Appendix B: Photo Review of Study Reaches

Table of Contents

List of Figures

Photo Review of Study Reaches

The primary purpose of this appendix is to provide the reader with a photographic tour of the study area. Some general characteristics of the reaches are provided in the discussion.

1.0 ROCK CREEK

Rock Creek Mainstem, Reaches 1 through 4 lie between the upper end of the area inundated by the Columbia River and the confluence with Squaw Creek, the first significant tributary encountered moving upstream from the mouth. All other tributaries within this area are ephemeral channels which channel snowmelt to the river, but otherwise do not flow. Reach 3 could not be sampled due to lack of access. All three of the sampled reaches tended to have similar characteristics. These reaches lie within a broad floodplain flanked on each side by steep slopes rising 800 feet or more above the valley bottom (Figure 1). The stream adjacent slopes are composed of broken rock overlain with a shallow layer of soil. These slopes contribute large quantities of rock to the stream. The channels within these reaches are low gradient reaches (average 0.9% gradient) dominated by cobble and boulders. The stream tends to run subsurface through the accumulations of cobble in portions of these reaches (Figure 1). The reaches tend to have little instream wood within the wetted width, but quantities of wood can be found on the floodplain. Riparian vegetation is largely confined within 15 to 25 feet of the stream. A study completed in 2005 (Aspect 2005) looked at the long-term trends in riparian vegetation in this area. They found that vegetation has been generally increasing for many decades, potentially resulting from fire suppression. The study also noted that these lower reaches tended to migrate frequently during major storm events. Numerous old channels can be found within the floodplain along these reaches. Suring the snorkel surveys, no fish were observed in Reach 1, dace were observed in segments 6 and 7 of Reach 2, and 590 *O. mykiss*, over 300 dace, and over 550 redside shiners were observed in Reach 4. The *O. mykiss* were found primarily in segments 1 and 4 of Reach 4. Overall, Reach 4 contained 14 percent of the *O. mykiss* observed throughout the Rock Creek basin.

Figure 1. The lower reaches of the mainstem of Rock Creek; Reach 1 Segment 8 (upper left), Reach 2 Segment 6 (upper rights), Reach 4 Segment 1 (lower left), and Reach 4 Segment 4 (lower right).

Rock Creek Mainstem, Reaches 5 and 6 lie in the 2 miles upstream of the confluence with Squaw Creek. All tributaries within this area, with the exception of Squaw Creek, are ephemeral channels which channel snowmelt to the river, but otherwise do not flow. These reaches are similar in many ways to the reaches downstream of Squaw Creek, except they tend to be narrower and also have a narrower floodplain. The floodplain is flanked on each side by steep slopes. The channels are dominated by cobble and boulder, reflecting the large amount of large material delivered to the stream from the adjacent slopes. Gradient in reaches 5 and 6 also tends to be less than 1%. Generally, riparian vegetation is denser along these reaches than that found along Reaches 1 through 4 (Figure 2). Riparian vegetation in these reaches has also been increasing over the past several decades (Aspect 2005). During the snorkel surveys, 396 *O. mykiss* and over 400 dace were observed in Reach 5 and 646 *O. mykiss*, roughly 160 dace, and a few shiners were observed in Reach 6. Overall, reaches 5 and 6 contained 9.9 and 16.1 percent, respectively, of the total *O. mykiss* observed in the Rock Creek basin.

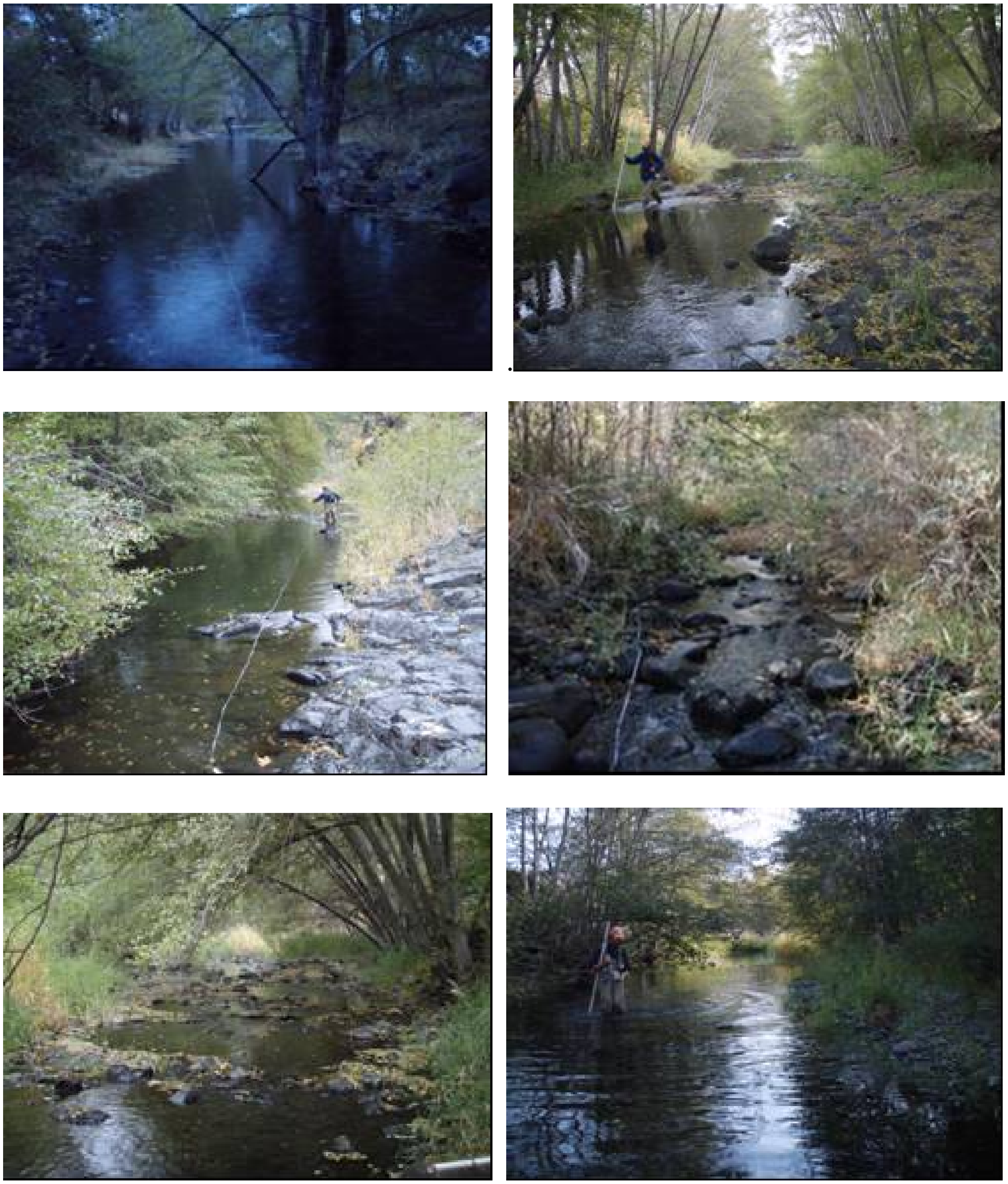

Figure 2. Rock Creek Reach 5, segment 1 (top left), Reach 5, segment 2 (top right) , Reach 5, Segment 3 (middle left), Reach 6, segment 1 (middle right), Reach 6, segment 2 (bottom left) and Reach 6, segment 3 (bottom right).

