, flow conditions at the date and time of the survey, and side-channel/off channel habitats.
- Sketch maps of plan view and typical cross sections of the survey site.
- Photo log for each survey site.

Refer to Attachment K-1 for summaries of the physical habitat data for each of the four Tongue River valley segments, as well as Moon, Canyon, and Otter Creeks. The following sections describe and compare the valley segments and site characteristics.

K.1.1 Valley Segment Comparison (Tongue River)

OEA conducted physical surveys at four valley segments along the Tongue River. Among the four valley segments, Valley Segment 2 has the greatest habitat complexity, with an average of 16.7 habitat units per kilometer. Valley Segment 2 was the largest segment surveyed in terms of area (340,413 square meters) and length (9,057 meters). Segment 4 has the least habitat complexity, with 4.8 habitat units per kilometer. On average, across all of the sites that were physically surveyed, the Tongue River has approximately 12 habitat units per kilometer. Glides are the dominant habitat unit in each valley segment, followed by riffles (except for Valley Segment 3 where pools are the secondary habitat unit). These results are consistent with field observations noting that the Tongue River in the study area is dominated by regime and, to a lesser degree, pool-riffle reaches.

Average bankfull width and wetted width generally increase in the downstream direction, which is a common phenomenon in large river systems like the Tongue River (Schumm 1977). An exception to this is Valley Segment 4, which is located below the Tongue River Reservoir and Dam. Although it is located upstream, the average bankfull width and average wetted width at Valley Segment 4 were similar to those at Valley Segment 1, which is located downstream. This is most likely because either the managed flow releases from the Tongue River Reservoir and Dam have created a larger channel cross-sectional area downstream of the dam or the channel gradient and geology affect channel width.

Along the Tongue River, riparian vegetation is dominated by grasses and open field. An exception to this is Valley Segment 3, which is dominated by shrubs. Overall, shrubs were the second most dominant riparian vegetation type, followed by trees. Bank heights generally remain similar in the downstream direction (with a combined left and right bank average of approximately 3.2 meters); however, the stream banks in Valley Segment 1 are considerably higher than the other valley segments (with a combined left and right bank average of 3.5 meters).

Valley segment, the presence of undercut stream banks, and bank instability (those banks that are actively eroding) are clearly correlated in the study area. The percentage of eroding banks increases significantly in the downstream direction, from 12.1 percent combined for both banks in Valley Segment 4 to 46.3 percent combined for both banks in Valley Segment 1. In contrast, the percentage of undercut banks decreases significantly in the downstream direction, from 33.1 percent combined for both banks in Valley Segment 4 to 6.7 percent combined for both banks in Valley Segment 1. This decrease is directly related to the downstream increase in bank instability. As bank instability increases, the bank's ability to maintain undercutting decreases and banks erode. This may be attributable to the Tongue River Dam, which moderates peak flows in the spring in Valley Segment 4, thereby reducing the potential for bank erosion.

K.1.2 Valley Segment 1

This section describes the sites that OEA surveyed along Valley Segment 1 of the Tongue River.

K.1.2.1 Site 1-1

Site 1-1 is the site furthest downstream on the Tongue River and is located a few kilometers upstream of the Tongue River's confluence with the Yellowstone River (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). Site 1-1 is characterized by a large mid-channel island in the downstream portion of the site with split flow on each side. A large left bank escarpment laterally confines the left bank on the downstream portion of the site. This escarpment is actively eroding and releasing sediment (including boulders) into the Tongue River. Upstream of the left bank escarpment, the river is bordered by an elevated terrace with

grasses and open field. On the right bank, a cornfield occupies most of the floodplain/terrace.

Habitat complexity is relatively high at Site 1-1, with a mixture of glides, riffles, pools, and other features, such as an island and mid-channel bar. Substrate is dominated by gravel and sand, with secondary amounts of cobble and bedrock. Stream banks are considerably higher on the left bank than on the right bank because of the left bank escarpment. Bank instability is very high throughout the site (90 percent on the left bank and 85 percent on the right bank), and only 10 percent of each bank is undercut. Average wetted width and thalweg depth are 38 meters and 0.35 meters, respectively. Average bankfull width and depth are 40 meters and 1.3 meters, respectively. An active side channel is present on the right bank. No debris jams were detected at the time of the survey.

Based on field observation, epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is high, with heavy deposits of fine material and increased bar development. No significant anthropogenic factors (roads, levees, instream structures) are present.

K.1.2.2 Site 1-2

Site 1-2 is approximately 5 kilometers upstream of Site 1-1 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by a large channel bend with a steep cutbank on the left bank, and a large point bar and slip-off slope on the right bank. On the left bank beyond the cutbank, the landscape consists of a terrace dominated by grasses and shrubs. On the right bank, a mature riparian forest occupies most of the floodplain/terrace.

Habitat complexity is high, with a mixture of lateral scour pools, glides, and riffles. No islands are present at Site 1-2. Substrate is dominated by gravel, with secondary amounts of sand, cobble, and fines. Stream banks are considerably higher on the left bank (because of the cutbank). Bank instability is very high on the left bank, and low on the right bank (85 percent and 15 percent, respectively), and only 15 percent of the left bank and 5 percent of the right bank are undercut. Average wetted width and thalweg depth are 31 meters and 0.7 meters, respectively. Average bankfull width and depth are 46 meters and 1.4 meters, respectively. An inactive side channel is present on the right bank. No debris jams were detected at the time of the survey.

Based on field observation, epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is high, with heavy deposits of fine material and increased bar development. No significant anthropogenic factors (roads, levees, instream structures) are present.

K.1.2.3 Site 1-3

Site 1-3 is approximately 5 kilometers upstream of Site 1-2 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is the uppermost site in Valley Segment 1. Similar to Site 1-2, Site 1-3

is characterized by a large channel bend with a steep cutbank on the left bank, and a large point bar and slip-off slope on the right bank. On the left bank beyond the cutbank, the landscape consists of a terrace dominated by grasses and shrubs. On the right bank, a mature riparian forest occupies most of the floodplain/terrace.

Habitat complexity is low, with two glides and a riffle. No islands are present. Substrate is dominated by sand, with secondary amounts of bedrock, cobble, and gravel. Stream banks are higher on the left bank because of the cutbank. Bank instability is low on each bank (3 percent on the left bank and 0 percent on the right bank), and no undercut banks are present. Average wetted width and thalweg depth are 37 meters and 1.1 meters, respectively. Average bankfull width and depth are 41 meters and 1.5 meters, respectively. An attached gravel bar is on the left bank with a dewatered side channel. No debris jams were detected at the time of the survey.

Based on field observations, epifaunal substrate cover is poor. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. No significant anthropogenic factors (roads, levees, instream structures) are present.

K.1.3 Valley Segment 2

This section describes the sites that OEA surveyed along Valley Segment 2 of the Tongue River.

K.1.3.1 Site 2-1

Site 2-1 is the site farthest downstream in Segment 2 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is located approximately 10 kilometers upstream of the Tongue and Yellowstone Diversion Dam on the Tongue River and the Tongue River's confluence with Pumpkin Creek. It is characterized by a large mid-channel island (with an associated smaller island) in the downstream portion of the site, with split flow on each side. A large cutbank is on the left bank. On the left bank, beyond the cutbank, the landscape consists of a terrace dominated by grasses and open field. On the right bank, grasses, open field, and some scattered trees are present on the floodplain.

Habitat complexity is high, with a mixture of glides, a riffle, two islands, and a mid-channel pool. Substrate is dominated by sand and gravel, with secondary amounts of fines. Stream banks are considerably higher on the left bank because of the cutbank. Bank instability is low on each bank (5 percent on the left bank and 0 percent on the right bank). No undercut banks are present on the left bank and 75 percent of the right bank is undercut. Average wetted width and thalweg depth are 32 meters and 0.55 meters, respectively. Average bankfull width and depth are 33 meters and 1.3 meters, respectively. An active side channel is on the left bank. No debris jams were detected at the time of the survey.

Based on field observations, epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is marginal, with

moderate deposits of fine material and increased bar development. Bridge abutments are present on both sides of the river.

K.1.3.2 Site 2-2

Site 2-2 is approximately 1.5 kilometers upstream of Site 2-1 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by a large channel bend with a steep cutbank on the left bank, and a large point bar and slip-off slope on the right bank. On the left bank, beyond the cutbank, the landscape consists of a terrace dominated by a mixture of trees, grasses, and open field. On the right bank, dense willow shrubs occupy most of the floodplain/terrace.

Habitat complexity is low, with one long glide present. Substrate is dominated by gravel, with secondary amounts of sand. Stream banks are higher on the left bank (because of the cutbank). Bank instability is high on the left bank and low on the right bank (60 percent and 15 percent, respectively). No undercut banks are on either bank. Average wetted width and thalweg depth are 28 meters and 0.7 meters, respectively. Average bankfull width and depth are 39 meters and 1.9 meters, respectively. No side channels are present. No debris jams were detected at the time of the survey.

Epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is high, with heavy deposits of fine material and increased bar development. Anthropogenic influence (past or present) is low.

K.1.3.3 Site 2-3

Site 2-3 is approximately 0.5 kilometer upstream of Site 2-2 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by two moderately sized mid-channel exposed gravel bars in the upstream portion of the site with split flow on each side. The landscape on both banks consists of floodplain/terrace dominated by grasses and open field.

Habitat complexity is high, with a mixture of glides, riffles, and mid-channel bars. Substrate is dominated by gravel and sand, with secondary amounts of cobble. Both stream banks heights are similar. Bank instability is generally low on each bank (25 percent for each bank), and only a small percentage of banks are undercut (2 percent on the left bank and 3 percent on the right bank). Average wetted width and thalweg depth are 31 meters and 0.5 meter, respectively. Average bankfull width and depth are 35 meters and 1.3 meters, respectively. No side channels are present. No debris jams were detected at the time of the survey.

Based on field observations, epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with minor new bar formation. Anthropogenic influence (past or present) is minor, except for the presence of old bridge abutments, of which only soil signatures remain.

K.1.3.4 Site 2-4

Site 2-4 is approximately 9 kilometers upstream of Site 2-3 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by a long, narrow island in the upstream portion of the site with split flow on each side, as well as an island/bar complex in the portion of the site that is farthest downstream. The landscape on the left bank consists of a broad, low-elevation floodplain/terrace dominated by grasses and open field. On the right bank, shrubs cover most of the bank. Behind the shrubs, a tall right bank escarpment is adjacent to the channel and laterally confines the river. The escarpment starts at a small, unnamed, non-fish-bearing tributary confluence approximately 200 meters upstream of the downstream limit of the site.

Habitat complexity is high at Site 2-4, with a mixture of glides, islands, and a riffle. Substrate is dominated by sand, gravel, and bedrock, with secondary amounts of boulder and fines. The streambank heights are similar on both banks. Bank instability is generally low on each bank (10 percent on the left bank and 40 percent on the right bank); approximately 60 percent of the left bank and 25 percent of the right bank are undercut. Average wetted width and thalweg depth are 41 meters and 0.49 meters, respectively. Average bankfull width and depth are 49 meters and 1.4 meters, respectively. Besides the tributary on the right bank, there are a few other active side channels in the island/bar complex in the downstream portion of the site. No debris jams were detected at the time of the survey; however, large woody material pieces are present in the island/bar complex in the downstream portion of the site.

Epifaunal substrate cover is suboptimal, suggesting the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with minor new bar formation. Anthropogenic influence (past or present) is negligible.

K.1.3.5 Site 2-5

Site 2-5 is immediately upstream of Site 2-4 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by a long, narrow island in the left upstream portion of the site with split flow on each side. The landscape on the left bank consists of a floodplain/terrace dominated by shrubs on the banks and an open field above the banks. Farther upstream, a sparse riparian forest occupies the floodplain/terrace. On the right bank, a mature riparian forest covers most of the floodplain/terrace.

Habitat complexity is high with a mixture of glides, riffles, a lateral scour pool, and an island. Substrate is dominated by gravel, bedrock, and sand, with secondary amounts of boulder, cobble, and fines. The streambank heights are similar on both banks. Bank instability is generally low on each bank (35 percent on the left bank and 25 percent on the right bank). Approximately 30 percent of the left bank and 20 percent of the right bank are undercut. Average wetted width and thalweg depth are 39 meters and 0.47 meter, respectively. Average bankfull width and depth are 44 meters and 1.3 meters, respectively. An active side

channel is on the left bank, associated with the long, narrow island in the left upstream portion of the site. No debris jams were detected at the time of the survey.

As visually determined in the field, epifaunal substrate cover is suboptimal suggesting the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with minor new bar formation. Anthropogenic influence (past or present) is negligible. However, a portable diversion pump is at the downstream end of the site on the right bank and livestock can access the right bank in one location.

K.1.3.6 Site 2-6

Site 2-6 is approximately 10 kilometers upstream of Site 2-5 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by a long, narrow island in the downstream portion of the site with split flow on each side, as well as a left bar complex in the upstream end. The landscape on the left bank consists of a floodplain/terrace dominated by a mature riparian forest in the downstream area, and grasses and open field further upstream. On the right bank, grasses and open field cover most of the floodplain/terrace.

Habitat complexity is high, with a mixture of glides, riffles, a bar complex, and an island. Site 2-6 is the only Tongue River site with a cascade habitat unit. This cascade consists of a bedrock ledge with an approximate 0.2-meter sheeting drop. Substrate is dominated by bedrock, gravel, and sand, with secondary amounts of fines and cobble. Stream banks are somewhat higher on the left bank. Bank instability is significantly higher on the left bank than on the right bank (70 percent and 5 percent, respectively).Approximately 5 percent of the left bank and 20 percent of the right bank are undercut. Average wetted width and thalweg depth are 36 meters and 0.47 meter, respectively. Average bankfull width and depth are 44 meters and 1.2 meters, respectively. Active side channels are on each bank, associated with the island and bar complex. One debris jam was detected at the time of the survey that consisted of a large downed tree with wracked debris.

Epifaunal substrate cover is marginal suggesting the substrate is frequently removed or disturbed. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) exists in the form of cattle trampling on the entire left bank. Cattle also have access to the bar complex at the upstream end of the site. The extensive cattle trampling contributes to the erosion and sediment deposition observed throughout the site. Additionally, a portable diversion pump and a fence across the channel are at the upstream end of the site.

K.1.3.7 Site 2-7

Site 2-7 is approximately 3.5 kilometers upstream of Site 2-6 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by a long island in the upstream portion of the site with split flow on each side, as well as a small island along the left side of the channel at the downstream end. A very tall left bank escarpment extends approximately 185 meters from the downstream end of the reach in the upstream direction. Additionally, the right bank has a

very tall cutbank that borders the top 170 meters of the site. The landscape on the left bank consists of a floodplain/terrace dominated by the rocky escarpment and shrubs. On the right bank, grasses and open field cover most of the floodplain/terrace.

Habitat complexity is high with a mixture of glides, riffles, runs, mid-channel and lateral scour pools, and islands. Substrate is dominated by sand, gravel, and boulder, with secondary amounts of fines, cobble, boulder, and bedrock. The streambank heights are similar on both banks. Bank instability is similar on each bank (50 percent on the left bank and 40 percent on the right bank). Approximately 40 percent of the left bank and 20 percent of the right bank are undercut. Average wetted width and thalweg depth are 32 meters and 0.72 meter, respectively. Average bankfull width and depth are 38 meters and 1.7 meters, respectively. An active side channel is on the left bank, associated with the small island at the downstream end. Woody debris jams were detected at the time of the survey near the downstream end of the site.

Epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is high, with heavy deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible. However, a portable diversion pump is at the upstream end of the site on the right bank.

K.1.3.8 Site 2-8

Site 2-8 is approximately 0.7 kilometer upstream of Site 2-7 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by an island complex in the upstream portion of the site with split flow on each side. A tall left bank escarpment extends approximately 200 meters from the downstream end of the reach in an upstream direction. The landscape on the left bank consists of a floodplain/terrace dominated by grasses and open field. On the right bank, a mature riparian forest covers most of the floodplain/terrace.

Habitat complexity is high, with a mixture of glides, a lateral scour pool, and the island complex. Substrate is dominated by gravel and sand, with secondary amounts of fines and cobble. The streambank heights are similar on both banks. Bank instability is higher on the left bank with 50 percent of the left bank classified as eroding and 25 percent of the right bank classified as eroding. Approximately 25 percent of the left bank and 60 percent of the right bank are undercut. Average wetted width and thalweg depth are 27 meters and 0.59 meter, respectively. Average bankfull width and depth are 33 meters and 1.4 meters, respectively. Active and inactive side channels are on the right bank, associated with the island complex at the upstream end. No woody debris jams were detected at the time of the survey.

Epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible. However, a portable diversion pump is at the upstream end of the site on the right bank.

K.1.3.9 Site 2-9

Site 2-9 is near the approximate middle of Valley Segment 2 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is approximately 3 kilometers downstream of the Tongue River's confluence with Foster Creek. Site 2-9 is characterized by two exposed bars in the downstream portion of the site with split flow on each side, as well as a larger island with split flow on each side closer to the upstream portion of the site. The landscape on the left bank consists of a floodplain/terrace dominated by shrubs. On the right bank, grasses and open field covers most of the floodplain/terrace.

Habitat complexity is high with a mixture of glides, riffles, runs, lateral scour pools, bars, and the island. Substrate is dominated by gravel, sand, and fines. Streambank heights are considerably higher on the right bank. Bank instability is absent on each bank. None of the left bank and 1 percent of the right bank are undercut. Average wetted width and thalweg depth are 30 meters and 0.67 meter, respectively. Average bankfull width and depth are 30 meters and 1.3 meters, respectively. Active side channels are on the right bank, associated with the island at the upstream end. No woody debris jams were detected at the time of the survey.

Epifaunal substrate cover is suboptimal, suggesting the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with minor new bar formation. Anthropogenic influence (past or present) is moderate. Two portable diversion pumps are in the channel (one old, one new), and riprap is downstream of the site, protecting a private bridge.

K.1.3.10 Site 2-10

Site 2-10 is near the approximate middle of Valley Segment 2 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is characterized by a long glide. Two exposed gravel bars are on each bank in the middle of the site. Each gravel bar has associated backwater habitat. The landscape on both banks consists of a floodplain/terrace dominated grasses and open field.

Habitat complexity is moderate, with one long glide, one riffle, and two backwater habitats associated with the gravel bars. Substrate is dominated by gravel and sand, with secondary amounts of fines. The streambank heights are similar on both banks. Bank instability is absent on each bank. Approximately 7 percent of the left bank and 2 percent of the right bank are undercut. Average wetted width and thalweg depth are 39 meters and 0.68 meter, respectively. Average bankfull width and depth are 40 meters and 1.1 meters, respectively. The backwater habitats on each bank represent the only (active) side channels within the site. No woody debris jams were detected at the time of the survey.

Epifaunal substrate cover is marginal, suggesting the substrate is frequently removed or disturbed. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is low. A tee-post, a barbed-wire fence, and overhead power lines cross the river.

K.1.3.11 Site 2-11

Site 2-11 is approximately 4 kilometers downstream of Beaver Creek and 0.6 kilometer downstream of where the Tongue River Road crosses the river toward the left valley wall (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). Brandenberg Road heads south just before the Tongue River Road crosses the river. Site 2-11 is characterized by a long glide interrupted by a lateral scour pool. It is a highly sinuous site, with alternating point bars and cutbanks on each bank. The landscape on the left bank consists of a floodplain/terrace with mature riparian forest at the upstream and downstream ends, but grasses and open field most of the length of this bank. On the right bank, a mature riparian forest covers most of the floodplain/terrace.

Habitat complexity is low, with two glides and a lateral scour pool. Substrate is dominated by gravel and sand, with secondary amounts of fines. The streambank heights are similar on both banks. Approximately 50 percent of the banks were classified as eroding on each bank, and approximately 5 percent of each bank is undercut. Average wetted width and thalweg depth are 22 meters and 1.41 meters, respectively. Average bankfull width and depth are 30 meters and 2.2 meters, respectively. Inactive side channels are on the point bars on each bank. An alcove was observed on the right side point bar approximately 184 meters upstream from the downstream end of the site. Two large woody debris jams were detected at the time of the survey.

Epifaunal substrate cover is poor. Sediment deposition is high, with heavy deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible, with the exception of some trash that was encountered within one of the debris jams.

K.1.3.12 Site 2-12

Site 2-12 is in the upper portion of Valley Segment 2, approximately 6 kilometers downstream of where Greenleaf Lay Creek Road joins Tongue River Road from the east (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). Site 2-12 is the southernmost site included in the burn scar of the 2012 Ash Creek Fire. A large, unnamed non-fish-bearing tributary has deposited a gravel bar sequence in the Tongue River toward the upstream end of the site. Presumably, a significant amount of this sediment delivery was exacerbated by the 2012 Ash Creek Fire. The left bank floodplain also contained small, burned deposits that suggested deposition from overbank flow. Besides the deltaic gravel bar sequence, Site 2-12 is characterized by another small island toward the right bank in the upstream portion of the site. The landscape on the left bank consists of a low elevation floodplain dominated by shrubs. Beyond the immediate floodplain, a higher terrace exists. Toward the upstream end of the reach, the left bank canyon wall encroaches onto the site. On the right bank, shrubs, grasses, and open field cover most of the floodplain.

