CHAPTER 4.0 AFFECTED ENVIRONMENT

This chapter describes the existing conditions in the Ahtanum Creek Watershed that would be affected by the ACWRP.

4.1 Earth

This section summarizes the geologic and geomorphic setting for the Ahtanum Creek Watershed. The focus of the discussion is the potential for erosion and sedimentation.

4.1.1 Geologic and Geomorphic Overview

The Ahtanum Creek Watershed straddles two very different physiographic and geologic provinces: the Cascade Mountains in the western part of the watershed and the Columbia Plateau to the east. East to west trending rounded or flat-topped ridges characterize the upper Ahtanum Creek and tributary watersheds, where deep, steep-walled canyons cut into the eastern foothills of the Cascade Mountains. The valleys and floodplains widen in the middle portion of the watershed near the confluence of the North Fork and South Forks with the mainstem; the valley continues to widen as Ahtanum Creek flows eastward toward the Yakima River. Elevations range from 940 feet where Ahtanum Creek joins the Yakima River to 6,981 feet at the creek's headwaters on Darland Mountain in the western portion of the watershed.

The geology of the Ahtanum Creek Watershed is dominated by Columbia River Basalts, which underlie a large portion of the watershed and control much of its topographic character. The Columbia Basin Basalts eruptions began~~ed~~ between 15 and 16 million years ago, transforming much of eastern Washington into a broad, flat basin. Later, as the north to south trending Cascade mountain range developed, the basalt flows were tilted and uplifted into a series of east to west trending folds that formed ridges along the eastern slopes of the Cascades. Flows of the Columbia River Basalt Group overlap a wide variety of rocks and structures along the northwestern margin of the basalt, including several large fault-bounded basins. The basalts are probably 5,000 feet thick on the eastern edge of the watershed, transitioning to less than 500 feet thick in the western upper end of the drainage (WDNR, 1997a). Between eruptions, lakes and streams deposited blankets of fine sediment buried by later basalt flows. These deposits form the sedimentary layers located between successive basalt layers. The sedimentary rock and cemented gravel thicken from west to east. Alluvium covers the floor of the lower Ahtanum Valley, and cemented sand and gravel form the ridges and upland terraces north of Ahtanum Road.

Recurring cycles of Pleistocene (1.81 to 0.01 million years ago) alpine glaciation in the Cascade Mountains within the upper Ahtanum Creek Watershed created glacial cirques in the heads of some tributary drainage basins. The basalt flows overlap into the eastern edge of the Cascade Mountains. Differential erosion of individual basalt flows developed a cliff-bench or stair-stepped profile along canyon walls of the upper and middle portions of the watershed. Numerous catastrophic floods during the Pleistocene inundated the lowlands of the watershed, modifying the topography and depositing fine to coarse unconsolidated materials (Dames and

Moore, 1999a). These flood deposits extend through the lower watershed and cover~~define~~ much of the wide floodplain in this area (Golder, 2004).

Soils in the watershed have been mapped by the Natural Resource Conservation Service (formerly known as the Soil Conservation Service) (2003). General soil groups present in the watershed are shown on Figure 4-1 and are briefly described below. Soils mapping is unavailable for large portions of the Yakama Reservation.

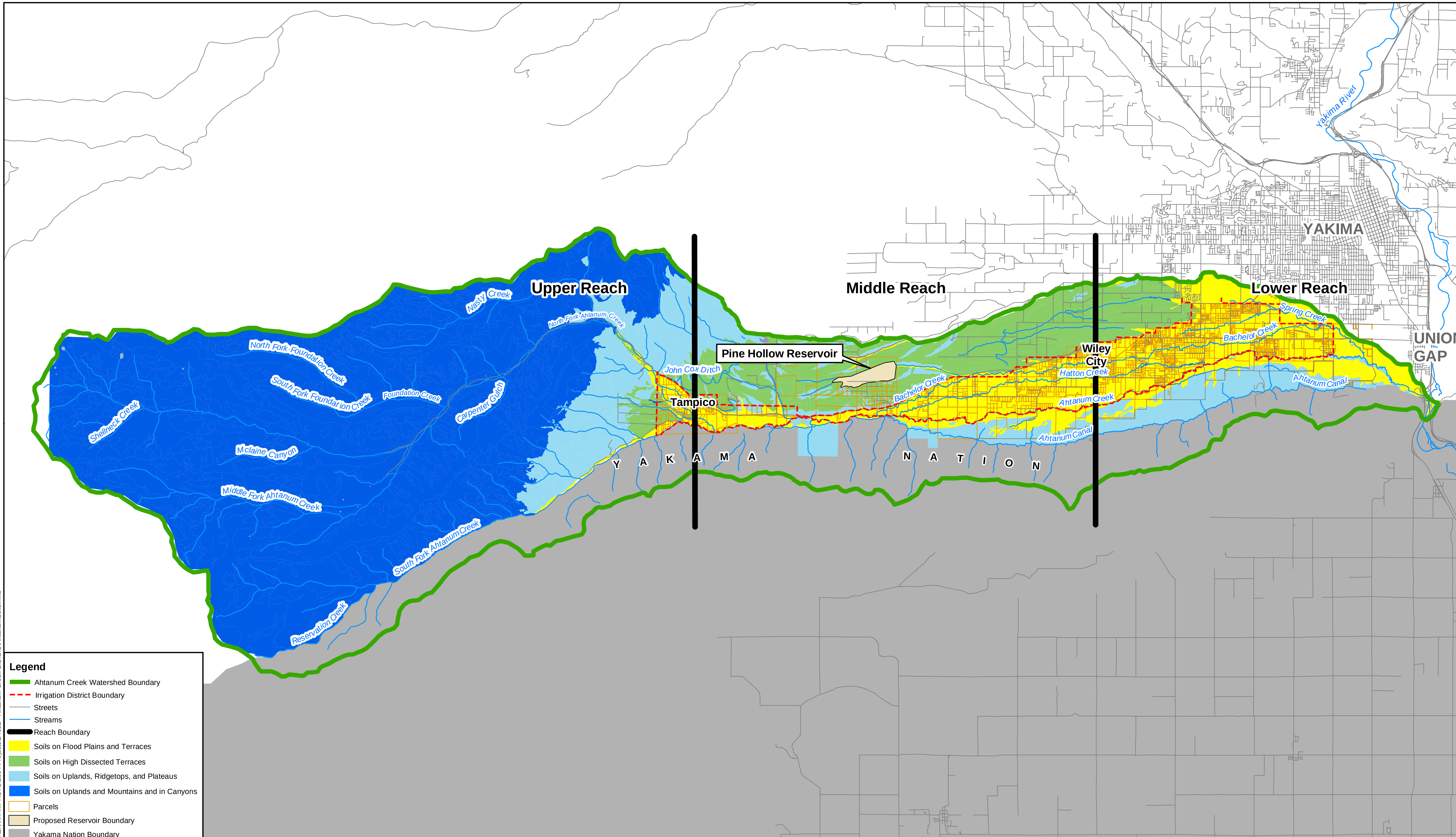
Access roads are a major source of sediment delivery to streams in the Ahtanum Creek Watershed. Early in the twentieth century, road access was initiated from the lower ends of Ahtanum Creek, and tributary streams and the valley bottoms provided the easiest transportation routes (WDNR, 1997a). As a result, roads parallel all of the major streams in the watershed for much of their length, often on the active floodplain and close to the channel. These streamside roads, particularly improperly drained gravel- and dirt-surfaced roads, contribute to generally high rates of sediment deposition in stream channels (WDNR, 1997a).

4.1.2 Upper Reach

Canyons and stream courses dissect the landscape of the upper reach of the Ahtanum Creek Watershed (Figure 1-2). The relief is generally steep. Alpine glacial erosion created broad U-shaped valleys at high elevations, while streams formed narrower V-shaped canyons in the lower portions of the drainages. During and after glaciation, large quantities of glacial drift were deposited in the form of moraines, outwash, and lacustrine materials (WDNR, 1997a). Erosion has dissected the Columbia River Basalts to expose pre-basalt units in the valley bottoms. These older, exposed units are composed of metamorphosed marine sediments and volcanic rocks (WDNR, 1997a). In the middle of the upper reach of the watershed, later basalt flows interfinger with the Ellensburg formation. The Ellensburg formation is a sedimentary formation consisting of weakly cemented gravels, silts, sands, and clays that were deposited by debris flows and gravel bedload (Figure 4-2) (WDNR, 1997a).

Stream courses in the middle portion of the upper reach of the Ahtanum Creek Watershed transition from narrow, steep headwater channels to low-gradient systems in the valley bottoms. The very high-gradient headwater channels are subject to intermittent scour by torrent and debris flows (Montgomery and Buffington, 1993). As the gradient decreases, the headwater channels transition into moderately steep tributary streams; these moderately steep channels rapidly convey increased sediment inputs and are minimally responsive to inputs of sediment, bedload, and wood (WDNR, 1997a). In the widening stream valleys of the lower portions of the upper watershed, the low gradient tributary and mainstem channels of the South and North Forks of Ahtanum Creek have defined floodplains and are more morphologically sensitive; these streams have the potential for significant channel adjustment in response to increased flow and inputs of sediment, bedload, and woody debris (Montgomery and Buffington, 1993).

Large, ancient deep-seated landslides have shaped significant portions of the landscape in the upper Ahtanum Creek Watershed (WDNR, 1997a). Recent landslides, however, are rare. The low rate of recent landslides is the result of minimal annual precipitation and generally stable soil and bedrock units (WDNR, 1997a).



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Map data are the property of the sources listed below.
Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data dipiction.

SOURCE: Ahtanum EIS, 2004; USGS topographic map, 1995
NRCS-SSURGO, 2002

0 6,250 12,500 25,000 37,500 50,000
Feet

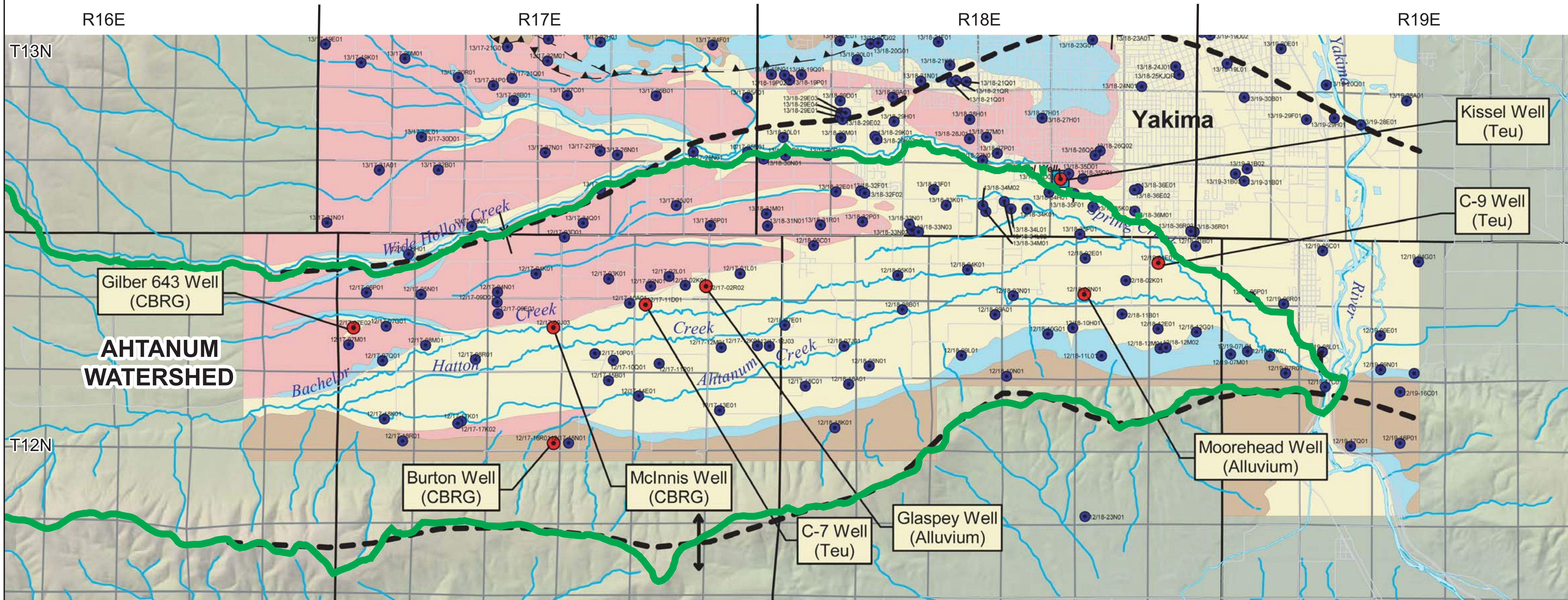
1:150,000
1 inch equals 12,500 feet

FIGURE 4-1

AHTANUM CREEK WATERSHED GENERAL SOIL UNITS

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON



LEGEND

12/17-17K	Well Location and ID
Surficial Geology	
Qal	Quaternary Alluvium
Ttg	Pliocene Thorp Sand and Gravel
Qta	Tieton Andesite
Teu	Upper Ellensburg Formation
Tes	Selah Member (Lower Ellenburg Formation)
Tev	Vantage Member (Lower Ellensburg Formation)
CRBG	Columbia River Basalt Group

- Lake / Major River
- Stream
- Major Road
- City Limits
- Wells
- Ahtanum Watershed
- High-Angle Reverse Fault (approximate location)
- Anticline - Showing Trace of Crestline (dashed where inferred)
- Syncline - Showing Trace of Troughline (dashed where inferred)
- Wells with long term water-level data (Completion formation in parenthesis)

0 10,000
Scale 1" = 10,000 Feet

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet

Source: USGS, WSDOE, WSDOT, WDFW, Golder Associates

NOTE: Information provided by the well owner indicates that the McInnis Well is actually located 300 feet south of Bachelor Creek.

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SOURCE: Golder Associates, 2003

FIGURE 4-2

GENERALIZED GEOLOGIC MAP OF THE LOWER AHTANUM VALLEY

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

Slope aspect exerts a strong influence on vegetation and soil development. North facing slopes typically have more dense vegetation and are likely to have more pronounced soil profile development because of higher soil moisture. In general, soils on the north-facing slopes of the upper reach are deep and well drained, have moderate permeability, and have a surface consisting of stony loam. Soils in the upper reach of the watershed consist mainly of the Jumpe-Sutkin-Sapkin and Rock Creek-McDaniel soil map units (Figure 4-1) (NRCS, 2003). These soil units are well drained. They formed in residuum (mineral material that accumulated as consolidated rock and disintegrated in place) and/or colluvium (soil material and/or rock fragments moved by creep, slide, or local wash and deposited at the base of a steep slope) derived from basalt containing a minor amount of loess (fine-grained wind deposited material) and volcanic ash. The surface layer is a stony loam to very stony loam. The erosion potential of these soils is moderate. A combination of glacial deposits and wind-blown material form soils in the higher elevations of the upper reach of the watershed.

Residential development, recreational vehicles, and roadways in proximity to the creek and riparian area have resulted in significant impacts to bank stability and sedimentation upstream of Tampico on both the North and South Forks of Ahtanum Creek (Yakima Subbasin Fish and Wildlife Planning Board, 2004). The Washington Department of Natural Resources (WDNR) has completed a watershed analysis on the upper North Fork and South Fork Ahtanum basin that examined the delivery of sediment to stream channels. These studies indicate that the high-density road networks in the upper reach increase the contribution of fine-grained sediments into the streams (WDNR, 1997a).

4.1.3 Middle and Lower Reaches

The middle and lower reaches of Ahtanum Creek are characterized by a broad valley and wide floodplain (Figure 4-1). Loess deposits can be found throughout the lower watershed on top of major geologic formations. This unconsolidated, silt-sized, basalt rich sediment was deposited by wind and varies in depth from 0 feet on exposed southeast ridge flanks to over 20 feet on protected slopes (north side). The source of most of the loess is considered to be the Glacial Lake Missoula Flood sediments, which were deposited by wind from the southwest blowing across the area over the past 20,000 years. The modern soil and most of the farmlands are developed on these loess deposits. Soils in the middle and lower reaches of the watershed consist mainly of Harwood-Gorst-Selah soil units on highly dissected terraces, and Weirman-Ashue and Umapine-Wenas soil units on floodplains and terraces (NRCS, 2003). The Harwood-Gorst-Selah soils are well drained and formed in loess and old alluvium (material deposited on land by streams). The Weirman-Ashue and Umapine-Wenas soil units formed in alluvium. Drainage of these soil units varies from excessively well drained to poorly drained. The surface layer is loam to loamy fine sand. The erosion potential of these soils is slight to moderate. These soils are also subject to periods of flooding.