Rock Creek Mainstem, Reaches 7 lies downstream of the confluence with Luna Gulch. In this reach, the channel is avulsed due to the deposition of large quantities of cobble and boulders. As a result, the floodplain is wider near the confluence with Luna Gulch and summer stream flows run subsurface in portions of the reach. The reach contains several large pools (Figure 3). More *O. mykiss* were observed in Reach 7 than in any other reach in the study area. The reach contained 29.6 percent of the *O. mykiss* observed during snorkel surveys in the Rock Creek basin. The gradient in this reach averages less than 1 percent. Roughly two-thirds of the length of Segment 3 in Reach 7 is dry. The majority of the *O. mykiss* in Reach 7 were in Segment 2, which is predominately a long glide.

Figure 3. Rock Creek Reach 7, Segment 1 (upper left), Reach 7, Segment 2 (upper right), dry portion of Reach 7, Segment 3 (bottom left), and the pool in Reach 7, Segment 3 (bottom right).

Rock Creek Mainstem, Reach 8 is a short reach which lies just upstream of the confluence with Luna Gulch. This area is also affected by the deposition of large rock where the mainstem and Luna Gulch come together. The quantities of rock are not as expansive as seen in Reach 7, but are sufficient to cause summer stream flow to move subsurface in some areas of Segment 1 and all of Segment 3 (Figure 4). Segment 2 of Reach 8 contained 10 *O. mykiss* and some dace. No fish were found in Segments 1 and 3.

Figure 4. Rock Creek Reach 8, segment 1 (top, left), segment 2 (top right), and segment 3 (bottom).

Rock Creek Mainstem, Reaches 9 and 10 are similar. Reach 9 extends a little more than a mile downstream of the confluence with Badger Gulch. Reach 10 extends from the confluence with Badger Gulch upstream for approximately 1 mile to an unnamed tributary. Throughout these reaches, the channel is more confined than Reaches 7 and 8 and riparian vegetation tends to be denser. Gradients continue to be less than 1% and substrate continues to be dominated by cobbles and boulders (Figure 5). Pools are abundant in Reach 9, but only 2 pools were found in Reach 10. The stream segments between riffles in Reach 10 were largely glides (Figure 5). During the snorkel surveys, 110 *O. mykiss* were observed in Reach 9, primarily in segment 2. A few dace were also present in segment 2 of Reach 9. Sixty-one *O. mykiss* were observed in Reach 10, most of which were in Segment 6.

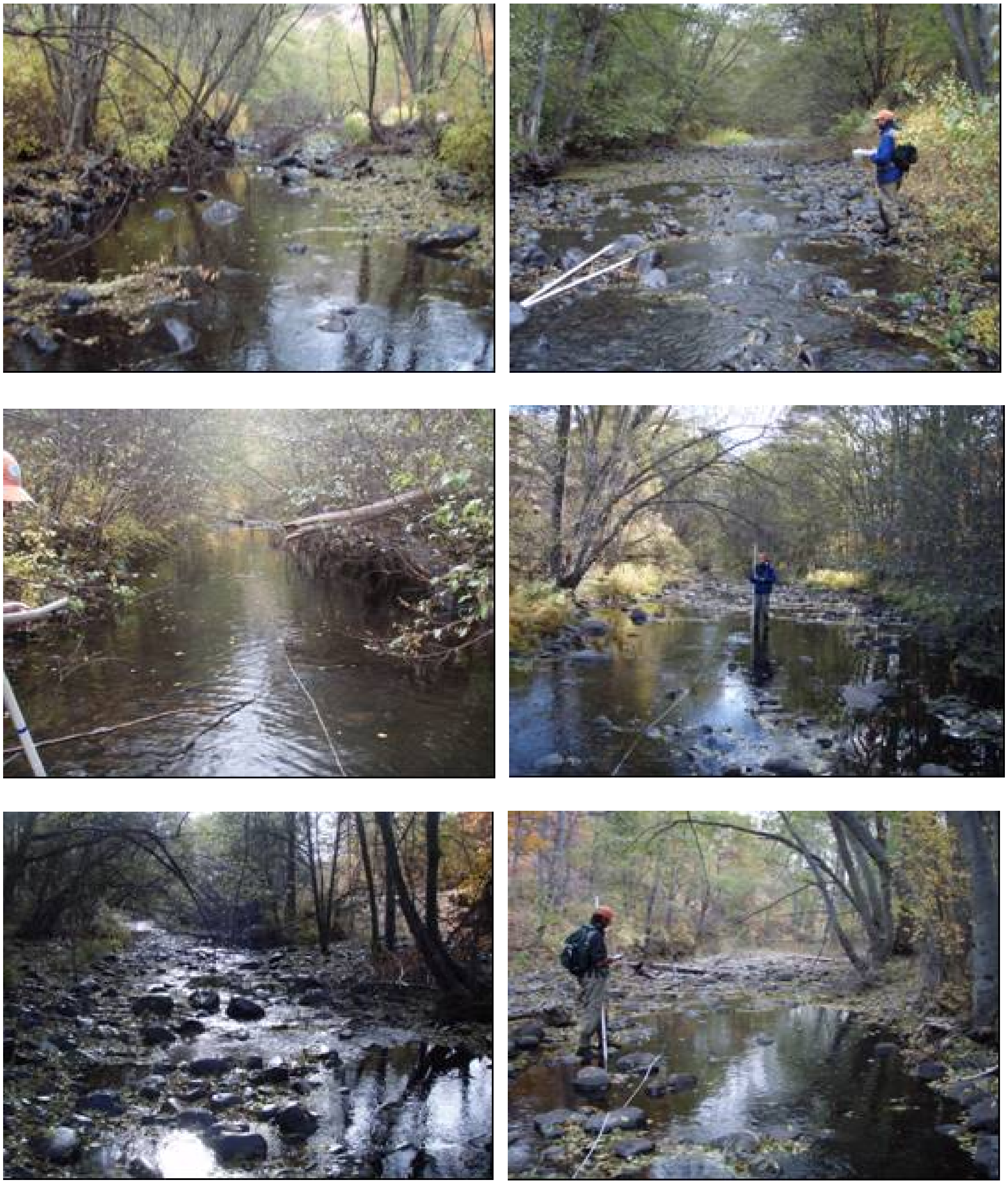

Figure 5. Rock Creek Reach 9, Segment 2 (top left), Reach 9, Segment 3 (top right), Reach 9, Segment 5 (center left), Reach 10, Segment 1 (center right), Reach 10, Segment 4 (bottom left), and Reach 10, Segment 6 (bottom right).