Habitat complexity is high with glides, a run, a riffle, and a mid-channel pool. Substrate is dominated by gravel and fines, with secondary amounts of cobble, boulder, and sand. Streambank heights are greater on the left bank. Approximately 25 percent of the banks on the left bank were classified as eroding; 20 percent of the banks on the right bank were classified as eroding. Approximately 60 percent of each bank is undercut. Average wetted width and thalweg depth are 37 meters and 0.57 meter, respectively. Average bankfull width and depth are 45 meters and 1.6 meters, respectively. Inactive side channels are on each bank, and the deltaic gravel bar sequence consists of a series of complex, shallow, backwater habitats. Some woody debris was detected on the deltaic gravel bar sequence.

Epifaunal substrate cover is poor. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible.

K.1.3.13 Site 2-13

Site 2-13 is in the upper portion of Valley Segment 2, approximately 6 kilometers upstream of where Greenleaf Lay Creek Road joins Tongue River Road from the east (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is also a site included in the burn scar of the 2012 Ash Creek Fire. Site 2-13 is a relatively straight reach characterized by a long, narrow island in the center of the channel in the middle of the site. In addition, another island complex is on the left side toward the upstream end of the site. The left bank is bordered by a massive cliff escarpment through its entire length. The landscape on the left bank consists of a floodplain/terrace dominated by shrubs. On the right bank, shrubs cover most of the banks adjacent to the massive, relatively barren-sloped cliff.

Habitat complexity is high with glides, runs, a riffle, mid-channel pools, and islands. Substrate is dominated by gravel, sand, boulder, and cobble, with secondary amounts of fines. Streambank heights are significantly greater on the right bank, owing to the presence of the massive escarpment. Approximately 5 percent of the banks on the left bank were classified as eroding and 85 percent of the banks on the right bank were classified as eroding. Approximately 90 percent of the left bank and 45 percent of the right bank are undercut. Average wetted width and thalweg depth are 34 meters and 0.61 meter, respectively. Average bankfull width and depth are 43 meters and 1.5 meters, respectively. An active and an inactive side channel are on the left bank. The active channel is associated with the island complex; the inactive channel is associated with a large gravel bar on the left bank—it is essentially an overflow channel. No woody debris jams were detected at the time of the survey.

Epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible.

K.1.3.14 Site 2-14

Site 2-14 is in the upper portion of Valley Segment 2, approximately 3 kilometers upstream of Site 2-13 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is also a site included in the burn scar of the 2012 Ash Creek Fire. Site 2-14 is characterized by two islands (one in the center of and one toward the left side of the channel) in the middle and upstream portions of the site, respectively. In addition, a steep cutbank is on the right bank along the upstream portion of the site. Habitat complexity is achieved by the presence of the islands and by large woody debris jams (one of which consists of a former, breached beaver dam) that have influenced channel form and pattern. The landscape on the left bank consists of a floodplain/terrace dominated by shrubs. On the right bank, grasses and open field cover most of the floodplain/terrace.

Habitat complexity is high with glides, riffles, a run, a lateral scour pool, and islands. Substrate is dominated by gravel, cobble, and sand, with secondary amounts of boulder and fines. The streambank heights are similar on both banks. Approximately 40 percent of the banks on the left bank were classified as eroding and 50 percent of the banks on the right bank were classified as eroding. Approximately 25 percent of the left bank and 35 percent of the right bank are undercut. Average wetted width and thalweg depth are 32 meters and 0.59 meter, respectively. Average bankfull width and depth are 36 meters and 1.4 meters, respectively. An active side channel is on the left bank associated with the island toward the left side of the channel in the upstream portion of the site. Active and inactive side channels are on the right bank to the right of the island in the center of the channel in the middle portion of the site. These side channels occur downstream of the breached beaver dam. A woody debris jam (the breached beaver dam) was detected at the time of the survey.

Epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible; however, some trash is associated with the large woody debris jam.

K.1.3.15 Site 2-15

Site 2-15 is in the upper portion of Valley Segment 2, approximately 2.5 kilometers upstream Site 2-14 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is also a site included in the burn scar of the 2012 Ash Creek Fire. It is characterized by a large channel bend in the downstream portion of the site with a steep cutbank on the right bank leading up to a local road. An exposed gravel bar is in the downstream portion of the site near the left bank. The landscape on both banks consists of a floodplain/terrace dominated by grasses and open field.

Habitat complexity is high with glides, a riffle, a lateral scour pool, and a bar. Substrate is dominated by gravel, cobble, and sand, with secondary amounts of boulder and fines. The right bank is considerably higher than the left bank, due to the steep cutbank that leads up to the road. No bank instability was observed and no undercut banks were present. Average

wetted width and thalweg depth are 35 meters and 1.04 meters, respectively. Average bankfull width and depth are 36 meters and 1.0 meters, respectively. No side channels or woody debris jams were observed.

As visually determined in the field, epifaunal substrate cover is poor suggesting the lack of habitat is obvious. Sediment deposition is high, with heavy deposits of fine material and increased bar development. Anthropogenic influence (past or present) is minor—there is a portable diversion pump on one of the banks.

K.1.3.16 Site 2-16

Site 2-16 is in the upper portion of Valley Segment 2, approximately 2 kilometers upstream Site 2-15 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is also a site included in the burn scar of the 2012 Ash Creek Fire. It is characterized by a large channel bend in the upstream portion of the site. An island in the upstream portion of the site splits the flow. The landscape on the left bank consists of a floodplain/terrace dominated by shrubs. On the right bank, grasses and open field cover most of the floodplain/terrace.

Habitat complexity is high with glides, riffles, a lateral scour pool and a mid-channel pool, and an island. Substrate is dominated by gravel, cobble, sand, and fines. The right bank is higher than the left bank. No bank instability was observed on the left bank, and 3 percent of the right bank was classified as eroding. No undercut banks were present. Average wetted width and thalweg depth are 37 meters and 1.06 meters, respectively. Average bankfull width and depth are 38 meters and 1.4 meters, respectively. No side channels or woody debris jams were observed.

Epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with minor new bar formation. Anthropogenic influence (past or present) is minor. A road with some riprap is on the right bank in the upper portion of the site.

K.1.3.17 Site 2-17

Site 2-17 is the uppermost site within Valley Segment 2, approximately 5 kilometers downstream of Otter Creek's confluence with the Tongue River and approximately 1 kilometer north of Ashland (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). Site 2-17 is in the burn scar of the 2012 Ash Creek Fire. It is characterized by a large channel bend with no islands, and two cutbank areas on the right bank. The landscape on the left bank consists of a floodplain/terrace dominated by grasses and open field. On the right bank, shrubs cover most of the floodplain/terrace.

Habitat complexity is high with glides, two mid-channel pools, and a riffle. Substrate is dominated by gravel and sand, with secondary amounts of bedrock, cobble, and fines. The right bank is considerably higher than the left bank, due to the presence of the steep cutbanks. No bank instability was observed on the left bank; 5 percent of the right bank was classified

as eroding. Approximately 5 percent of the left bank and none of the right bank are undercut. Average wetted width and thalweg depth are 36 meters and 1.20 meters, respectively. Average bankfull width and depth are 36 meters and 1.7 meters, respectively. No side channels or woody debris jams were observed.

Epifaunal substrate cover is poor. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible.

K.1.4 Valley Segment 3

K.1.4.1 Site 3-1

Site 3-1 is the most downstream site within Valley Segment 3, approximately 15 kilometers upstream of Otter Creek's confluence with the Tongue River and approximately 7 kilometers south of Ashland (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is a relatively straight, uniform site although a channel bend exists at the downstream portion of the site. A small island is along the right bank in the middle of the site. The landscape on the left bank consists of a floodplain/terrace dominated by a mature riparian forest. On the right bank, shrubs cover most of the floodplain/terrace, although a mature riparian forest is setback from the shrubs.

Habitat complexity is high with glides, a lateral scour pool, and an island. Substrate is dominated by gravel, sand, and fines, with secondary amounts of organics. The right bank is slightly higher than the left bank. Approximately 5 percent of the left bank was classified as eroding, and 20 percent of the right bank was classified as eroding. Approximately 80 percent of the left bank and 60 percent of the right bank are undercut. Average wetted width and thalweg depth are 32 meters and 1.03 meters, respectively. Average bankfull width and depth are 34 meters and 1.8 meters, respectively. An active side channel associated with the small island is present on the right bank. A woody debris jam was observed at the upstream end of the right bank side channel. In addition, submerged logs are along each bank.

Epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is high, with heavy deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible.

K.1.4.2 Site 3-2

Site 3-2 is approximately 6 kilometers upstream of Site 3-1 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). The site is along a channel bend and has no islands. The landscape on the left bank consists of a floodplain/terrace dominated by grasses and open field. On the right bank, shrubs cover most of the floodplain/terrace.

Habitat complexity is moderate with glides, a mid-channel pool, and a riffle. Substrate is dominated by gravel and sand, with secondary amounts of cobble. The right bank is slightly higher than the left bank. None of the left bank was classified as eroding, and 30 percent of the right bank was classified as eroding. No undercut banks are present on either bank. Average wetted width and thalweg depth are 26 meters and 1.11 meters, respectively. Average bankfull width and depth are 27 meters and 1.8 meters, respectively. An inactive side channel is present on the right bank floodplain in the upper portion of the site. No woody debris jams were detected at the time of the survey.

Epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is high, with heavy deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible.

K.1.4.3 Site 3-3

Site 3-3 is approximately 8 kilometers upstream of Site 3-2 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). The site is along a channel bend and has islands and a bar complex in the middle and upper portions of the site. In addition, a steep right bank escarpment (a cliff) borders the channel for the full length of the site. The landscape on the left bank consists of a floodplain/terrace dominated by a mature riparian forest. On the right bank, trees and shrubs equally cover most of the floodplain/terrace, downslope of the relatively barren right bank escarpment.

Habitat complexity is high with glides, two mid-channel pools, riffles, runs, a gravel bar, islands, and backwater habitat. Substrate is dominated by gravel and fines, with secondary amounts of sand and cobble. The right bank is considerably higher than the left bank due to the steep right bank escarpment. Approximately 35 percent of the left bank was classified as eroding, and 45 percent of the right bank was classified as eroding. Approximately 65 percent of the left bank and 50 percent of the right bank are undercut. Average wetted width and thalweg depth are 33 meters and 0.65 meter, respectively. Average bankfull width and depth are 37 meters and 1.2 meters, respectively. Active side channels associated with the islands and bar complex are present on the each bank. A woody debris jam was observed at the head of the bar complex. A small channel traverses the large island in the upper portion of the site that will most likely avulse through the island in the future, creating two separate islands.

Epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is negligible.

K.1.4.4 Site 3-4

Site 3-4 is approximately 5 kilometers upstream of Site 3-3 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is the uppermost site within Valley Segment 3. Site 3-4 is along a channel bend and has no islands. In addition, a steep right bank cutbank is along the entire

length of the site. A small non-fish-bearing tributary, Dry Creek, joins the Tongue River on the right bank toward the middle portion of the site. The landscape on the left bank consists of a floodplain/terrace dominated by shrubs. On the right bank, grasses and open field cover most of the floodplain/terrace.

Habitat complexity is high with glides, two lateral scour pools and one mid-channel pool, and a riffle. Substrate is dominated by gravel and sand, with secondary amounts of fines and cobble. The right bank is considerably higher than the left bank due to the steep right bank cutbank. None of the left bank was classified as eroding, and 20 percent of the right bank was classified as eroding. No undercut banks were observed on either bank. Average wetted width and thalweg depth are 26 meters and 1.40 meters, respectively. Average bankfull width and depth are 27 meters and 1.8 meters, respectively. No side channels or woody debris jams were observed.

Epifaunal substrate cover is marginal, suggesting that the substrate is frequently removed or disturbed. Sediment deposition is marginal, with moderate deposits of fine material and increased bar development. Anthropogenic influence (past or present) is minor. A portable diversion pump and overhead power lines are on the right bank at the downstream end of the site.

K.1.5 Valley Segment 4

K.1.5.1 Site 4-1

Site 4-1 is the site farthest downstream in Valley Segment 4 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is 10 kilometers upstream of Hanging Woman Creek and the town of Birney, upstream of where Tongue River Road crosses the river toward the left valley wall. It is a relatively straight, uniform site with no islands and a left bank cutbank in the downstream portion of the site. The landscape on both banks consists of a floodplain/terrace dominated by grasses and open field.

Habitat complexity is low with one long glide. Substrate is dominated by gravel, with secondary amounts of sand. The left bank is higher than the right bank, due to the presence of the left bank cutbank. Neither of the banks was classified as eroding. No amount of the left bank and 2 percent of the right bank are undercut. Average wetted width and thalweg depth are 41 meters and 0.80 meter, respectively. Average bankfull width and depth are 41 meters and 1.1 meters, respectively. No side channels or woody debris jams were observed.

Epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with only some new increased bar formation. Anthropogenic influence (past or present) is moderate due to the presence of a bridge (Tongue River Road) that crosses the Tongue River as well as some overhead power lines crossing the river 75 meters upstream of the bridge.

K.1.5.2 Site 4-2

Site 4-2 is approximately 12 kilometers upstream of Site 4-1 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). The site is along a channel bend and has no islands. A steep cutbank on the left bank borders the channel for more than half the site. The landscape on both banks consists of a floodplain/terrace dominated by grasses and open field.

Habitat complexity is low with two glides and a run. Substrate is dominated by gravel, with secondary amounts of cobble and sand. The left bank is considerably higher than the right bank due to the presence of the left bank cutbank. Neither bank was classified as eroding. No undercut banks are present on either bank. Average wetted width and thalweg depth are 45 meters and 0.79 meters, respectively. Average bankfull width and depth are 45 meters and 1.0 meters, respectively. No side channels or woody debris jams were observed.

Epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is very low, with little or no enlargement of islands or bars. Anthropogenic influence (past or present) is negligible. However, an abandoned diversion dam is at the downstream end of the site.

K.1.5.3 Site 4-3

Site 4-3 is approximately 2 kilometers upstream of Site 4-2 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is a straight reach with a series of islands at the upstream end of the site. The landscape on both banks consists of a floodplain/terrace dominated by grasses and open field.

Habitat complexity is low with two glides, a riffle, and islands. Substrate is dominated by gravel, with secondary amounts of cobble, sand, and fines. The streambank heights are similar on both banks. Neither bank was classified as eroding. No undercut banks are present on either bank. Average wetted width and thalweg depth are 42 meters and 0.54 meter, respectively. Average bankfull width and depth are 42 meters and 1.3 meters, respectively. Active side channels associated with the islands are present on the left bank. No woody debris jams were observed.

Epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with minor new bar formation. Anthropogenic influence (past or present) is negligible.

K.1.5.4 Site 4-4

Site 4-4 is approximately 6.5 kilometers upstream of Site 4-3 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is a straight reach for most of its length with a channel bend on the upstream end. No islands are present. The left bank slopes steeply up to the Tongue River Road. Upslope of the Tongue River Road, a steep escarpment (a cliff) runs along the entire

left side of the site. The landscape on the left bank is mostly considered developed because of the road, and the right bank floodplain is dominated by grasses and open field.

Habitat complexity is low with two glides. Substrate is a mixture of cobble and gravel, with secondary amounts of boulder and organics. The left bank is considerably higher than the right bank due to the presence of the steep slopes that lead up to the road. Approximately 80 percent of the left bank was classified as eroding, and 5 percent of the right bank was classified as eroding. Approximately 30 percent of the left banks and 90 percent of the right banks are undercut. Average wetted width and thalweg depth are 41 meters and 0.64 meter, respectively. Average bankfull width and depth are 43 meters and 1.4 meters, respectively. An inactive side channel was observed on the left bank. No woody debris jams were observed.

Epifaunal substrate cover is suboptimal, suggesting that the channel is well suited for epifaunal colonization. Sediment deposition is generally low, with minor new bar formation. Anthropogenic influence (past or present) is present in the form of the Tongue River Road.

K.1.5.5 Site 4-5

Site 4-5 is approximately 6 kilometers upstream of Site 4-4 (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It consists of a sinuous planform with a cutbank on the right bank toward the lower portion of the site and a steeply sloping left banks that lead up to Tongue River Road in the upper portion of the site. No islands are present. Upslope of Tongue River Road is a steep escarpment (a cliff). The landscape on both banks is dominated by grasses and open field.

Habitat complexity is moderate with a glide, two lateral scour pools, and a run. Substrate is dominated by gravel and sand, with secondary amounts of boulder, cobble, fines, and organics. The left bank is considerably higher than the right bank due to the presence of the steep slopes that lead up to the road. Approximately 20 percent of the left bank was classified as eroding, and 15 percent of the right bank was classified as eroding. Approximately 35 percent of the left banks and 70 percent of the right banks are undercut. Average wetted width and thalweg depth are 36 meters and 0.87 meter, respectively. Average bankfull width and depth are 44 meters and 1.46 meters, respectively. An inactive side channel was observed on the right bank floodplain. No woody debris jams were observed.

Epifaunal substrate cover is optimal, suggesting that the channel is highly favorable for epifaunal colonization. Sediment deposition is very low, with little or no enlargement of islands or bars. Anthropogenic influence (past or present) is moderate due to the presence of the road, as well as a rock groin that is present on the left bank toward the upper end of the site. The rock groin appears to have been constructed to deflect flow away from the left bank. It has created a lateral scour pool immediately downstream.

K.1.5.6 Site 4-6

Site 4-6 is the uppermost site in Valley Segment 4 and the study area (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is approximately 1 kilometer downstream of the Tongue River Dam and Reservoir. The straight site has a steeply sloping left bank that leads up to Tongue River Road. No islands are present. Upslope of Tongue River Road is a steep escarpment (a cliff). The landscape on the left bank is mostly considered developed because of the road, and the right bank floodplain is dominated by grasses and open field.

Habitat complexity is low, one glide. Substrate is an even mixture of cobble, gravel, sand, and organics. The left bank is considerably higher than the right bank because steep slopes lead up to the road. Approximately 20 percent of the left bank and 5 percent of the right bank were classified as eroding. Approximately 80 percent of the left banks and 90 percent of the right banks are undercut. Average wetted width and thalweg depth are 39 meters and 1 meter, respectively. Average bankfull width and depth are 40 meters and 1.6 meters, respectively. No side channels or woody debris jams were observed.

Epifaunal substrate cover is optimal, suggesting that the channel is highly favorable for epifaunal colonization. Sediment deposition is very low, with little or no enlargement of islands or bars. Anthropogenic influence (past or present) is moderate due to the presence of the road.

K.1.6 Physical Surveys Summary (Tongue River)

Valley Segment 2 has the most habitat complexity, with 16.7 habitat units per kilometer. Valley Segment 4 has the least habitat complexity (almost entirely glide habitat), with 4.8 habitat units per kilometer. Glides are the dominant habitat unit in each valley segment, followed by riffles (except for Valley Segment 3 where mid-channel pools are the secondary habitat unit). As shown in Attachment K-1, in Valley Segment 1, other habitat units consist of islands (12.4 percent), lateral scour pools (9.9 percent), and mid-channel pools (3.2 percent). In Valley Segment 2, other habitat units consist of islands (7.1 percent), mid-channel pools (4.9 percent), lateral scour pools (4.0 percent), and runs (3.5 percent). There are also small percentages of bars, cascades or falls, and backwater habitats. In Valley Segment 3, other habitat units consist of runs (8.9 percent), lateral scour pools (7.1 percent), islands (4.9 percent), and riffles (4.0 percent). There are also small percentages of bars and backwater habitats. In Valley Segment 4, other habitat units consist of islands (3.2 percent), lateral scour pools (3.1 percent), and runs (2.9 percent).

Lack of backwater habitats in Valley Segments 1 and 4 (and the overall small percentages of these habitats within the study area) reflect a system that is experiencing ongoing aggradation, especially in the lowest (most downstream) reaches. As previously described, eroding banks increase significantly and undercut banks decrease significantly in the downstream direction. In general, fine sediments increase in the downstream direction with larger and finer-grained bar complexes and islands.

Another important observation is that streamflow diminishes in Valley Segment 1 due to the Tongue and Yellowstone Diversion Dam. The diversion has the effect of reducing the transport capacity of the river, this allowing more sediment to be deposited in this lower valley segment.

K.2 Physical Survey Results (Tributaries)

K.2.1 Tributary Comparison

As shown in Attachment K-1, Otter Creek has the least habitat complexity of any of the tributary physical surveys, with 19.7 habitat units per kilometer. Canyon Creek has the most habitat complexity, with 56.6 habitat units per kilometer. On average, for all sites that were physically surveyed within the tributaries, there are approximately 37 habitat units per kilometer. Glides are the dominant habitat unit in each tributary.

Average bankfull width ranges from 4 to 6 meters, and average wetted width ranges from 2.5 meters on Canyon Creek to 5 meters on Otter Creek. Riparian vegetation composition is dominated by grasses and open field. Shrubs and trees were the other dominant riparian vegetation types. Bank heights are similar for all tributaries, with values of either 1 or 2 meters for each bank. Bank instability is generally high for each stream, especially on Moon and Canyon Creeks. Undercut banks are absent on Otter Creek, and approximately 10 percent present for both Moon and Canyon Creeks.