The lower mainstem Ahtanum Creek flows through a wide valley with an extensive floodplain. The channel through the lower watershed is low gradient and moderately sinuous, and the floodplain increases in width downstream of the confluence of the North and Middle Forks of Ahtanum Creek. Glacial Lake Missoula Flood deposits underlie much of the wide floodplain in the lower watershed. The channel through the lower watershed exhibits high stream powers during peak flow events and is very sensitive to inputs of sediment. Recent habitat studies completed in the lower watershed indicate that accumulations of sediments in Ahtanum Creek are contributing to habitat degradation. There are specific areas in the lower reach of Ahtanum Creek where both fine- and coarse-grained sediments are causing a variety of problems with water and bedload conveyance, channel form, and channel forming processes, all of which are leading to aquatic habitat changes (Golder, 2004). To date, there have been no comprehensive assessments of sediment transport and channel deposition linking the upper, middle, and lower Ahtanum Creek Watershed (Golder, 2004).

4.2 Surface Water

This section summarizes the characteristics of surface water in the Ahtanum Creek Watershed.

4.2.1 Surface Water Overview

The Ahtanum Creek Watershed consists of approximately 116,000 acres from which surface water runoff is collected and conveyed through Ahtanum Creek and its tributaries. Stream flow in the watershed is typically characterized by the occurrence of high stream flows during the late spring and early summer and low flows during the late summer and early fall.

Stream flow through the upper watershed is influenced primarily by snowmelt and rainfall. As reported in the *Ahtanum Creek Watershed Assessment* (Golder, 2004), precipitation varies from less than 10 inches a year in the lower watershed near the Yakima River, to more than 40 inches a year in the higher elevations along the west end of the upper watershed. A significant portion of the precipitation falls over the upper watershed as winter snow. High stream flows during the late spring and early summer are primarily due to snowmelt runoff from the upper watershed. As was noted previously, the upper watershed includes mountainous terrain, and steep, narrow stream channels. These channels convey runoff from rainfall and snowmelt to the North and South Forks of Ahtanum Creek.

The North and South Forks join near Tampico to form the mainstem of Ahtanum Creek (Figure 1-1). The mainstem of Ahtanum Creek collects and conveys surface water through the middle and lower reaches of the watershed. Stream flows in the middle and lower portions of the watershed are influenced by flows from the upper watershed, diversions for irrigation, and interaction between surface water and groundwater. In lower portion of the upper reach and in the middle reach, the stream transitions to wider, more gently sloping channels. Because of the gentle slope and broad floodplain that characterizes the lower reach, surface water flows through a network of natural stream channels, including Bachelor and Hatton Creeks.

There are currently conflicting demands for surface water within the Ahtanum Creek Watershed. Agriculture is the primary land use in the watershed, and surface water is generally the preferred source of irrigation water. Ahtanum Creek and its tributaries also provide habitat for fish and wildlife.

Evaluation and analysis of surface water conditions in the watershed have focused on the North Fork and mainstem of Ahtanum Creek, because the flow of surface water in those streams would be influenced by the ACWRP. Current surface water conditions are described in the following sections.

4.2.2 Upper Reach

The upper reach consists primarily of the South and North Forks of Ahtanum Creek. The North Fork is the larger of the two tributaries, and currently provides surface water for irrigation to the Johncox and Shaw Knox Ditches. Previous studies indicate that the upper watershed includes long reaches of stream that would be considered excellent habitat for fish species. However, low flow conditions in the lower watershed have created problems for fish passage; therefore, the habitat in the upper watershed is not being fully used by fish.

Historical stream flow data for the upper watershed have been gathered by gauges operated by the U.S. Geological Survey (USGS) for water years[1] 1911 to 1978, by the WIP for water years 1979 to 1992, and by the AID for water years 1993 to 1998 on both the North and South Forks of Ahtanum Creek. Although the gauges have not been operated continuously during the periods shown, the set of average daily flow data is complete from water year 1932 to water year 1992. Several months of available data are also available through water year 1998. These gauges are located above the irrigation diversions, so the flows measured represent naturally occurring stream flow conditions. Stream flows in the upper watershed are primarily influenced by snowmelt and rainfall.

Analysis of flow records indicate that the mean monthly stream flow for the North Fork ranges from a low of approximately 20 cfs in September and October to a high of approximately 190 cfs in May. Mean monthly stream flows for the South Fork range from a low of approximately 7 cfs in September and October to a high of approximately 46 cfs in May. Peak flows during flooding have been as high as 1,230 cfs on the South Fork and 1,580 cfs on the North Fork (both occurring on January 15, 1974). No data are available from the most recent large flood that occurred in February 1996.

Figure 4-3 illustrates the pattern of runoff from the upper reach of the Ahtanum Creek Watershed. Mean monthly flows from the period of available flow records for the North and South Forks (water year 1932 to water year 1998) are plotted and compared to records for dry (water year 1977) and wet (water year 1951) years. The graph illustrates the difference in stream flow and water supply that occurs during dry years. The mean monthly flow in May 1977 (dry year) on the North Fork was approximately 28 cfs, or 162 cfs less than the historical mean for that month.

Flows with a recurrence interval of approximately 1.5 to 2 years have been identified as "channel-forming" flows, or flows that have statistically been determined to be most active in forming the channel and transporting sediment. The channel-forming flow was determined by calculating the recurrence interval for flows in the North Fork based on historic stream flow data. The data indicated that channel-forming flows are likely in the range of 350 to 400 cfs.

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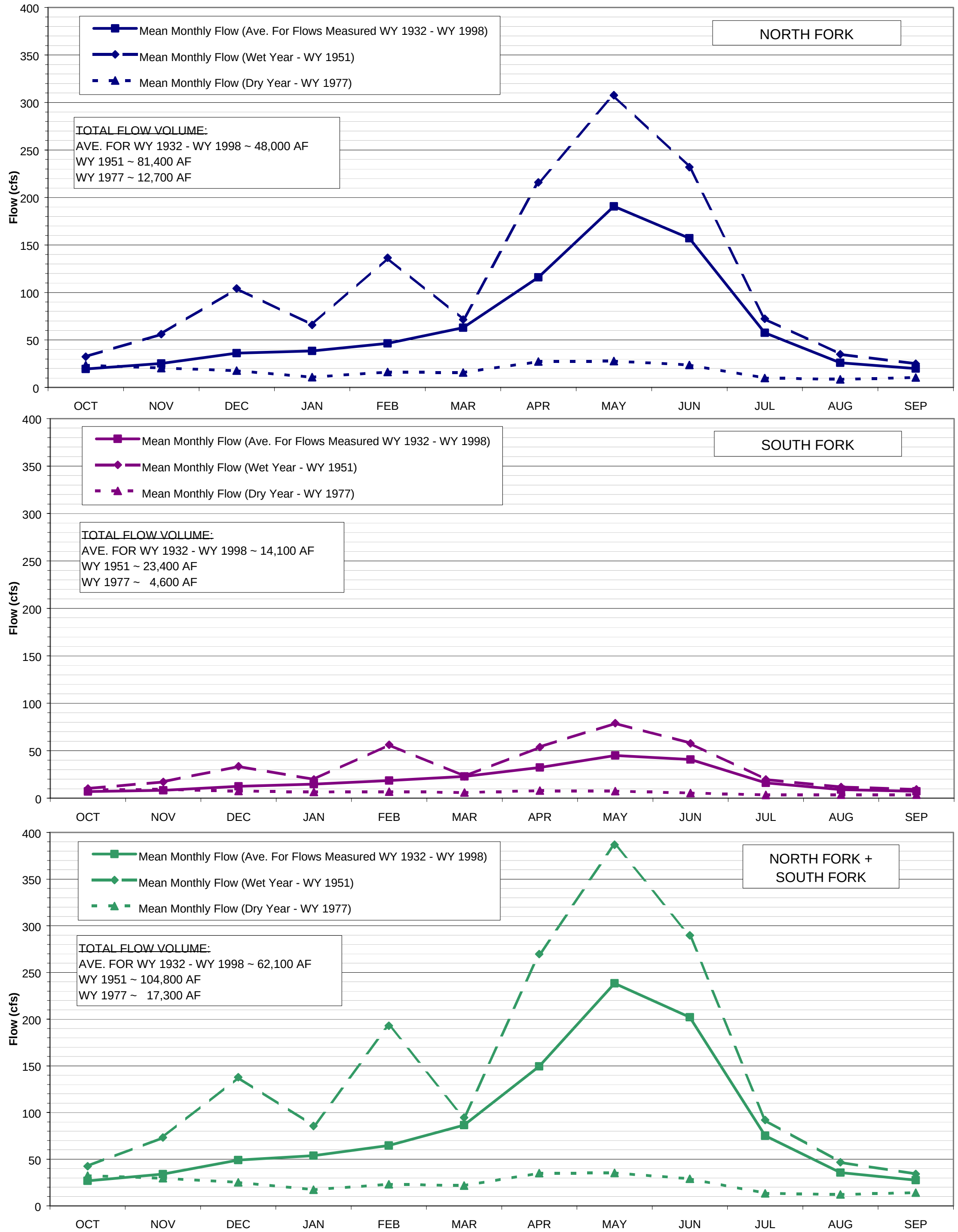
[1] A water year is measured from October 1 to September 30.

Figure 4-3. Mean Monthly Flows – Upper Reach of Ahtanum Creek Watershed



4.2.3 Middle and Lower Reaches

The mainstem of Ahtanum Creek begins at the confluence of the North and South Forks and extends to its mouth at the Yakima River in Union Gap (Figure 1-2). Stream flows in the mainstem are influenced by a variety of conditions, including surface water flows from the upper watershed, diversions for irrigation, runoff, and seepage losses and gains.

Historical flow data for the mainstem of Ahtanum Creek are available from gauging stations operated by the USGS near Tampico (water years 1909 to 1968), just below the confluence of the North and South Forks, and at Union Gap (water years 1904 to 2003) near the mouth of the creek. The gauge near Tampico has only been operated for a few years at a time. The gauge at Union Gap has been operated nearly continuously since 1961. Flow records indicate that the mean monthly stream flow at Union Gap for the period of record ranges from approximately 16 cfs in August to approximately 169 cfs in May. The highest peak flows during flooding were approximately 3,100 cfs, on January 16, 1974, and approximately 2,660 cfs, on February 9, 1996.

The *Ahtanum Creek Watershed Assessment* (Golder, 2004) noted that, in general, peak flows and base flows measured on Ahtanum Creek at Union Gap are similar in magnitude to flows from the upper watershed. This is unusual because the area contributing to the flow at Union Gap is much greater than the area contributing to the flow in the upper watershed. In addition to the impact that diversions have on the flows in the lower watershed, it has been suggested that the geology of the watershed plays a role in the stream flow pattern. Surface water is lost through seepage in alluvial deposits in the upper and middle reaches of the watershed, transported through perched channels, and regained in the lower reaches of the creek as groundwater return flow.

Stream flow is diverted for irrigation by agricultural users on both the north and south sides of Ahtanum Creek. Water diversions from the mainstem of Ahtanum Creek are operated by the AID and the WIP.

The AID diverts water from the mainstem of Ahtanum Creek for irrigation through a diversion structure to Bachelor and Hatton Creeks. Bachelor and Hatton Creeks are used to distribute surface water to customers north of the mainstem of Ahtanum Creek. Stream flows in Bachelor and Hatton Creeks, which are natural stream channels, are primarily influenced by irrigation diversions. The AID currently diverts surface water for irrigation until July 10. In 2002, the average rate of diversion ranged from 14 cfs in March to 30 cfs in May.

The WIP diverts water from the mainstem of Ahtanum Creek at two locations. The upper diversion is located just upstream of the AID diversion to Bachelor and Hatton Creeks near River Mile 19.6. The lower diversion is located upstream of the Hatton Creek return near River Mile 9.9. The WIP currently diverts surface water mostly during the late spring and summer. In 2002, the average rate of diversion ranged from approximately 56 cfs in June to less than 4 cfs in September. The 2002 diversion is the most recent information available and does not reflect the amount of diversion the Yakama Nation is entitled to under its water right.

Flows have not historically been monitored along the mainstem of Ahtanum Creek between Tampico and Union Gap below the AID and WIP irrigation diversions. However, anecdotal evidence suggests that Ahtanum Creek has often been dry below the AID and WIP diversions during the late summer and early fall. Recent changes in the amount and schedule of surface water diversions by the WIP have resulted in continuous flow being maintained in the creek after 2001. ~~Recently, routine s~~Stream flow measurements have been taken at gauging sites monitored by the Yakama Nation above the WIP Upper Canal, near Carson Road, and at American Fruit Road periodically starting in the summer of 2000. The flow data indicate that from 2000 to 2004, late summer~~continuous~~ flows have been ~~maintained~~ increased downstream of the AID and WIP diversions, but flows ~~have~~ continue to drop~~ped~~ below 10 cfs during the late summer below the ~~AID and WIP~~ diversions.

Data collected from a survey of farmers, residents, and businesses within the watershed for the analysis presented in the *Ahtanum Creek Watershed Assessment* indicate that approximately 14,000 acres were used in 2002 to grow a variety of crops within the AID and the WIP (Golder, 2004). It was estimated that approximately 11,100 acres were irrigated, at least in part, by surface water. A model was developed as part of the analysis for the *Ahtanum Creek Watershed Assessment* (Golder, 2004) to calculate crop water demand based on a variety of conditions. Based on the data from the survey, the total amount of water needed to irrigate the crops was estimated at 46,400 acre-feet annually. Based on data from the survey related to the number of acres irrigated with surface water versus groundwater each month, the surface water demand was estimated at more than 18,000 acre-feet annually. It was assumed that the remaining crop water demand was supplied by groundwater, or that some of the acreage was under-irrigated.