Rock Creek Mainstem, Reaches 11, 12, and 13 are the upper most reaches sampled in the study. These reaches lie in a deep, relatively narrow canyon, with side slope extended 600 feet or more above the valley bottom. The material on the side slopes continues to be dominated by loose talus-like material overlain with a thin layer of soil. Large rock is recruited into the stream bed from these side slopes. As a result, the channels in these reaches are also dominated by cobble and boulders. Reach 11 lies between the unnamed tributary at the top of Reach 11 and Quartz Creek.

Figure 6. Rock Creek Reach 11, segment 5 (top right), Reach 11, Segment 3 (top left), Reach 12, Segment 1 (middle left), Reach 12, Segment 2 (middle right), Reach 13, Segment 5 (lower left), and Reach 13, Segment 1 (lower right).

Reach 11 has an average gradient of 2%. The gradients in Reaches 12 and 13 average 3.3 and 3.5%, respectively. There are no roads near the canyon reaches and local landowners indicated that the slopes into the valley bottom are too steep for cattle to navigate, so the valley bottoms are not grazed. Vegetation is relatively dense along Reaches 11 and 12, but starts to thin out along Reach 13 as the stream gains elevation (Figure 6). Pools are typically shallower, reflecting the decreased flows in the headwaters. During the snorkel surveys, 134 *O. mykiss* were observed in Reach 11, primarily in Segment 5. Three *O. mykiss* were observed in Reach 12 and 2 were observed in Reach 13.

Quartz Creek, Reach 1, is similar to Rock Creek Reach 13 in that the gradient is steeper (3 percent) and the height of the adjacent hillslopes is somewhat reduced. The channel is confined in a relatively narrow valley bottom and is dominated by boulders and cobbles. Riparian vegetation is relatively dense along the creek (Figure 7).

Figure 7. Quartz Creek, Reach 1 Segment 3 (left) and Segment 4 (right).

Luna Gulch, reaches 1, 2, and 3, is a small tributary to Rock Creek. All three sampled segments have an average gradient of 1 percent. Reach 1 contains an abundance of alluvial deposits (cobble). Forty-one percent of Reach 1, Segment 1 and all of Reach 1, Segments 2 and 3 were dry at the time of sampling (Figure 8). Reaches 2 and 3 contained water throughout their length. Reed canary grass was abundant throughout reaches 2 and 3 (Figure 8). Riparian trees were largely absent along reach 1, but are present along most of reaches 2 and 3, although sparse in some areas of those reaches. No fish were observed in Reach 1 during the snorkel surveys. Snorkelers observed 180 *O. mykiss* in Reach 2, primarily in segment 2, and 21 *O. mykiss* were observed in Reach 3, segment 2. Dace were also present in reaches 2 and 3.


Figure 8. Luna Gulch, Reach 1 (top left), Reach 2 (top right and bottom left), and Reach 3 (bottom right).

Squaw Creek, Reach 1 is lined with a narrow band of riparian trees throughout most of its length (Figure 9). The stream is dominated by cobble and boulders and 27 percent of its length is dry. This reach is dominated by pools isolated by occasional dry segments. Segment 1 of Reach 1 was partially dry at the time of sampling. Snorkelers observed 17 and 21 *O. mykiss* in Segments 2 and 3, respectively. Dace were also present.


Figure 9. Squaw Creek, Reach 1, Segment 2 (left) and Segment 3(right).

Squaw Creek, Reach 2, Segments 1 and 2 were dry at the time of sampling. The reaches are low gradient with a poorly defined channel and a scattering of larger trees in the riparian area. Segment 3 contained a short length of dry channel, one very long, shallow, "glide", and a large pool (Figure 10). The channel was well-defined in this segment and lined with riparian trees of varying density. Eighty-eight *O. Mykiss* were observed in Reach 2, all in Segment 3. Dace were also present in Segment 3.

Figure 10. Squaw Creek Reach 2, Segment 1 (top left), Segment 2 (top right), Segment 3 glide (bottom left), and Segment 3 pool (bottom right).

Swale Creek, Reach 3, Segments 1 and 2 are low gradient channels that contained a shallow sequence of pools and riffles at the time of sampling (Figure 11). During the snorkel surveys, 427 *O. mykiss* and 533 dace were observed in segment 1. A few more *O. mykiss* and more dace were observed in Segment 2. Segment 3 was dry on each end, but had a long shallow glide in the middle of the segment. No fish were observed in Segment 3. Riparian vegetation was denser along the wetted portions of the reach.

Only 1 segment of **Squaw Creek, Reach 4** was sampled. The sampled segment was wetted along its entire length. The stream was shallow, confined to a narrow valley bottom, and lined short, brushy riparian vegetation (Figure 11). Eighty-three *O. Mykiss* were observed in segment 6 of the reach.

Figure 11. Squaw Creek, Reach 3, Segment 1 (top left), Segment 2 (top right), a dry reach of Segment 3 (bottom left), and a segment in Reach 4.

Squaw Creek, Reaches 5 and 6 were dry along their entire length at the time of sampling. **Squaw Creek, Reach 7**, Segments 1 and 2 were also dry (Figure 12). The rest of the length of Reach 7 had a gradient ranging from 2.5 to 5 percent. Segments 4 and 5 were within the area that burned in the Cleveland Fire of 1998 (www.wsp.wa.gov/fire/docs/mobilization/mobe_history_for_2008.pdf). The fire burned a total of 18,500 acres of timber and brush land in the headwaters of the Rock Creek basin, primarily in the Squaw Creek Subbasin. Squaw Creek is a shallow, narrow, plunge pool/riffle dominated stream throughout the majority of the segments in Reach 7. Only Segments 10 and 13 contained fish. Riparian vegetation is generally sparse (Figure 12).