K.2.1.1 Site 5-1 (Otter Creek)

Site 5-1 is the downstream site in Otter Creek (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is approximately 10 kilometers upstream of Ashland. Site 5-1 is a sinuous site with a narrow channel with no islands. The landscape on both banks consists of a floodplain/terrace dominated by grasses and open field.

Habitat complexity is high with a mixture of glides and runs. Substrate is dominated by organics (anaerobic, thick, black mud), with secondary amounts of fines and one instance of bedrock. The streambank heights are similar on both banks. Approximately 15 percent of each bank was classified as eroding. None of the banks is undercut. Average wetted width and thalweg depth are 4.2 meters and 0.58 meter, respectively. Average bankfull width and depth are 5.3 meters and 1.0 meter, respectively. No side channels or woody debris jams were observed.

Anthropogenic influence (past or present) is negligible; however, a human-made drainage ditch is along the northern parcel boundary.

K.2.1.2 Site 5-2 (Otter Creek)

Site 5-2 is the upstream site within Otter Creek (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*). It is approximately 3 kilometers upstream of Site 5-1. Site 5-2 is a sinuous site with a narrow channel with no islands. The left bank is bordered by a steep terrace at the downstream portion of the site, and by a terrace with a levee/berm at the upstream end. The landscape on both banks consists of a floodplain dominated by grasses and open field.

Habitat complexity is high with a mixture of glides and a run. Substrate is dominated by organics (anaerobic, thick, black mud), with secondary amounts of fines. The streambank heights are similar on both banks. Approximately 70 percent of the left bank was classified as eroding, and 40 percent of the right bank was classified as eroding. None of the banks is undercut. Average wetted width and thalweg depth are 5.7 meters and 0.56 meter, respectively. Average bankfull width and depth are 6.8 meters and 0.93 meter, respectively. No side channels or woody debris jams were observed.

Anthropogenic influence (past or present) is minor—the levee/berm at the upstream end on the left bank terrace is set back far enough from the channel that it doesn't interfere with channel hydrology at almost all flows.

K.2.1.3 Site 6-1 (Moon Creek)

Site 6-1 is the site farthest downstream in Moon Creek (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). The site is approximately 13.5 kilometers upstream of Moon Creek's confluence with the Yellowstone River. It is a sinuous site with a narrow channel and a side channel with no islands. Numerous wetland depressions are on each bank. The landscape on both banks consists of a floodplain dominated by grasses and open field.

Habitat complexity is high with a mixture of glides, mid-channel pools, a riffle, and runs. Substrate is dominated by fines, with minor amounts of gravel and sand. The channel is incised into the floodplain. Stream banks on both banks were inundated, but evidence of slumping occurs throughout the entire site. Approximately 60 percent of the left bank was classified as eroding (and undercut) and 40 percent of the right bank was classified as eroding (and undercut). Average wetted width and thalweg depth are 3.0 meters and 1.06 meters, respectively. Average bankfull width and depth are 3.0 meters and 0.81 meter, respectively. A large active side channel (an overflow channel) is on the right bank. Woody debris material (possibly a former beaver dam) creates a grade break in the water surface about halfway through the site.

Anthropogenic influence (past or present) is negligible; however, cattle have direct access to the site.

K.2.1.4 Site 6-2 (Moon Creek)

Site 6-2 is approximately 2 kilometers upstream of Site 6-1 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is a sinuous site with a narrow channel and a side channel with no islands. Numerous wetland depressions are on each bank. The landscape on both banks consists of a floodplain dominated by grasses and open field.

Habitat complexity is high with a mixture of glides, mid-channel pools, a lateral scour pool, riffles, and runs. Substrate is dominated by fines, with secondary amounts of sand and gravel. The channel is incised into the floodplain. Both stream banks were inundated, but evidence of slumping occurs throughout the entire site. Streambank heights are similar. Approximately 90 percent of the left bank was classified as eroding (with no bank undercuts) and 95 percent of the right bank was classified as eroding (with no bank undercuts). Average wetted width and thalweg depth are 4.9 meters and 1.14 meters, respectively. Average bankfull width and depth are 4.9 meters and 1.17 meters, respectively. An active side channel (an overflow channel) is on the left bank. An active beaver dam is approximately 370 meters from the downstream end of the site.

Anthropogenic influence (past or present) is negligible; however, cattle have direct access to the site.

K.2.1.5 Site 6-3 (Moon Creek)

Site 6-3 is approximately 2 kilometers upstream of Site 6-2 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is a sinuous site on a large channel bend with a narrow channel and side channels with no islands. Numerous wetland depressions are on each bank. A large cutbank is at the upper end of the site on the right bank. The landscape on both banks consists of a floodplain dominated by grasses and open field. A significant amount of in-channel vegetation is at the upstream end of the site. A large ponded wetland feature created in part by beaver dam construction is located between Site 6-2 and Site 6-3.

Habitat complexity is high with a mixture of glides, lateral scour pools, a riffle, and a run. Substrate is dominated by fines, with minor amounts of sand. The channel is incised into the floodplain. Both stream banks were inundated, but evidence of slumping occurs throughout the entire site. The right bank is higher than the left bank, due to the cutbank. None of the left bank was classified as eroding (with no bank undercuts) and 50 percent of the right bank was classified as eroding (with 1 percent of the bank undercut). Average wetted width and thalweg depth are 4.2 meters and 1.01 meters, respectively. Average bankfull width and depth are 4.2 meters and 1.02 meters, respectively. Active side channels are on both banks. A downed tree toward the downstream end of the site could be considered a debris jam.

Anthropogenic influence (past or present) is negligible; however, cattle have direct access to the site.

K.2.1.6 Site 6-4 (Moon Creek)

Site 6-4 is approximately 7 kilometers upstream of Site 6-3 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). It is a sinuous site with a narrow channel, no side channels, and no islands. Numerous wetland depressions are on each bank. A large cutbank is at the lower end of the site on the left bank. The landscape on both banks consists of a floodplain dominated by grasses and open field.

Habitat complexity is high with a mixture of glides, mid-channel pools, and runs. Substrate is dominated by fines. The channel is much incised into the floodplain— there is extremely limited floodplain connectivity. Stream banks are similar in height. All (100 percent) of both banks were classified as eroding (with no bank undercuts). Average wetted width and thalweg depth are 2.5 meters and 0.52 meter, respectively. Average bankfull width and depth are 3.9 meters and 0.99 meter, respectively. Minor debris jams are located throughout the site.

Anthropogenic influence (past or present) is negligible; however, cattle have direct access to the site.

K.2.1.7 Site 6-5 (East Fork Moon Creek)

Site 6-5 is approximately 4.5 kilometers upstream of Site 6-4 (Figure 8.4-1a in Chapter 8, Section 8.4, *Fish*). The site is on the East Fork of Moon Creek. It is a sinuous site with a narrow channel, an active side channel, and no islands. The channels are shallow, vegetated, and discontinuous. A large wetland complex is immediately upstream of the site. The landscape on both banks consists of a floodplain dominated by trees.

Habitat complexity is moderate with four glides. Substrate is dominated by fines. The left bank is taller that the right bank. Approximately 70 percent of both banks were classified as eroding (with no bank undercuts). Average wetted width and thalweg depth are 3.9 meters and 0.42 meter, respectively. Average bankfull width and depth are 4.1 meters and 0.8 meter, respectively. Minor debris jams are located throughout the site.

Anthropogenic influence (past or present) is present—a road and culvert cross near the downstream end of the site. In addition, cattle have direct access to the site.

K.2.1.8 Site 7-1 (Canyon Creek)

Site 7-1 is the only surveyed site on Canyon Creek (Figure 8.4-1b in Chapter 8, Section 8.4, *Fish*), near the Decker Alternatives. Canyon Creek is a tributary to the Tongue River and the confluence is in Valley Segment 4. The confluence of Canyon Creek and the Tongue River is approximately 26.5 kilometers upstream of the Tongue River's confluence with Hanging Woman Creek (the downstream end of Valley Segment 4). It is a sinuous site with a narrow channel and alternating cutbanks. It has a few very small islands and gravel bar complexes.

It was partially dry at the time of the survey (only the downstream portion had water). The landscape on both banks consists of a floodplain dominated by grasses and open field.

Habitat complexity is very high with a mixture of glides, lateral scour and mid-channel pools, riffles, runs, and cascades/falls. Substrate is dominated by fines, gravel, cobble, and organics, with secondary amounts of boulder and sand. Left and right banks had similar heights. Approximately 75 percent of each bank was classified as eroding (and 10 percent of each bank is undercut). Average bankfull width is 6 meters, and average bankfull thalweg depth and wetted depth are 0.7 meter and 0.2 meter, respectively. No side channels or woody debris jams were noted. However, a small tributary joins Canyon Creek near the downstream end of the site. The water in the tributary is overflow from a pump-fed stock pond.

Anthropogenic influence (past or present) is present—an access road crosses the site at approximately the halfway point. In addition, cattle have direct access to the site.

K.2.2 Physical Surveys Summary (Tributaries)

Otter Creek has the least habitat complexity, with 19.7 habitat units per kilometer. Canyon Creek has the most habitat complexity, with 56.6 habitat units per kilometer. Glides are the dominant habitat unit in each tributary. As shown in Attachment K-1, in Otter Creek, the other habitat unit consists of runs (12.0 percent). In Moon Creek, an independent tributary to the Yellowstone River, other habitat units consist of mid-channel pools (12.0 percent), and runs (10.3 percent). There are also small percentages of riffles and lateral scour pools. In Canyon Creek, other habitat units consist of midchannel pools (35.4 percent), runs (17.0 percent), and riffles (5.9 percent). There are also small percentages of cascades or falls and lateral scour pools.

Substrate composition is dominated by fine sediments. Each tributary has a high amount of habitat complexity. However, bank instability is generally high for each tributary, especially on Moon and Canyon Creeks. Undercut banks are absent on Otter Creek, and present along approximately 10 percent of the stream banks in both Moon and Canyon Creeks. The tributaries are generally incised and actively eroding, lack substantial amount of vegetative growth on the banks, and are negatively affected by cattle trampling on the banks and in the channel.

K.3 Fish Community Structure and Habitat Requirements

If the proposed rail line is constructed and operated, one or more aquatic ecosystems would be affected, depending on the build alternative that is approved. These ecosystems could include the Tongue River and its major tributaries, such as Otter, Foster, Beaver, Ash, and Canyon Creeks. Tributaries to the Yellowstone River, such as Rosebud and Moon Creeks, could also be affected, as could numerous smaller tributary streams to the Tongue River.

The number affected would vary by build alternative. The majority of these smaller tributary streams are intermittent streams that are either non-fish-bearing, or are fish-bearing for limited periods when connected to perennial streams by high seasonal flows.

All of the potentially affected streams are located within the Yellowstone River Basin in the Northern Great Plains ecoregion (Omernik 1995, U.S. Environmental Protection Agency 2012), an area with a diverse native and nonnative fish community composed of up to 63 species (Stagliano 2005). This level of diversity is typical of large, warm water river ecosystems around the globe (Galat et al. 2005, Persinger et al. 2011, Welcomme et al. 2006).

Many of the streams and smaller rivers in the lower elevation prairie ecosystems of Montana have not been extensively studied, yet these systems support highly intact native fish and invertebrate communities (Stagliano 2005). These aquatic ecosystems are biologically rich and can support a diverse community of aquatic species. This diversity can present challenges when assessing aquatic habitat suitability and identifying the potential impacts of proposed actions on ecosystem functions. For example, a large aquatic ecosystem like the Tongue River may support over 50 native and introduced fish species, each having a range of habitat requirements. Tributaries to the Tongue River may support a similarly large number of species, including species that actively migrate between these ecosystems for spawning and other species that are specially adapted to live in smaller tributaries. Evaluating the habitat requirements of each individual species and compiling an integrated assessment would be a complex exercise. Therefore, habitat assessments in biologically diverse aquatic ecosystems commonly focus on species assemblages. Assemblages are groups of fish species that are likely to occur in a given ecosystem type based on their known geographic distribution and primary habitat associations.

Assemblage-based habitat assessments commonly rely on hierarchical organization and classification methods for different ecosystem types in a region, the species assemblages associated with each ecosystem type, and the habitat requirements of the fish species that make up these assemblages. The Montana Natural Heritage Program (Stagliano 2005) developed an assemblage-based classification system for Montana's streams and rivers and their associated biological communities at the aquatic ecological system (AES) scale (e.g., large prairie river, medium prairie river, core prairie stream, intermittent fish-bearing stream). This system simplifies the characterization of diverse fish communities like those in the study area by predicting which species could be present based on ecosystem type and the habitat conditions present. This is particularly useful where fish distribution data are limited, as is the case in the majority of streams in the study area.

For the purpose of this EIS, OEA classified the aquatic habitats in the study area and their associated fish communities using the aquatic ecosystem and fish community classification scheme developed by Stagliano (2005). As described above, this classification organizes rivers and streams based on habitat characteristics and the typical fish species assemblages they support. The fish species within those assemblages are further subdivided into

functional groups, or guilds, based on habitat preferences and feeding requirements. The concept of habitat guilds has been applied broadly as a basis for organizing fish species habitat requirements and habitat suitability in biologically diverse rivers (Galat et al. 2005, Kinsolving and Bain 1993, Pegg and Pierce 2002, Persinger et al. 2011, Welcomme et al. 2006, Wildhaber et al. 2012). The habitat guild approach is routinely used to describe the fish communities of the Missouri and Mississippi River systems (Galat et al. 2005, O'Hara et al. 2007, Pegg and Pierce 2002, Persinger et al. 2011, Wildhaber et al. 2012).

K.3.1 Aquatic Ecological System Classes

Stagliano (2005) describes a set of major AES classes developed to describe and categorize riverine habitats in the state of Montana based on their ecological characteristics. AES classes are defined hierarchically based on ecoregion as described by Omernik (1995), taking into account stream size, stream order, and associated habitat characteristics. The study area is located in the Northern Great Plains Ecoregion and includes the AES classes as described in Table K-1. The classes range from Large Prairie River (Class A003) to Great Plains Intermittent Streams (Classes D005 and E005) ecosystem types. The intermittent streams are subdivided, per Stagliano (2005), to distinguish fish-bearing (Class D005) and non-fish-bearing (Class E005) water bodies based on observed fish presence in Montana FWP fisheries surveys (2012) correlated with drainage area (Table K-1). Fish-bearing intermittent streams may include streams that hold fish year around in disconnected pools and streams that only support fish during flashy moisture events (rain storms) that provide a contiguous connection to perennial fish-bearing streams. Some fish species reside primarily in perennial streams but use intermittent streams as spawning habitat when such streams are accessible. While not used directly as habitat, non-fish-bearing streams are ecologically important as they can serve as a source of nutrients and sediment that support riparian conditions that are beneficial to aquatic habitat and they may maintain standing water that may support a variety of amphibian, insect, and/or other wildlife species during the summer dry season (Stagliano 2005).

Table K-1. Aquatic Ecological System (AES) Classes of the Northern Great Plains Ecoregion, Example River Systems in the Study Area and Vicinity, and Predicted Fish Community Assemblages by AES Class

Aquatic Ecosystem Class	AES Code	Ecosystem Type	Examples in Study Area and Vicinity	Typical Length (river miles)	Average Wetted Width (feet)	Typical Fish Community Assemblage	Characteristics
Large Mainstem River	A002	7th order and larger rivers of the Northern Great Plains Ecoregion	Yellowstone River	>500	200+	Healthy SPA 5 SPA 1	Large mainstem rivers characterized by wide and deep main channels. This ecosystem type, specifically the Yellowstone River, does not occur in the study area but species that are associated with this AES class are known to use the Tongue River and Rosebud Creek.
Large Prairie River	A003	Primary 5th order tributaries of the Yellowstone River	Tongue River	>200	50–100+	Healthy SPA 1 SPA 2 SPA 9 Impaired SPA 3	Highly sinuous, low-gradient systems with long glides, deep pools, and occasional riffles. Glides sand and gravel dominated, riffles and runs gravel and cobble dominated. Pool substrates range from sand to fine silt and organic material. Large woody debris (LWD) and undercut banks provide substantial fish habitat. Lower reaches offer substantial spawning and nursery habitat for large and endemic fish species of the Yellowstone River, including the shovelnose sturgeon and the blue sucker.
Medium Prairie River	B005	Secondary 4th–5th order rivers, typically direct tributaries to the Yellowstone River or other Large Prairie Rivers	Rosebud Creek	>100	50	Healthy SPA 1 (at A003 confluences) SPA 2, 18, 20 SPA 9 Impaired SPA 3	Unconfined valley bottom rivers, typically wadeable in summer. Sinuous, low-gradient channel composed of long glides and pools, moderate gradient reaches contain moderate-frequency riffles (~20 x wetted width interval) that remain wetted continuously. Riffles typically cobble/gravel dominated, gravel-dominated glides and silted pools. LWD, deep pools and undercut banks provide substantial fish habitat. Lower reaches near large river confluences provide spawning and nursery habitat for large river assemblage fish species.

Aquatic Ecosystem Class	AES Code	Ecosystem Type	Examples in Study Area and Vicinity	Typical Length (river miles)	Average Wetted Width (feet)	Typical Fish Community Assemblage	Characteristics
Great Plains Core Prairie Stream	C005	Small to medium 3rd–4th order streams and tributaries	Otter Creek Pumpkin Creek Hanging Woman Creek Moon Creek (lower) Beaver Creek	<100	15	Healthy SPA 2 SPA 18 SPA 20 Impaired SPA 3	Sinuous, low-gradient systems composed of long glides and pools. Moderate gradient sections have low-frequency riffles (40–50 wetted width interval) that remain continuously inundated. Riffles typically cobble/gravel dominant (when present), Glides are gravel, sand and silt dominant. Pools are typically silted. Vegetated side channels, undercut banks and LWD provide diverse fish habitat.
Great Plains Intermittent Stream	D005, E005	Common and widely distributed small 1st–3rd order streams and tributaries of larger river systems. Regularly intermittent.	Moon Creek (upper) – D005 Canyon Creek – E005 Bull Creek – E005 Other intermittent streams in the study area	<50	<15	Healthy SPA 20 Non-fish-bearing streams support amphibians	Low to moderate gradient intermittent stream systems. Riffle and run habitats regularly dewater forming interrupted pools, streamflow connectivity to fish-bearing ecosystems occurs regularly under high flow conditions (D005). Systems that lose regular connectivity to fish-bearing habitat become fishless isolated pools (E005) often used extensively by amphibians. Riffles are typically cobble/gravel dominant when present, majority of habitat is composed of gravel- and sand-dominated glides, and sand- and silt-dominant pools. Substrate composition may vary considerably depending on local conditions.

Notes:
Typical Fish Community Assemblage: See Table K-2
Source: Stagliano 2005
AES: aquatic ecological system classification

K.3.2 Predicted Fish Species Assemblages and Indicator Species

Stagliano (2005) associates each AES class in the Northern Great Plains Ecoregion with one or more fish species assemblages. Species assemblage and AES class associations likely to occur in the study area and proximity are described in Table K-2. As the table shows, these assemblages include a mixture of native and nonnative species across a broad taxonomic spectrum. Some species are likely to occur in several habitat types while others are relatively limited in distribution, indicating that they are dependent on the habitat characteristics offered by specific aquatic ecosystem types.

River and tributary stream confluences are ecologically diverse habitat features that share characteristics of both contributing systems and typically support more than one species assemblage. Several species that are primarily associated with a single AES class are commonly observed in higher-order AES class streams near confluences with larger systems. These species may rely on these habitats for portions of their life cycle. For example, several species that occur primarily in the mainstem Yellowstone River may also occur in Segment 1 of the Tongue River (Large Prairie River AES Class) near the confluence. Similarly, several species that are associated with the Large Prairie River AES class are likely to occur in the confluence area of smaller tributary systems (e.g., Medium Prairie River, Core Prairie Stream AES Classes [B005/C005]).