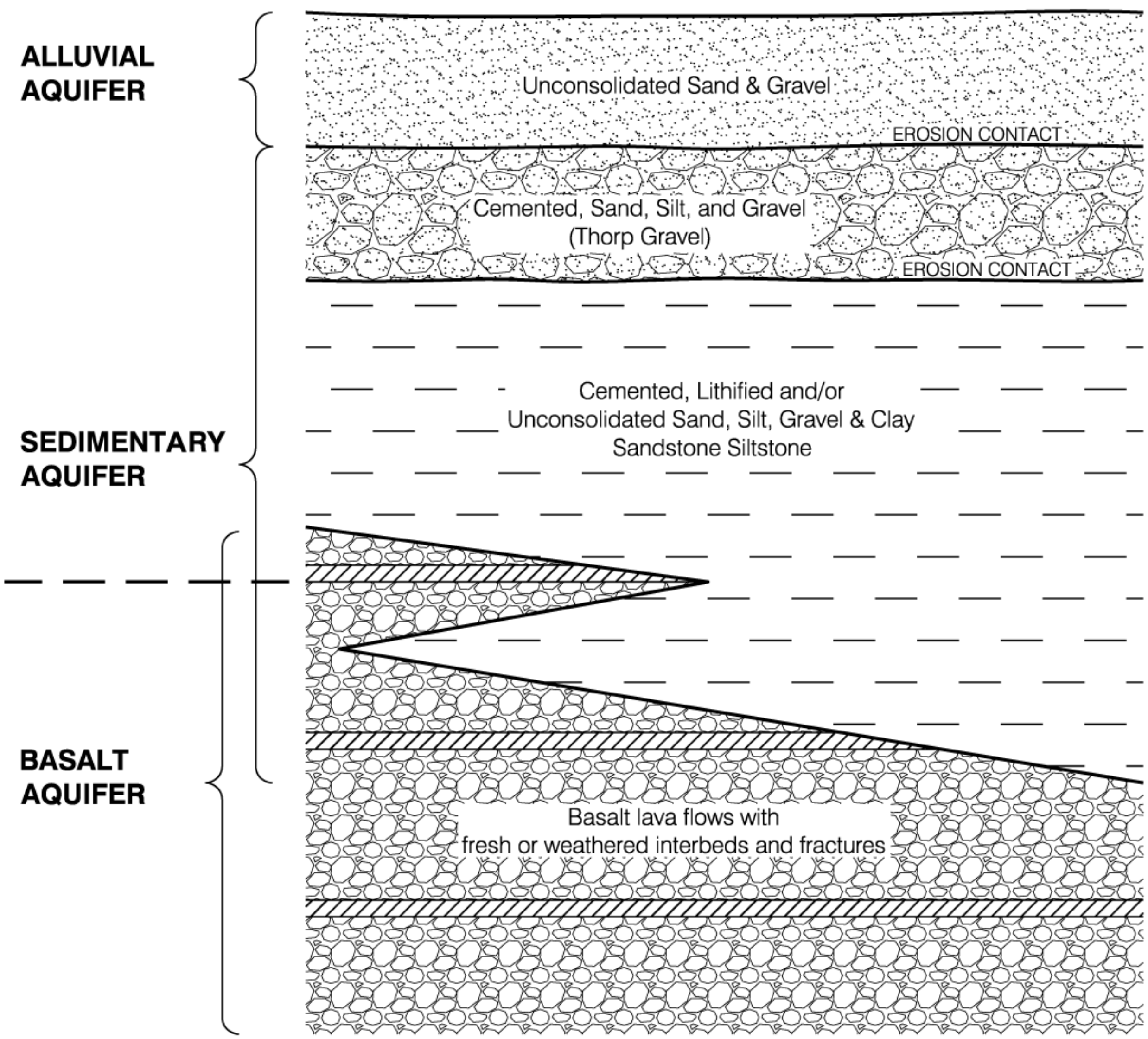
The estimate of surface water demand includes water that is diverted and lost through conveyance and on-farm irrigation inefficiencies. The AID conveys water to users through Bachelor and Hatton Creeks, which are natural stream channels. The WIP conveys water to users through two mostly unlined irrigation canals. Field inspection, conversations with AID and WIP staff, and flow measurements indicate that significant seepage occurs resulting in reduced irrigation efficiency The efficiency of conveyance and on-farm irrigation systems is the ratio of water that is actually applied to crops for their use to the amount of water diverted from the stream or pumped from groundwater wells. The *Ahtanum Creek Watershed Assessment* (Golder, 2004) estimated that the overall efficiency of the AID and WIP conveyance structures was approximately 75 percent. The analyses presented in the *Ahtanum Creek Watershed Assessment* (Golder, 2004) and in this EIS assume that the conveyance efficiency of AID facilities has typically been closer to 85 percent, and that the efficiency of WIP facilities has typically been closer to 63 percent. It was also estimated that on-farm irrigations systems were, on average, approximately 70 percent efficient. This means that overall, 75 percent of the surface water diverted from Ahtanum Creek is delivered to individual irrigation systems by the AID and WIP systems, and that 70 percent of the water delivered to individual irrigation systems from surface water and groundwater sources is consumptively used by crops. The remainder presumably seeps into the alluvial aquifer and is either pumped out by other water users or enters a surface water body at some point.

In general, stream flow in Ahtanum Creek and its tributaries is highly variable from year to year and from season to season. As a result, surface water has not been a very reliable resource for irrigation of crops, habitat for wildlife, or other beneficial uses. One of the primary goals of the ACWRP is to increase the reliability of surface water.

4.3 Groundwater

Groundwater in the Ahtanum Creek Watershed flows within three distinct hydrostratigraphic units (aquifers) that control the quantity, quality, surface water recharge, and groundwater supply to wells (see Figure 4-4). The depositional and structural history of the geologic units determine the aquifer characteristics (permeability and orientation) that control groundwater flow direction within the aquifers. The hydraulic conditions that control rate and direction of groundwater discharge vary with location and depth, the seasonal and long-term variations in precipitation in the watershed, and the artificial transfer and use of groundwater and surface water in the watershed.

Figure 4-4. Hydrostratigraphic Units of the Ahtanum Creek Watershed



This section summarizes the hydrogeologic characteristics of the Ahtanum Creek Watershed. The information provided herein is compiled from several sources, including local and regional geologic and groundwater studies, driller's well logs filed with Ecology, and intermittent groundwater elevation and surface water flow data. As previous authors have concluded, a synthesis of available geologic and hydrologic information into a complete conceptual model of the groundwater-surface water system in the Ahtanum Valley does not exist. With each subsequent review, however, the general understanding of natural conditions and man-made influences on groundwater within the watershed is further developed and improved.

4.3.1 Sources of Information

The *Ahtanum Creek Watershed Assessment* (Golder, 2004) and *Naches Basin (WRIA 38) Watershed Planning* (Golder, 2002) present the most recent summaries of hydrogeologic and hydrologic conditions in the watershed. These reports describe geologic conditions based on previous investigations (Foxworthy, 1962; Campbell, 1979; Bentley and Campbell, 1983; Walsh, 1986) and provide additional geologic interpretation based on review of drillers' well logs. Water level data collected by USGS, Ecology, AID, and WIP were used to evaluate stream-aquifer relationships, seasonal variations in groundwater elevations, and hydraulic connection between aquifers. Geologic conditions are discussed above in Section 4.1.1.

4.3.1.1 Hydrogeologic Conditions

Streams within the lower reaches of the Ahtanum Watershed generally follow the east-west axis of the structural trough. Stream channels in the upland terraces north of Ahtanum Road are generally parallel to each other. These streams may follow zones of preferential weathering and erosion that developed along regionally oriented joints and fractures. Alluvial processes have obscured any east-west structural or erosional features that may exist in the Ahtanum Creek floodplain. However, east to west trending joints and faults may exist in the Upper Ellensburg Formation or basalt that underlie the lower Ahtanum watershed.

Hydrostratigraphic Units

In this study, three water-bearing hydrostratigraphic units based on distinct geologic and hydraulic characteristics have been identified: a basalt aquifer system consisting of confined porous and fractured zones between massive lava flows; a system of sedimentary aquifers consisting of unconfined to confined porous sand and gravel layers in the Upper Ellensburg Formation and Thorp Gravel; and the alluvial aquifer consisting of unconfined, unconsolidated sand and gravel lenses and layers (see Figure 4-4).

Basalt Aquifer System. The basalt aquifer system consists of porous, weathered, and fractured zones formed primarily along lava flow tops and ~~occasionally~~ in the weathered zones between lava flows. Massive lava flows and clayey sedimentary units between porous lava flow tops form zones of lower vertical permeability that may ~~tend to~~ hydraulically isolate individual water-bearing zones within the basalt aquifer system. The total thickness and depth of the basalt aquifer system beneath the valley are unknown; drilling to 1,100 feet at the east end of the Ahtanum Valley has not fully penetrated the basalt. The basalt extends the full width and length of the watershed. Basalt is exposed at the west end of the lower valley at the confluence of the North and South Forks, and forms the north and south valley walls. To the east near the Yakima airport, basalt is covered by sedimentary rock and alluvium to a depth of approximately 1,500 feet.

Porous zones within the basalt readily store and transmit groundwater primarily along the interface between flows. A complex structural pattern controls groundwater flow in the direction parallel to basalt layers. Vertical layers of basalt exposed at the ground surface readily transmit precipitation downward. Groundwater then flows along basalt layers parallel to the axis of the syncline (downward and to the east). The syncline plunges at a steeper angle than the topographic slope of the valley. Consequently, as groundwater moves deeper, artesian pressure increases toward the east within the basalt aquifer system. Fractures and joints in the basalt layers may create vertical conduits for groundwater to flow vertically upward between aquifers in the basalt.

The majority of groundwater recharging the basalt aquifer system enters along valley walls and in the upper Ahtanum Watershed above the North and South Fork Ahtanum Creek confluence. A less significant amount of recharge enters the uppermost basalt aquifers along the valley margins via the Thorp Gravel north of Ahtanum Road and the alluvium south of Ahtanum Road. Surface water recharges the basalt aquifers during periods of high flow where a thin layer of alluvium overlies the basalt, particularly along the creek near the confluence of the North and South Forks (Foxworthy, 1962).

Groundwater in the basalt aquifer system ultimately discharges laterally out of the Ahtanum Watershed into the Yakima River Watershed near Union Gap. Vertical hydraulic gradients within the basalt aquifer system indicate potential for upward vertical leakage of groundwater into overlying sedimentary aquifer system. The rate of upward vertical leakage and discharge to overlying aquifers cannot yet be determined without groundwater level data for the aquifers, surface water level data, and aquifer permeability estimates.

Drillers' logs provide information indicating that the upper layers of basalt are fractured and porous along the middle reach of Ahtanum Creek, where the alluvium cover is thin. Stream gauge data indicate that Ahtanum Creek loses water along this reach. The porous basalt receives and transmits the infiltrated water deeper into the basalt aquifer system. Groundwater following the easterly plunge of the basalt aquifer system flows from recharge areas above elevation 1,700 feet above mean sea level to the east end of the watershed at elevation 500 feet below means sea level near Union Gap. This significant topographic decrease creates artesian conditions (upward vertical gradient) at the east end of the watershed. Several wells completed in the basalt aquifers currently flow at the ground surface or historically flowed at the surface at the time of completion. Near the confluence of Bachelor and Hatton Creeks in the middle reach of the creek, groundwater occurs in wells at depths ranging from 25 to 100 feet.

Sedimentary Aquifer System. The sedimentary aquifer system consists of water-bearing solidified, partially cemented, and unconsolidated sand and gravel layers within the Upper Ellensburg Formation. An intermediate fine-grained member isolates upper and lower coarse-grained members within the sedimentary aquifers. The top of the sedimentary aquifer system also includes water-bearing layers within the cemented sand and gravel of the Thorp Gravel.

The cemented gravel increases in thickness to the east. The total thickness and depth of the sedimentary aquifer system beneath the middle and lower reaches of Ahtanum Creek ranges from tens of feet at the west end to 1,500 feet at the east end of the valley. The sedimentary aquifer system extends east from the confluence of the North and South Forks to the confluence with the Yakima River and beyond. The sedimentary aquifer system extends north beneath the Wide Hollow Creek watershed north of and including Cottonwood Canyon. Low permeability zones at the top of the sedimentary aquifer system impedes vertical groundwater flow between the alluvium and deeper units.

The sedimentary aquifer system plunges to the east and tilts inward towards the valley center. The coarse-grained upper and lower water-bearing zones of the sedimentary aquifers readily store and transmit groundwater through hydraulically continuous layers and zones beneath the lower reach of Ahtanum Creek. Well logs indicate that the base of the Upper Ellensburg Formation in some areas consists of clay or shale, which impedes hydraulic connection with the underlying basalt aquifer system. Fractures and joints in the sedimentary rocks may create vertical conduits for groundwater to flow into the underlying basalt aquifer system and overlying alluvium.

Precipitation recharges the sedimentary aquifer system. ~~Recharge~~ Leakage from underlying and adjacent basalt contributes some additional recharge to the sedimentary aquifers, primarily in the lower reaches of the valley, although the rate of recharge is unknown and inferred only from upward vertical gradients observed at the east end of the valley. The Upper Ellensburg Formation does not extend into the upper Ahtanum Watershed above the North and South Fork Ahtanum Creek confluence. Precipitation and irrigation water percolating into the Thorp Gravel north of Ahtanum Road and into the alluvium south of Ahtanum Road locally recharges the upper member of the sedimentary aquifer system. Recharge rates vary according to the amount and thickness of the clayey units in the uppermost 30 feet of the Upper Ellensburg Formation.

Some of the water lost from Ahtanum Creek along the creek by the confluence of the North and South Forks likely recharges the sedimentary aquifer system. Water level data are not sufficient to quantify the rate and timing of recharge.

The easterly sloping sedimentary aquifer system transmits groundwater from the various locations of recharge above elevation 1,700 feet to the point of discharge at elevation 1,000 to 500 feet near Union Gap. Similar to the basalt aquifer system, significant topographic decrease creates artesian conditions (upward gradient) at the east end of the valley in the sedimentary aquifers. Several wells completed in the sedimentary aquifer system currently flow at the surface, or historically flowed at the surface at the time of completion. At the west end of the valley, groundwater occurs in wells at depths ranging from 25 to 100 feet. Groundwater in the sedimentary aquifer system ultimately discharges out of the Ahtanum Creek Watershed into the Yakima River Watershed near Union Gap.

Vertical hydraulic gradients within the sedimentary aquifer system indicate the potential for upward leakage of groundwater into overlying alluvial aquifer. The rate of upward leakage and discharge of the alluvial aquifer and subsequent discharge to surface water cannot yet be determined without groundwater level data for the aquifers, surface water level data, and aquifer permeability estimates.

Alluvial Aquifer. The alluvial aquifer consists of water-bearing unconsolidated, unconfined layers of sand, silt, and gravel deposited by fluvial processes associated with Ahtanum Creek flow. The alluvial aquifer ranges in thickness from several feet up to 30 feet at the east end of the watershed. The western limit of the alluvial aquifer extends several miles upstream in the North and South Forks of the Ahtanum Creek, through the confluence of the North and South Forks, then spreads out into the middle and lower Ahtanum Creek reaches to the creek's confluence with the Yakima River and beyond. The alluvial aquifer underlies the entire lower portion of the Ahtanum Creek Watershed and generally becomes finer-grained to the east (Foxworthy, 1962). Golder (2004) reported that Glacial Lake Missoula Flood deposits potentially extend to approximately 1 mile west of American Fruit Road near the west end of the middle reach. These fine-grained deposits, if present, would impede vertical groundwater flow between the alluvial aquifer and sedimentary aquifer system. Alluvial aquifer transmissivity, therefore, likely decreases from west to east.

The coarse-grained layers of the alluvial aquifer readily store and transmit groundwater, which flows preferentially through hydraulically continuous layers and zones beneath the length of the Ahtanum Watershed. Groundwater within the alluvial aquifer occurs at depths of less than 10 feet, and the groundwater gradient slopes with topography to the east.

Groundwater within the alluvial aquifer is derived primarily from precipitation; infiltrating surface water from Ahtanum, Bachelor, and Hatton Creeks; ~~and~~ irrigation water; and upward leakage from underlying aquifers. On the basis of upward vertical gradients measured in wells, the sedimentary aquifer system appears to contribute additional recharge at the east end of the lower reach; however, recharge rates from upward leakage are unknown. Recharge rates for the alluvium vary widely based on the local geologic conditions and irrigation rates. A surface recharge map in Golder (2004) (see Figure 4-5) suggests that recharge to the alluvium is widespread in the middle reach of the Ahtanum Creek Watershed. However, this areal recharge map is based on rainfall distribution and evaporation and does not consider topography, soil type, land use, or extent of the alluvium.

Declining stream flow between stream gauges along the middle reaches of the mainstem suggest that Ahtanum Creek (and tributaries) west of American Fruit Road generally loses water to recharge the alluvial aquifer. East of American Fruit Road, stream flow generally increases, most likely from groundwater discharging from the Alluvial Aquifer and from irrigation return flow. The boundary between losing and gaining reaches varies seasonally with natural runoff and irrigation patterns. The rate and timing of stream gain and loss also varies widely, even from day to day.

Groundwater in the alluvial aquifer ultimately discharges out of the Ahtanum Creek Watershed into the Yakima River Watershed near Union Gap. Figure 4-5 illustrates the general regions of alluvial aquifer recharge and discharge.

4.3.2 Environmental Conditions that Affect Groundwater Quantity

The Ahtanum Valley experiences hot, dry summers and cool, moist winters. Winter and spring rainfall and spring meltwater generate the maximum runoff observed in late spring, which quickly declines after June. Late summer to early fall minimal stream flow derives from groundwater baseflow (and irrigation runoff) discharging from the alluvial aquifer into Ahtanum Creek. Wet season surface water flow is generally 10 times the dry season water flow. Wet season recharge from precipitation and streams (including snowmelt) accounts for most of the seasonal replenishment of the alluvial aquifer. Groundwater levels in the alluvial aquifer fluctuate between 3 and 10 feet per year, depending on the location within the lower watershed and proximity to recharge sources. This range represents direct influence of recent rainfall and snowmelt rates. Little or no snow remains in the watershed by late summer; therefore, snowmelt does not supplement runoff during drought years.