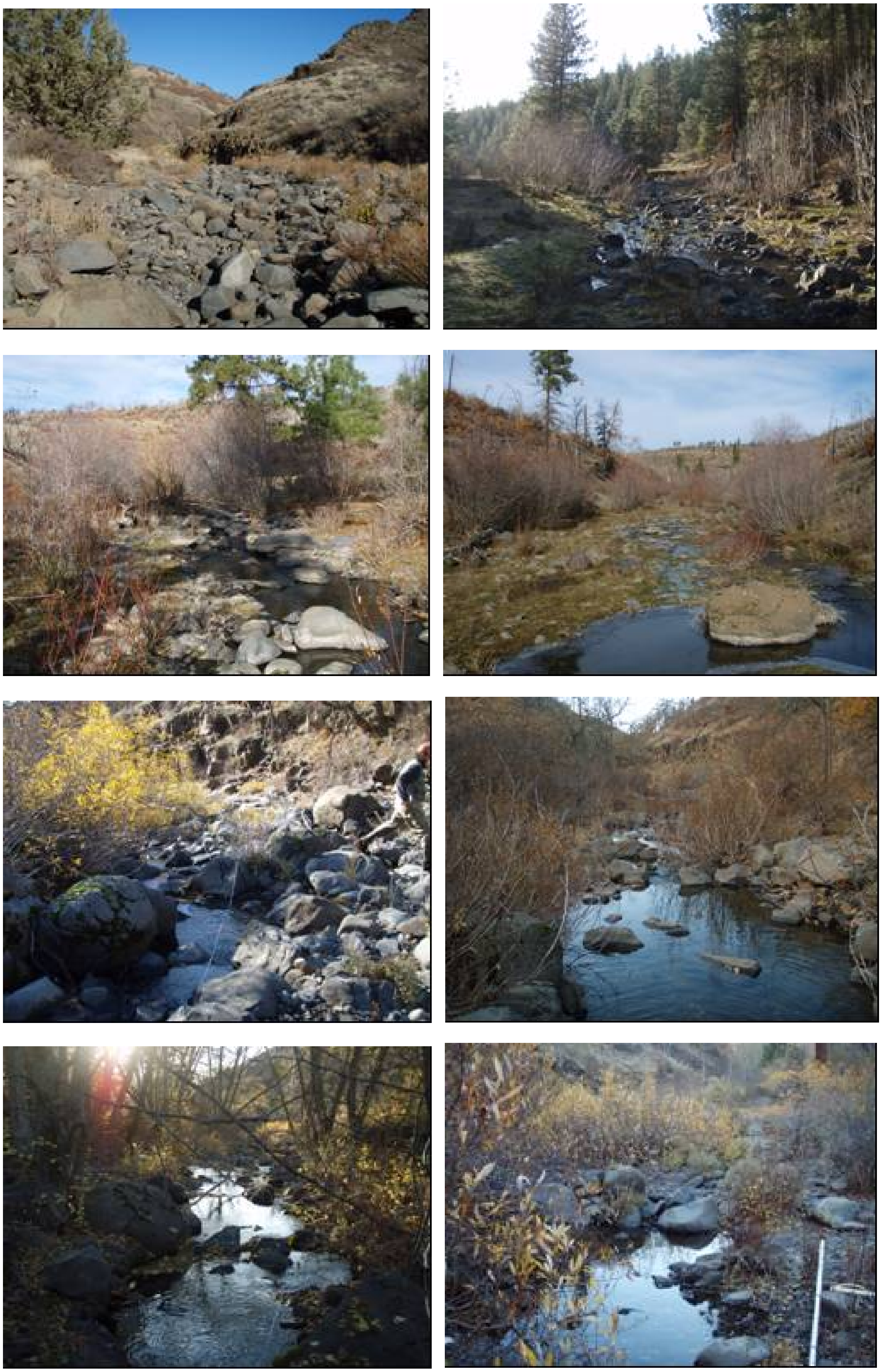

Figure 12. Squaw Creek, Reach 7, Segment 1 (first row, left), Segment 3 (first row, right), Segment 4 (2nd row, left) Segment 5 (2nd row, right), Segment 6 (3rd row, left), Segment 8 (3rd row, right), Segment 10 (4th row, left) and Segment 13 (4th row, right).

2.0 CHAPMAN CREEK

Chapman Creek, Reach 1 is a narrow creek with a sandy bottom and lots of large woody debris in the channel (Figure 13). The reach contains at least 4 beaver dams. A series of chutes extending 53 feet upstream is present in Segment 2. The segment includes one chute that is 4.0 feet high with a gradient of 8 degrees. A 10 foot long pool with a 9 foot average width and 1.0 foot maximum depth is present upstream of the first chute. Upstream of the pool is a 28 foot long cascade/fall with a 9.6 degree slope and 12 foot total height. This is not likely to be a migration barrier for steelhead, but may be a difficult passage at certain flows. There is no flow gage on Chapman Creek, so the range of flows is unknown. Upstream of the chutes, the stream gradient increases to 3.5 percent through Segment 3.

Figure 13. Chapman Creek, Reach 1, Segment 1 (upper left), chute in Segment 2 (right), and Segment 3 (lower left).

Chapman Creek, Reach 2, Segments 1 and 2 look much like Reach 1. Throughout the lower Reach 2, the valley bottom becomes increasingly incised between vertical walls extending upwards 10 to 20 feet high (Figure 14). The vertical walls are composed of loess (Aspect and WPN 2004), a fine-grained, wind-blown derived soil. Through Segments 3 and 4, the valley bottom narrows and the vertical walls on either side of the floodplain become more pronounced. Segments 5 through 8 are confined within the narrow cliffs; these segments have a gradient ranging from 1 to 2 percent. Segments 9 and 10 contain one very long riffle that extends beyond reach 10. Trees are present along most of the segments in Reach 2, primarily growing at the base of the cliff adjacent to the stream. Many of the channel units in Reach 2 are choked with aquatic vegetation (Figure 14). The substrate throughout Reach 2 is generally dominated by fine sediments. Boulders and large cobbles are present within the riffles but are rarely seen elsewhere.