Table K-2. Montana Fish Species Assemblage and Predicted Species Occurrence by Aquatic Ecological System Classification

Species Assemblage	Representative Species	Predicted Occurrence by Aquatic Ecological System Classification				
		A002	A003	B005	C005	D005
Group SPA 1 – Large Warmwater River Assemblage	Bigmouth buffalo (*Ictiobus cyprinellus*)	●	●	--	--	--
	Northern pike (*Esox lucius*)	○	--	●	●	--
	Sauger (*Sander canadense*) *	○	●	○	--	--
	Smallmouth bass (*Micropterus dolomieu*)	○	○	--	--	--
	Smallmouth buffalo (*Ictiobus bubalus*)	●	●	--	--	--
	Stonecat (*Noturus flavus*) *	●	●	●	●	--
	Channel catfish (*Ictalurus punctatus*) *	●	●	●	●	--
	Walleye (*Sander vitreum*)	●	●	○	--	--
	Yellow perch (*Perca flavescens*)	○	○	○	--	--
	Emerald shiner (*Notropis atherinoides*) *	▼	●	--	--	--
	Burbot (*Lota lota*)	●	●	--	--	--
	Goldeye (*Hiodon alosoides*) *	▼	●	--	--	--
	River carpsucker (*Carpiodes carpio*) *	▼	●	●	--	--
	Shorthead redhorse (*Moxostoma macrolepidotum*) *	○	●	●	○	--
Group SPA 2 – Medium Warmwater River Assemblage	Common carp (*Cyprinus carpio*)	●	●	●	●	--
	Flathead chub (*Platygobio gracilis*) *	▼	▼	●	●	--
	Green sunfish (*Lepomis cyanellus*)	--	●	●	--	--
	Plains minnow (*Hybognathus placitus*)	●	●	●	●	--
	Sand shiner (*Notropis stramineus*) *	▼	▼	●	●	--
	Black bullhead (*Ameiurus melas*)	--	●	●	●	--
	Western silvery minnow (*Hybognathus argyritis*)*	▼	▼	●	○	--
	Longnose sucker (*Catostomus catostomus*)	●	--	--	--	--
	Mountain sucker (*Catostomus platyrhynchus*)	●	--	--	--	--
Group SPA 2 Subgroup SPA 18 – Brook Stickleback Assemblage	Brook stickleback (*Culaea inconstans*) *	--	--	●	●	▼
	Brassy minnow (*Hybognathus hankinsoni*)	--	--	●	●	●

Species Assemblage	Representative Species	Predicted Occurrence by Aquatic Ecological System Classification				
		A002	A003	B005	C005	D005
Group SPA 2 Subgroup SPA 20 – Core Prairie Stream Assemblage	Fathead minnow (*Pimephales promelas*) *	●	●	●	●	●
	Longnose dace (*Rhinichthys cataractae*)	▼	●	●	●	--
	White sucker (*Catostomus commersoni*) *	●	●	●	●	--
	Lake chub (*Couesius plumbeus*) *	--	--	●	●	●
Group SPA 3 – Warmwater Sunfish Assemblage (Indicative of degradation)	Bluegill (*Lepomis macrochirus*)	--	--	--	--	--
	Black crappie (*Pomoxis nigromaculatus*)	--	--	--	--	--
	White crappie (*Pomoxis annularis*)	--	--	--	--	--
	Golden shiner (*Notemigonus crysoleucas*)	--	--	--	--	--
	Spottail shiner (*Notropis hudsonius*)	--	--	--	--	--
	Largemouth bass (*Micropterus salmoides*)	--	--	--	--	--
	Pumpkinseed (*Lepomis gibbosus*) *	--	--	--	--	--
	Rock bass (*Ambloplites rupestris*) *	○	--	--	--	--
	Yellow bullhead (*Ameiurus natalis*)	--	--	●	--	--
Group SPA 5 – Large Mainstem River Assemblage	Blue sucker (*Cycleptus elongatus*) *	○	--	--	--	--
	Freshwater drum (*Aplodinotus grunniens*) *	●	●	--	--	--
	Paddlefish (*Polyodon spathula*) *	●	--	--	--	--
	Pallid sturgeon (*Scaphirhynchus albus*) *	○	--	--	--	--
	Shovelnose sturgeon (*Scaphirhynchus platorynchus*) *	●	●	--	--	--
	Sicklefin chub (*Macrhybopsis meeki*) *	○	--	--	--	--
Group SPA 7 – Traditional Trout Stream Assemblage	Brook trout (*Salvelinus fontinalis*)	--	--	--	--	--
	Brown trout (*Salvelinus trutta*)	--	--	--	--	--
	Rainbow trout (*Oncorynchus mykiss*)	--	--	--	--	--
Group SPA 9 – Creek Chub Assemblage	Plains killifish (*Fundulus zebrinus*)	--	○	○	--	--
	Sturgeon chub (*Macrhybopsis gelida*) *	○	●	--	--	--
	Creek chub (*Semotilus atromaculatus*) *	--	○	●	--	--

* = A species assemblage indicator species; Underlined species = Introduced/nonnative species

Note: Predicted Occurrence
▼ = Predicted as dominant species or highly abundant in AES class
● = Predicted as common in AES class
○ = Predicted as uncommon/rare in AES class
-- = Not predicted to occur in AES class

K.3.3 Fish Species Observed in the Study Area and Habitat Requirements

OEA compared the predicted species assemblages (per Stagliano 2005) to the actual species observed in the study area in order to assess baseline aquatic habitat conditions. OEA obtained data on actual species from Montana FWP (2012), which conducted surveys of selected streams in the study area between 2005 and 2012. These survey data documented the presence of several fish species in the Tongue River and Rosebud, Hanging Woman, Otter, Foster, and Beaver Creeks (the latter four are tributaries to the Tongue River). Montana FWP also surveyed several other tributary streams in the immediate proximity, including several small tributaries to the Tongue River. OEA compared the species observed in Montana FWP (2012) fish presence/absence surveys to predicted assemblage occurrence (Stagliano 2005) in surveyed tributaries, and then tentatively classified surveyed and unsurveyed streams based on drainage area and characteristics that OEA observed in the field.

OEA classified fish species in the study area were classified by species assemblage (Stagliano 2005), observed and predicted occurrence by water body, and a species-specific suite of ecological and habitat parameters obtained from the Long Term Resource Monitoring Program (LTRMP) Database for Upper Mississippi River Fishes (O'Hara et al. 2007). Classification parameters are described in Table K-3 and presented by species in Table K-4.

OEA used these physical survey data to evaluate the potential habitat for fish species by Valley Segment in the Tongue River, Otter Creek, and Moon Creek in Section K.2, *Physical Survey Results (Tributaries)*. OEA used data from physical surveys to predict the suitability of habitat conditions in surveyed streams segments for fish species associated with the applicable AES classes. Physical survey data is discussed in Section K.4, *Fish Habitat Potential*, and summarized in Table K-5.

Table K-3. Habitat Guild, Trophic Guild, and Other Ecological Parameters used to Classify Fish Species Observed in the Study Area

Parameter	Category	Definition
Habitat Guild	Fluvial Dependent	Species are found in a variety of habitat types but require flowing water during some point in their life cycle. The dependent life stages are typically spawning and incubation, and/or dispersal of emergent larvae or juveniles that depend on river currents for dispersal to suitable rearing habitats.
	Fluvial Specialist	Species are found almost exclusively in streams and rivers or are dependent on flowing water habitats throughout the majority of their life cycle.
	Macrohabitat Generalist	Species are capable of completing their life cycle in both lotic and lentic ecosystems providing that suitable habitat characteristics are present (Galat et al. 2005, Simon 1999). Includes the majority of nonnative species occurring in the study area and vicinity.
Origin	Native	Species native to the Northern Great Plains Ecoregion.
	Introduced	Species that are not native to the Northern Great Plains Ecoregion. Includes species that are native elsewhere in the upper Missouri River and Mississippi River ecosystems as well as species introduced from outside these basins.
Species Assemblage	See Table K-2.	See Table K-2.
Trophic Guild	Piscivore	Preys primarily on other fish as adults, prey requirements more flexible during juvenile life stage.
	Invertivore	Preys primarily on aquatic macroinvertebrates (insects), terrestrial macroinvertebrates may also comprise a significant portion of diet.
	Detritivore/ Herbivore	Forages on organic detritus and/or aquatic vegetation.
	Omnivore	Species has flexible diet, capable of shifting from predation to herbivorous diet depending on available food resources and seasonal metabolic requirements.
	Planktivore	Species filter feeds on phytoplankton and zooplankton as adults. Preys directly on zooplankton during larval and juvenile life stages.
Predicted/ Observed Occurrence	Symbol = Δ	Observed in water body by Montana FWP (2012).
	Symbol = ▼	Predicted as dominant species or highly abundant in AES class.
	Symbol = ●	Predicted as common in AES class.
	Symbol = ○	Predicted as uncommon/rare in AES class.
Current Preference	Fast	Prefers fast-flowing environments, including fast glides, runs, and riffles.
	Moderate	Prefers moderate current environments, including glides and pool tailouts.
	Slow–none	Prefers low-current environments, emphasizing pools, side channels and backwater areas, and slow glides with cover.
	General	Flexible, species found in a variety of current environments.
Water Column Preference	Benthic	Species is associated directly with the channel bed.
	Epibenthic	Species is associated with near-bottom habitats, typically in deeper water.
	Pelagic	Species occupies mid-water habitats, may be surface oriented.
Primary Adult and Spawning Habitat Associations	Symbol = ♦●	Primary adult habitat and spawning habitat.
	Symbol = ♦	Primary adult habitat.
	Symbol = ●	Primary spawning habitat.

Parameter	Category	Definition
Substrate Preferences	Silt	Fine-grained silt and mud, particle diameter 0.00015–0.0025 inches (3.90–62.5 micrometers [µm])
	Sand	Fine to coarse sand, particle diameter 0.0025-0.079 inches (62.5 µm – 2 millimeters [mm]).
	Gravel	Fine to coarse gravel, particle diameter 0.079-2.5 inches (2–64 mm).
	Cobble	Larger rock ranging from 2.5 to 10.1 inches (64–256 mm)
	Boulder	Large rock >10.1 inches (>256 mm) diameter, includes fractured bedrock.
	Structure	Logs, woody debris, large rocks, or other features that provide cavities, crevices, or overhanging cover.
	General	Species associated with a wide variety of substrate types with no particular preference.
	Pelagic (spawning)	Spawning occurs in the water column, no substrates are used
	Vegetation	Submerged leaves, stems, roots, or branches of aquatic, emergent, or terrestrial vegetation.
Ecological and Turbidity Tolerance	High	High tolerance for ecological disturbance; high turbidity tolerance, average levels from 75 to 115 nephelometric turbidity units (NTU).
	Moderate	Moderate tolerance for ecological disturbance; moderate turbidity tolerance, average levels from 25 to 75 NTU
	Low	Low tolerance for ecological disturbance; turbidity tolerance less than 25 average NTU.

Sources: Galat et al. 2005, Kinsolving and Bain 1993, O'Hara et al. 2007, Simon 1999, Stagliano 2005, Trebitz et al. 2007, Winemiller and Rose 1992.

Table K-4. Habitat Guilds and Ecological Characteristics of Fish Species Observed in Study Area Aquatic Habitats (see Table K-3 for parameter definitions and symbology)

Habitat Guild	Origin	Species	Assemblage	Observed and Predicted Occurrence in Study Area									Primary Adult Habitat Associations (♦) and Spawning Habitat Requirements (●)									Ecological Tolerance	
				Tongue River	Rosebud Creek	Pumpkin Creek	Hanging Woman Cr.	Otter Creek	Beaver Creek	Cook Creek	Foster Creek	Moon Creek	Current Preference	Water Column	Pool - Mid Channel	Pool - Lateral	Glide	Run	Riffle	Preferred Substrate	Spawning Substrate	Habitat Degradation	Turbidity
Fluvial Dependent	Native	Shorthead redhorse (*Moxostoma macrolepidotum*)	SPA 1	Δ ●	Δ ●	Δ ○	Δ ○	Δ ○	--	-- ○	-- ○	--	Mod	Epibenthic	--	♦	♦	♦ ●	●	Gravel	Gravel	Low	High
		White sucker (*Catostomus commersoni*)	SPA 20	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Slow–none	Epibenthic	♦	♦	♦ ●	●	●	Gravel	Gravel	High	Mod
		Lake chub (*Couesius plumbeus*)	SPA 20	--	Δ ●	Δ ●	Δ ●	Δ ●	--	Δ ●	●	●	Slow–none	Pelagic	♦ ●	♦ ●	♦	--	--	General	--	Mod	Mod
		Plains minnow (*Hybognathus placitus*)	SPA 2	Δ ●	●	Δ ●	●	Δ ●	Δ ●	●	Δ ●	--	Mod	Benthic	--	- -	♦	♦ ●	♦ ●	Sand	Sand	Mod	High
		Goldeye (*Hiodon alosoides*)	SPA 1	Δ ●	Δ	Δ	--	--	--	--	--	--	Gen	Pelagic	♦	♦	♦ ●	♦ ●	●	Sand	Gravel	Low	High
		Paddlefish (*Polyodon spathula*)	SPA 5	Δ	--	--	--	--	--	--	--	--	Slow–none	Pelagic	♦	♦	●	●	--	Pelagic	Gravel	Low	High
	Introduced	Brook trout (*Salvelinus fontinalis*)	--	--	Δ	--	--	--	--	--	--	--	Mod	Pelagic	♦	♦	♦ ●	♦ ●	●	General	Gravel	Low	Low
		Brown trout (*Salmo trutta*)	--	Δ	--	--	--	--	--	--	--	--	Mod	Pelagic	♦	♦	♦ ●	♦ ●	♦ ●	General	Gravel	Mod	Mod
		Rainbow trout (*Oncorhynchus mykiss*)	--	Δ	--	--	--	--	--	--	--	--	Fast	Pelagic	♦	♦	♦ ●	♦ ●	♦ ●	Gravel	Gravel	Med	Low
Ad Sp Re tiv		Shovelnose sturgeon	SPA 5	Δ ●	--	--	--	--	--	--	--	--	Fast	Benthic	--	- -	♦ ●	♦ ●	--	Sand	Gravel	Low	High

Habitat Guild	Origin	Species	Assemblage	Observed and Predicted Occurrence in Study Area									Primary Adult Habitat Associations (♦) and Spawning Habitat Requirements (●)									Ecological Tolerance	
				Tongue River	Rosebud Creek	Pumpkin Creek	Hanging Woman Cr.	Otter Creek	Beaver Creek	Cook Creek	Foster Creek	Moon Creek	Current Preference	Water Column	Pool - Mid Channel	Pool - Lateral	Glide	Run	Riffle	Preferred Substrate	Spawning Substrate	Habitat Degradation	Turbidity
		(*Scaphirhynchus platorynchus*)																					
		Blue sucker (*Cycleptus elongatus*)	SPA 5	Δ	--	--	--	--	--	--	--	--	Fast	Benthic	--	-- --	♦	♦ ●	♦ ●	Gravel	Cobble	Mod	High
		Flathead chub (*Platygobio gracilis*)	SPA 2	Δ ▼	Δ ●	Δ ●	●	Δ ●	Δ ●	●	●	Δ	Fast	Epibenthic	--	-- --	♦ ●	♦ ●	♦ ●	Sand	Sand	Mod	High
		Sand shiner (*Notropis stramineus*)	SPA 2	Δ ▼	●	Δ ●	Δ ●	Δ ●	●	●	Δ ●	Δ	Mod	Pelagic	♦	♦	♦ ●	●	●	Sand	Gravel	Mod	Mod
		Sturgeon chub (*Macrhybopsis gelida*)	SPA 9	Δ ●	--		--	--	--	--	--	--	Fast	Benthic	--	-- --	♦ ●	♦ ●	♦ ●	Sand	Sand	Mod	High
		Western silvery minnow (*Hybognathus argyritis*)	SPA 2	Δ ▼	●	Δ ○	○	Δ ○	Δ ○	-- ○	-- ○	Δ	Slow–none	Benthic	♦ ●	♦ ●	--	--	--	Silt	Silt	Mod	High
		Stonecat (*Noturus flavus*)	SPA 1	Δ ●	Δ ●	●	Δ ●	Δ	--	●	●	--	Mod	Benthic	--	-- --	♦ ●	♦ ●	♦	Cobble	Struc-ture	Low	Low
Macrohabitat Generalist	Native	Bigmouth buffalo (*Ictiobus cyprinellus*)	SPA 1	Δ ●	--	Δ	--	--	--	--	--	--	Slow–none	Epibenthic	♦	♦	♦ ●	●	●	General	Genera l	Mod	High
		Longnose sucker (*Catostomus catostomus*)	SPA 2	Δ ▼	Δ	Δ ●	--	--	--	--	--	--	Slow–none	Epibenthic	♦	♦	♦ ●	●	●	General	Gravel	Low	Low
		Mountain sucker (*Catostomus platyrhynchus*)[b]	SPA 2	Δ ●	--	--	--	--	--	--	--	--	Gen	Epibenthic	♦	♦	♦ ●	●	●	General	Gravel	High	

Habitat Guild	Origin	Species	Assemblage	Observed and Predicted Occurrence in Study Area									Primary Adult Habitat Associations (♦) and Spawning Habitat Requirements (●)									Ecological Tolerance	
				Tongue River	Rosebud Creek	Pumpkin Creek	Hanging Woman Cr.	Otter Creek	Beaver Creek	Cook Creek	Foster Creek	Moon Creek	Current Preference	Water Column	Pool - Mid Channel	Pool - Lateral	Glide	Run	Riffle	Preferred Substrate	Spawning Substrate	Habitat Degradation	Turbidity
		River carpsucker (*Carpiodes carpio*)	SPA 1	Δ ●	Δ ●	Δ	Δ	Δ	--	--	--	--	Slow–none	Epibenthic	♦	♦ ●	♦ ●	--	●	General	Sand	Mod	High
		Smallmouth buffalo (*Ictiobus bubalus*)	SPA 1	Δ ●	--	--	--	--	--	--	--	--	Slow–none	Epibenthic	♦	♦	♦ ●	●	●	General	General	Mod	Mod
		Green sunfish (*Lepomis cyanellus*)	SPA 2	Δ ●	--	Δ	Δ	Δ	--	--	Δ --	Δ	Gen	Epibenthic	♦ ●	♦ ●	♦	--	--	General	General	High	High
		Smallmouth bass (*Micropterus dolomieu*)	SPA 1	Δ ○	--	Δ	Δ	Δ	--	--	--	--	Mod	Epibenthic	♦ ●	♦ ●	♦ ●	--	--	Gravel	Gravel	Low	Low
		Brassy minnow (*Hybognathus hankinsoni*)	SPA 18	Δ	--	Δ ●	Δ ●	Δ ●	Δ ●	●	Δ ●	●	Slow–none	Benthic	♦ ●	♦ ●	♦	--	--	Sand	Vegeta-tion	Mod	Mod
		Brook stickleback (*Culea inconstans)*	SPA 18	Δ		●	●	●	●	●	●	●	Gen	Epibenthic	♦ ●	♦ ●	♦	--	--	General	Vegeta-tion	Mod	High
		Creek chub (*Semotilus atromaculatus*)	SPA 9	Δ ○	--	Δ	--	--	--	--	--	--	Slow–none	Pelagic	♦ ●	♦ ●	♦ ●	--	--	Gravel	Gravel	Mod	High
		Emerald shiner (*Notropis atherinoides*)	SPA 1	Δ ●	--	Δ	Δ	--	--	--	--	--	Mod	Pelagic	♦	♦ ●	♦ ●	--	--	General	Sand	Mod	High
		Fathead minnow (*Pimephales promelas*)	SPA 20	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	Slow–none	Pelagic	♦ ●	♦ ●	♦	--	--	General	Struc-ture	High	High
		Longnose dace (*Rhinichthys cataractae*)	SPA 20	Δ ●	Δ ●	Δ ●	Δ ●	--	--	Δ ●	●	●	Fast	Epibenthic	--	--	♦ ●	♦ ●	♦ ●	Gravel	Gravel	Low	Med
		Spottail shiner (*Notropis*	SPA 3	Δ	--	--	--	--	--	--	--	--	Slow–none	Pelagic	♦	♦ ●	♦ ●	--	--	Gravel	Sand	Mod	Mod

Habitat Guild	Origin	Species	Assemblage	Observed and Predicted Occurrence in Study Area									Primary Adult Habitat Associations (♦) and Spawning Habitat Requirements (●)									Ecological Tolerance	
				Tongue River	Rosebud Creek	Pumpkin Creek	Hanging Woman Cr.	Otter Creek	Beaver Creek	Cook Creek	Foster Creek	Moon Creek	Current Preference	Water Column	Pool - Mid Channel	Pool - Lateral	Glide	Run	Riffle	Preferred Substrate	Spawning Substrate	Habitat Degradation	Turbidity
		hudsonius)																					
		Burbot (*Lota lota*)	SPA 1	Δ ●	Δ	--	--	--	--	--	--	--	Slow–none	Epibenthic	♦ ●	♦ ●	♦ ●	--	--	General	Gravel	Mod	Mod
		Channel catfish (*Ictalurus punctatus*)	SPA 1	Δ ●	Δ ●	Δ ●	Δ ●	Δ	--	●	●	Δ	Mod	Benthic	♦ ●	♦ ●	♦ ●	--	--	General	Struc-ture	Mod	High
		Sauger (*Sander canadense*)	SPA 1	Δ ●	Δ ○	Δ	Δ	--	--	--	--	--	Mod	Epibenthic	♦	♦ ●	♦ ●	●	●	General	Gravel	Mod	High
		Sauger x Walleye hybrid (*S. canadense x S. vitreum*)	--	Δ	--	--	--	--	--	--	--	--	Mod	Epibenthic	♦	♦ ●	♦ ●	●	●	General	Gravel	Mod	Mod
		Freshwater drum (*Aplodinotus grunniens*)	SPA 5	Δ ●	--	--	--	--	--	--	--	--	Slow–none	Epibenthic	♦ ●	♦ ●	♦ ●	--	--	Silt	Pelagic	Mod	High
	Introduced	Black crappie (*Pomoxis nigromaculatus*)	--	Δ	--	--	Δ	--	--	--	--	--	Slow–none	Pelagic	♦ ●	♦ ●	♦	--	--	General	Gravel	Mod	Mod
		Bluegill (*Lepomis macrochirus*)	SPA 3	--	--		Δ	--	--	--	--	--	Slow–none	Epibenthic	♦ ●	♦ ●	♦	--	--	General	Genera l	Mod	Mod
		Pumpkinseed (*Lepomis gibbosus*)	SPA 3	Δ	--	--	Δ	Δ	--	--	--	--	--	Epibenthic	♦ ●	♦ ●	♦	--	--	General	Sand	Mod	Mod
		Largemouth bass (*Micropterus salmoides*)	SPA 3	Δ	--	--	--	--	--	--	--	--	Slow-none	Epibenthic	♦ ●	♦ ●	♦	--	--	Gravel	Cobble	Mod	Mod
		Rock bass (*Ambloplites rupestris*)	SPA 3	Δ	--	--	Δ	Δ	--	--	--	--	Mod	Epibenthic	♦ ●	♦ ●	♦ ●	--	--	Gravel	Sand	Low	Low
		Plains killifish	SPA	--	--	--	--	--	--	--	--	Δ	Gen	Pelagic	♦	♦	♦	●	--	Sand	Vegeta	High	High