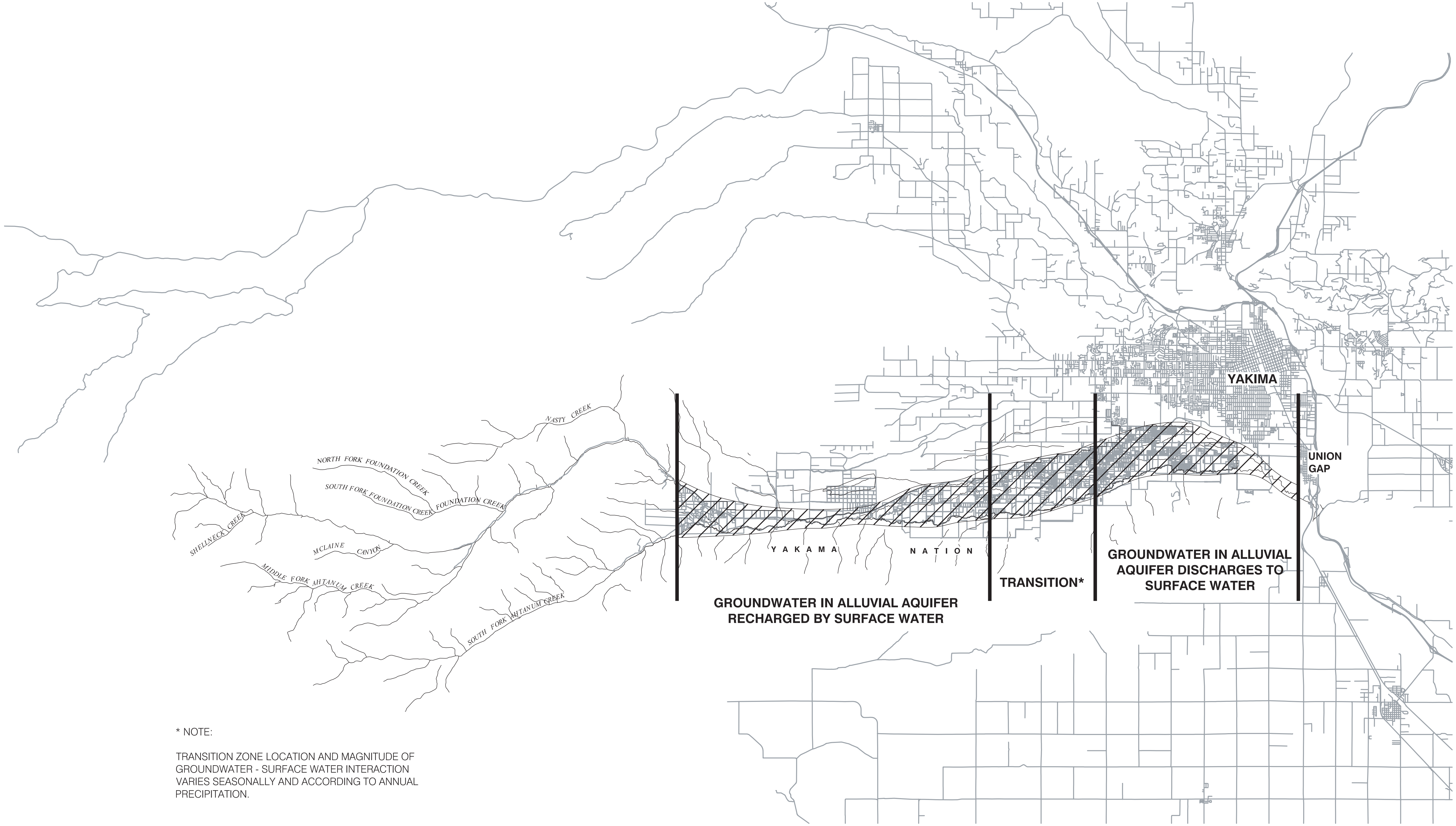
The available water level measurements from USGS and Ecology databases are not sufficient to accurately resolve seasonal fluctuations in the sedimentary or basalt aquifer systems. The groundwater levels appear to fluctuate seasonally by a few feet up to 10 feet, although groundwater pumping effects may mask water level fluctuations.

Longer-term fluctuations in groundwater levels depend on climatic conditions that affect seasonal precipitation. In general, long-term trends in groundwater levels correlate to precipitation trends. From 1980 to 1990, annual rainfall exceeded average levels, and from 1990 to 2000, rainfall generally was lower than average (PRISM data). Groundwater levels measured in wells completed in the sedimentary and basalt aquifer systems appear to have declined from 1985 to 1995, but rose thereafter. Foxworthy (1962) also reported general declines in basalt aquifer wells during the 1950s. However, the groundwater elevation data are not sufficient to quantify and distinguish between climatic and man-made influences on groundwater levels.

4.3.2.1 Groundwater Use

Approximately 2,000 water supply well logs are recorded with Ecology for the AID service area. This number does not account for wells not on file with Ecology, which could include up to 500 more wells in the service area. Figure 4-2 shows a generalized geologic map of the lower Ahtanum valley, illustrating the surface exposure of geologic rock types and mapped well locations. Figure 4-6 illustrates the west to east geologic cross-section through the middle reach of the Ahtanum Watershed. Of the recorded wells, approximately 10 percent are completed at depths less than 40 feet and are presumably completed in the alluvial aquifer. The majority of groundwater users, therefore, depend primarily on the sedimentary aquifers and basalt aquifer systems for groundwater supply.

Accounting for the rate of groundwater withdrawal by aquifer source, depth, location, and use would require a substantial effort of “ground-truthing” by direct user inquiry to establish accurate patterns of groundwater use in the watershed. However, good approximations are available using a water use survey completed by Fitch and Marshall (2003), which queried groundwater use by landowners in the watershed. The study concluded that of the 2,376 wells identified in the watershed study area, more than 2,000 wells were used for domestic supply and approximately 250 wells (10 percent) were used for agriculture. The survey results indicated that 29 percent of the domestic wells supplied some water for agricultural use, although only 3 percent of the agricultural wells supported domestic use (watering lawns and gardens).



* NOTE:

TRANSITION ZONE LOCATION AND MAGNITUDE OF GROUNDWATER - SURFACE WATER INTERACTION VARIES SEASONALLY AND ACCORDING TO ANNUAL PRECIPITATION.

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FIGURE 4-5

SURFACE RECHARGE MAP

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

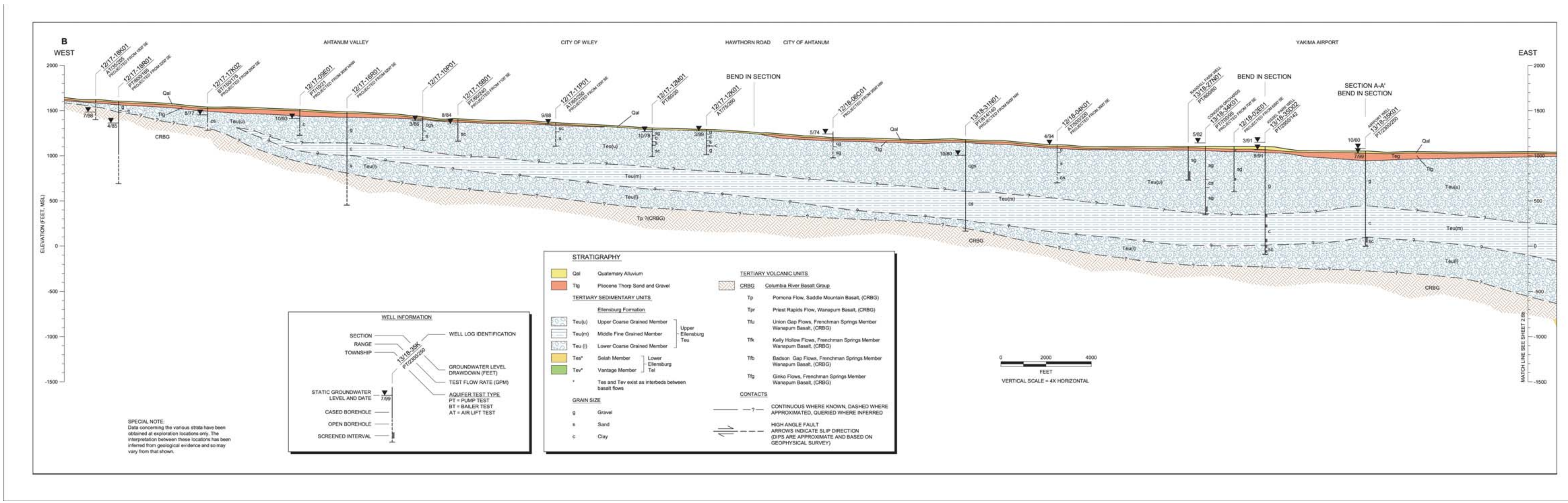

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FIGURE 4-6

GEOLOGIC CROSS-SECTION OF THE LOWER AHTANUM VALLEY

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

The *Ahtanum Creek Watershed Assessment* (Golder, 2004) indicates that approximately 15,000 to 20,000 acre-feet of irrigation water applied in the AID service area in 2002 were derived from groundwater sources. Putting this volume in perspective, Foxworthy (1962) estimated that 5,000 acre-feet flows through the alluvial aquifer per year. The well depth and the irrigation use data clearly indicate dependence on deeper aquifer sources for irrigation supply.

Active groundwater rights in the AID service area total 23,280 acre-feet, which is close to the estimate of annual groundwater use. Without accurate surveys and metering, it is not possible to associate the groundwater use with a specific aquifer. Most of the irrigation water derives from wells with an average depth of 466 feet (Fitch and Marshall, 2003), which indicates sources from both the sedimentary and basalt aquifer systems.

The alluvial aquifer has the capacity to yield several hundred gallons per minute to wells and is a potential source for irrigation use. However, irrigators may limit their withdrawal from the alluvial aquifer to avoid interference with shallow domestic uses, and to avoid drawing water from streams. The alluvial aquifer tends to be used for domestic supply with demands less than 50 gpm.

The alluvial aquifer has the capacity to yield several hundred gallons per minute to wells. However, because the thickness and grain size of layers in the alluvial aquifer vary widely, wells may yield this rate only for short time periods where the aquifer is discontinuous. In addition, irrigators may not use some high-capacity wells completed in the alluvial aquifer to avoid drawing water from streams.

There are no data available to assess the amount of groundwater derived from exempt wells (see Section 3.2.1.1 in Chapter 3). The Fitch and Marshall (2003) study indicated that average depth of domestic wells in the study area is 198 feet, equivalent to the sedimentary aquifer system.

The water balance approach used by Golder (2004) to simulate effects of water transfer was calibrated by adjusting the hydraulic relationship between surface water and groundwater along different reaches of Ahtanum Creek. Actual recharge-discharge relationships were not measured. Typically, groundwater modeling assumes a local or regional value of vertical hydraulic conductivity~~aquifer transmissivity~~ and vertical hydraulic gradient to estimate the flow between surface water and groundwater. Modeling approaches, however, only generalize the patterns of flow and provide order-of-magnitude estimates of groundwater flow rates. To quantify actual flow, detailed measurements of groundwater elevations, aquifer parameters, and groundwater geochemistry are necessary. These data are not yet available.

Groundwater users in the study area primarily depend on deeper aquifers to supply most irrigation and domestic water. The alluvial aquifer meets a significantly smaller percentage of demand. Changes to groundwater withdrawal for irrigation, therefore, would affect current water balance in deeper aquifers, whereas changes to water application or efficiency would primarily affect water balance in the shallow alluvial aquifer.

4.3.2.2 Timing of Groundwater Use

Groundwater withdrawals for irrigation use occur primarily from June to September. Irrigators holding surface water rights may supplement irrigation demand with groundwater, but convert almost entirely to groundwater when the AID supply is discontinued after July 10. Groundwater withdrawn from deep aquifers for irrigation primarily returns to the alluvial aquifer and Ahtanum Creek; little of the deeper groundwater returns to the source aquifer except in the upper portions of the middle reach. Foxworthy (1962) estimated that 25 percent of the applied water returns to the alluvial aquifer and/or streams. The alluvial aquifer therefore, is recharged during much of the irrigation season.

Declines in deep aquifer groundwater levels indicate that in certain areas, the discharge from wells exceeds recharge by natural and artificial (irrigation infiltration) sources. The effect of groundwater usage is a net loss of groundwater from the deep aquifers and transfer of deep source water to the alluvial aquifer and streams. Irrigation diversion redistributes the stream flow from one to several channels and therefore distributes groundwater recharge of the alluvial aquifer throughout middle and lower reaches of Ahtanum Creek

Domestic groundwater use consists of a year-round demand for consumption and summer demand for yard and garden irrigation. Non-irrigation domestic groundwater use is non-consumptive, and the majority of the water returns to the groundwater system. Non-irrigation domestic groundwater use essentially transfers deeper groundwater from the sedimentary and basalt aquifer systems to the alluvial aquifer and Ahtanum Creek Watershed.

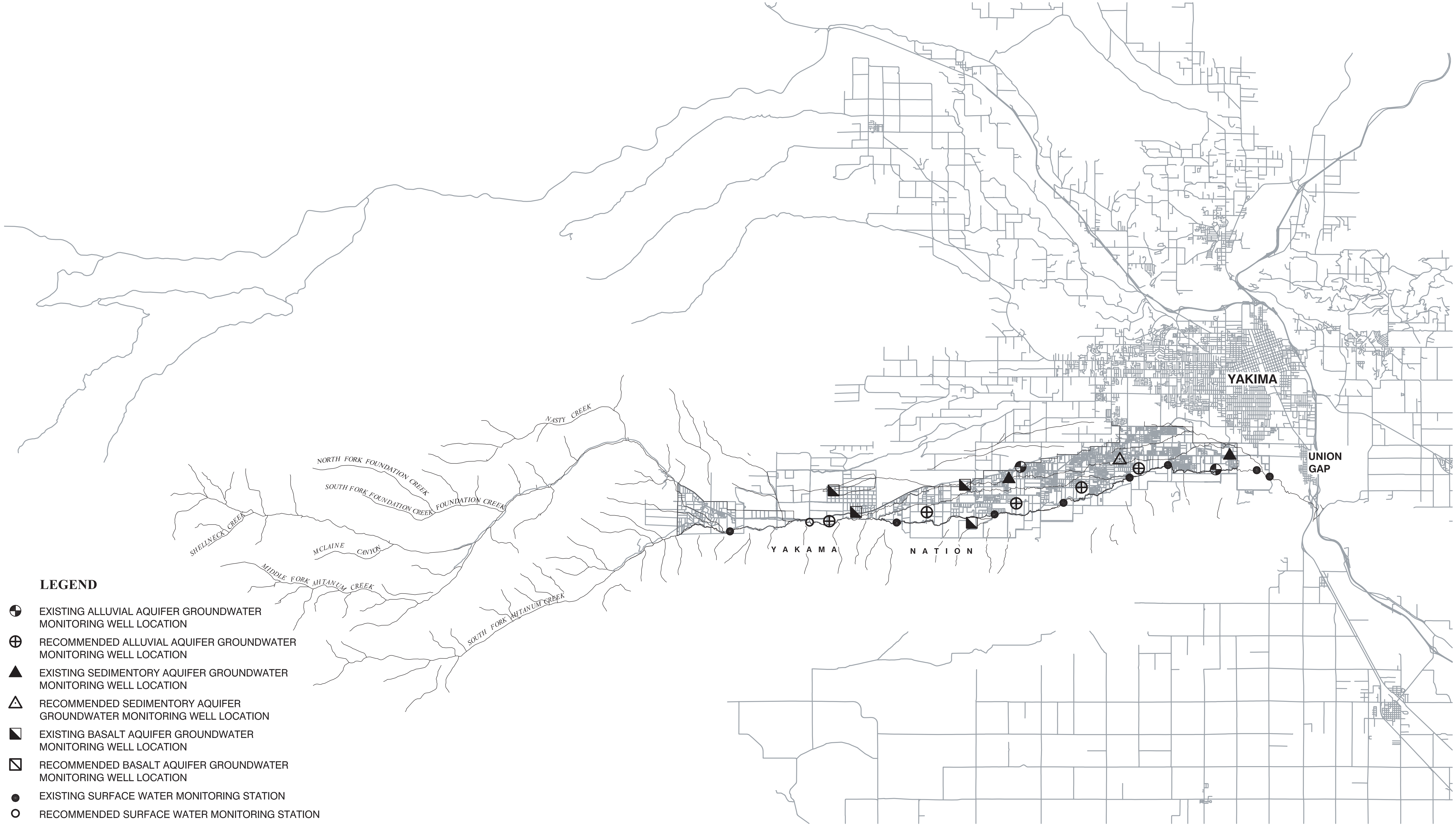
4.3.2.3 Data Needs

Groundwater level data for the study area are sporadic, discontinuous, unevenly distributed, and subject to interference by groundwater pumping. These data are necessary to identify both the natural climatic effects on groundwater levels and availability of groundwater. Data from active pumping wells can support evaluation of pumping influence on local groundwater levels and interaction with surface water. Concurrent surface water level data, however, are also needed to evaluate hydraulic continuity. Figure 4-7 shows the distribution of groundwater and surface water monitoring locations in the study area. The figure also includes recommended additional monitoring locations to support long-term monitoring and areas potentially impacted by alternative uses of surface water and groundwater in the study area.