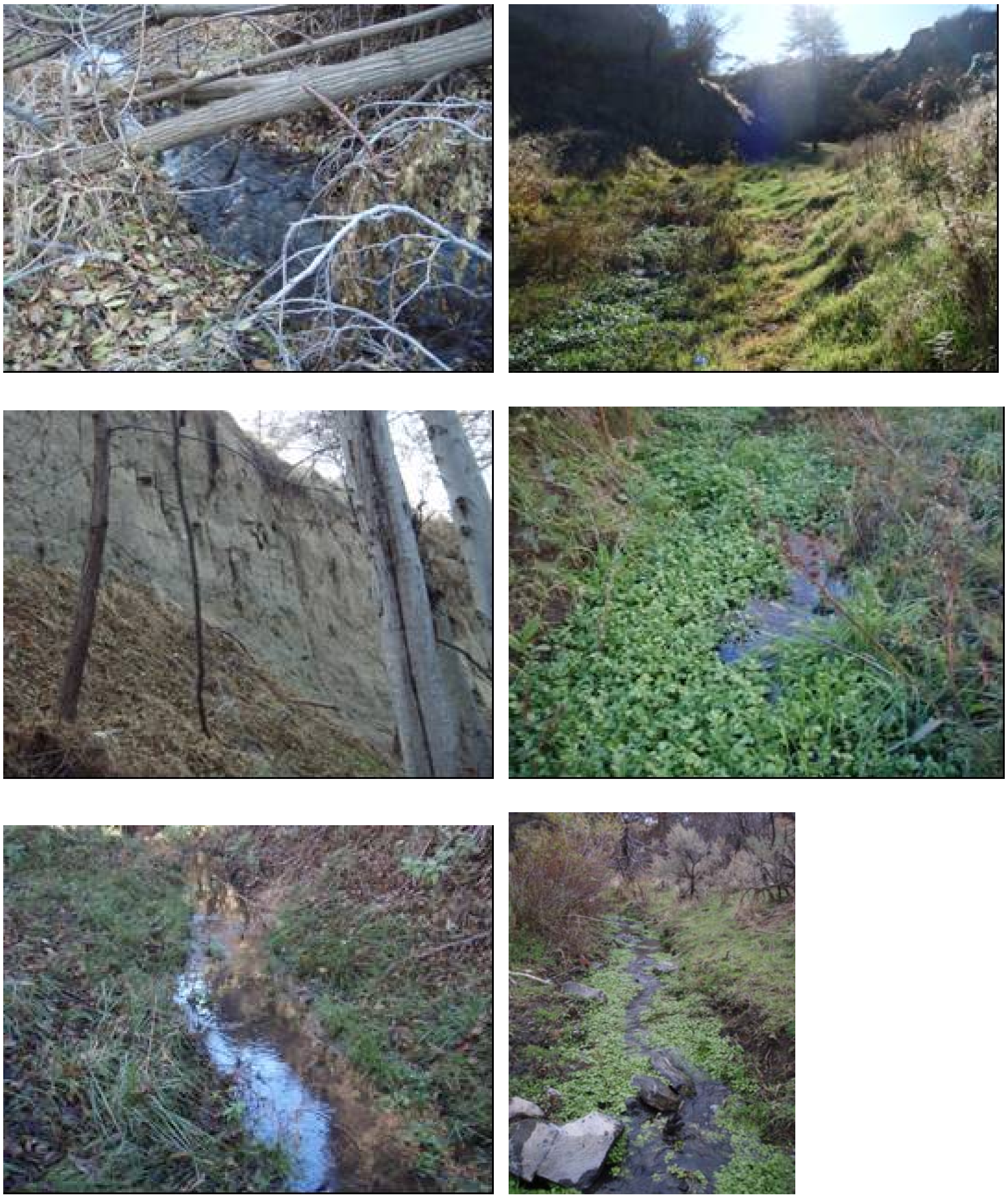

Figure 14. Chapman Creek, Reach 2, Segment 2 (upper left), Segment 3 (upper right), vertical banks composed of loess (middle left), Segment 3 (middle right), segment 7 (bottom left), and part of the long riffle spanning Segments 9 and 10 (bottom right).

Chapman Creek, Reach 3 contains at least 4 large beaver dams. Much of the riparian vegetation has been damaged, felled, or removed by beaver, including some very large trees (Figure 15). A complex of beaver dams ranging in length from 30 to 60 feet long is present between Segments 5 and 6.

Reach 3 is generally confined between vertical cliffs reaching 20 to 40 feet high (Figure 16). The creek has a well-developed floodplain at the base of the cliffs. Many of the riparian trees have been downed by beaver. Riparian vegetation is dominated by a dense growth of brush and forbs with scattered clusters of trees. The substrate continues to be dominated by fine sediments with scattered cobbles and boulders, reflecting the local geology (loess).

Figure 15. Beaver damaged trees in the riparian area of Reach 3, between segments 5 and 6.

Figure 16. Chapman Creek Reach 3, looking into canyon between the vertical cliffs adjacent to the valley bottom (top), Segment 2 (middle left), Segment 3 (middle right), Segment 5 (lower left), and Segment 6 (lower right).

3.0 WOOD GULCH

Wood Gulch, Reach 1, Segments 1 and 2 were 100% dry at the time of sampling (Figure 17). The substrate throughout Reaches 1 and 2 is generally dominated by cobble. Riparian vegetation includes a few scattered trees and brushy plants typical of local xeric (dryland) communities, suggesting water is rarely available in these reaches. Segment 3 was wetted its entire length at the time of sampling. The segment contained one pool and a length of shallow water running over cobble, boulders, and bedrock (Figure 17). The water depth averaged 0.6 feet in segment 3. No fish were observed in reach 1.

Figure 17. Wood Gulch, Reach 1, Segment 1 (top left), Segment 2 (top right), segment 3 (bottom left) and the one pool in segment 3 (bottom right).

Wood Gulch, Reach 2, contained 58% of the 434 *O. mykiss* observed in the entire Wood Gulch basin during the snorkel surveys. The majority of the *O. mykiss* were seen in Segment 1 (26% of the *O. mykiss* observed in the basin) and Segment 10 (25% of the observed *O. mykiss*). Segment 2, 4, and 7 also contained *O. mykiss*. All segments of Reach 2 contained an abundance of dace (2,535 dace were observed in Segment 2, which accounted for 96% of all the dace observed in the basin).

A series of weirs are located just downstream of Segment 1 (Figure 18). The weirs are not considered a fish barrier, but may hinder passage of smaller fish. The weirs are located a little downstream of a pipeline crossing.

Twenty-five percent of the length of reaches 1 and 2 combined were pools; the balance of the length was comprised of riffles. The substrate is composed of cobble, boulders, and bedrock. Riparian vegetation is largely limited to a narrow band of brushy plants with occasional small trees scattered along the creek (Figure 18). Gradient in Reach 2 ranged from 1 to 2 percent.