Habitat Guild	Origin	Species	Assemblage	Observed and Predicted Occurrence in Study Area									Primary Adult Habitat Associations (♦) and Spawning Habitat Requirements (●)									Ecological Tolerance	
				Tongue River	Rosebud Creek	Pumpkin Creek	Hanging Woman Cr.	Otter Creek	Beaver Creek	Cook Creek	Foster Creek	Moon Creek	Current Preference	Water Column	Pool - Mid Channel	Pool - Lateral	Glide	Run	Riffle	Preferred Substrate	Spawning Substrate	Habitat Degradation	Turbidity
		(*Fundulus zebrinus*)[a]	18												●	●	●				-tion		
		White crappie (*Pomoxis annularis*)	--	Δ	Δ	--	Δ	Δ	--	--	--	--	Slow–none	Pelagic	♦ ●	♦ ●	♦	--	--	General	Gravel	Mod	High
		Common carp (*Cyprinus carpio*)	SPA 2	Δ ●	Δ ●	Δ ●	Δ ●	Δ ●	--	Δ ●	Δ ●	Δ	Gen	Benthic	♦ ●	♦ ●	♦ ●	♦	--	General	Struc-ture	High	High
		Golden shiner (*Notemigonus crysoleucas*)	SPA 3	Δ	--	--	Δ	Δ	--	Δ --	--	--	Slow–none	Pelagic	♦ ●	♦ ●	--	--	--	Silt	Vegeta-tion	High	Mod
		Northern pike (*Esox lucius*)	SPA 1	Δ	Δ	Δ	Δ ●	--	--	--	--	--	Slow-none	Pelagic	♦ ●	♦ ●	●	--	--	Vegeta-tion	Vegeta-tion	Mod	Low
		Black bullhead (*Ameiurus melas*)	SPA 2	Δ ●	Δ ●	●	Δ ●	Δ ●	--	Δ ●	●	--	Slow–none	Benthic	♦ ●	♦ ●	♦ ●	--	--	General	Struc-ture	High	High
		Yellow bullhead (*Ameiurus natalis*)	SPA 3	Δ	--	●	--	Δ	--	--	--	--	Slow–none	Benthic	♦ ●	♦ ●	♦	--	--	General	Struc-ture	High	Mod
		Walleye (*Sander vitreum*)	SPA 1	Δ ●	Δ ○	--	Δ	Δ	--	--	--	--	Mod	Epibenthic	♦ ●	♦ ●	♦ ●	●	--	General	Struc-ture	Mod	Mod
		Yellow perch (*Perca flavescens*)	SPA 1	Δ ○	--	--	Δ	--	--	--	--	--	--	Epibenthic	●	●	●	--	--	Vegeta-tion	Genera l	Mod	Mod

-- = Not associated with any species assemblages, i.e., they were introduced to this ecoregion
Sources: Montana Fish, Wildlife & Parks (2012) except for [a] Rahel and Thel (2004) and [b] Belica and Nibbelink (2006).

K.4 Fish Habitat Potential

OEA based the method used to assess fish habitat potential on the physical habitat data collected in the field, species presence and absence observed by Montana FWP (2012), and the methods outlined in the Aquatic Community Classification and Ecosystem Diversity in Montana's Missouri River Watershed (Stagliano 2005). The fish habitat potential for each water body or class of water bodies in the study area is described in the following sections.

K.4.1 Tongue River

Stagliano (2005) classifies the Tongue River as a Large Prairie River (AES Class A003). Only a portion of the Tongue River is located in the study area. OEA divided this portion into four segments based on geomorphic parameters observed in the field (channel confinement, anthropogenic features such as the Tongue and Yellowstone Diversion Dam, sediment transport). OEA conducted habitat surveys at 30 sites along the Tongue River in late July 2013. Each survey site consisted of a 500-meter stretch of stream. The sites were distributed proportionally across the four river segments based on the number of locations where a fish-bearing stream channel fell within 985 feet of a proposed right-of-way. The location and characteristics of each site are described in Section K.1.1, *Valley Segment Comparison (Tongue River)*.

Montana FWP (2012) conducted several fish presence surveys along the Tongue River. Montana FWP documented 50 different fish species representing all of the assemblage types predicted to occur in AES Class A003 rivers, as well as species that are typically observed in either lower or higher order systems (Table K-2). The list includes paddlefish (*Polyodon spathula*), shovelnose sturgeon (*Scaphirhynchus platorynchus*), and blue sucker (*Cycleptus elongatus*), which are included in the Large Mainstem River assemblage (Species Assemblage [SPA] 5). Montana FWP observed these species in the lower 20 miles of the system. The Tongue River provides important spawning habitat for these species and may provide suitable juvenile rearing and adult habitat. Pallid sturgeon (*Scaphirhynchus albus*), a protected species under the federal Endangered Species Act have not been observed in recent surveys and are presumed to be absent from the Tongue River. However, the system is located within the historical range of pallid sturgeon. Refer to Chapter 8, Section 8.5, *Special-Status Species*, for discussion of federally protected as well as federal and state sensitive species.

The Tongue River also supports species from the Medium Warmwater River Assemblage (SPA 2) and subgroups, the Creek Chub Assemblage (SPA 9), and the Warmwater Sunfish Assemblage (SPA 3). The species present include members from each fluvial habitat guild. They represent a broad variety of habitat preferences and have different levels of tolerance for turbidity and ecological degradation.

Observed habitat conditions in the Tongue River varied by segment. Valley Segment 1 is heavily influenced by surface water withdrawals at the Tongue and Yellowstone Diversion Dam, which diverts an average of 150 cubic feet per second (cfs) into the Tongue and Yellowstone Irrigation Canal from April through October (U.S. Environmental Protection Agency 2007). This segment is also influenced by relatively high levels of sediment deposition and channel widening, as observed in the July 2013 habitat surveys (Section K.1.2, *Valley Segment 1*). Extensive bank erosion and a lack of bank undercutting contribute to relatively limited habitat complexity in comparison to upstream segments. Turbidity levels observed during the July 2013 habitat surveys were relatively high. Visibility within the water column was uniformly less than 1 foot at all survey sites and often less than 6 inches. It is not clear if these observations are representative of typical conditions or are seasonal outliers in a year with relatively extreme conditions. The summer of 2013 was marked by unusually high seasonal flows 1 year after the Ash Creek Fire, a large event that burned approximately 390 square miles of forest and rangeland in the middle of the Tongue River subbasin, suggesting the potential for higher than typical sediment loads. Aerial photograph interpretation of years prior to the fire suggests that this segment maintains moderate to high turbidity levels throughout the summer low flow period during most years (Google Earth 2013).

Habitat conditions generally improve progressing upstream through Segment 2 and into Segment 3. Bank erosion generally decreases and the level of microhabitat complexity, expressed by bank undercutting, side channels, large woody debris jams, and other features, increases. Relatively high turbidity levels were present at all surveyed sites in Segment 2 during the July 2013 field surveys. This suggests that this portion of the Tongue River is likely to be more suitable for species with moderate to high levels of turbidity tolerance. As with Segment 1, this conclusion is tentative due to a lack of certainty about the representativeness of conditions observed in the field. Aquatic habitat conditions in Segments 2 and 3 appear to become progressively more suitable on an upstream gradient for species with low tolerance for habitat degradation.

Segment 4 is strongly influenced by the Tongue River Dam and Reservoir, which controls river hydrology by moderating peak flows and maintaining minimum base flows and captures a significant portion of the sediment load transported from headwater areas. Water clarity and bank stability were much higher in this segment compared to those downstream, with observed visibility levels approaching 4 feet and active erosion limited to less than 10 percent of surveyed stream banks. Based on OEA's interpretation of aerial photographs, these conditions appear to persist downstream to the segment boundary at Hanging Woman Creek. This suggests that habitat suitability improves in Segment 4 for species with low turbidity tolerance, such as smallmouth bass (*Micropterus dolomieu*), northern pike (*Esox Lucius*), and stonecat (*Noturus flavus*). Conversely, habitat suitability would decrease for species that are more turbidity dependent like goldeye (*Hiodon alosoides*) and sturgeon chub (*Macrhybopsis gelida*).

Table K-5 highlights the fish species that Montana FWP (2012) observed in the Tongue River, Otter Creek, and Moon Creek, as well as the habitat preferences of these fish, their ecological and turbidity tolerance, and the estimated amount of habitat area suitable for adult and spawning life stages.

The habitat suitability estimates (Table K-5) are based on conditions observed in the survey sites in each river segment (see Attachment K-1 for summary of survey data by segment). OEA matched the observed habitat types with species-specific adult and spawning habitat preferences in order to determine the total area within each site that could provide suitable habitat for each species. The suitable area in each unit was then modified by substrate composition, based on species preference, to provide an estimate of habitat suitability as a proportion of unit area. For example, each species had preference for one or more habitat types and one substrate type. The area of each suitable habitat type was weighted by the percentage of suitable substrates present in that habitat type. OEA then summed the suitable habitat area in each habitat unit at the segment level and converted this sum into a categorical percentage of total area, under the assumption that the survey sites are representative of larger segment-level habitat conditions. OEA used species-specific sensitivity to turbidity levels and ecological degradation to identify segments where these factors may limit habitat suitability.

Table K-5. Habitat Suitability Estimates for Fish Species Observed in the Tongue River, Moon Creek, and Otter Creek by River Segment, based on Surveyed Habitat Conditions (* denotes assemblage indicator species)

Species	Origin	Assemblage	Habitat Guild	Adult Habitat Preference and Spawning Habitat Requirements[a]									Suitable Adult Habitat[b, c] (percent of segment area)						Suitable Spawning Habitat[b, c] (percent of segment area)						Ecological Tolerance[d]	
				Current Preference	Pool – Mid-channel	Pool – Lateral	Glide	Run	Riffle	Water Column	Preferred Substrate	Spawning Substrate	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Habitat Degradation	Turbidity
Shorthead redhorse*	Native	SPA 1	Fluvial Dependent	Mod	--	♦	♦	♦ ●	●	Epi benthic	Gravel	Gravel	10 – 20	20 – 40	40 – 60	20 – 40	<10	--	10 – 20	<10	<10	<10	<10	--	Low	High
White sucker*	Native	SPA 20		Slow–none	♦	♦	♦ ●	●	●	Epi benthic	Gravel	Gravel	10 – 20	20 – 40	20 – 40	20 – 40	<10	--	20 – 40	20 – 40	40 – 60	20 – 40	<10	--	High	Mod
Plains minnow	Native	SPA 2		Mod	--	--	♦	♦ ●	♦ ●	Benthic	Sand	Sand	20 – 40	20 – 40	40 – 60	20 – 40	<10	--	10 – 20	<10	<10	<10	<10	--	Mod	High
Goldeye*	Native	SPA 1		Gen	♦	♦	♦ ●	♦ ●	●	Pelagic	Sand	Gravel	10 – 20	20 – 40	40 – 60	20 – 40	--	--	20 – 40	20 – 40	40 – 60	20 – 40	--	--	Low	High
Paddlefish*	Native	SPA 5		Slow–none	♦	♦	●	●	--	Pelagic	Pelagic	Gravel	<10	<10	--	--	--	--	10 – 20	20 – 40	--	--	--	--	Low	High
Brown trout	Introduced	--		Mod	♦	♦	♦ ●	♦ ●	♦ ●	Pelagic	General	Gravel	20 – 40	20 – 40	40 – 60	40 – 60	--	--	20 – 40	20 – 40	40 – 60	20 – 40	--	--	Mod	Mod
Rainbow trout	Introduced	--		Fast	♦	♦	♦ ●	♦ ●	♦ ●	Pelagic	Gravel	Gravel	**20 – 40**	**20 – 40**	40 – 60	40 – 60	--	--	**20 – 40**	**20 – 40**	40 – 60	20 – 40	--	--	Mod	Low
Shovelnose sturgeon*	Native	SPA 5	Fluvial Specialist	Fast	--	--	♦ ●	♦ ●	--	Benthic	Sand	Gravel	10 – 20	20 – 40	--	--	--	--	10 – 20	20 – 40	--	--	--	--	Low	High
Blue sucker*	Native	SPA 5		Fast	--	--	♦	♦ ●	♦ ●	Benthic	Gravel	Cobble	20 – 40	20 – 40	--	--	--	--	10 – 20	<10	--	--	--	--	Mod	High
Flathead chub*	Native	SPA 2		Fast	--	--	♦ ●	♦ ●	♦ ●	Epi benthic	Sand	Sand	20 – 40	20 – 40	40 – 60	20 – 40	<10	<10	20 – 40	20 – 40	40 – 60	20 – 40	<10	<10	Mod	High

Species	Origin	Assemblage	Habitat Guild	Adult Habitat Preference and Spawning Habitat Requirements[a]									Suitable Adult Habitat[b, c] (percent of segment area)						Suitable Spawning Habitat[b, c] (percent of segment area)						Ecological Tolerance[d]	
				Current Preference	Pool – Mid-channel	Pool – Lateral	Glide	Run	Riffle	Water Column	Preferred Substrate	Spawning Substrate	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Habitat Degradation	Turbidity
Sand shiner*	Native	SPA 2		Mod	♦	♦	♦ ●	●	●	Pelagic	Sand	Gravel	10 – 20	20 – 40	20 – 40	20 – 40	<10	--	20 – 40	20 – 40	40 – 60	20 – 40	<10	--	Mod	Mod
Sturgeon chub*	Native	SPA 9		Fast	--	--	♦ ●	♦ ●	♦ ●	Benthic	Sand	Sand	20 – 40	20 – 40	40 – 60	20 – 40	--	--	20 – 40	20 – 40	40 – 60	20 – 40	--	--	Mod	High
Western silvery minnow	Native	SPA 2		Slow–none	♦ ●	♦ ●	--	--	--	Benthic	Silt	Silt	<10	<10	<10	<10	<10	--	<10	<10	<10	<10	<10	--	Mod	High
Stonecat*	Native	SPA 1		Mod	--	--	♦ ●	♦ ●	♦	Benthic	Cobble	Structure	**20 – 40**	**20 – 40**	40 – 60	20 – 40	**<10**	--	**10 – 20**	**20 – 40**	20 – 40	20 – 40	**<10**	--	Low	Low
Bigmouth buffalo	Native	SPA 1	Macrohabitat Generalist	Slow–none	♦	♦	♦ ●	●	●	Epi benthic	General	General	10 – 20	20 – 40	20 – 40	20 – 40	--	--	20 – 40	20 – 40	40 – 60	20 – 40	--	--	Mod	High
Longnose sucker	Native	SPA 2		Slow–none	♦	♦	♦ ●	●	●	Epi benthic	General	Gravel	**10 – 20**	**20 – 40**	20 – 40	20 – 40	--	--	**20 – 40**	**20 – 40**	40 – 60	20 – 40	--	--	Low	Low
River carpsucker*	Native	SPA 1		Slow–none	♦	♦ ●	♦ ●	--	●	Epi benthic	General	Sand	10 – 20	20 – 40	20 – 40	20 – 40	--	--	20 – 40	20 – 40	20 – 40	20 – 40	--	--	Mod	High
Smallmouth buffalo	Native	SPA 1		Slow–none	♦	♦	♦ ●	●	●	Epi benthic	General	General	10 – 20	20 – 40	20 – 40	20 – 40	--	--	20 – 40	20 – 40	40 – 60	20 – 40	--	--	Mod	Mod
Green sunfish	Native	SPA 2		General	♦ ●	♦ ●	♦	--	--	Epi benthic	General	General	10 – 20	20 – 40	20 – 40	20 – 40	--	--	<10	<10	<10	<10	--	--	High	High
Smallmouth bass	Native	SPA 1		Mod	♦ ●	♦ ●	♦ ●	--	--	Epi benthic	Gravel	Gravel	**10 – 20**	**20 – 40**	20 – 40	20 – 40	--	--	**10 – 20**	**20 – 40**	20 – 40	20 – 40	--	--	Low	Low
Brassy minnow	Native	SPA 18		Slow–none	♦ ●	♦ ●	♦	--	--	Benthic	Sand	Vegeta-tion	10 – 20	20 – 40	20 – 40	20 – 40	<10	<10	<10	<10	<10	<10	<10	<10	Mod	Mod

Species	Origin	Assemblage	Habitat Guild	Adult Habitat Preference and Spawning Habitat Requirements[a]									Suitable Adult Habitat[b, c] (percent of segment area)						Suitable Spawning Habitat[b, c] (percent of segment area)						Ecological Tolerance[d]	
				Current Preference	Pool – Mid-channel	Pool – Lateral	Glide	Run	Riffle	Water Column	Preferred Substrate	Spawning Substrate	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Habitat Degradation	Turbidity
Creek chub*	Native	SPA 9		Slow–none	♦●	♦●	♦●	--	--	Pelagic	Gravel	Gravel	10–20	20–40	20–40	20–40	--	--	10–20	20–40	20–40	20–40	--	--	Mod	High
Emerald shiner*	Native	SPA 1		Mod	♦	♦●	♦●	--	--	Pelagic	General	Sand	10–20	20–40	20–40	20–40	--	--	10–20	20–40	20–40	20–40	--	--	Mod	High
Fathead minnow*	Native	SPA 20		Slow–none	♦●	♦●	♦	--	--	Pelagic	General	Structure	10–20	20–40	20–40	20–40	<10	--	<10	<10	<10	<10	<10	--	High	High
Golden shiner	Introduced	SPA 3		Slow–none	♦●	♦●	--	--	--	Pelagic	Silt	Vegetation	<10	<10	<10	<10	--	--	<10	<10	<10	<10	--	--	High	Mod
Lake chub*	Native	SPA 20		--	♦●	♦●	♦	--	--	Pelagic	General	--	10–20	20–40	20–40	20–40	<10	<10	<10	<10	<10	<10	<10	<10	Mod	Mod
Longnose dace	Native	SPA 20		Fast	--	--	♦●	♦●	♦●	Epi benthic	Gravel	Gravel	20–40	20–40	40–60	20–40	<10	--	20–40	20–40	40–60	20–40	<10	--	Low	Mod
Spottail shiner	Native	SPA 3	Macrohabitat Generalist	Slow–none	♦	♦●	♦●	--	--	Pelagic	Gravel	Sand	10–20	20–40	20–40	20–40	--	--	10–20	20–40	20–40	20–40	--	--	Mod	Mod
Burbot	Native	SPA 1		Slow–none	♦●	♦●	♦●	--	--	Epi benthic	General	Gravel	10–20	20–40	20–40	20–40	--	--	10–20	20–40	20–40	20–40	--	--	Mod	Mod
Channel catfish*	Native	SPA 1		Mod	♦●	♦●	♦●	--	--	Benthic	General	Structure	10–20	20–40	20–40	20–40	<10	--	10–20	20–40	20–40	20–40	<10	--	Mod	High
Sauger*	Native	SPA 1		Mod	♦	♦●	♦●	●	●	Epi benthic	General	Gravel	10–20	20–40	20–40	20–40	--	--	20–40	20–40	40–60	40–60	--	--	Mod	High
Sauger x Walleye hybrid	Native	--		Mod	♦	♦●	♦●	●	●	Epi benthic	General	Gravel	10–20	20–40	20–40	20–40	--	--	20–40	20–40	40–60	40–60	--	--	Mod	Mod