4.4 Plants and Wildlife

This section describes the plants and wildlife in the Ahtanum Creek Watershed. Fish are described in Section 4.5.

The headwaters of the Ahtanum Creek Watershed are at an elevation of almost 7,000 feet. Elevation decreases to less than 1,000 feet at the mouth of the creek. This elevation change results in a gradient of vegetation from the headwaters to the mouth. The watershed traverses two plant community zones: the ponderosa pine *(Pinus ponderosa*) zone and the sagebrush (*Artemesia spp.)*-steppe zone (Franklin and Dyrness, 1988). Historically, the ponderosa pine



LEGEND

- EXISTING ALLUVIAL AQUIFER GROUNDWATER MONITORING WELL LOCATION
- RECOMMENDED ALLUVIAL AQUIFER GROUNDWATER MONITORING WELL LOCATION
- EXISTING SEDIMENTORY AQUIFER GROUNDWATER MONITORING WELL LOCATION
- RECOMMENDED SEDIMENTORY AQUIFER GROUNDWATER MONITORING WELL LOCATION
- EXISTING BASALT AQUIFER GROUNDWATER MONITORING WELL LOCATION
- RECOMMENDED BASALT AQUIFER GROUNDWATER MONITORING WELL LOCATION
- EXISTING SURFACE WATER MONITORING STATION
- RECOMMENDED SURFACE WATER MONITORING STATION

SOURCE: ATHANUM EIS, 2004; USGS TOPOGRAPHIC MAP, 1995

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SOURCE: SLR International Corp, 2005

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FIGURE 4-7
GROUNDWATER AND SURFACE WATER MONITORING LOCATIONS
AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS
AHTANUM, WASHINGTON

zone occupied the lower eastern slopes of the Cascade Mountains from elevations of approximately 1,800 feet to 3,000 feet. This zone currently extends from the headwaters to approximately the confluence of the North and South Forks Ahtanum Creek. The sagebrush-steppe is historically found in the lower elevations and extends from the confluence to the mouth of the creek.

The ponderosa pine zone was dominated prior to settlement by its namesake in a climax forest. Other tree species included grand fir (*Abies grandis*), western larch (*Larix occidentalis*), Douglas fir (*Pseudotsuga menzeisii*), quaking aspen (*Populus tremuloides*), western white pine (*Pinus monticola*), and lodgepole pine (*Pinus contorta*). Common understory species included grasses such as Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Agropyron spicatum*), and shrubs such as antelope brush (*Purshia tridentata*) and snowberry (*Symphorocarpos albus*)(Franklin and Dyrness, 1988).

The sagebrush-steppe association in this portion of the state is dominated by antelope brush and Idaho fescue in its climax state. This association is a shrub and meadow community with significant amounts of grasses and forbs. Shrub species found in lesser amounts in this association include *green rabbit-brush (Chrysothamnus vicidiflorus)* and *common rabbit-brush (C. nauseous*). Understory associates include Sandburg's bluegrass (*Poa sandbergii*), arrow-leaf balsam root (*Balsamorhiza sagitata*), and mule's ear (*Wyethia amplexicaulis*). Vegetation communities in the Ahtanum Creek Watershed have been disturbed by human activities to various degrees throughout the lower, middle, and upper reaches of the watershed. Little of the native vegetation, especially of the sagebrush-steppe association, remains. The scale of human disturbance decreases across a continuum from the lower to upper reaches, with cropland and higher density urban and rural development prevalent in the lower watershed and forested areas dominant in the upper watershed.

4.4.1 Federally Listed Species

The USFWS lists Ute ladies tresses (*Spiranthes diluvialis),* an orchid species, as a threatened plant under the ESA. Although the USFWS list for Yakima County includes this plant, it is unlikely to be located in the project area because of the disturbed condition of vegetation. The plant is currently only known to be found in Chelan and Okanogan Counties (NatureServe, 2003).

Bald eagle (*Haliaeetus leucocephalus*) is listed as a threatened species in Yakima County. No bald eagle nesting or roosting habitat is available, and foraging habitat is limited in the Ahtanum Watershed. No bald eagle nests are located in the watershed. Communal roost sites are located along the Yakima River a few miles northeast and southeast of the project area, and a wintering area is located along the Naches River a few miles north of the project area (WDFW, 2004). Bald eagles typically nest and roost in large, old trees near open water away from human habitation (Stinson et al., 2001). Open water in the watershed is limited to several small streams and large trees are limited to the upper reach of the watershed. Foraging opportunities for bald eagles are limited to small numbers of waterfowl, fish, small mammals, and carrion.

4.4.2 Upper Reach

Vegetation at the headwaters in the upper reach is dominated by a relatively moist, high elevation Douglas fir, western larch, grand fir, and lodgepole pine forest. As elevation decreases, the forest transitions to a dry ponderosa pine and Douglas fir forest. Near the confluence of the North and South Forks, vegetation gives way to steppe and cropland. In riparian areas, black cottonwood *(Populus balsamifera ssp. trichocarpa)*, Pacific willow *(Salix lucida ssp. lasiandra)*, red alder *(Alnus rubra)*, red-osier dogwood *(Cornus stolonifera)*, and snowberry dominate. Wildlife use in the upper reach is likely to be more varied and include more forest-dependent species such as woodpeckers than the lower and middle reaches. Forests in the upper reach are used for commercial timber and have been extensively harvested. The upper reach of the Ahtanum Creek Watershed is less developed than the middle or lower reaches and has fewer areas of cropland or residential landscaping.

4.4.3 Middle Reach

Some areas of shrub or grassland steppe remain in the middle reach, although mostly in a degraded state due to grazing. Most of the remaining steppe areas are located on the Yakama Reservation south of Ahtanum Creek. Areas of agricultural and residential development have replaced the native vegetation with cropland and residential landscaping. The width of riparian vegetation along the creek varies, but it is generally more extensive than the vegetation remaining in the lower reach. Dominant plants in the native riparian communities include Pacific willow, quaking aspen, black cottonwood, red-osier dogwood, and Wood's rose *(Rosa woodsii)*.

Riparian conditions along the middle and lower reaches of Ahtanum Creek were assessed as part of the *Ahtanum Creek Watershed Assessment* (Golder, 2004). The riparian area generally has a diverse species composition and age class distribution. There are pockets of late-successional black cottonwood, which likely reflect the historic vegetation of the area. However, these stands contain high amounts of dead and decaying material and are declining, possibly as a result of limited floodplain inundation. Mid-successional Pacific willow habitat is now the dominant habitat type and is indicative of historical disturbance. Invasive plant species, such as reed canarygrass *(Phalaris arundinacea)*, are common in the riparian area. In several areas there is little or no riparian buffer, with agricultural and other land uses immediately adjacent to the creek. The watershed assessment identified four major problems that contribute to the poor riparian conditions:

- Presence of invasive plant species;
- Lack of streambank root mass protection;
- Restriction of riparian width due to encroachment and upland land uses; and
- Structural alterations of the channel.

Wildlife species observed and likely to occur in the area include beaver *(Aplodontia rufa)*, muskrat *(Ondatra zibethicus)*, meadow vole *(Microtus pennsylvanicus)*, deer mouse *(Peromyscus maniculatus)*, short-horned lizard *(Phrynosoma douglassii)*, California quail *(Callipepla californica)*, red-tailed hawk *(Buteo jamaicensis)*, northern harrier *(Cicus cyaneus)*, American kestrel *(Falco sparverius)*, barn owl *(Tyto alba)*, black-billed magpie *(Pica hudsonia)*, violet-green swallow *(Tachycineta thalassina)*, American robin *(Turdus migratorius)*, black-capped chickadee *(Poecile atricapilla),* and western meadowlark *(Sturnella neglecta)*.

The proposed Pine Hollow Reservoir location is in the middle reach of the watershed. Grasses dominate the proposed reservoir area. Vegetation in the proposed reservoir area is sparse because of the thin, gravelly soils and exposed basalt parent material.

4.4.4 Lower Reach

Little native vegetation remains in the lower reach. Vegetation in the area consists mostly of residential landscaping and agricultural crops such as pasture and hay with some orchards and vegetable crops. Riparian vegetation along Ahtanum Creek is limited or lacking in some areas, but most areas have at least a narrow band of woody, deciduous cover. Along a number of stream reaches, riparian vegetation extends at least 500 feet from the stream. Riparian species in the lower reach are similar to the middle reach, but black cottonwood is less prevalent. Riparian conditions are similar to those described in the middle reach. Wildlife use is similar to the middle reach, but species such as western meadowlark and short-horned lizard, which prefer less developed areas, are less likely to occur. Bank erosion and stream incision are problems in many areas of the lower reach.

4.5 Fish

The Ahtanum Creek Watershed provides habitat for a variety of fish species, including species listed under the ESA. Fish present in the watershed include summer steelhead (*Oncorhynchus mykiss,* ~~and its resident form, rainbow trout~~) and bull trout (*Salvelinus confluentus*), both of which are threatened species under the ESA. Currently, steelhead and bull trout spawn and rear in the watershed. In addition, spring Chinook (O. *tschawytscha*) salmon occur in the lower portion of Ahtanum Creek. Although several stocks of Chinook throughout Washington are listed under the ESA, the population in Ahtanum Creek is not part of an ESA-listed Ecologically Significant Unit (ESU). Spring Chinook are included in the Mid-Columbia River Spring-run ESU that is not listed under the ESA. Hatchery-origin coho (*O. kisutch*) are currently naturally spawning in Ahtanum Creek. Coho in Washington have been determined to not be warranted for listing under ESA.

Westslope cutthroat trout (*Oncorhynchus clarki lewisi*) are the most widely dispersed resident fish species in the watershed (WDNR, 1997). Resident rainbow trout (*O. mykiss*, non-anadromous) are also present in the watershed. Other native fish species known to occur in the watershed are listed below (WDNR, 1997a; NPPC, 2001):

- Peamouth chub (*Mylocheilus caurinus*)
- Cottids: shorthead sculpin (*Cottus confuses*) and others
- Redside shiner (*Richardsonius baltatus*)
- Mountain whitefish (*Prosopium williamsoni*)
- Speckled dace (*Rhinichthys osculus*)

- Lamprey (*Lampetra sp*.)
- Northern pike minnow (*Ptychocheilus oregonensis*)
- Bridgelip sucker (*Catostomus columbianus*)

Figure 4-8 displays the distribution of ESA-listed and other salmonid species in the Ahtanum Creek Watershed.

4.5.1 Key Fish Population Status and Habitat Conditions

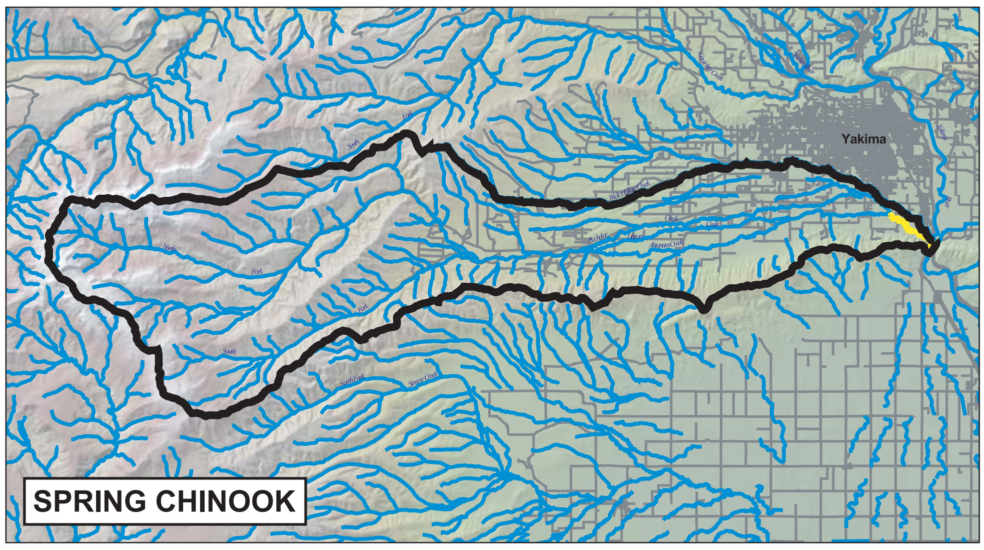
This section summarizes the status of key fish populations and aquatic/riparian habitat within the Ahtanum Creek Watershed. The discussion of fish habitat and populations focuses on spring Chinook, coho, steelhead, and bull trout. Fish habitat was characterized using a comprehensive modeling approach that compared current habitat to historic conditions. This approach identified habitat limitations for the four key fish populations and evaluated habitat restoration and protection actions and priorities throughout the Ahtanum Creek Watershed.

4.5.1.1 Modeling Fish Habitat Potential and Restoration Priorities

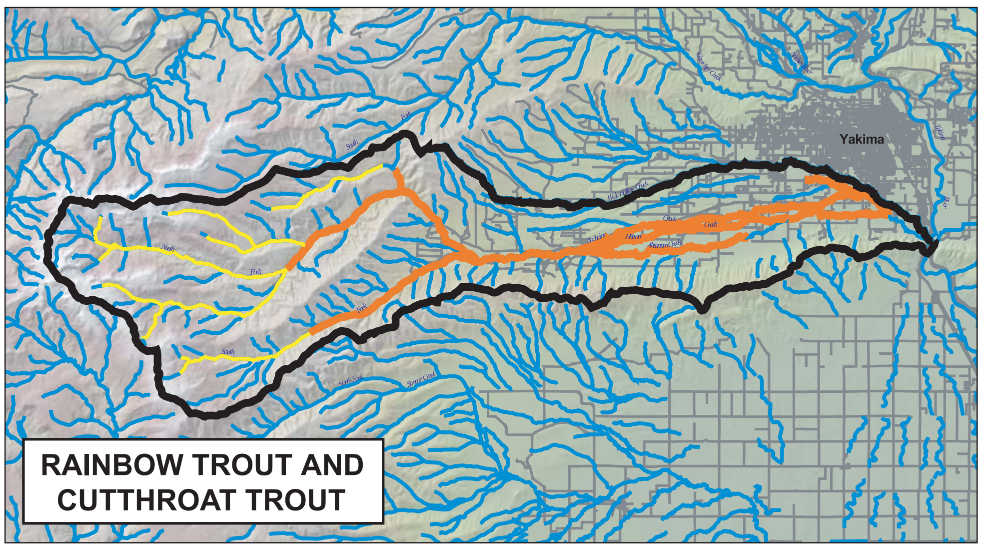
The potential of aquatic and riparian habitat within the Ahtanum Creek Watershed was identified in order to describe fish population conditions and assess habitat restoration and protection actions and priorities. Limitations of habitat were also identified. The Ecosystem Diagnosis and Treatment model (EDT) was used to identify the most important aquatic habitat and environmental factors affecting Chinook and coho salmon and steelhead populations in the watershed. An alternative model, described below, was used to assess the environmental factors impacting bull trout. The EDT model compares the potential of current environmental conditions to support fish populations to the potential under historical or normative conditions. The model uses the description of historic and current conditions to derive fish population production values from an analysis of the quantity and quality of habitat available to the different species of fish. These habitat-based performance estimates are derived from a large number of interrelated “rules” that summarize known relationships between fish survival and 46 different environmental variables.

The EDT model was used to assess the impact of the current conditions on spring Chinook, coho, and summer steelhead populations that spawn (or potentially could spawn) in the Ahtanum Creek Watershed. The model provides estimates of the key population “health” indicators of mean Abundance, Productivity, and Life History Diversity. In terms of the model outputs, Abundance denotes the expected average number of returning adults; Productivity is an estimate of the maximum number of returning adults per spawner; and Diversity describes the proportion of life history patterns that are self-sustaining (that result in at least one returning adult per spawner).