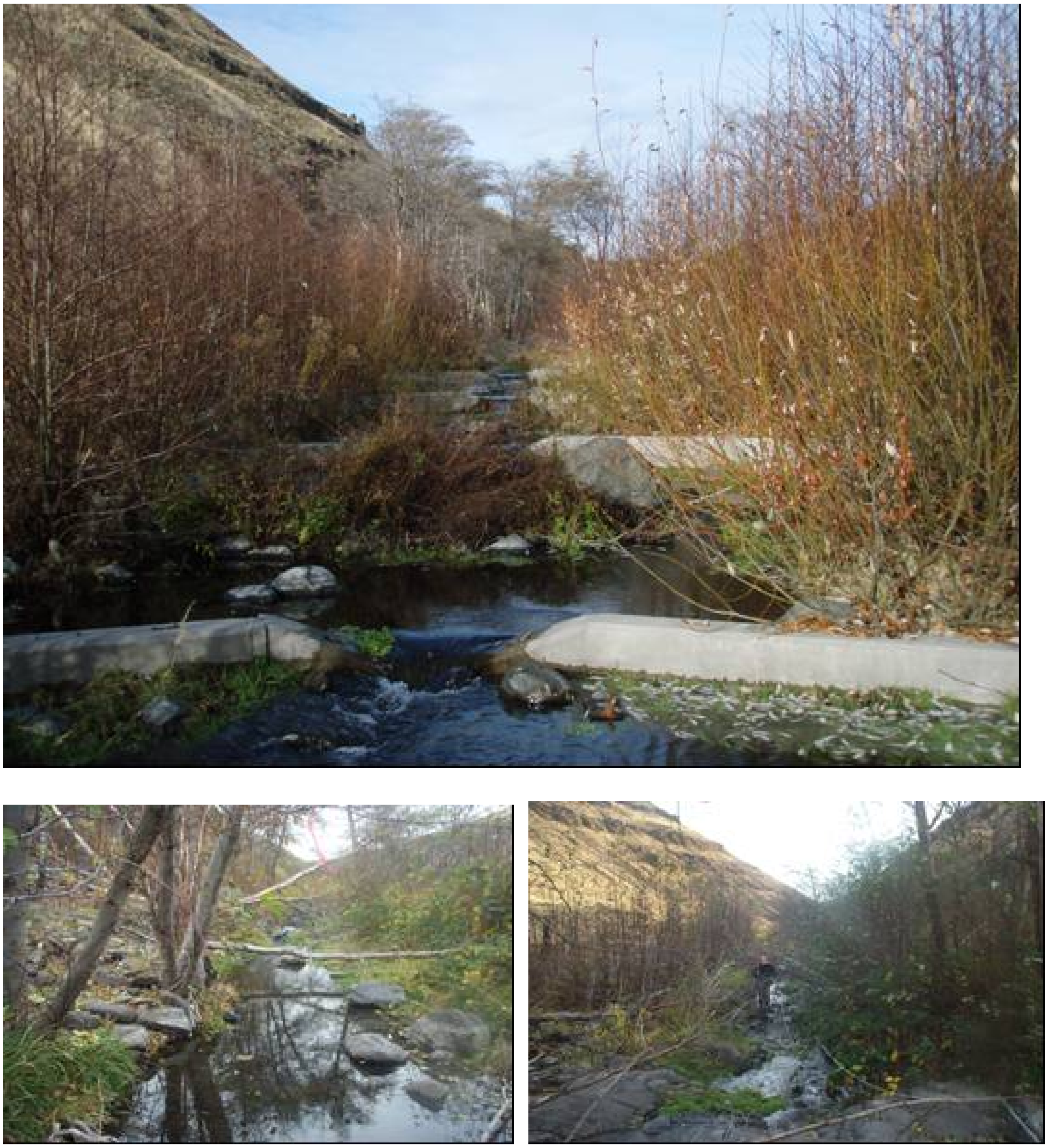

Figure 18. Weirs in Wood Gulch located downstream of Reach 2, Segment 1 (top), Reach 2, Segment 1 (bottom left) and Reach 2, Segment 2 (bottom right).

Reach 2, Segments 3 through 9 were all similar (Figure 19). The stream was narrow and shallow, flowing over cobble and boulders. A narrow band of brushy vegetation was present along each of the segments and occasional small trees were also scattered along the creek. Reaches 4 and 7 had the densest riparian vegetation and reaches and reaches 6 and 8 had very little vegetation along them.

Figure 19. Wood Gulch, Reach 2, Segment 3 (upper left), Segment 4 (upper right), Segment 6 (middle left), Segment 7 (middle right), Segment 8 (lower left), and Segment 9 (lower right).

Reach 2, segment 10 contained 110 *O. mykiss* (25% of the total observed in Wood Gulch) and 15% of the dace observed in the basin. The reach had one riffle and one 153 foot long pool which average 0.6 foot deep (Figure 20). Riparian vegetation was somewhat denser than observed in the other segments in Reach 2.

Figure 20. Wood Gulch, Reach 2, Segment 10 showing the pool in the reach (left) and the riffle (right).

Wood Gulch, Reach 3 is located upstream of the confluence with Big Horn Canyon and runs through a steeper section of terrain; gradients ranged from 2 to 17 percent. Reach 3 contained a series of four waterfalls, all of which are considered to be passable by fish under higher flows (Figure 21). Waterfall 1 was located just downstream of Segment 4 and Waterfalls 2, 3, and 4 were located just downstream of Segment 5.

Figure 21. Wood Gulch, Reach 3 waterfalls: Waterfall 1 (upper left), Waterfall 2 (upper right), Waterfall 3 (lower left), and Waterfall 4 (lower right).

Wood Gulch, Reach 3, contained 38 *O. mykiss* and 111 dace; the majority of both species were found in Segment 10. Several segments within the reach were affected by the Wood Gulch fire.

Segments 1 and 2 were the steepest segments in Reach 3. Stream gradients in segments 1 and 2 were 17 percent and 6.5 percent, respectively. These stream segments have stands of oaks on one or more of the banks, many of which are scarred with sign of an understory burn (Figure 22). The channel is dominated by gravel, cobble, and boulders.

Figure 22. Wood Gulch, Reach 3, Segment 1 (upper left), Segment 2 (upper right), and fire scarred trees along Segment 2 (lower).

Wood Gulch, Reach 3, Segments 4 through 12 are all 1 to 3 percent gradient streams with the exception of segment 7 which had an average gradient of 5 percent. The substrate is predominantly cobble and boulder. All the reaches are pool/riffle complexes. The riparian areas were 5 to 25 feet deep and contained young to mature alder (Figure 23). Many of the trees in segments 4, 5, and 7 were scorched or damaged by fire. Sixty-one (61) dace and 19 *O. mykiss* were observed in Segments 4 through 12 during the snorkel surveys. Most of these fish were in segments 5 and 10.