Species	Origin	Assemblage	Habitat Guild	Adult Habitat Preference and Spawning Habitat Requirements[a]									Suitable Adult Habitat[b, c] (percent of segment area)						Suitable Spawning Habitat[b, c] (percent of segment area)						Ecological Tolerance[d]	
				Current Preference	Pool – Mid-channel	Pool – Lateral	Glide	Run	Riffle	Water Column	Preferred Substrate	Spawning Substrate	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Habitat Degradation	Turbidity
Walleye	Introduced	SPA 1		Mod	♦ ●	♦ ●	♦ ●	●	--	Epi benthic	General	Structure	10 – 20	20 – 40	20 – 40	20 – 40	--	--	10 – 20	20 – 40	40 – 60	20 – 40	--	--	Mod	Mod
Freshwater drum*	Native	SPA 5		Slow–none	♦ ●	♦ ●	♦ ●	--	--	Epi benthic	Silt	Pelagic	10 – 20	20 – 40	20 – 40	20 – 40	--	--	10 – 20	20 – 40	20 – 40	20 – 40	--	--	Mod	High
Black crappie	Introduced	--		Slow–none	♦ ●	♦ ●	♦	--	--	Pelagic	General	Gravel	10 – 20	20 – 40	20 – 40	20 – 40	--	--	<10	<10	<10	<10	--	--	Mod	Mod
Pumpkinseed	Introduced	SPA 3		--	♦ ●	♦ ●	♦	--	--	Epi benthic	General	Sand	10 – 20	20 – 40	20 – 40	20 – 40	--	--	<10	<10	<10	<10	--	--	Mod	Mod
Rock bass	Introduced	SPA 3		Mod	♦ ●	♦ ●	♦ ●	--	--	Epi benthic	Gravel	Sand	**10 – 20**	**20 – 40**	20 – 40	20 – 40	--	--	**10 – 20**	**20 – 40**	20 – 40	20 – 40	--	--	Low	Low
White crappie	Introduced	--		Slow–none	♦ ●	♦ ●	♦	--	--	Pelagic	General	Gravel	10 – 20	20 – 40	20 – 40	20 – 40	--	--	<10	<10	<10	<10	--	--	Mod	High
Common carp	Introduced	SPA 2		General	♦ ●	♦ ●	♦ ●	♦	--	Benthic	General	Structure	10 – 20	20 – 40	40 – 60	20 – 40	<10	--	10 – 20	20 – 40	20 – 40	20 – 40	<10	--	High	High
Northern pike	Introduced	SPA 1		Slow–none	♦ ●	♦ ●	●	--	--	Pelagic	Vegetation	Vegeta-tion	**<10**	**<10**	<10	<10	--	--	**10 – 20**	**20 – 40**	20 – 40	20 – 40	--	--	Mod	Low
Black bullhead	Introduced	SPA 2		Slow–none	♦ ●	♦ ●	♦ ●	--	--	Benthic	General	Structure	10 – 20	20 – 40	20 – 40	20 – 40	<10	--	10 – 20	20 – 40	20 – 40	20 – 40	<10	--	High	High
Yellow bullhead	Introduced	SPA 3		Slow–none	♦ ●	♦ ●	♦	--	--	Benthic	General	Structure	10 – 20	20 – 40	20 – 40	20 – 40	--	--	<10	<10	<10	<10	--	--	High	Mod
Yellow perch	Introduced	SPA 1		--	●	●	●	--	--	Epi benthic	Vegetation	General	10 – 20	20 – 40	20 – 40	20 – 40	--	--	10 – 20	20 – 40	20 – 40	20 – 40	--	--	Mod	Mod

Species	Origin	Assemblage	Habitat Guild	Adult Habitat Preference and Spawning Habitat Requirements[a]									Suitable Adult Habitat[b, c] (percent of segment area)						Suitable Spawning Habitat[b, c] (percent of segment area)						Ecological Tolerance[d]	
				Current Preference	Pool – Mid-channel	Pool – Lateral	Glide	Run	Riffle	Water Column	Preferred Substrate	Spawning Substrate	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Habitat Degradation	Turbidity

[a] See Table K-3 for explanation of symbology
[b] Habitat meets all species requirements
[c] Suitable habitat types present but may be limited by turbidity and/or habitat degradation tolerance
[d] Suitable habitat types present but habitat suitability is likely to be limited by low species tolerance for turbidity conditions and/or habitat degradation

K.4.2 Rosebud Creek

Stagliano (2005) classifies Rosebud Creek as a Medium Prairie River (AES Class B005) and Montana FWP (2012) has documented several fish species in this system that are consistent with this classification (Table K-4). Unimpaired Medium Prairie Rivers are associated with a diverse selection of species assemblages, including members of the Large Warmwater River Assemblage (SPA 1), which is typically found close to larger river confluences; the Medium Warmwater River Assemblage (SPA 2); and subgroup Core Prairie Stream Assemblage (SPA 20). Under degraded conditions, species from the Warmwater Sunfish Assemblage (SPA 3) are also likely to be present.

The native species that are known or predicted to occur in Rosebud Creek are intolerant of habitat degradation (e.g., goldeye, shorthead redhorse), as well as nonnative species (e.g., white crappie), that are commonly associated with degraded habitat conditions (Table K-4). Eight of the species observed are assemblage indicator species (asterisked*). The type and diversity of species observed suggests that, while some areas may be degraded, the system is ecologically functional despite the presence of nonnative species.

OEA did not survey habitat units in Rosebud Creek because of access constraints. In May 2013, visual reconnaissance was conducted near the Greenleaf Creek / Rosebud Creek confluence under high flow conditions. The Colstrip Alternatives would cross Rosebud Creek in this area (Figure 8.4-2, in Chapter 8, Section 8.4, *Fish*). This section of Rosebud Creek is composed primarily of glide and run habitats, with scattered structure provided by undercut banks, exposed root wads, and large woody debris. OEA reviewed aerial photographs and concluded that these habitats are most likely pools, glides, and bar-associated riffles under low flow conditions. This level of habitat diversity would be expected to support most species that Montana FWP observed, indicating that the area that would be affected by the proposed rail line is ecologically sensitive.

K.4.3 Moon Creek

Moon Creek is classified as large Great Plains Intermittent Stream (AES Class D005) based on overall drainage size, channel length, and conditions observed in the field. This stream is nearly large enough to maintain perennial flow conditions in the lower reaches near the Yellowstone River confluence, meaning that the portion of the drainage north (downstream) of Interstate 94 may be more representative of a Core Prairie Stream type system. Access constraints prevented surveys in this portion of the system.

Physical habitat conditions were surveyed in five 500-meter sites in the intermittent portion of Moon Creek in late-May 2013. These sites are representative of habitat conditions within the 300-meter buffer of the Moon Creek Alternatives. The habitat composition of these sites is summarized in Section K.2, *Physical Survey Results (Tributaries)*. As shown, the composition of these five sites ranged from 40 to 80 percent glide habitat, with the remaining

habitats divided between pools and runs. Riffles composed less than 3 percent of combined total habitat area across the five sites

Lower Moon Creek is expected to provide suitable habitat for fish species assemblages characteristic of larger intermittent streams near large river-confluences. Predicted assemblages include the Medium Warmwater River Assemblage (SPA 2) and the Core Prairie Stream Assemblage (SPA 20). Representative species include the fathead minnow (*Pimephales promelas*), longnose dace (*Rhinichthys cataractae*), lake chub (*Couesius plumbeus*), and brassy minnow (*Hybognathus hankinsoni*), and white sucker (*Catostomus commersonii*).

The habitat conditions observed in the Moon Creek site surveys include pools, glides, and scattered riffles, with substrate composition dominated by fines and areas of sand and gravel. These habitat conditions are consistent with the habitat preferences for the predicted species. Detailed descriptions of habitat preferences for the SPA 20 indicator species fathead minnow and white sucker are provided in Section K.4.7, *Indicator and Representative Species Occurring in the Study Area*. Habitat preferences for all species in this assemblage are summarized in Table K-4.

K.4.4 Otter Creek

Stagliano (2005) classifies Otter Creek as a Core Prairie Stream (AES Class C005). Core Prairie Streams are perennial and maintain continuous habitat connectivity with larger water bodies. The species assemblages that are predicted to occur in Core Prairie Streams include the Medium Warmwater River Assemblage (SPA 2), the Brook Stickleback Assemblage (SPA 18), and the Core Prairie Stream Assemblage (SPA 20) (Table K-2).

Montana FWP (2012) has documented the presence of one or more fish species from each of these assemblages in Otter Creek, as well as several fish species that are not predicted to occur in this system based on its AES classification. Montana FWP documented four nonnative species from the Warmwater Sunfish Assemblage (SPA 3), including pumpkinseed (*Lepomis gibbosus*), rock bass (*Ambloplites rupestris*), golden shiner (*Notemigonus crysoleucas*), and yellow bullhead (*Ameiurus natalis*), as well as a number of species more commonly found in larger systems, including walleye (*Sander vitreus*), river carpsucker (*Carpiodes carpio*), smallmouth bass (*Micropterus dolomieu*), and channel catfish (*Ictalurus punctatus*).

OEA surveyed habitat conditions in two adjacent 500-meter sites in lower Otter Creek in May 2013. These survey sites are representative of habitat conditions within the 300-meter impact analysis buffer of one or more alternatives. The two sites contained 12 habitat units and were almost identical in composition. Otter Creek Site 5-1 had seven habitat units, five slow glides and two runs comprising 89.8 percent (2,021 square meters) and 10.2 percent (229 square meters) of total habitat area, respectively. Otter Creek Site 5-2 was similar and

had five habitat units, four glides and one run comprising 86.6 percent (2,461 square meters) and 13.4 percent (380 square meters) of total habitat area, respectively.

The surveyed section of Otter Creek is in a low-gradient valley bottom environment on private lands that have been developed for agriculture and cattle ranching. This portion of the Otter Creek channel is highly sinuous and low gradient with a nearly uniform trapezoidal cross-section. Substrates at both survey sites were almost 100 percent anaerobic fines, suggesting high levels of nutrient and organic material loading to the stream channel. Turbidity levels were high at the time of the survey. Cover and structural complexity is limited to a few pieces of woody debris, anthropogenic debris, and aquatic vegetation. The riparian zone is predominantly grassy field with scattered trees and shrubs. Site 5-2 had a small active side channel that may provide limited cover and refuge.

Based on observed conditions, aquatic habitat in this section of Otter Creek is suitable for species that are tolerant of moderate to high levels of ecological degradation and high levels of turbidity, and are habitat generalists or preferentially select slow to moderate current environments dominated by fine substrates (Table K-4).

Several other fish species observed or likely to occur in Otter Creek may transit the affected habitat during pre- and post-spawning migration and/or downstream dispersal of eggs, larvae, and juveniles, including shorthead redhorse and white sucker (Table K-4). Both of these species are in the fluvial dependent habitat guild and are known to be locally migratory during spawning, moving from larger rivers into smaller tributaries that provide suitable spawning habitat. Spawning migration and subsequent downstream migration of juveniles occurs when streamflows peak during the spring snowmelt period.

K.4.5 Beaver Creek

Beaver Creek is classified as a Core Prairie Stream (AES Class C005) by Stagliano (2005). Predicted species assemblages in this AES class include the Medium Warmwater River Assemblage (SPA 2), the Brook Stickleback Assemblage (SPA 18), and the Core Prairie Stream Assemblage (SPA 20) (see Table K-2).

Montana FWP (2012) surveyed fish presence in Beaver Creek and identified several species representative of SPA 2, SPA 18, and SPA 20. No SPA 3 species were observed (Table K-4). An unknown fish species was observed during visual surveys of Beaver Creek in May 2013. The survey scope did not include fish capture and identification, but based on observed size, coloration, and schooling behavior, OEA concluded these fish were likely one of the minnow or chub species characteristic of this aquatic ecosystem type.

Summaries of habitat preferences for assemblage indicator species are provided in Section K.4.7, *Indicator and Representative Species Occurring in the Study Area*. Habitat preferences for all species observed in Beaver Creek are summarized in Table K-4. As the table shows, these species are representative of three different fluvial habitat guilds and collectively require diverse habitat conditions. While each of these species is tolerant of

moderate to high levels of turbidity and ecological degradation, their collective dependence on diverse habitat types suggests that any form of degradation that results in habitat simplification could be detrimental. In addition, each of these species, with the exception of brassy minnow and flathead minnow, is either locally or extensively migratory. This indicates these species are potentially vulnerable to migratory barriers that would result from the proposed project.

K.4.6 Minor Tributaries

The study area includes a large number of small tributary streams draining to larger systems in the study area. These tributaries fall into four categories.

- Small intermittent tributaries: Flow only during periods of heavy runoff and are dry the remainder of the year (the majority of minor tributaries).
- AES Class E005 Great Plains Intermittent Streams: Fishless intermittent streams, typically 1st to 3rd order tributaries and headwaters of larger systems that maintain fragmented pool habitat in most years but are fishless and have limited connectivity to larger stream systems.
- AES Class D005 Great Plains Intermittent Streams: Fish-bearing intermittent streams, typically 1st to 3rd order tributaries and headwaters of larger systems that maintain perennial pools fragmented by dry riffles and grade breaks in summer.
- AES Class C005 Core Prairie Streams: Perennial fish-bearing streams, typically 3rd to 4th order systems less than 100 miles in length with an average wetted width less than 15 feet.

OEA assessed fish habitat potential in minor tributaries using a combination of methods and information sources, including a GIS-based drainage area and channel length analysis, visual survey observations, stream surveys, Montana FWP (2012) fish presence/absence survey data, and the following criteria recommended by Montana FWP for identifying fish-bearing intermittent streams.

- The presence of a defined confluence connecting the stream to fish-bearing waters (the channel does not disappear when it flows onto the floodplain of a perennial fish-bearing stream).
- The presence of defined channel bed and banks over the majority of stream length between a perennial stream confluence and the nearest stream crossing by one or more build alternatives.
- A build alternative stream crossing within 2 stream miles of a perennial stream confluence, the upstream limit of potential fish habitat in intermittent streams.

OEA applied these criteria to streams in the 1:24,000 scale National Hydrography Dataset using a GIS-based analysis of stream length and aerial photograph interpretation. The results of this analysis are summarized in Table K-6. As shown, OEA identified 98 perennial and

intermittent tributaries to known fish-bearing waters in the study area, 75 of which would be crossed by one or more of the build alternatives at one or more locations. Of the streams potentially affected by the build alternatives, 41 are known or likely to be fish-bearing. Rosebud Creek and the Tongue River are known fish-bearing water bodies, explicitly classified by Stagliano (2005) as a Medium Prairie River (AES Class B005) and a Large Prairie River (AES Class A005), respectively. Five smaller perennial streams (Beaver Creek, Moon Creek, Otter Creek, Ash Creek, and Foster Creek) are classified as Core Prairie Streams (AES Class C005), based on the documented presence of fish species that Stagliano (2005) concluded are unlikely to occur in intermittent streams. The remaining 32 streams potentially affected by one or more build alternatives are classified as fish-bearing Intermittent Prairie Streams (AES Class D005), including eight unnamed tributaries that meet the Montana FWP criteria for seasonally fish-bearing tributaries to larger waterbodies.

The perennial AES Class C005 streams are likely to support a diverse community of fish species from many different assemblages (Table K-2). The fish species most likely to be found in the intermittent AES Class D005 streams are those belonging to the Brook Stickleback Assemblage (SPA 18) and the Core Prairie Stream Assemblage (SPA 20) (Table K-2). Comparison of the documented and projected stream classification suggests that a fish-bearing intermittent stream (AES Class D005) requires a contributing drainage area of at least 4,000 acres, a threshold that eliminates several, but not all of the minor tributaries in the study area. A perennial Core Prairie Stream (AES Class C005) appears to require a total drainage area of at least 40,000 acres.

Table K-6. Known and Potential Fish-Bearing and Non-Fish-Bearing Streams in the Study Area based on Drainage Characteristics, Field Observations, and Montana Fish, Wildlife & Park Fish Surveys

Stream Name[1]	Approximate Drainage Area (acres)	Tributary To:	Surveyed by Montana FWP[2]	Projected AES classification	Basis for AES classification
23 unnamed tributaries	--	Tongue River	No	E005	A, B
Cheever Creek	1,575	Tongue River	No	E005	A, B
Chunning Creek	--	Otter Creek	No	E005	A, B
Coal Creek	--	Tongue River	No	E005	A, B
Geddes Creek	--	Tongue River	No	E005	A, B
Fourmile Creek	--	Tongue River	No	E005	A, B
Sand Creek	1,575	Tongue River	No	E005	A, B
Plunket Creek	--	Tongue River	No	E005	A, B
Leaf Rock Creek	--	Tongue River Reservoir	No	E005	A, B
Alfalfa Creek	3,846	Tongue River	No	E005	A, B
Big John Creek	3,846	Tongue River	No	E005	A, B
Diamond Creek	3,846	Tongue River	No	E005	A, B
Freda Creek	3,846	Tongue River	No	E005	A, B, C
Goodale Creek	3,846	Tongue River	No	E005	F
Hart Creek	3,846	Tongue River	No	E005	A, B
SF Monument Creek	--	Tongue River Reservoir	No	E005	A, B
Straight Creek	3,846	Tongue River	No	E005	A, B
Trail Creek	3,846	Tongue River	No	E005	F
Dry Creek (South)	4,838	Tongue River	No	D005	A, B, C
Bridge Creek	--	Tongue River	No	D005	A, B, C
Coon Creek	6,694	Tongue River	No	D005	A, B, C
Garden Creek	6,694	Tongue River	No	E005	A, B, C
Black Eagle Creek	--	Tongue River	No	D005	A, B, C
Circle L Creek	--	Tongue River	No	D005	A, B, C
8 unnamed tributaries	--	Tongue River	No	D005	A, B
Cow Creek (on Moon Creek Rd)	7,022	Tongue River	No	D005	A, B, C
Kennedy Creek	--	Tongue River	No	D005	A, B
Paddy Fay Creek	--	Tongue River	No	D005	A, B
Pump Creek	--	Tongue River	No	D005	A, B
Dry Creek (North)	7,087	Tongue River	No	D005	F
Elk Creek	7,265	Tongue River	No	D005	F
Stony Creek	7,265	Tongue River	No	D005	F
Brown Creek	8,031	Tongue River	No	D005	F

Stream Name[1]	Approximate Drainage Area (acres)	Tributary To:	Surveyed by Montana FWP[2]	Projected AES classification	Basis for AES classification
Jack Creek	8,031	Tongue River	No	D005	F
Kelty Creek	8,256	Tongue River	No	D005	F
Bring Off Creek	8,273	Tongue River	No	E005	A, B
Roe and Cooper Creek	8,273	Tongue River	No	D005	A, B, C
Thorpe Creek	--	Tongue River	No	D005	A, B
Whitten Creek	--	Tongue River	No	D005	A, B
Wolf Creek	--	Tongue River	No	D005	A, B
Yank Creek	--	Tongue River	No	D005	A, B
Miller Creek	10,319	Tongue River	No	E005	A, B
Pratt Creek	10,649	Tongue River	Yes: No fish captured	D005	A, B, C, F
South Fork Cow Creek	11,218	Rosebud Creek	No	D005	A, B
Reservation Creek	11,863	Tongue River	No	D005	A
Nelson Creek	11,882	Tongue River	No	D005	A, B, C, F
Poker Jim Creek	12,806	Tongue River	No	E005	A, B
Stebbins Creek	12,854	Tongue River	No	D005	F
Haddow Creek	12,979	Tongue River	No	D005	A, B, C
Horse Creek	--	Tongue River	No	D005	
King Creek	--	Tongue River	No	D005	A, B, F
Lay Creek	--	Tongue River	No	D005	A, B, C, F
Miles Creek	--	Tongue River	No	D005	A, B, F
Prairie Dog Creek	15,489	Tongue River	No	D005	A, B, F
Sixmile Creek	16,091	Tongue River	No	D005	A, B, F
Greenleaf Creek	20,055	Rosebud Creek	No	D005	A, B, C, F
Tie Creek	22,348	Tongue River	No	D005	F
Logging Creek	22,897	Tongue River	No	D005	F
Mill Creek	23,021	Tongue River	Yes: No fish captured	D005	F
Lay Creek	25,647	Tongue River	Yes: No fish captured	D005	A, B, C, F
O'Dell Creek	29,680	Tongue River	Yes: Dry/No fish captured	D005	F
Liscom Creek	30,420	Tongue River	Yes: No fish captured	D005	A, B, C, F
North Woman Creek	31,937	Tongue River	Yes: Fish captured	D005	D
Canyon Creek	32,257	Tongue River	No	D005	B, E, F
Home Creek	37,788	Otter Creek	Yes: Fish captured	C005	D
Cook Creek	40,044	Tongue River	Yes: Fish captured	C005	D

Stream Name[1]	Approximate Drainage Area (acres)	Tributary To:	Surveyed by Montana FWP[2]	Projected AES classification	Basis for AES classification
Ash Creek	47,144	Tongue River	No	C005	A, B, C, F
Moon Creek	53,015	Yellowstone River	Yes: Fish captured	C005	A, B, D, E, F
Beaver Creek	58,998	Tongue River	Yes: Fish captured	C005	C, D, F
Foster Creek	74,410	Tongue River	Yes: Fish captured	C005	A, B, C, D, F
Otter Creek	455,228	Tongue River	Yes: Fish captured	C005	D, E, F
Rosebud Creek	836,497	Yellowstone River	Yes: Fish captured	B005	C, D, F
Tongue River	3,459,293	Yellowstone River	Yes: Fish captured	A005	D, E, F

[1] Streams in bold are crossed by one or more build alternatives at one or more locations within 2 miles of a confluence with a perennial waterbody

[2] Montana FWP stream surveys are conducted during low water season, lack of fish observations may not be representative of actual fish use during high flow periods

A = Presence of a contiguous confluence with a fish-bearing waterbody

B = Presence of defined bed and bank features over majority of length between confluence and alternative crossing

C = Visual survey 2013

D = Fish observed by Montana FWP (2012), species/assemblages used to predict AES class

E = Habitat survey

F = Drainage area comparable to known or likely fish-bearing streams

-- = Not applicable

K.4.7 Indicator and Representative Species Occurring in the Study Area

Stagliano (2005) identifies one or more indicator species for each species assemblage—native species that are representative of the fish community and habitat requirements supported by the AES classes associated with each assemblage. This framework provides a useful means for distilling an exceptionally diverse fish community down to a useful set of indicator species that can be used to characterize ecologically functional habitat conditions. The Warmwater Sunfish Assemblage (SPA 3) is composed primarily of nonnative Centrarchid species; therefore, two representative species were selected to characterize the habitat requirements of this assemblage. The indicator and representative species descriptions for the species listed below are provided in the following sections and include the following information.