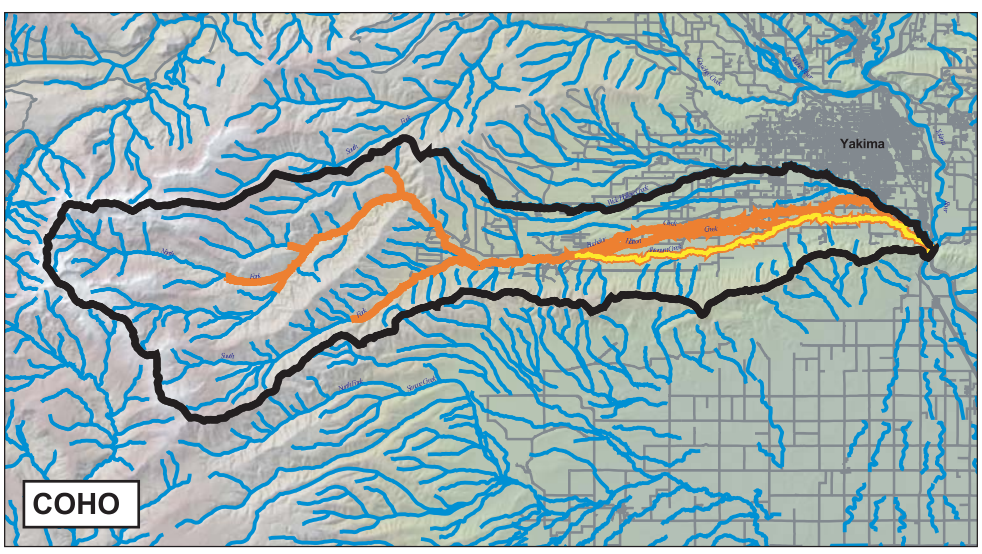
Based on the analysis of fish population performance, the EDT model provides a summary of the reaches prioritized by preservation value and restoration potential. For the purpose of the EDT analysis, Ahtanum Creek was divided into 32 reaches (see Figure 4-9). The *p*reservation value is the degree to which the population performance indicators (Abundance, Productivity, and Life



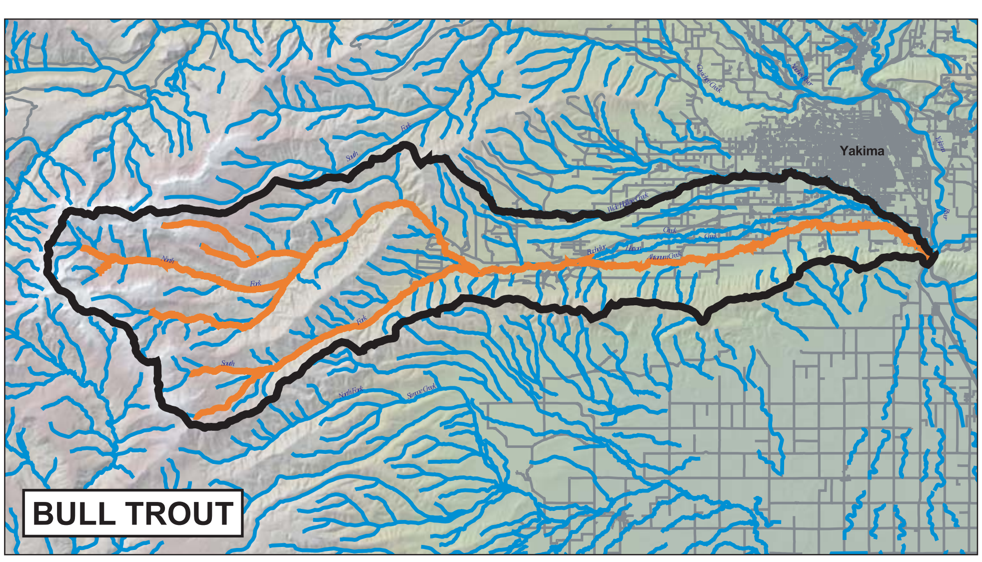
LEGEND
- Ahtanum Watershed Boundary
- Spring Chinook Distribution (Juvenile rearing only)
- Streams and Rivers
- Street and Roads



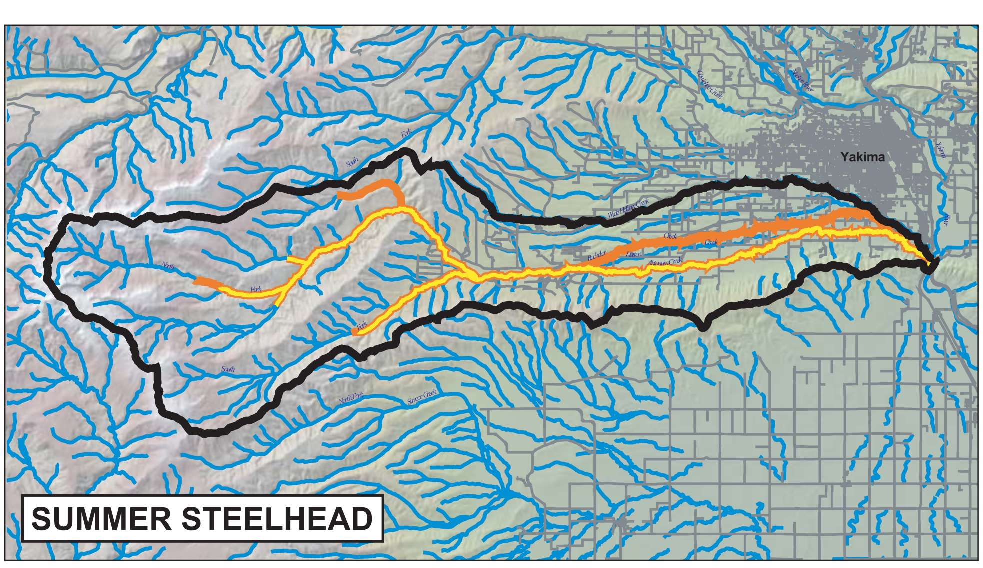
LEGEND
- Ahtanum Watershed Boundary
- Cutthroat Trout Distribution
- Rainbow Trout Distribution
- Streams and Rivers
- Street and Roads



LEGEND
- Ahtanum Watershed Boundary
- Coho Distribution (Adult spawning)
- Coho Distribution (Juvenile rearing)
- Streams and Rivers
- Street and Roads



LEGEND
- Ahtanum Watershed Boundary
- Bull Trout Distribution
- Streams and Rivers
- Street and Roads



LEGEND
- Ahtanum Watershed Boundary
- Summer Steelhead Distribution (Adult spawning)
- Summer Steelhead Distribution (Juvenile rearing)
- Streams and Rivers
- Street and Roads

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FIGURE 4-8

SPRING CHINOOK, RAINBOW TROUT, CUTTHROAT TROUT, COHO, BULL TROUT, AND SUMMER STEELHEAD DISTRIBUTION

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

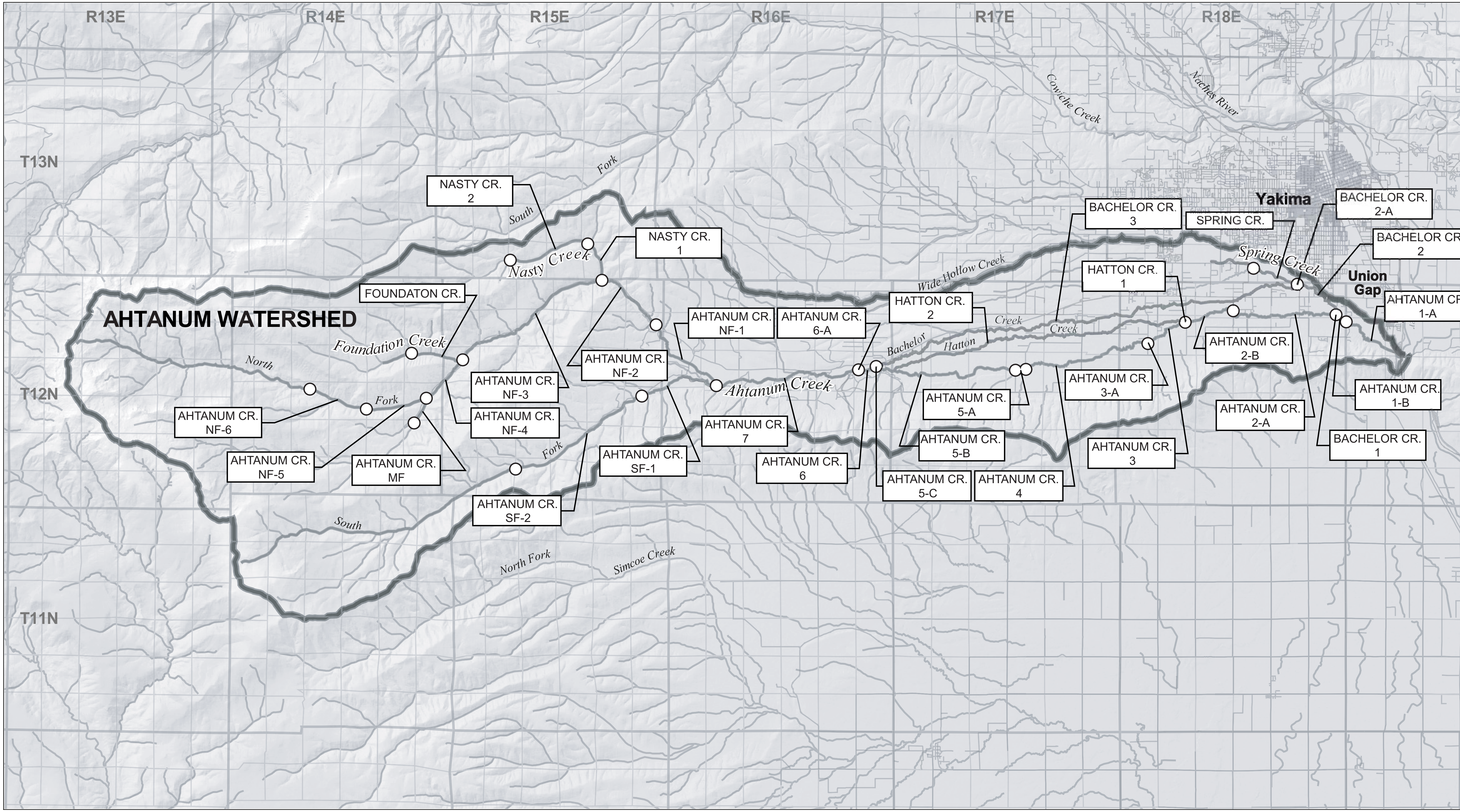

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FIGURE 4-9

AHTANUM CREEK STREAM REACHES

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

History Diversity) for each fish species are supported by a reach. The restoration potential is the increase in the performance indicators the fish population would experience if the reach were restored to historical conditions. The preservation value is estimated as the percent decrease in the population's performance that would result if the reaches were thoroughly degraded. Reaches with a high preservation value are candidates for protection because their degradation would have a disproportionately severe impact on fish population production. The significance of a reach with high restoration potential is that a given degree of restoration there would result in considerably more benefit to the population as a whole than if the same effort was applied to a reach with low restoration value.

Because existing data were not available to expand the database to include the extreme headwaters reaches and tributaries in which bull trout spawn, the EDT model was not applied to the bull trout population. Instead, the Qualitative Habitat Analysis (QHA) tool was used to diagnose environmental limiting factors for bull trout. QHA relies on expert knowledge to describe conditions in stream reaches and assess changes in relation to a target species such as bull trout. QHA is a structured approach to gathering and organizing expert knowledge to arrive at a documented conclusion regarding habitat limitations. Because it is much less data intensive, QHA analysis can be completed much more rapidly than a full EDT analysis. The QHA tool does, however, have limitations relative to EDT. QHA results represent the subjective conclusions of experts rather than the results of application of the objective habitat rating rules in EDT. Each reach is rated independently in QHA without the connectivity between life stages in EDT. Finally, QHA does not predict future biological performance, but only describes limiting factors.

Each of the 32 reaches identified for the EDT analysis represents a relatively uniform area as defined by the general habitat types (e.g., low gradient, unconfined channels), management impacts (e.g., confined channel, fish passage obstructions), or fish distribution (e.g., limit of historical spring Chinook distribution) (see Figure 4-9 and Table 4-1). Habitat, water quality, and other characteristics potentially affecting the populations (e.g., predation and harassment) were developed for each of the reaches. In the late 1990s, habitat conditions for the Ahtanum Creek Watershed were described by Yakama Nation biologists, in collaboration with many other local biologists and resource managers. After review and refinement, this habitat data set provided the input data for the EDT analysis used in the *Yakima Subbasin Plan* (Yakima Subbasin Fish and Wildlife Planning Board, 2004). In addition, local biologists with extensive familiarity with the Ahtanum Creek Watershed further refined the watershed-specific data (Rogers, personal communication, 2004; Freudenthal, personal communication, 2004). The data used in the current analysis are the best available for the Ahtanum Creek Watershed.

Table 4-1. Ahtanum Creek Watershed EDT Reach Descriptions

Reach Name	Description	Length (mi.)[1]	Gradient	Mean Width (ft.) [1]
Ahtanum Creek-1A	Ahtanum Creek: mouth to Goodman Rd (RM 0.0 - 2.8)	2.8	0.3 %	30.3
Ahtanum Creek-1B	Ahtanum Creek: Goodman Road to Bachelor confluence (RM 2.8 - 3.2)	0.4	0.3 %	30.3
Bachelor Creek-1(Adult rack)	Bachelor Creek: Adult barrier at mouth	0.0		
Bachelor Creek-2	Bachelor Creek: Current adult rack to Spring Creek and potential new rack (RM 17.15)	2.0	0.4%	17.6
Spring Creek (Bachelor)	Spring Creek, mouth to access limit at right bank tributary 1.5 miles from mouth	1.5	0.5%	13.9
Bachelor Creek-2A(new adult rack)	Bachelor Creek: Site of potential new adult rack just above mouth of Spring Creek.	0	- -	- -
Bachelor Creek-3	Bachelor Creek: Spring Creek/new rack site to Bachelor/Hatton Diversion (RM 17.2 to 17.15)	15.8	0.8%	12.0
Ahtanum Creek-2A	Ahtanum Creek: Bachelor return to 42nd Avenue (upper end of UGA; RM 3.2 - 6.8)	3.6	0.7 %	25.0
Ahtanum Creek-2B	Ahtanum Creek: 42nd Avenue to Hatton return (RM 6.8 - 8.5)	1.7	0.7 %	25.0
Hatton Creek-1(Adult rack)	Hatton Creek: Adult barrier at mouth	0.0		
Hatton Creek-2	Hatton Creek: Return to source near Bachelor/Hatton diversion (RM 0 to 10.5)	10.5	1.0%	10.0
Ahtanum Creek-3	Ahtanum Creek: Hatton return to lower WIP diversion (RM 8.5 to 9.9)	1.4	0.8 %	19.0
Ahtanum Creek-3A (Lower WIP Diversion Dam)	Ahtanum Creek: Lower WIP Diversion Dam (RM 9.9)	--	0	--
Ahtanum Creek-4	Ahtanum Creek: Lower WIP Diversion Dam to American Fruit Rd. Bridge (RM 9.9 to 14.0) (downstream end of natural losing reach)	4.1	0.9 %	24.5
Ahtanum Creek-5A	Ahtanum Creek: American Fruit Rd to Marks Rd (subdivisions prohibited; RM 14.0 - 14.6)	0.6	1.0 %	21.9
Ahtanum Creek-5B	Ahtanum Creek: Marks Rd to Bachelor-Hatton Diversion (RM 14.6 - 18.9)	4.3	1.0 %	21.9

Table 4-1. Ahtanum Creek Watershed EDT Reach Descriptions (continued)

Reach Name	Description	Length (mi.)[1]	Gradient	Mean Width (ft.)[1]
Ahtanum Creek-5C (Bachelor /Hatton Diversion Dam)	Ahtanum Creek: Bachelor/Hatton Diversion Dam (RM 18.9)	--	1.0 %	--
Ahtanum Creek-6	Ahtanum Creek: Bachelor/Hatton Diversion to Upper WIP Diversion Dam (RM 18.9 to 19.6)	0.7	1.4 %	32.3
Ahtanum Creek-6A (Upper WIP Diversion Dam)	Ahtanum Creek: Upper WIP Diversion Dam (RM 19.6)	--	1.4 %	--
Ahtanum Creek-7	Ahtanum Creek: Upper WIP Diversion Dam to confluence of NF and SF (RM 19.6 to 23.1)	3.5	1.4 %	33.8
Ahtanum Creek NF-1	Ahtanum Creek NF: Mouth to historical spring Chinook access limit (RM 0 to 2.0)	2.0	1.6 %	25.6
Ahtanum Creek NF-2	Ahtanum Creek NF: Spring Chinook access limit to Nasty Creek (RM 2.0 to 5.3)	3.3	2.0 %	42.5
Nasty Creek-1	Nasty Creek, Mouth to end of intermittent section (RM 0.0 to 1.1)	1.1	5.6 %	8.3
Nasty Creek-2	Nasty Creek, end of intermittent section to access limit (RM 1.1 - 3.7)	2.6	4.9 %	12.5
Ahtanum Creek NF-3	Ahtanum Creek NF: Nasty Creek to Foundation Creek (RM 5.3 to 10.2)	4.9	2.0 %	20.4
Foundation Creek	Foundation Creek: Mouth to steelhead/coho access limit (RM 0 to 0.8)	0.8	6.4 %	14.7
Ahtanum Creek NF-4	Ahtanum Creek NF: Foundation Creek to MF Ahtanum Creek (RM 10.2 to 11.6)	1.4	0.8 %	19.0
MF Ahtanum Creek	MF Ahtanum Creek: Mouth to steelhead/coho access limit (RM 0 to 0.9)	0.9	3.9 %	17.2
Ahtanum Creek NF-5	Ahtanum Creek NF: MF Ahtanum Creek to McLain Canyon (RM 11.6 to 13.1) (upper access limit for coho)	2.5	3.1 %	17.2
Ahtanum Creek NF-6	Ahtanum Creek NF: McLain Canyon to upper access limit for steelhead (RM 13.1 to 14.5)	1.4	3.6	17.2
Ahtanum Creek SF-1	Ahtanum Creek SF: Mouth to historical spring Chinook access limit (RM 0 to 2.0)	2.0	1.6 %	18.9
Ahtanum Creek SF-2	Ahtanum Creek SF: Spring Chinook access limit to coho/steelhead access limit (RM 2 to 6.3)	4.3	2.6 %	17.0

[1] In the EDT reach database, fish passage obstructions, such as division dams, are designated as reaches but do not have lengths or widths.