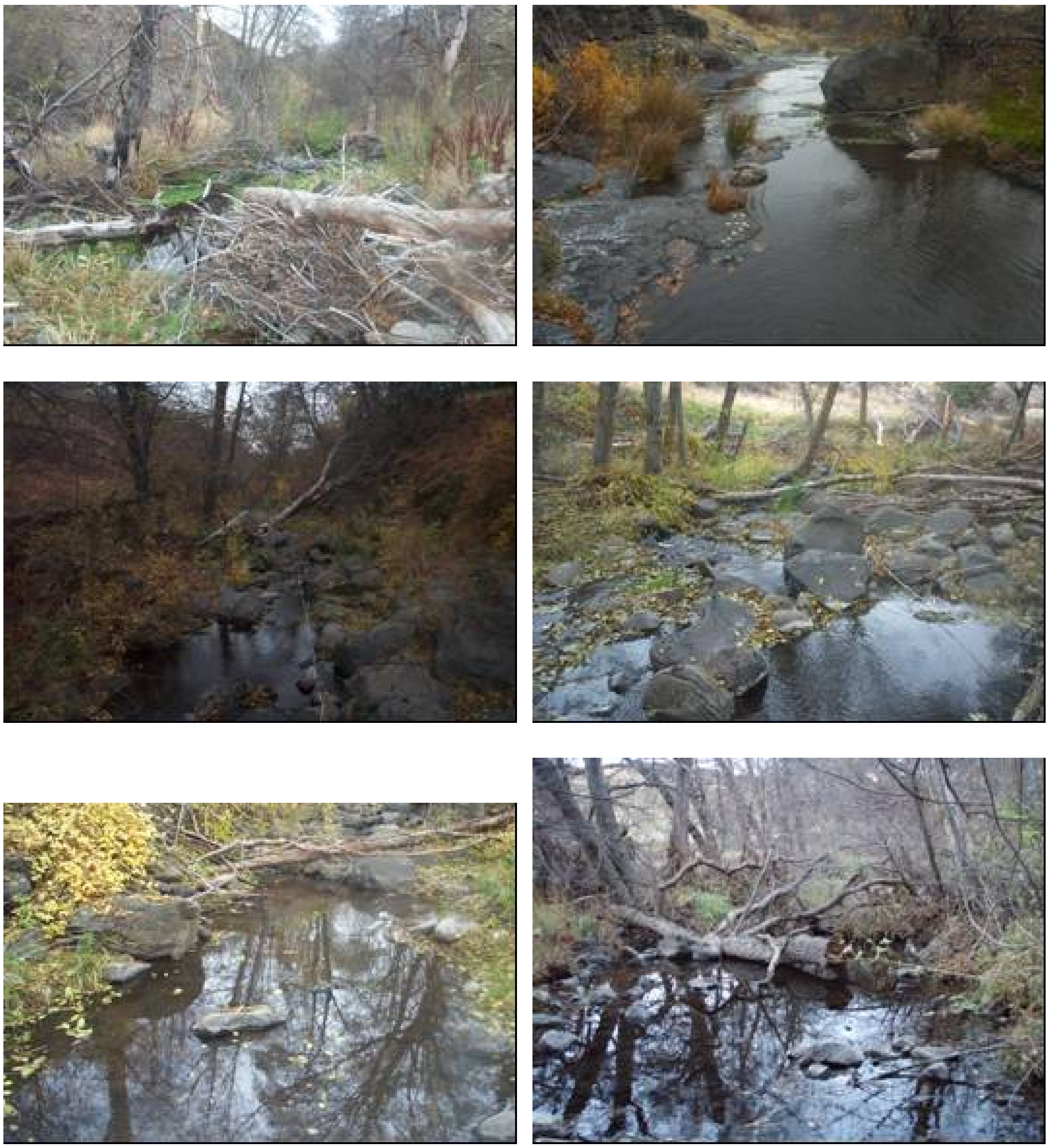

Figure 23. Wood Gulch, Reach 3, Segment 4 (top left), Segment 5 (top right), Segment 7 (middle left), Segment 10 riffle (middle right), Segment 10 pool (bottom left) and Segment 12 (bottom right).

Wood Gulch, Reach 4, Segment 3 was dominated by pools (89 percent of the segment length). The segment has an average slope of 0.5 percent. Riparian vegetation along Segment 3 was sparse and consisted primarily of alder and various shrub species (Figure 24). The segment contained 28 *O. mykiss* and no dace.

Figure 24. Wood Gulch, Reach 4, Segment 3 (upper left), Segment 6 riffle (upper right), Segment 6 pool (lower left), and Segment 9 (lower right).

Reach 4, Segment 6 contained no dace and 96 *O. mykiss* (22 percent of the *O. mykiss* observed in the Wood Gulch basin), which appeared to be primarily resident trout based on their size distribution. The segment had a 1.75 percent grade. Alder was the dominant tree species in the riparian area (Figure 24). The substrate in the riffles was large comprised of larger gravel, cobbles, and boulders.

Reach 4, Segment 9 contained no fish. The reach was a pool/riffle complex with a 1 percent grade, lined with small alders (Figure 24). The substrate in the riffles was of coarse material; however, the riffles also contained an abundance of upland grasses and forbs, suggesting that flow may not have been present during the summer months. It was raining on the day the reach was sampled.

Wood Gulch, Reach 5 was largely dry at the time of sampling. Only two segments had water in them. A large marsh was present in Segment 3; the marsh covered 68 percent of the length of the segment (Figure 25). Segment 3 also contained a large pool and a short glide, but no riffles. Eight percent of Segment 3 was also dry. The entire length of Segment 6 was a combination of shallow pools and glides (Figure 26). There were no fish in the wetted areas of Reach 5.

The channel bottom throughout Reach 5 contained an abundance of large, broken rock. The substrate within the channel reflected the rocky condition of the upslope areas (see Figure 25, upper left). The riparian vegetation in this area is transitioning to a mix of ponderosa pine and white oak, with willow near the steam. The entire reach had a 1 percent gradient.

Figure 25. Wood Gulch, Reach 5, Segment 1 (top left), Segment 2 (top right), marshy area in Segment 3 (bottom left), and pool in Segment 3 (bottom right).

Figure 26. Wood Gulch, Reach 5, Segment 4 (upper left), Segment 5 (upper right), Segment 6 (lower left) and Segment 7 (lower right).

4.0 PINE CREEK

Pine Creek, Reach 1 is intermittently dry. Note, the numbering of the Segments in Reach 1 is not sequential. The segments are ordered from downstream to upstream in the following order: Segment 3, Segment 11, Segment 6, Segment 9, Segment 10, and Segment 1 (see maps in Appendix A). Segments 1, 2, 3, 9, and 45 percent of segment 10 were dry (Figure 27). The reach has an average gradient of 1 to 2 percent with the exception of Segment 11 which had a gradient of 3 percent. The substrate in the channel is dominated by coarser material, reflecting the raveling hillslopes in the area. Riparian widths ranged from zero (along segments 3 and 4) to 25 feet deep. In general, riparian vegetation was sparse along most of the reach. Forty O. mykiss (resident) were observed in the reach, most of which were observed in Segment 11. Dace were also present in Segment 10.

Figure 27. Pine Creek, Reach 1, Segment 3 (top left), Segment 6 (top right), Segment 9 (middle left), Segment 10 dry section (middle right), Segment 10 wetted section (bottom left), and Segment 11 (bottom right).

Pine Creek, Reach 2 was intermittently dry. Sections 3, 7, 8, and 9 were sampled. Note, the numbering of the Segments in Reach 2 is not sequential. The segments are ordered from downstream to upstream in the following order: Segment 9, Segment 3, Segment 7, and Segment 8 (see maps in Appendix A). Section 3 was 52 percent dry, Section 7 was 70 percent dry, Section 8 was 50 percent dry, and Section 9 was wetted along its entire length. There is a waterfall present between Section 9 and Section 2. The waterfall is considered passable provided sufficient flow is present. Channel gradients in Sections 2 and 7 were 2 percent. Gradient in Sections 8 and 9 were 3 to 4 percent. The riparian zone tended to be 15 to 20 feet deep, dominated by willow near the creek. Juniper was the dominant species in the outer riparian zone. Four resident *O. mykiss* were found in Segment 7 and 2 were found in Segment 9. Segment 9 also contained dace.