- Taxonomic family, assemblage, and origin.
- Fluvial habitat and functional feeding guilds.
- Primary habitat preferences by life stage.
- Reproductive habitat requirements.
- Regional status, including Global and State conservation ranking (NatureServe 2009), federal status, and Montana FWP Conservation Tier (and Montana Natural Heritage Program and Montana Fish Wildlife and Parks 2013).

The indicator species description is organized by species habitat guild. The guilds are described in Section K.3.3, *Fish Species Observed in the Study Area and Habitat Requirements*. The information presented is derived from the LTRMP database (O'Hara et al. 2007), the Montana Field Guide (Montana Natural Heritage Program and Montana Fish Wildlife and Parks 2013), the NatureServe Explorer species conservation database (NatureServe 2009), the FishBase life history database (Froese and Pauly 2013), Goodyear et al. 1982, Trebitz et al. 2007, and other literature sources as cited.

K.4.7.1 Fluvial Dependent Habitat Guild

The fluvial dependent habitat guild includes fish species that are found in a variety of habitat types but require flowing water during some part of their life cycle (Galat et al. 2005, Simon 1999). Typically the dependent life cycle stages are spawning and/or early dispersal of emergent larvae or juveniles that depend on river current for transport to suitable rearing habitats.

Catostomidae – Suckers

Shorthead Redhorse

Scientific name: *Moxostoma macrolepidotum*
Species assemblage: SPA 1 – Large Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 224
Rosebud Creek – RM 0 to 207
Hanging Woman Creek to RM 0 to 31
Otter Creek – RM 0 to 37
Trophic guild: Invertivore
Current preference: Moderate current, dependent on moving water for spawning
Adult habitat preferences: Epibenthic in lateral pools, glides, and runs with predominantly gravel substrate
Spawning habitat: Spring spawning on riffles and runs with gravel substrate. Males congregate around females and broadcast spawn.
Migration: Locally migratory
Ecological tolerance: Intolerant
Turbidity tolerance: High, prefers turbid environments
Size at maturity: 15 to 16 inches total length (38–40 cm) at age 5
Maximum size/age: 30 inches total length (75 cm)/9 years
Status: G5/S5, Montana FWP Tier III species

White Sucker

Scientific name: *Catostomus commersoni*
Species assemblage: SPA 20 – Core Prairie Stream Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 224
Rosebud Creek – RM 0 to 207
Hanging Woman Creek – RM 0 to 25
Otter Creek – RM 0 to 75
Beaver Creek – RM 4.6 to 5.6 (limited survey reach)
Trophic guild: Omnivore
Current preference: Slow or no current, dependent on moving water for spawning
Adult habitat preferences: Epibenthic in pools and glides with predominantly gravel substrate
Spawning habitat Fast glides, runs, and riffles with gravel substrate
Migration: Migratory during spawning
Ecological tolerance: Tolerant
Turbidity tolerance: Moderate
Size at maturity: 4–14 inches total length (12–35 cm)/age 3–8
Maximum size/age: 26 inches total length (65 cm)/12 years
Status: G5/S5, Montana FWP Tier III species

Cyprinidae – Minnows and Carp

Plains Minnow

Scientific name:	*Hybognathus placitus*
Species assemblage:	SPA 2 – Medium Warmwater River Assemblage
Origin/Type:	Native/assemblage indicator species
Observed in study area:	Tongue River – RM 0 to 202 Otter Creek – RM 21.7 to 22.7 (limited survey reach) Foster Creek – RM 5.2 to 6.2 (limited survey reach)
Trophic guild:	Detrivore/herbivore
Current preference:	Moderate current
Adult habitat preferences:	Benthic in glides, runs and riffles with predominantly sand substrate
Spawning habitat	Runs and riffles with sandy substrate
Migration:	Dependent on egg and larval dispersal by currents
Ecological tolerance:	Intermediate
Turbidity tolerance:	High
Size at maturity:	3 inches total length (7 cm) at age 1
Maximum size/age:	5 inches total length (13 cm)/unknown
Status:	G4/S4, Montana FWP Tier III species

Hiodontidae – Goldeyes and Mooneyes

Goldeye

Scientific name:	*Hiodon alosoides*
Species assemblage:	SPA 1 – Large Warmwater River Assemblage
Origin/Type:	Native/assemblage indicator species
Observed in study area:	Tongue River – RM 0 to 202 Rosebud Creek – RM 0 to 183
Trophic guild:	Invertebrate feeder
Current preference:	General, prefers a range of current speeds
Adult habitat preferences:	Pelagic in pool, glide and run habitats over sandy substrate
Spawning habitat:	Fast glide, run and riffle habitats over gravel substrate
Migration:	Highly migratory during spawning, egg dispersal by currents to larval rearing areas, and juvenile dispersal by currents to adult habitats
Ecological tolerance:	Intolerant
Turbidity tolerance:	High
Size at maturity:	Variable size at maturity between 3 to 4 years
Maximum size/age:	52 cm fork length (20 inches)/14 years
Status:	G5/S5, Montana FWP Tier III species

Polyodontidae

Paddlefish

Scientific name: *Polyodon spathula*

Species assemblage: SPA 5 – Large Mainstem River Assemblage

Origin/Type: Native/assemblage indicator species

Observed in study area: Tongue River – RM 0 to 21

Trophic guild: Planktivore

Current preference: Adults prefer slow or no current environments

Adult habitat preferences: Pelagic in pools, glides and side channels with slow currents and depths of at least 5 feet (1.5 m)

Spawning habitat: Deep glides and runs with swift current over sand or gravel substrate, depend on flowing water for egg incubation and larval maturation

Migration: Highly migratory during spawning and egg/larval dispersal

Ecological tolerance: Intolerant

Turbidity tolerance: High

Size at maturity: Males approximately 33 inches total length (85 cm) at age 9, females approximately 41 inches total length (105 cm) at age 16–17 in the Missouri River basin (Scarnecchia et al. 2007)

Maximum size/age: 87 inches total length (221 cm)/55 years

Status: G4/S2, BLM sensitive species, Montana FWP Tier I species

K.4.7.2 Fluvial Specialist Habitat Guild

The fluvial specialist habitat guild includes fishes that are usually found only in streams and rivers, or that use flowing water habitats throughout most of their life cycle (Galat et al. 2005, Kinsolving and Bain 1993, Simon 1999). This guild includes both large species such as the shovelnose sturgeon, which in the study area and vicinity is restricted exclusively to the Yellowstone River and Tongue River, as well as smaller fish species that are more widespread in distribution and AES class associations.

Acipenseridae – Sturgeons

Shovelnose Sturgeon

Scientific name:	*Scaphirhynchus platorynchus*
Species assemblage:	SPA 5 – Large Mainstem River Assemblage
Origin/Type:	Native/assemblage indicator species
Observed in study area:	Tongue River – RM 0 to 21
Trophic guild:	Invertivore
Current preference:	Fast current environments
Adult habitat preferences:	Benthic in deep runs, fast glides, and lateral pools during high flow events over gravel substrate
Spawning habitat:	Fast glide and run habitats over gravel and cobble substrate
Migration:	Highly migratory during spawning and larval dispersal
Ecological tolerance:	Intolerant
Turbidity tolerance:	High
Size at maturity:	Males 22–26 inches (57–65 cm) at age 8–10, females 24–26 inches (60–66 cm) at age 9–12 (Tripp et al. 2009)
Maximum size/age:	39 inches (100 cm)/43 years
Status:	G4/S4, Montana FWP Conservation Tier III species

Catostomidae – Suckers

Blue Sucker

Scientific name: *Cycleptus elongatus*
Species assemblage: SPA 5 – Large Mainstem River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 21
Trophic guild: Invertivore
Current preference: Fast current environments
Adult habitat preferences: Benthic in deep fast glides, runs and riffles over gravel, cobble, boulder and/or bedrock substrate
Spawning habitat: Run and riffle habitats with cobble substrate
Migration: Highly migratory during spawning and juvenile dispersal
Ecological tolerance: Moderate
Turbidity tolerance: High
Size at maturity: Males 10–16 inches total length (27–42 cm) at age 2–4, females 19–21 inches total length (49–55 cm) at age 6 (LeBey et al. 2007)
Maximum size/age: 36 inches total length (93 cm)/17 years
Status: G3/S2, Montana FWP Conservation Tier I species, BLM sensitive species

Cyprinidae – Minnows and Carp

Flathead Chub

Scientific name: *Platygobio gracilis*
Species assemblage: SPA 2 – Medium Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 224
Rosebud Creek – RM 0 to 208
Otter Creek – RM 0 to 22
Beaver Creek – RM 0 to 28
Trophic guild: Invertivore
Current preference: Fast current
Adult habitat preferences: Epibenthic in fast glide, run and riffle habitats over sandy substrate
Spawning habitat: Fast glide, run and riffle habitats over sandy substrate
Migration: Locally migratory
Ecological tolerance: Moderate
Turbidity tolerance: High
Size at maturity: 5 inches total length (12 cm) at age 2 (Tibbs 1998)
Maximum size/age: 15 inches (37 cm)/10 years
Status: G5/S5, Montana FWP Conservation Tier III species

Sand Shiner

Scientific name: *Notropis stramineus*
Species assemblage: SPA 2 – Medium Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 224
Hanging Woman Creek – RM 0 to 18
Otter Creek – RM 0 to 36
Foster Creek – RM 5.2 to 6.2 (limited survey reach)
Trophic guild: Invertivore
Current preference: Moderate current
Adult habitat preferences: Pelagic in pools and glides with moderate current over sandy substrate
Spawning habitat: Fast glide, run and riffle habitats over gravel substrate
Migration: Locally migratory
Ecological tolerance: Moderate
Turbidity tolerance: Moderate
Size at maturity: 1.5 inches (3.8 cm) at age 1 (Smith et al. 2010)
Maximum size/age: 3 inches (8.2 cm)/3 years
Status: G5/S4, Montana FWP Conservation Tier III species

Sturgeon Chub

Scientific name: *Macrhybopsis gelida*
Species assemblage: SPA 9 – Creek Chub Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 15
Trophic guild: Invertivore
Current preference: Fast current
Adult habitat preferences: Benthic in fast glides, runs and riffles over sandy substrate
Spawning habitat: Similar to adult habitat
Migration: No (except for gradual colonization)
Ecological tolerance: Moderate
Turbidity tolerance: High
Size at maturity: 3 inches (7.6 cm) at age 2
Maximum size/age: 4.7 inches total length (12.1 cm)/ 4 years
Status: G3/S2, Montana FWP Conservation Tier I species, BLM sensitive species

Western Silvery Minnow

Scientific name: *Hybognathus argyritis*
Species assemblage: SPA 2 – Medium Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 202
Otter Creek – RM 21.7 to 22.7 (limited survey reach)
Beaver Creek – RM 0 to 28
Trophic guild: Detritivore/Herbivore
Current preference: Slow-none
Adult habitat preferences: Benthic in mid-channel and side channel pools and backwater areas with little or no current over silty substrate
Spawning habitat: Same as adult habitat
Migration: No
Ecological tolerance: Moderate
Turbidity tolerance: High
Size at maturity: 2 inches total length (5 cm) at age 1
Maximum size/age: 7 inches total length (18 cm)/ 4 years
Status: G4/S4, Montana FWP Conservation Tier III species

Ictaluridae

Stonecat

Scientific name: *Noturus flavus*
Species assemblage: SPA 1 – Large Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 224
Rosebud Creek – RM 0 to 208
Hanging Woman Creek – RM 0 to 8
Otter Creek – RM 0 to 10
Trophic guild: Invertivore
Current preference: Moderate current
Adult habitat preferences: Benthic in glide, run, and riffle habitats with moderate current and cobble to boulder sized substrates
Spawning habitat: Glide and run habitats with large rock or other structure
Migration: Locally migratory between summer and winter habitats
Ecological tolerance: Low
Turbidity tolerance: Low
Size at maturity: 5 inches (12 cm) at age 3 (Walsh and Burr 1985)
Maximum size/age: 12 inches total length (31 cm)/ 9 years
Status: G4/S4, Montana FWP Conservation Tier III species

K.4.7.3 Macrohabitat Generalist Habitat Guild

The macrohabitat generalist habitat guild include species that have flexible habitat requirements and are capable of completing their life cycle in both lotic and lentic ecosystems providing that suitable habitat characteristics are present (Galat et al. 2005; Simon 1999). This guild includes the majority of nonnative species occurring in the study area and vicinity.

Catostomidae

River Carpsucker

Scientific name:	*Carpiodes carpio*
Species assemblage:	SPA 1 – Large Warmwater River Assemblage
Origin/Type:	Native/assemblage indicator species
Observed in study area:	Tongue River – RM 0 to 221 Rosebud Creek – RM 0 to 183 Hanging Woman Creek – RM 0 to8 Otter Creek – RM 0 to 10
Trophic guild:	Omnivore
Current preference:	Slow–none
Adult habitat preferences:	Epibenthic in pools and slow glides over a variety of substrate types
Spawning habitat:	Pools, glides, and slow-current riffles with sandy substrate
Migration:	Extensive migration during spawning and larval dispersal
Ecological tolerance:	Moderate
Turbidity tolerance:	High
Size at maturity:	Males 9 inches (24 cm) at age 3, females 9–10 inches (24–26 cm) at age 3–5, both sexes may mature as early as age 2 (Morris 1965)
Maximum size/age:	25 inches total length (64 cm)/10 years
Status:	G5/S5, Montana FWP Conservation Tier III species

Centrarchidae – Bass and Sunfish

Several centrarchid species occur in the study area and vicinity, but none of these species is native to the Northern Great Plains Ecoregion. Each of these species was introduced from elsewhere in the Mississippi River basin or from other river basins in the eastern United States. These species are now common throughout the region where habitat conditions are suitable, and are typically associated with degraded habitat conditions and/or declining abundance of native species because of direct predation and other competitive effects.

Rock Bass

Scientific name: *Ambloplites rupestris*
Species assemblage: SPA 3 – Warmwater Sunfish Assemblage
Origin/Type: Introduced/representative species for SPA 3
Observed in study area: Tongue River – RM 0 to 28, and RM 87 to 224
Hanging Woman Creek – RM 0 to 8
Otter Creek – RM 0 to 10
Trophic guild: Omnivore
Current preference: Moderate
Adult habitat preferences: Epibenthic in pools and glides with gravel substrate, commonly associated with cover and undercut bank habitats
Spawning habitat: Pools and glides with sandy substrate
Migration: No
Ecological tolerance: Intolerant
Turbidity tolerance: Low
Size at maturity: 4 inches total length (10 cm) at age 3 (Hile 1941)
Maximum size/age: 17 inches (43 cm)/18 years
Status: G5/no state ranking, Montana FWP Conservation Tier IV species

Pumpkinseed

Scientific name: *Lepomus gibbosus*
Species assemblage: SPA 3 – Warmwater Sunfish Assemblage
Origin/Type: Introduced/representative species for SPA 3
Observed in study area: Tongue River – RM 0 to 224
Hanging Woman Creek – RM 0 to 31
Otter Creek – RM 0 to 47
Trophic guild: Invertivore
Current preference: Moderate
Adult habitat preferences: Epibenthic in pools and glides over a variety of substrates, commonly associated with, vegetation, structural cover and undercut bank habitats
Spawning habitat: Pools and glides with sandy substrate
Migration: No
Ecological tolerance: Moderate
Turbidity tolerance: Moderate
Size at maturity: 3–5 inches (8–12 cm) at age 2–3
Maximum size/age: 15 inches (40 cm)/12 years
Status: G5/no state ranking, Montana FWP Conservation Tier IV species

Cyprinidae – Minnows and Carp

Emerald Shiner

Scientific name:	*Notropus atherinoides*
Species assemblage:	SPA 1 – Large Warmwater River Assemblage
Origin/Type:	Native/assemblage indicator species
Observed in study area:	Tongue River – RM 0 to 201 Hanging Woman Creek – RM 0 to 0.5 (limited survey reach)
Trophic guild:	Invertivore
Current preference:	Moderate current
Adult habitat preferences:	Pelagic in pools and glides over a wide range of substrate types
Spawning habitat:	Shallow areas around pool margins, substrate generalist
Migration:	No
Ecological tolerance:	Intermediate
Turbidity tolerance:	High
Size at maturity:	3.5 inches (9 cm) at age 2 (Fuchs 1967)
Maximum size/age:	5 inches (13 cm)/4 years, rarely live beyond 3 years
Status:	G5/S5, Montana FWP Conservation Tier III species

Fathead Minnow

Scientific name:	*Pimephales promelas*
Species assemblage:	SPA 20 – Core Prairie Stream Assemblage
Origin/Type:	Native/assemblage indicator species
Observed in study area:	Tongue River – RM 0 to 225 Rosebud Creek – RM 0 to 208 Hanging Woman Creek – RM 0 to 48 (and tributaries) Foster Creek – RM 5.2 to 6.2 (limited survey reach) Otter Creek – RM 0 to 43 Beaver Creek – RM 0 to 28 Cook Creek – RM 0 to 4
Trophic guild:	Omnivore
Current preference:	Slow–none
Adult habitat preferences:	Pelagic in pools and slow glides over a variety of substrate types
Spawning habitat:	Pools and slow glides on rock, woody debris, and other structure
Migration:	No
Ecological tolerance:	High
Turbidity tolerance:	High
Size at maturity:	1–1.5 inches (3–3.5 cm) at age 0.3–1
Maximum size/age:	4 inches (10.1 cm)/ 5 years
Status:	G5/S5, Montana FWP Conservation Tier III species

Ictaluridae - Catfish

Channel Catfish

Scientific name: *Ictalurus punctatus*
Species assemblage: SPA 1 – Large Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 221
Rosebud Creek – RM 0 to 183
Hanging Woman Creek – RM 0 to 8
Otter Creek – RM 0 to 6
Trophic guild: Omnivore
Current preference: Moderate
Adult habitat preferences: Benthic in pools and glides over a variety of substrate types
Spawning habitat: Pool and glide habitats with structure (cavity nesting)
Migration: No
Ecological tolerance: Moderate
Turbidity tolerance: High
Size at maturity: 13–22 inches total length (33–56 cm) at age 2–6
Maximum size/age: 52 inches total length (132 cm)/24 years
Status: G5/S5, Montana FWP Conservation Tier III species

Percidae

Sauger

Scientific name: *Sander canadense*
Species assemblage: SPA 1 – Large Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 202
Rosebud Creek – RM 0 to 183
Trophic guild: Piscivore
Current preference: Moderate current
Adult habitat preferences: Epibenthic in pools and glides with slow to moderate current over a variety of substrate types
Spawning habitat: Lateral pools, glides, runs and riffles with slow to moderate current and gravel substrate
Migration: Extensive spawning migration
Ecological tolerance: Moderate
Turbidity tolerance: High
Size at maturity: Males 10 inches total length (27 cm) at age 2, females 13–16 inches total length (33–40 cm) at age 2–5
Maximum size/age: 30 inches total length (76 cm)/18 years
Status: G5/S2, Montana FWP Conservation Tier I species, BLM sensitive species

Sciaenidae

Freshwater Drum

Scientific name: *Aplodinotus grunniens*
Species assemblage: SPA 5 – Large Warmwater River Assemblage
Origin/Type: Native/assemblage indicator species
Observed in study area: Tongue River – RM 0 to 202
Trophic guild: Piscivore
Current preference: Slow–none
Adult habitat preferences: Epibenthic in pools, slow glides, protected side channels and backwaters with silty substrate
Spawning habitat: Pelagic spawners, broadcast free floating eggs in pool and slow glide habitats
Migration: No
Ecological tolerance: Moderate
Turbidity tolerance: High
Size at maturity: Males 7–16 inches total length (17.8–40.6 cm) at age 2–5, females 9–13 inches total length (22.9–33 cm) at age 3–7 (Edsall 1967)
Maximum size/age: 37 inches total length (95 cm)/58 years (Davis-Foust et al. 2009)
Status: G5/S4, Montana FWP Conservation Tier II species

K.5 Fish Resources Terminology

Key terms used in the fish species and habitat assessment are defined below.

- **Aquatic ecological system (AES) Class:** Aquatic ecosystem types present in Great Plains prairie ecoregion, as defined by Stagliano (2005).
    - **Class E005, Great Plains Intermittent Stream:** Non-fish-bearing intermittent stream, characterized by isolated pools periodically connected by continuous stream flow. Typical drainage area is less than 30,000 acres.
    - **Class D005, Great Plains Intermittent Stream:** Fish-bearing intermittent stream, characterized by isolated pools periodically connected by continuous stream flow. Pools are perennial and sufficiently persistent to support fish. Typical drainage area between 30,000 and 40,000 acres, average wetted width is less than 15 feet with a typical channel length less than 50 miles (e.g., North Woman Creek).
    - **Class C005, Great Plains Core Prairie Stream:** Fish-bearing perennial stream, characterize by continual year-round flow and a diverse range of aquatic habitats. Typical drainage area is greater than 40,000 acres, average wetted width is greater 15 feet with typical channel length between 50 and 100 miles (e.g., Otter Creek).
    - **Class B005, Medium Prairie River:** Larger perennial stream system with an average wetted width of up to 50 feet and typical channel length greater than 100 miles (e.g., Rosebud Creek).