4.5.1.2 Fish Population Status Under Current Environmental Conditions

The EDT simulation analyzed the performance of adult coho, spring Chinook, and steelhead populations in terms of life history diversity, productivity, carrying capacity, and mean abundance under current and historical habitat conditions. The results of the simulation for the three populations are summarized in Table 4-2. Based on the EDT simulation results, there have been dramatic reductions in the populations from historic conditions. All three populations within the Ahtanum Creek Watershed have reduced diversity, productivity, capacity, and abundance. The fish population results derived from the model are consistent with the observations of reduced populations based on field inventories over time (Golder, 2004).

Table 4-2. Predicted Current and Historical Production of Coho, Steelhead, and Spring Chinook Populations in the Ahtanum Creek Watershed (Based on the EDT model simulation)

Population	Scenario	Diversity Index	Productivity	Capacity	Abundance
Ahtanum Coho	Current without fisheries harvest	1%	1.5	188	59
	Historic potential	98%	5.0	3,830	3,065
Ahtanum Spring Chinook	Current without fisheries harvest	4%	1.3	118	26
	Historic potential	100%	8.8	2,653	2,353
Ahtanum Steelhead	Current without fisheries harvest	2%	1.3	753	174
	Historic potential	97%	10.1	5,672	5,113

Under current watershed conditions, productivity for all three species range from 1.3 to 1.5 returning adults per spawner. These very low productivity values indicate that under current habitat conditions Ahtanum Creek Watershed coho, spring Chinook, and steelhead have very limited prospects for long-term persistence as healthy populations. Based on EDT simulations for other watersheds, fish populations with a productivity value of less than 3.0 are usually classified as “depressed,” and populations with a productivity of less than 2.0 usually have ESA-listed status or have already been extirpated. The results for Ahtanum Creek Watershed indicate that the three populations could theoretically increase if environmental conditions remained relatively stable. However, even a short period of environmentally marginal years (e.g., persistent drought conditions) could easily result in extirpation of the local populations. These productivity values describe “satellite populations” of fish that colonize marginal habitat and persist at low levels during periods with productive environmental conditions, disappear during periods with poor environmental conditions, and never become abundant. In addition, under current conditions there are extremely low life history diversity values for the three species. These figures range from 1 to 4 percent, indicating that from 96 percent to 99 percent of all biologically possible life history patterns are not viable in the current habitat available.

Information from the EDT model simulation provides an overview of the aquatic and riparian habitat factors contributing to the reduced Ahtanum Creek Watershed fish populations. The factors most responsible for limiting the production of coho and spring Chinook salmon, steelhead, and bull trout populations are fine sediment, excessive water temperatures, a lack of key habitat (especially pools and off-channel habitat), channel stability, a lack of habitat diversity associated with very low quantities of large woody debris (LWD), and fish passage barriers. Sediment deposition is probably the most important limiting factor affecting most of the reaches and all three fish populations. Low flows from diversions and withdrawals also limit fish populations primarily by contributing to higher water temperatures. Degraded riparian vegetation also contributes to factors limiting fish production through reduced canopy cover over the stream (and thus increased water temperatures), diminished channel stability through the absence of roots and supporting vegetation, and minimization of future inputs of LWD to stream channels. Fish passage barriers limit access to productive spawning and rearing areas in the watershed. The EDT simulation-based findings on key factors limiting fish populations are consistent with the general observations outlined in the *Ahtanum Creek Watershed Assessment* (Golder, 2004).

The following is a summary of the primary aquatic and riparian habitat factors limiting spring Chinook, coho, and steelhead populations in the Ahtanum Creek Watershed.

Fine Sediment

Fine sediment deposition in stream channels is perhaps the single greatest limiting factor on fish production in the Ahtanum Creek Watershed,. Sediment routing and delivery to channels is caused by different factors in different portions of the drainage. Streamside roads, particularly roads within 200 feet of streams, are the major cause of sediment in the upper watershed (WDNR, 1997a). Bank erosion and channel incision is the principal source of sediment in the middle and lower portions of the watershed, particularly along Ahtanum Creek (Golder, 2004). As a result, the sediment issues in the Ahtanum Creek mainstem are attributable both to the movement of material from upstream sources and local sources associated with bank erosion and confinement. Recent habitat studies completed in the lower watershed indicate that accumulations of sediments in Ahtanum Creek are contributing to habitat degradation. There are specific areas in lower Ahtanum Creek where both fine- and coarse-grained sediments are causing a variety of problems with water and bedload conveyance, channel form, and channel-forming processes, all of which are leading to aquatic habitat changes (Golder, 2004).

Excessive Water Temperatures

Elevated water temperatures are cited as impacting fish populations in both the upper (WDNR, 1997) and lower portions of Ahtanum Creek Watershed (Golder, 2004). The primary factor causing increased water temperature is minimal shade over stream channels from reduced riparian vegetation.

Key Habitat Quantity

Key habitats are those aquatic habitats that are essential for success of each fish life stage. For example, appropriately sized and well-sorted gravels are necessary for spawning; pools and off-channel areas are important for juvenile rearing, particularly during winter high flow periods.

Ahtanum Creek spawning habitats have been impacted by excessive sedimentation, and there has been a significant loss of juvenile fish rearing habitat associated with reduced side channel areas, channelized stream segments, and limited wood in channels.

Large Wood in the Channels

Almost the entire length of Ahtanum Creek has channels that are wood-deficient, which causes problems with fish habitat diversity (particularly pool frequency and cover) and exacerbates problems related to channel stability/bed scour, off-channel habitats, predation risk, and harassment.

Fish Passage Barriers

Currently, a rack at the mouth of Bachelor Creek blocks access to all of Bachelor Creek and to its Spring Creek tributary. This rack was installed to prevent salmon and steelhead adults from spawning in a channel that is now dewatered after July 10 each year. Spring Creek provides fair to good spawning and rearing habitat for coho and steelhead for about 1.5 miles and, as its name implies, is supplied by spring water, which is considerably cooler than the water in Ahtanum Creek.

4.5.1.3 Priority Reaches for Habitat Restoration and Preservation

Of the 32 reaches comprising the Ahtanum Watershed (See Figure 4-9), four reaches stand out in terms of combined restoration potential for spring Chinook, coho, and steelhead populations, based on the EDT model simulation. Because bull trout habitat restoration priorities were derived from QHA, the habitat restoration priorities are described separately (see the subsection on bull trout under Section 4.5.1.4). The four reaches with the highest restoration potential for the three anadromous species as well as the primary aquatic and riparian limiting factors are:

- Ahtanum Creek – Reach 7: Upper WIP Diversion to the confluence of the North and South Forks (highest restoration potential for all three species). Primary limiting factors for this reach are sediment, habitat diversity, key habitats, and elevated water temperatures.
- North Fork – Reach NF-1: The North Fork from its mouth to RM 2.0, which marks the end of historic spring Chinook distribution. Primary limiting factors for this reach are sediment, habitat diversity, key habitats, channel stability, and elevated water temperatures.
- Ahtanum Creek – Reach 5B: Marks Road to the Bachelor-Hatton Diversion. Primary limiting factors for this reach are sediment, habitat diversity, key habitats, channel stability, elevated water temperatures, and flow.
- Ahtanum Creek – Reach 4: Lower WIP Diversion to American Fruit Road Bridge. Primary limiting factors for this reach are sediment, habitat diversity, key habitats, channel stability, elevated water temperatures, and flow.

In addition, there are reaches with high quality habitat that warrant a preservation strategy to maintain the habitat. Tables C-2 though C-7 (Appendix C) describe the relative habitat protection benefits for all of the reaches by fish population. In many cases the reaches that have the highest protection benefits also have large restoration benefits. This is because these reaches are important for the fish population productivity and both habitat degradation (if not protected) and habitat restoration will have a disproportionate impact on the populations. For all of the reaches evaluated the restoration benefits are greater than the protection benefits.

Restoration benefits for stream reaches are shown in the tables in Appendix C. The five highest ranking habitat protection reaches for the spring Chinook population are (Table C-2):

- Ahtanum – Upper WIP diversion to the forks (rank = 1);
- Ahtanum – Mouth to RM 2.0 (rank = 2);
- Ahtanum – Bachelor/Hatton Diversion to Upper WIP diversion (rank = 3);
- Yakima Toppenish to Sunnyside Dam (rank = 3, tie);
- Ahtanum – Lower WIP diversion to American Fruit Road (rank = 4);
- Ahtanum – Marks Road to Bachelor-Hatton Diversion (rank = 5);
- Ahtanum –Bachelor return to 42nd Avenue (rank = 5, tie).

The five highest ranking habitat protection reaches for the summer steelhead population are (Table C-4):

- Ahtanum – Upper WIP diversion to the forks (rank = 1);
- South Fork Ahtanum – RM 2.0 to the access limit (rank = 1, tie);
- North Fork Ahtanum – McLain Canyon to the access limit (rank = 2); North Fork Ahtanum – Middle Fork Ahtanum to McLain Canyon (rank = 3);
- Ahtanum – Marks Road to Bachelor/Hatton Diversion (rank = 4);
- Middle Fork Ahtanum – Mouth to access limit (rank = 5).

The five highest ranking habitat protection reaches for the coho population are (Table C-6):

- Ahtanum – Upper WIP diversion to the forks (rank = 1);
- Ahtanum – Marks Road to Bachelor/Hatton Diversion (rank = 2);
- Ahtanum – Lower WIP diversion to American Fruit Road (rank = 3);
- North Fork Ahtanum – Mouth to RM 2.0 (rank = 4);
- Ahtanum – Hatton return to lower WIP diversion (rank = 5);

The five highest ranking habitat protection reaches for the bull trout population are (Table C-7):

- North Fork – RM 11.8 to McLain Canyon (rank = 1);
- North Fork – McLain Canyon to steelhead access limit (rank = 1, tie);
- North Fork – RM 14.5 to Cougar Flat (rank = 2);

- North Fork – Cougar Flat to Shellneck Creek (rank = 3);
- North Fork – Middle Fork to beginning of spawning in North Fork (rank = 4);
- Middle Fork – Lower end of bull trout spawning to Tree Phones Camp Ground (rank = 5).

4.5.1.4 Fish Life Histories and Key Limiting Factors

The following discussion provides an overview of the life history patterns and the primary aquatic and riparian habitat factors limiting spring Chinook, coho, steelhead, and bull trout populations in the Ahtanum Creek Watershed. The *Ahtanum Creek Watershed Assessment* (Golder, 2004) provided information on fish species life histories and population status. The current and historical habitat factors affecting each of the fish populations in the watershed are derived from the EDT model simulation.

Spring Chinook Salmon

Current spring Chinook salmon use of the Ahtanum Watershed is limited to juvenile rearing ~~and migration~~ in the lower reaches~~several miles~~ of Ahtanum Creek near Union Gap. Historically, spring Chinook use included all life history stages, including spawning and the distribution extended several miles into the North and South Forks (Haring, 2000). The following discussion of life history stages describes~~is for~~ potential spring Chinook utilization if the population and habitat were restored. Migration begins in April and lasts through June. Spawning typically occurs between July and September, with the fry emergence beginning in February and extending through June. Following emergence, juveniles colonize downstream during the spring and summer. There is extensive downstream pre-smolt migration during the late fall and early winter when water temperatures in the lower Yakima River drop sharply. Most juvenile spring Chinook salmon complete their winter migration between October and January and over-winter between December and March. Smolt out-migration typically occurs between March and June.

The EDT model simulation identified the aquatic and riparian habitat factors impacting Ahtanum Creek watershed spring Chinook populations (Table C-1 in Appendix C). The factors with the greatest impact on the population are sediment, elevated water temperatures, habitat diversity, key habitat quantity, and flow.

Based on the EDT model simulation of spring Chinook population response to historic and current habitats, the four highest priority reaches for habitat restoration, in rank order, are (Table C-2 in Appendix C) (Figure 4-9):

- Ahtanum Creek – Reach 7: Upper WIP Diversion Dam to confluence of North and South Forks
- Ahtanum Creek – Reach 5B: Marks Road to Bachelor-Hatton Diversion
- Ahtanum Creek – Reach 2A: Bachelor return to 42nd Avenue
- Ahtanum Creek – Reach 4: Lower WIP Diversion Dam to American Fruit Road Bridge

Summer Steelhead

Summer steelhead distribution within the watershed includes Ahtanum Creek, the North and South and Middle Forks, and tributaries. Summer steelhead migration typically occurs between September and May, with two peak periods: late October (fall migration period) and late February through early March (winter-spring migration period). The final migration to spawning areas typically occurs between January and May, and timing of this is likely triggered by water temperatures. Most spawning takes place in upper portions of the North and South Forks and tributary streams. Based on 1999-2003 data for Ahtanum Creek tributaries, most spawning activities occur between early Mach and mid to late June (Golder, 2004). After spawning, egg incubation takes place between March and July. Steelhead fry emerge between May and June.

Recent (1999-2003) steelhead spawner surveys suggest an upward trend in spawning activity within the Ahtanum Creek Watershed, which is consistent with other observations in the Yakima Basin (Golder, 2004). There also appears to be an upward trend in juvenile production and out-migration. Screw trap data from 2000-2002 collected by the Yakama Nation show yearly increases in juvenile observations (Golder, 2004). In 2002-2003, the breakdown of age-1 and age-2 steelhead juvenile smolts was 63.8 percent age-1, and 36.2 percent age-2 (Rogers, personal communication, 2004). The large proportion of age-1 smolts is significant because rearing out of the freshwater system greatly increases productivity. Faster growth rates that allow smoltification to occur at age-1 would results in higher smolt production because the second year of freshwater mortality is avoided.

The EDT model simulation identified the aquatic and riparian habitat factors impacting Ahtanum Creek Watershed summer steelhead populations (Table C-3 in C). The factors with the greatest impact on the population are sediment, elevated water temperatures, habitat diversity, key habitat quantity, channel stability, and flow.