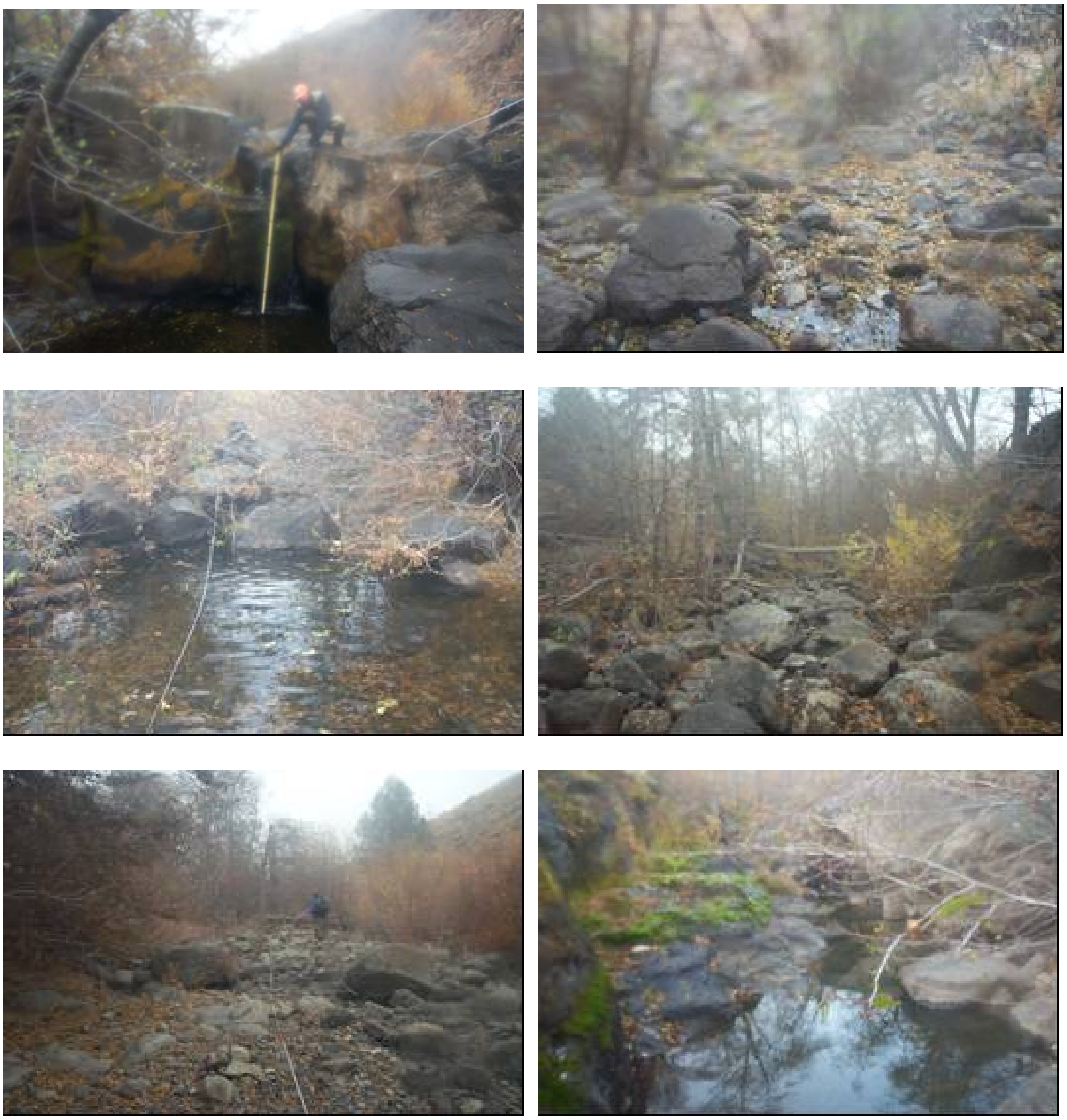

Figure 28. Pine Creek Reach 2, waterfall between Segments 2 and 9 (upper left), Segment 3 (upper right), Segment 7 (middle left), Segment 8 (middle right), Segment 8 (lower left), and Section 9 (lower right).

Pine Creek Reach 3 was largely intermittent. Note, the numbering of the Segments in Reach 3 is not sequential. The segments are ordered from downstream to upstream in the following order: Segment 4, Segment 1, Segment 5, Segment 3, and Segment 28 (see maps in Appendix A). Segment 1 was 45 percent dry, Segment 2 was 32 percent dry, Segment 3 was 79 percent dry, Segment 4 was 48 percent dry, and Segment 5 was wetted along its entire length. The entire reach had an average gradient of 1 percent. The substrate was dominated by gravel and cobble (Figure 29). Inner riparian widths ranged from 5 to 20 feet; willow and alder dominated the inner zone and juniper was the most common tree species in the outer zone. No fish were found in Segments 1, 2, or 3. Twenty-one dace were observed in Segment 4 and 3,800 dace were observed in the pools of Segment 5.

Figure 29. Pine Cree, Reach 3, Segment 2 (upper left), Segment 3 (upper right), Segment 4 (lower left), and Segment 5 (lower right).

Pine Creek, Segment 4 was sampled at four locations, segments 1, 3, 6, and 7. Note, the numbering of the Segments in Reach 4 is not sequential. The segments are ordered from downstream to upstream in the following order: Segment 1, Segment 6, Segment 7, and Segment 3 (see maps in Appendix A). All of the reaches were wetted along their entire length, although flow was barely exposed among the rocks in the substrate in many places (Figure 30). The inner riparian areas were dominated by alder and white oak and juniper were the dominant tree species present upslope of the riparian area. The gradient of the reach ranged from 1 to 1.5 percent. All the reaches were of a pool/riffle type complex with large gravel and cobble in the substrate. Dace were found in all the reaches. Reach 2 was not selected as part of randomly selected reaches to be sampled; nevertheless, a pool just upstream of segment 1 was snorkeled by the field crews because they thought they saw *O. Mykiss*. One hundred dace and 22 resident *O. mykiss* were found in the pool.

Figure 30. Pine Creek, Reach 4, Segment 1 (upper left), Segment 3 (upper right), Segment 6 (lower left), and Segment 7 (lower right).

5.0 GLADE CREEK

Glade Creek was sampled in May of 2009. Three reaches were identified between the mouth and the confluence of the East Branch with the mainstem (roughly 3.5 miles total). The surveyed portions of the creek had a gradient of less than 1.5 percent. The water was quite turbid, limiting the efficiency of the snorkeling efforts. Much of the area sampled contained wetlands and marshes. There were few riffles in the sample area. There is a large wetland located at the confluence of the two forks. Field crews continued up the creek past the confluence of the two forks to do some reconnaissance of the wetland and conditions further upstream. The following provides a photo overview of the characteristics of the creek.

Glade Creek, Reach 1 was located in a large marsh/wetland upstream of Highway 97 (Figure 31). The entire length of it was classified as pools and glides. No fish were observed in Segments 1 and 3, but 21 dace were observed in Segment 2.

Figure 31. Glade Creek, Reach 1 looking upstream at the marsh/wetland from Highway 97 (top left), Segment 1-1 (top right), Segment 1-2 (bottom left), Segment 1-3 (bottom right).

Glade Creek, Reach 2, Segment 1 was a long riffle, Segment 2 contained a combination of pools and riffles, Segment 3 contained a complex of glides, pools, and riffles, and Segment 4 was mostly pool (Figure 32). Segment 4 was the only segment snorkeled. Thirty dace were observed in the Segment.

Glade Creek, Reach 3 was largely a complex of mashes, pools, and glides (Figure 33). Only Sections 4 and 7 were snorkeled due to poor visibility. No fish were observed in either Section. Portions of Reach 3 are lined with a commercial cottonwood farm.

Glade Creek Wetland Upstream of Reach 3 extends upstream for approximately 2 river miles (Figure 34). One beaver dam was observed and others may be present. The wetland was spot-snorkeled and a few dace and numerous 3-spine sticklebacks were observed. A commercial cottonwood farm is present near much of the wetland.

Upstream of the wetland, Glade Creek is a sinuous, low gradient stream with a substrate composed of fine material reflecting the abundance of loess in the basin (Figure 35).

Figure 32. Glade Creek, Reach 2, Segment 1 (upper left), Segment 2 (upper right), Segment 3 (lower left), and Segment 4 (lower right).

Figure 33. Glade Creek, Reach 3, Segment 4 (left) and Segment 7 (right).


Figure 34. Glade Creek, wetland upstream of Reach 3 (left and right) and a beaver dam in the wetland (right).


Figure 35. Glade Creek upstream of wetland (left and right).