- **Class A003, Large Prairie River:** Large, low-gradient river system with an average wetted with ranging from 50 to 100 feet or more, and a typical channel length of greater than 200 miles (e.g., the Tongue River).
- **Class A002, Large Mainstem River:** Very large river system characterized by wide and deep main channels, with an average wetted width of 200 feet or greater and a typical channel length of 500 miles or more. The Yellowstone River is the only Class A002 river system close to the study area.

- **Aquatic habitat terminology:** The base habitat units and characteristics used to describe aquatic habitat composition in the study area.
  - **Bar:** A shallow or exposed sediment accumulation, typically located on the inside of a channel bend but may also occur in mid-channel.
  - **Bankfull channel:** The extent of channel that carries the typical 2-year recurrence interval stream flow, usually demarcated by established streambanks at the edge of riparian vegetation.
  - **Bankfull depth:** The depth of a habitat unit under bankfull flow conditions (i.e., the flow necessary to fill the channel to maximum depth at bankfull flow).
  - **Bankfull flow:** The stream flow volume necessary to fill the bankfull channel.
  - **Bankfull width:** The width of the bankfull channel, including both the main channel and any adjacent side channels that are inundated at bankfull flow.
  - **Cascade:** A unit characterized by a rapid change in gradient, including vertical drops (waterfalls).
  - **Delta/deltaic:** Conditions formed by sediment accumulation at the mouths of stream channels, specifically tributaries to the Tongue River.
  - **Floodplain:** The area adjacent to the channel that is prone to inundation by flooding at flows above bankfull channel width
  - **Glide:** A unit having uniform cross-sectional depth profile and flow without turbulent surface disturbance.
  - **Main channel:** The primary channel carrying surface flow.
  - **Pool:** A unit characterized by greater than average channel depth, low or no current, and generally finer substrates than average in a reach. Mid-channel pools extend across the majority of the stream channel with the deepest portion of the pool in the middle of the stream; in lateral pools, the deepest portion of the pool is adjacent to the bank.
  - **Reach:** A portion of a channel segment composed of one to many different habitat units.

- **Riffle:** A unit characterized by shallow depth and turbulent flow, with small hydraulic jumps over rough substrate causing ripples and waves without breaking the surface tension.
- **Run:** A unit similar to a glide but having greater gradient and turbulent surface disturbance.
- **Side channel:** A secondary channel connected to the main channel during at least some flow periods.
- **Thalweg:** The deepest area of the main channel that carries the primary stream flow.
- **Wetted width:** The width of channel inundated by surface flow at the time of the habitat survey.

- **Fish community classification terminology:** The species and community classification systems used to characterize the fish community in the study area.
  - **Assemblage:** A group of species typically associated with an AES class and the habitat types provided by that type of aquatic ecosystem.
  - **Origin:** Identifies if the species is native to the study area or has been introduced from another region.
  - **Habitat guild:** A grouping of species having similar habitat requirements or preferences (e.g., dependence on fast-flowing water during part of their life cycle), used to identify the species that could occur in a given location based on the types of habitats present.
  - **Trophic guild:** A grouping of species with similar feeding requirements.
  - **Current preference:** The general range of current speeds preferred by the species during subadult and adult life stages.
  - **Water column:** The position in the water column preferred by the species during the adult life stage. Benthic species are found directly associated with the bottom; epibenthic species are found near the bottom or shoreline, commonly associated with cover; pelagic species are found in mid-water or near the surface.
  - **Preferred substrate:** The preferred channel bed material with which the species typically associates.
  - **Spawning substrate:** The type of material used by the species for spawning.
- **Ecological tolerance:** Characteristics used to rate the sensitivity of a fish species to different ecological conditions
  - **Habitat degradation:** The tolerance of a species for degradation of aquatic habitat conditions resulting from human activity or broad-scale landscape disturbance.
  - **Turbidity:** The tolerance of a species for high levels of suspended sediments in the water column.

- **Epifauna/epifaunal:** The community of organisms that live on the surface of the channel substrate, including bacterial and algal biofilm, fungi, and macroinvertebrates.
- **Macroinvertebrate:** Aquatic invertebrates large enough to be seen with the naked eye. Typically refers to the aquatic life stages of various insect species but also includes worms, molluscs and other species.

K.6 References

Belica, L.T. and N.P. Nibbelink. 2006. Mountain Sucker (*Catostomus platyrhynchus*): a technical conservation assessment. Prepared by the University of Wyoming and University of Georgia for the USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/mountainsucker.pdf. Accessed February 25, 2015.

Davis-Foust, S. L., R. M. Bruch, S. E. Campana, R. P. Olynyk, and J. Janssen. 2009. Age Validation of Freshwater Drum using Bomb Radiocarbon. *Transactions of the American Fisheries Society* 138(2):385–396.

Edsall, T.A. 1967. Biology of the Freshwater Drum in Western Lake Erie. *Ohio Journal of Science 67*(6):321–-340.

Fitzpatrick, F. A., I. R. White, P. J. D'Arconte, M. R. Meador, M. A. Maupin, and M. E. Gurtz. 1998. *Revised Methods for Characterizing Stream Habitat in the National Water-Quality Assessment Program.* U.S. Geological Survey Water-Resources Investigations Report 98-4052.

Froese, R. and D. Pauly (eds.). 2013. *FishBase—Online Database of Fish Species Characteristics*. Last revised: August 2013. Available: http://fishbase.org/. Accessed: October 1–4, 2013.

Fuchs, E. H. 1967. Life History of the Emerald Shiner, *Notropis atherinoides*, in Lewis and Clark Lake, South Dakota. *Transactions of the American Fisheries Society* 96(3):247–256.

Galat, D. L., C. R. Berry, W. M. Gardner, J. C. Hendrickson, G. E. Mestl, G. J. Power, C. Stone, and M. R. Winston. 2005. Spatiotemporal Patterns and Changes in Missouri River Fishes. *American Fisheries Society Symposium* 45:249–291.

Goodyear, C. D., T. A. Edsall, D. M. Ormsby-Dempsy, G. D. Moss, and P. E. Polanski. 1982. Reproductive Characteristics of Great Lakes Fishes. Volume XIII in *Atlas of the Spawning and Nursery Areas of Great Lakes Fishes*. Prepared by the U.S. Fish and Wildlife Service Great Lakes Fisheries Laboratory. Prepared for the U.S. Army Corps of Engineers, Detroit District and U.S. Fish and Wildlife Service, Office of Biological Services. Agreement NCE-IS-78-30. FWS/OBS-82/52.

Google Earth Professional. 2013. *Historic Aerial Imagery for the Tongue River Subbasin, 1997–2011*. Last revised: August 2011. Available: Google Earth Pro Interactive Mapping Software. Accessed: October 8, 2013.

Hile, R. 1941. *Age and Growth of the Rock Bass, Ambloliptes Rupestris* (Rafinesque), *in Nebish Lake, Wisconsin*. Ann Arbor, MI: U.S. Bureau of Fisheries.

Kinsolving, A.D. and M.B. Bain. 1993. Fish Assemblage Recovery along a Riverine Disturbance Gradient. *Ecological Applications* 3(3):531–544.

LeBay, S., J. Kral and S. Stukel. 2007. *Three Year Summary Age and Growth Report for Blue Sucker – Pallid Sturgeon Population Assessment Project and Associated Fish Community Monitoring for the Missouri River*. Prepared by the South Dakota Department of Fish Game and Parks. Prepared for the U.S. Army Corps of Engineers – Northwest Division.

Montana Fish, Wildlife & Parks. 2012. *Montana Fish Distribution – Streams*. GIS data set of fish species distribution based on presence absence surveys conducted in the study area between 2005 and 2012. Last revised: 2012. Available: http://fwp.mt.gov/doingBusiness/reference/gisData/dataDownload.html. Accessed: April 2013.

Montana Natural Heritage Program and Montana Fish Wildlife and Parks. 2013. *Montana Field Guides*. Last revised: April 2010. Available: http://fieldguide.mt.gov/displayFamily.aspx?class=Actinopterygii. Accessed: October 1–4, 2013.

Morris, L. A. 1965. Age and Growth of the River Carpsucker, *Carpoides carpio*, in the Missouri River. The *American Midland Naturalist* 73(2):423–429.

NatureServe. 2009. *NatureServe Explorer*. Last revised: February 2, 2009. Available: http://www.natureserve.org/explorer/ranking.htm. Accessed: October 1, 2013.

O'Hara, M., B. S. Ickes, E. Gittinger, S. Delain, T. Dukerschein, M. Pett, and J. Kalas. 2007. *Development of a Life History Database for Upper Mississippi River Fishes*. La Crosse, WI: U.S. Geological Survey, Upper Midwest Environmental Services Center. LTRMP 2007-T001.

Omernik, J. M. 1995. *Ecoregions: A Spatial Framework for Environmental Management*. Pages 49–64 in Davis, W. and T. Simon (eds). *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making*. Boca Raton, London: Lewis Publishers.

Pegg, M. and C. Pierce. 2002. Fish Community Structure in the Missouri and Lower Yellowstone Rivers in Relation to Flow Characteristics. *Hydrobiologia* 479(1–3):155–167.

Persinger, J. W., D. J. Orth, and A. W. Averett. 2011. Using Habitat Guilds to Develop Habitat Suitability Criteria for a Warmwater Stream Fish Assemblage. *River Research and Applications* 27(8):956–966.

Rahel, F.J. and L.A. Thel. 2004. Plains killifish (*Fundulus zebrinus*): a technical conservation assessment. Prepared for the USDA Forest Service, Rocky Mountain Region by the University of Wyoming Dept. of Zoology and Physiology. Available: http://www.fs.fed.us/r2/projects/scp/assessments/plainskillifish.pdf. Accessed February 25, 2015.

Scarnecchia, D.L., LF. Ryckman, Y. Lim, G.J. Power, B.J. Schmitz, and J.A. Firehammer. 2007. Life History and the Costs of Reproduction in Northern Great Plains Paddlefish (*Polyodon Spathula*) as a Potential Framework for Other *Acipenseriform* Fishes. *Reviews in Fisheries Science* 15:211–263.

Schumm, S. A. 1977. The *Fluvial System*. New York, NY: John Wiley and Sons.

Simon, T. P (ed.). 1999. *Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities*. Boca Raton, FL: CRC Press.

Smith, C. D., T. E. Neebling, and M. C. Quist. 2010. Population Dynamics of the Sand Shiner (*Notropis stramineus*) in Non-Wadeable Rivers of Iowa. *Journal of Freshwater Ecology* 25(4):617–626.

Stagliano, D. M. 2005. *Aquatic Community Classification and Ecosystem Diversity in Montana's Missouri River Watershed*. Prepared for the U.S. Department of Interior, Bureau of Land Management. Helena, MT: Montana State Library - Montana Natural Heritage Program.

Tibbs, J. E. 1998. *Flathead Chub* (Platygobio gracilis) *Rangewide Status Assessment*. June. Prepared by the University of Missouri School of Natural Resources. Prepared for the U.S. Fish and Wildlife Service, Region 3.

Trebitz, A. S., J. C. Brazner, V. J. Brady, R. Axler and D. K. Tanner. 2007. Turbidity Tolerances of Great Lakes Coastal Wetland Fishes. *North American Journal of Fisheries Management* 27:619–633.

Tripp, S. J., R. E. Colombo, and J. E. Garvey. 2009. Declining Recruitment and Growth of Shovelnose Sturgeon in the Middle Mississippi River: Implications for Conservation. *Transactions of the American Fisheries Society* 138:416–422.

U.S. Environmental Protection Agency. 2007. Water Quality Assessment for the Tongue River Watershed, Montana. Final Draft. Montana Operations Office. August. Available: http://nepis.epa.gov/Exe/ZyNET.exe/P1004RB6.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2006+Thru+2010&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File

=D%3A%5Czyfiles%5CIndex%20Data%5C06thru10%5CTxt%5C00000009%5CP1004RB6.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p%7Cf&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL. Accessed: March 17, 2014.

U.S. Environmental Protection Agency. 2012. *Level III and Level IV Ecoregions of the Continental United States*. U.S. Environmental Protection Agency Western Ecology Division. Map products available in GIS and PDF format. Available: http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm. Accessed: December 1, 2012.

Walsh, S. J. and B. M. Burr. 1985. Biology of Stonecat, *Noturus flavus* (Siluriformes: Ictaluridae), in Central Illinois and Missouri Streams, and Comparisons with Great Lakes Populations and Congeners. *Ohio Journal of Science* 85(3):85–96.

Welcomme, R. L., K. O. Winemiller, and I. G. Cowx. 2006. Fish Environmental Guilds as a Tool for Assessment of Ecological Condition of Rivers. *River Research and Applications* 22(3):377–396.

Wildhaber, M. L., D. W. Gladish, and A. Arab. 2012. Distribution and Habitat Use of the Missouri River and Lower Yellowstone River Benthic Fishes from 1996 to 1998: A Baseline for Fish Community Recovery. *River Research and Applications* 28(10):1780–1803.

Winemiller, K. O. and K. A. Rose. 1992. Patterns of Life History Diversification in North American Fishes: Implications for Population Regulation. *Canadian Journal of Fisheries and Aquatic Sciences* 49(10):2186–2218.

ATTACHMENT K-1

Valley Segment Reports

Segment Valley Segment 1

Stream Name Tongue River

Description Yellowstone River to T&Y Diversion Dam.

Segment Dimensions

Area Surveyed (m^2)	Surveyed Length (m)	Avg Bankfull Width (m)	Max Bankfull Width (m)	Avg Bankful Thalweg Depth(m)	Max Bankful Thalweg Depth (m)	Avg Wetted Thalweg Depth (m)	Max Wetted Thalweg Depth (m)
60,019	1,533	41	59	1.4	2.4	0.7	1.7

Segment Aquatic Habitat Composition

Habitat Type	Percent of Segment	Area (m^2)
Glide	50.6%	30,391
Island	12.3%	7,360
Pool - lateral scour (bank)	9.9%	5,968
Pool - mid-channel	3.2%	1,925
Riffle	24.0%	14,375

Segment Riparian Composition

% Trees	% Shrubs	% Grass/Field	% Developed
22%	26%	52%	0%

Segment Bank Composition

	Left Bank	Right Bank
Height (m):	5	2
Eroding (%):	59	33
Undercut (%):	8	5

Habitat Complexity

Habitat Units per Kilometer
12.4

Segment Valley Segment 2

Stream Name Tongue River

Description T&Y Diversion Dam to Otter Creek.

Segment Dimensions

Area Surveyed (m^2)	Surveyed Length (m)	Avg Bankfull Width (m)	Max Bankfull Width (m)	Avg Bankful Thalweg Depth(m)	Max Bankful Thalweg Depth (m)	Avg Wetted Thalweg Depth (m)	Max Wetted Thalweg Depth (m)
340,413	9,057	30	62	1.3	3.2	0.8	2.5

Segment Aquatic Habitat Composition

Habitat Type	Percent of Segment	Area (m^2)
Backwater	0.1%	198
Bar	1.4%	4,814
Cascade or falls	0.1%	441
Glide	68.2%	232,285
Island	7.1%	24,287
Pool - lateral scour (bank)	4.0%	13,773
Pool - mid-channel	4.9%	16,687
Riffle	10.6%	36,172
Run	3.5%	11,757

Segment Riparian Composition

% Trees	% Shrubs	% Grass/Field	% Developed
19%	35%	46%	0%

Segment Bank Composition

	Left Bank	Right Bank
Height (m):	3	3
Eroding (%):	26	22
Undercut (%):	21	22

Habitat Complexity

Habitat Units per Kilometer
16.7

Segment Valley Segment 3

Stream Name Tongue River

Description Otter Creek to Hanging Woman Creek.

Segment Dimensions

Area Surveyed (m^2)	Surveyed Length (m)	Avg Bankfull Width (m)	Max Bankfull Width (m)	Avg Bankful Thalweg Depth(m)	Max Bankful Thalweg Depth (m)	Avg Wetted Thalweg Depth (m)	Max Wetted Thalweg Depth (m)
68,231	2,222	24	52	1.6	2.7	1.0	2.3

Segment Aquatic Habitat Composition

Habitat Type	Percent of Segment	Area (m^2)
Backwater	0.1%	40
Bar	0.3%	189
Glide	64.7%	44,164
Island	4.9%	3,340
Pool - lateral scour (bank)	7.1%	4,820
Pool - mid-channel	10.1%	6,897
Riffle	4.0%	2,709
Run	8.9%	6,072

Segment Riparian Composition

% Trees	% Shrubs	% Grass/Field	% Developed
30%	37%	34%	0%

Segment Bank Composition

	Left Bank	Right Bank
Height (m):	2	5
Eroding (%):	10	29
Undercut (%):	36	28

Habitat Complexity

Habitat Units per Kilometer
14.0

Segment Valley Segment 4

Stream Name Tongue River

Description Hanging Woman Creek to Tongue River Reservoir and Dam.

Segment Dimensions

Area Surveyed (m^2)	Surveyed Length (m)	Avg Bankfull Width (m)	Max Bankfull Width (m)	Avg Bankful Thalweg Depth(m)	Max Bankful Thalweg Depth (m)	Avg Wetted Thalweg Depth (m)	Max Wetted Thalweg Depth (m)
132,086	3,093	39	60	1.2	2.0	0.8	1.5

Segment Aquatic Habitat Composition

Habitat Type	Percent of Segment	Area (m^2)
Glide	86.0%	113,587
Island	3.2%	4,250
Pool - lateral scour (bank)	3.1%	4,030
Riffle	4.9%	6,439
Run	2.9%	3,780

Segment Riparian Composition

% Trees	% Shrubs	% Grass/Field	% Developed
11%	13%	67%	9%

Segment Bank Composition

	Left Bank	Right Bank
Height (m):	5	1
Eroding (%):	20	4
Undercut (%):	24	42

Habitat Complexity

Habitat Units per Kilometer
4.8

Segment Tributaries - Otter Creek

Stream Name: Otter Creek

Description: Otter Creek. Tributaries and nearby streams that do not necessarily flow into the Tongue River.

Segment Dimensions

Area Surveyed (m^2)	Surveyed Length (m)	Avg Bankfull Width (m)	Max Bankfull Width (m)	Avg Bankful Thalweg Depth(m)	Max Bankful Thalweg Depth (m)	Avg Wetted Thalweg Depth (m)	Max Wetted Thalweg Depth (m)
5,090	608	6	8	1.0	1.3	0.6	0.8

Segment Aquatic Habitat Composition

Habitat Type	Percent of Segment	Area (m^2)
Glide	88.0%	4,481
Run	12.0%	609

Segment Riparian Composition

% Trees	% Shrubs	% Grass/Field	% Developed
6%	1%	94%	0%

Segment Bank Composition

	Left Bank	Right Bank
Height (m):	1	1
Eroding (%):	43	28
Undercut (%):	0	0

Habitat Complexity

Habitat Units per Kilometer
19.7

Segment Tributaries - Moon Creek

Stream Name: Moon Creek

Description: Moon Creek. Tributaries and nearby streams that do not necessarily flow into the Tongue River.

Segment Dimensions

Area Surveyed (m^2)	Surveyed Length (m)	Avg Bankfull Width (m)	Max Bankfull Width (m)	Avg Bankful Thalweg Depth(m)	Max Bankful Thalweg Depth (m)	Avg Wetted Thalweg Depth (m)	Max Wetted Thalweg Depth (m)
8,418	2,273	4	9	1.0	2.0	0.9	2.0

Segment Aquatic Habitat Composition

Habitat Type	Percent of Segment	Area (m^2)
Glide	72.1%	6,068
Pool - lateral scour (bank)	2.1%	180
Pool - mid-channel	12.0%	1,009
Riffle	3.5%	292
Run	10.3%	869

Segment Riparian Composition

% Trees	% Shrubs	% Grass/Field	% Developed
9%	8%	82%	0%

Segment Bank Composition

	Left Bank	Right Bank
Height (m):	2	2
Eroding (%):	64	71
Undercut (%):	12	8

Habitat Complexity

Habitat Units per Kilometer
33.4

Segment Tributaries - Canyon Creek

Stream Name: Canyon Creek

Description: Canyon Creek. Tributaries and nearby streams that do not necessarily flow into the Tongue River.

Segment Dimensions

Area Surveyed (m^2)	Surveyed Length (m)	Avg Bankfull Width (m)	Max Bankfull Width (m)	Avg Bankful Thalweg Depth(m)	Max Bankful Thalweg Depth (m)	Avg Wetted Thalweg Depth (m)	Max Wetted Thalweg Depth (m)
1,116	1,043	6	15	0.7	1.0	0.2	0.6

Segment Aquatic Habitat Composition

Habitat Type	Percent of Segment	Area (m^2)
Cascade or falls	0.9%	10
Glide	40.0%	447
Pool - lateral scour (bank)	0.7%	8
Pool - mid-channel	35.4%	396
Riffle	5.9%	66
Run	17.0%	190

Segment Riparian Composition

% Trees	% Shrubs	% Grass/Field	% Developed
5%	30%	65%	0%

Segment Bank Composition

	Left Bank	Right Bank
Height (m):	2	2
Eroding (%):	75	75
Undercut (%):	10	10

Habitat Complexity

Habitat Units per Kilometer
56.6