Based on the EDT model simulation of summer steelhead population response to historic and current habitats, the four highest priority reaches for habitat restoration, in rank order, are listed below (Table C-4 in Appendix C) (Figure 4-9):

- Ahtanum Creek – Reach 7: Upper WIP Diversion Dam to confluence of North and South Forks; and (tie) North Fork Ahtanum Creek – Reach NF-3: Nasty Creek to Foundation Creek
- South Fork Ahtanum Creek – Reach SF-2: RM 2 to end of coho access limit
- North Fork Ahtanum Creek – Reach NF-2: RM 2 to Nasty Creek
- Nasty Creek – Reach 1: Mouth to start of perennial flow

Coho Salmon

Native coho salmon were extirpated from the entire Yakima River Basin, including the Ahtanum Creek Watershed in the ~~early 1980s~~mid to late 1970s. Coho decline was caused by a variety of in-basin and out-of-basin factors. In-basin factors included habitat degradation and stream flow impacts. Out-of-basin sources of coho mortality included over harvest and Columbia River dam impacts. Currently, hatchery-reared coho, which are ~~outplanted as smolts~~released as 0-age fry or fingerlings in the watershed, are now reproducing naturally in the system. Coho are distributed in Ahtanum Creek, the North and South Forks, and the lower portions of the Middle Fork and Nasty Creek. Historical information suggests that most of the hatchery-reared coho are early run, which is the same run timing as the native population. There is little information on the timing of life stages for Ahtanum Creek coho. Based on information supplied by the Yakama Nation, it appears that coho migration occurs between late August and late November, with most spawning activity taking place from late October through late December (Golder, 2004). Emergence takes place from late March through early June, and juveniles reside in the system for at least one year. Screw trap data indicates that juvenile outmigration peaks in May and June (Golder, 2004).

Recent (2000-2003) screw trap data supplied by the Yakima Nation provides information on juvenile coho production. Although the data are too limited to draw conclusive relationships, it appears there are yearly declines in juvenile coho production (Golder, 2004).

The EDT model simulation identified the aquatic and riparian habitat factors impacting Ahtanum Creek Watershed coho populations (Table C-5 in Appendix C). The factors with the greatest impact on the population are sediment, elevated water temperatures, habitat diversity, key habitat quantity, obstructions, and flow.

Based on the EDT model simulation of coho population response to historic and current habitats, the four highest priority reaches for habitat restoration, in rank order, are (Table C-6 in Appendix C) (Figure 4-9):

- Ahtanum Creek – Reach 7: Upper WIP Diversion Dam to confluence of the North and South Forks
- Ahtanum Creek – Reach 2A: Bachelor Creek return to 42nd Avenue
- Ahtanum Creek – Reach 5B: Marks Road to Bachelor-Hatton Diversion
- Ahtanum Creek – Reach 4: Lower WIP Diversion Dam to American Fruit Road Bridge

Bull Trout

The Ahtanum Creek Watershed supports a resident bull trout population, with all life stages represented—spawning, rearing, growth, and maturation. Bull trout spawning distribution includes Ahtanum Creek; the North, South and Middle Forks; Nasty Creek; and headwater tributaries. Both resident and fluvial life stages are likely to occur in Ahtanum Creek. Currently, the lower reaches of the stream are used mainly for migration purposes by fish seeking to access to the Yakima River. However, historically the lower stream reaches probably provided summer and winter rearing for bull trout as well. The resident population is the primary life history form present in the watershed. Historically, there was bull trout movement throughout the watershed and interaction between other Yakima River populations and the Ahtanum Creek population. The interaction between populations was limited due to low flows and other passage problems in the watershed. Interaction and movement between the bull trout populations is probably increasing as stream flows and watershed conditions improve.

The WDFW has conducted yearly resident bull trout spawner/redd counts within Ahtanum Creek mainstem and the North and South Forks; bull trout were~~are~~ present in all ~~the~~ three (see Table 4-3a). In a survey during 2000-2003, the largest number of redds were counted during 2001 and 2002, with 35 and 36, respectively (Golder, 2004).

Table 4-3a. Summary of bull trout spawning surveys (redd counts) in index areas Ahtanum Creek Watershed. (Data supplied by Washing Department of Fish and Wildlife, 2005)

Tributary Index Area	Year											
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
N.F. Ahtanum	9	14	6	5	7	5	7	11	20	17	12	8
M.F. Ahtanum				1*	1*		0*	10*	1*	6	8	11
S.F. Ahtanum								5*	14	13	7	5

* Incomplete survey: Index area not fully defined or adequately monitored.
SOURCE: Easterbrook, personal communication, 2005.

The QHA was used to organize and rank expert knowledge of reach level habitat conditions for bull trout in Ahtanum Creek. Most bull trout spawning habitat is found in the upper watershed—especially the Middle, North, and South Forks of Ahtanum Creek. The fluvial life cycle was rated especially important in the QHA review, which led to a high prioritization of conditions affecting the migration through lower Ahtanum Creek.

Based on this general model of bull trout in Ahtanum Creek and the description of conditions in each reach, protection and restoration priorities for each reach are shown in Table C-7 in Appendix C. The relative restoration and protection values for each reach were based on the expert opinion of individuals who have knowledge of the watershed's aquatic habitat conditions and factors limiting bull trout populations. The length of the bar corresponds to the reach's relative restoration or protection value weighted by its potential importance to bull trout. The protection and restoration confidence scores reflect the relative certainty of the ratings based on the expert knowledge of habitat conditions for the specific reach. The higher the value, the greater the confidence in the relative score of habitat protection or restoration conditions for the reach. Protection values were highest in the upper watershed, reflecting both the importance of conditions in these reaches for current production of bull trout and the relatively lower level of habitat degradation compared to downstream reaches. The reaches with high protection values have relatively intact aquatic and riparian habitat and are areas where there is less value in pursuing restoration actions. Reaches with high protection values were primarily concentrated in the upper Middle Fork, North Fork, and Shellneck Creek. Restoration values were generally higher in the lower reaches of Ahtanum Creek as a result of the generally more degraded habitat condition in these reaches (Table B-7). Restoration values were also high in the lower Middle Fork and the South Fork of Ahtanum Creek. The lower Middle Fork and the South Fork of Ahtanum Creek reaches also had relatively high protection values. This indicates that these reaches are important for the current potential of bull trout in Ahtanum Creek but still have significant habitat degradation that could be addressed through restoration.

The knowledge captured in QHA was used to rank the importance of degradation of 11 habitat attributes in terms of bull trout performance (Table 4-3b). Based on relative rankings of these values averaged over the entire Ahtanum Creek, the top three limiting factors for bull trout were high temperature, pollutants, and lack of habitat diversity.

Table 4-3b. Habitat restoration rank of the eleven habitat attributes in terms of Ahtanum Creek Watershed bull trout population performance

Habitat Attribute	Restoration Ranking
High Temperature	1
Pollutants	2
Habitat Diversity	3
Channel Form	4
Obstructions	5
Fine Sediment	6
Riparian Condition	7
Low Flow	8
High Flow	9
Oxygen	9
Low Temperature	9

The relative rankings were derived from the QHA process.

Limiting factors are arrayed across the Ahtanum Creek Watershed reaches in QHA. Tables C-8 through C-10 in Appendix C show the distribution of limiting condition for the top three overall factors (water temperature, pollution, and habitat diversity) across all the reaches within the Ahtanum Creek Watershed. Within these tables, the length of the bar corresponds to the degree of degradation of the attribute weighted by its potential importance to bull trout. The larger the bar, the greater the reach's restoration value for the specific factor. For the most part, conditions were most degraded in the lower reaches and were generally better in the upper watershed. High water temperature followed this general pattern. Temperatures were elevated throughout lower Ahtanum Creek and in portions of the South and Middle Fork (Table C-8 in Appendix C). Elevated temperature received a particularly high restoration values in Ahtanum Creek because of its impact on the fluvial life history and impediment to migration between spawning areas and the mainstem Yakima River. There were also extreme water temperature restoration ratings in a North Fork reach (Nasty Creek to Foundation Creek) and a South Fork reach (River Mile 2.0).

Pollutants in Ahtanum Creek are the result of runoff from roads throughout the watershed and urbanization in the lower reaches. Pollutants were rated as an impediment to bull trout performance throughout much of Ahtanum Creek (Table C-9 in Appendix C). There were high pollutant restoration values in most of the lower Ahtanum Creek reaches, including the heavily urbanized reaches near the creek's confluence with the Yakima River.

Loss of aquatic habitat diversity impacts bull trout primarily as a result of 1) low levels of woody debris throughout the watershed and 2) channel confinement in specific reaches. Reaches with minimal habitat diversity have high habitat restoration values. Reaches with relatively high habitat diversity restoration values are primarily in the lower Ahtanum Creek and Nasty Creek (Table C-10 in Appendix C). Reaches in the South Fork also have relatively high restoration values due to limited habitat diversity (Table C-10 in Appendix C)

4.6 Scenic Resources and Aesthetics

Aesthetic qualities are generally defined as features that have intrinsic qualities including scenic, recreational, or natural features that are considered representative, unique, or distinctly characteristic of an area. This section describes existing conditions of scenic and aesthetic resources in the upper, middle, and lower reaches of the Ahtanum Creek Watershed.

4.6.1 Upper Reach

The upper watershed consists of two relatively narrow canyons along the North and South Forks of Ahtanum Creek. Roads follow the creeks up both canyons. There are several tributary streams in the upper reach, including Nasty Creek, Foundation Creek, the Middle Fork Ahtanum Creek, and Reservation Creek. The upper reach scenery is dominated by exposed basalt outcrops and mixed Douglas fir and ponderosa pine forests, including areas that have been and are currently being logged. Near Tampico where the North and South Forks converge, the canyons become more broad.

4.6.2 Middle Reach

In the middle reach of the watershed, the topography is predominantly flat. Ahtanum Road follows the creek, with views of the creek limited by dense riparian vegetation in most places. Most of this area has been developed for agriculture and housing and both dominate the views in the immediate area. Ahtanum Ridge is visible to the south and Cowiche Mountain is visible to the north.

The proposed reservoir site, Pine Hollow, is located in the middle reach. Pine Hollow is approximately midway between Tampico and Wiley City. Pine Hollow is an asymmetrical valley with a steep north side and a less steep south side. The elevation of the north ridge is approximately 1,840 feet and the south ridge elevation is approximately 1,830 feet. The canyon is vegetated with grasses and scattered poplars. The area is primarily used for grazing, with some residences on the south and west sides.

Johncox Ditch, an irrigation canal, currently flows through Pine Hollow. The diversion point for the ditch is on the lower segment of the North Fork of the Ahtanum Creek. The ditch is approximately 6 feet wide and 2 feet deep. Riparian vegetation has established along the ditch.

4.6.3 Lower Reach

The lower reach of the watershed becomes increasingly flat and more urbanized as the creek flows toward its confluence with the Yakima River. The views in the immediate area are dominated by agricultural fields, housing, and commercial and industrial development. Ahtanum Ridge and Cowiche Mountain are visible, as are the ridge and valley areas to the north and east. Ahtanum Creek flows into the Yakima River just above Union Gap, where the river cuts through Ahtanum Ridge and Rattlesnake Ridge. This gap in the ridges is visible in the lower reach of the watershed.

4.7 Land and Shoreline Use

This section describes current land use, zoning, and comprehensive plan designations in the Ahtanum Creek Watershed, and summarizes relevant land use plans and policies related to the proposed program. In addition, this section briefly describes the implications of the Shoreline Management Act (SMA) (Chapter 173-18 WAC) on the North Fork, South Fork, and mainstem of Ahtanum Creek. To facilitate discussion, the Ahtanum Creek Watershed is separated into three reaches (upper, middle, and lower; see Figure 1-2). The watershed is located in Yakima County, mostly within the County's unincorporated areas. Portions of the watershed's lower reach fall within the jurisdictions of the Cities of Yakima and Union Gap. The southern portion of the watershed falls within the northern part of the Yakama Reservation. Two unincorporated communities, Wiley City and Tampico, are located within in the middle reach of the watershed (Figure 1-2).

Ahtanum Creek forms the northern boundary of the Yakama Reservation (see Figure 1-2). The portion of the watershed north of Ahtanum Creek is located within the Yakama Nation ceded lands. Ceded lands are lands outside the reservation on which the tribe reserves the right to hunt, fish, access and use traditional cultural sites, and gather traditional foods and medicines in all of their "usual and accustomed places." Tribal lands on the reservation are not subject to state or local land use regulations. There are several privately owned parcels, or inholdings, on the reservation, including the portion of the reservation in the Ahtanum Watershed. These lands are subject to county land use regulations.

A variety of sources were used to compile land use information and assess potential impacts. In addition to conversations with local officials, a number of local agencies administer plans that contain land use strategies and policies relating to the proposed watershed project, including the Yakima County *Plan 2015* (Yakima County, 1997), the City of Yakima *Urban Area Comprehensive Plan* (City of Yakima, 1997), and the City of Union Gap *Comprehensive Plan* (City of Union Gap, 1999).

4.7.1 Relevant Plan Goals and Policies

This section summarizes comprehensive plan, zoning, and shoreline designations of the three jurisdictions in the Ahtanum Creek Watershed: Yakima County, City of Yakima, and City of Union Gap.

4.7.1.1 Yakima County

In May 1997, Yakima County adopted *Plan 2015 - A Blueprint for Yakima County Progress* as the County Comprehensive Plan to comply with planning goals established in Washington's 1990 Growth Management Act (GMA). *Plan 2015* provided Yakima County decision-makers, the development industry, and the public with a framework for future development. The main goals of *Plan 2015* include ensuring present and future residents are not burdened by a heavy financial burden and including provisions to protect agricultural, forest, mineral, and open space resources for future generations (Yakima County, 1997).

Yakima County's *Plan 2015* Comprehensive Plan Land Use Map (Figure 4-10) provides the groundwork for zoning designations. That is, the Comprehensive Plan Land Use map depicts the planned land use conditions throughout the County (e.g., Urban), whereas zoning regulates the type of allowed land uses as established in the Yakima County Code (Title 15, Zoning). Together, the County Comprehensive Plan and Zoning Code guide development throughout the Ahtanum Creek Watershed.

Yakima County's *Plan 2015* generally divides existing land use within the County into three major land use categories identified in the 1990 Washington State GMA: urban, rural, and resource. The *Plan 2015* accordingly establishes goals and policies based on each of the three land use categories to guide future land use decisions in Yakima County.

Economic Resource Lands

Areas designated as Agricultural Resource Lands and Forest Resource Lands and zoned Agriculture (AG) and Forest-Watershed (FW), respectively, fall under the Economic Resource Land designation established by Yakima County. The following land use goals and policies of the Agricultural Resource Lands are relevant to the proposed Ahtanum Creek Watershed Restoration Program:

- Maintain and enhance productive agricultural lands and discourage uses that are incompatible with farming activities (Goal LU-ER-AG 1);
- Agricultural practices and supporting activities such as farm worker housing and water resources for irrigation should be included on commercial agricultural lands (Policy LU-ER-AG 1.2); and
- Yakima County will work directly with irrigation districts, the legislature, and other responsible entities to ensure that adequate irrigation water is available for agricultural uses (Policy LU-ER-AG 1.21).

Forest Resource land use goals and policies from the Yakima County *Plan 2015* include:

- Maintain and enhance the conservation of productive forest lands and discourage uses that are incompatible with forestry activities within the Forest Watershed District (Goal LU-ER-F 1); and
- Encourage the conservation of forest lands of long-term commercial significance for productive economic use (Policy LU-ER-F 1.1).

Rural Lands

Rural areas in Yakima County are characterized by a variety of development patterns that are largely determined by the density and type of water and wastewater service provided. Rural properties can range from areas of dispersed 5- to 10-acre ranchettes on private wells and septic systems to more densely settled rural community centers served by public water and/or wastewater systems. Yakima County has established goals and policies to ensure most of the population resides within cities rather than rural areas. By 2010, the County hopes to have 75 percent of the population residing within incorporated cities and only 25 percent outside cities. Some of the objectives adopted to meet this goal include restricting the creation of small lots in rural areas and restricting development outside UGAs so that the density does not necessitate urban level of public services (e.g., water and wastewater).

Yakima County has further separated Rural Lands into four separate land use categories: Rural Settlement, Rural Transitional, Rural Self-Sufficient, and Rural Remote/Extremely Limited Development Potential (Figure 4-10). Rural designations on the County Zoning Map are similar to most land use designation except rural Self-Sufficient lands are zoned as Valley Rural (Figure 4-11).

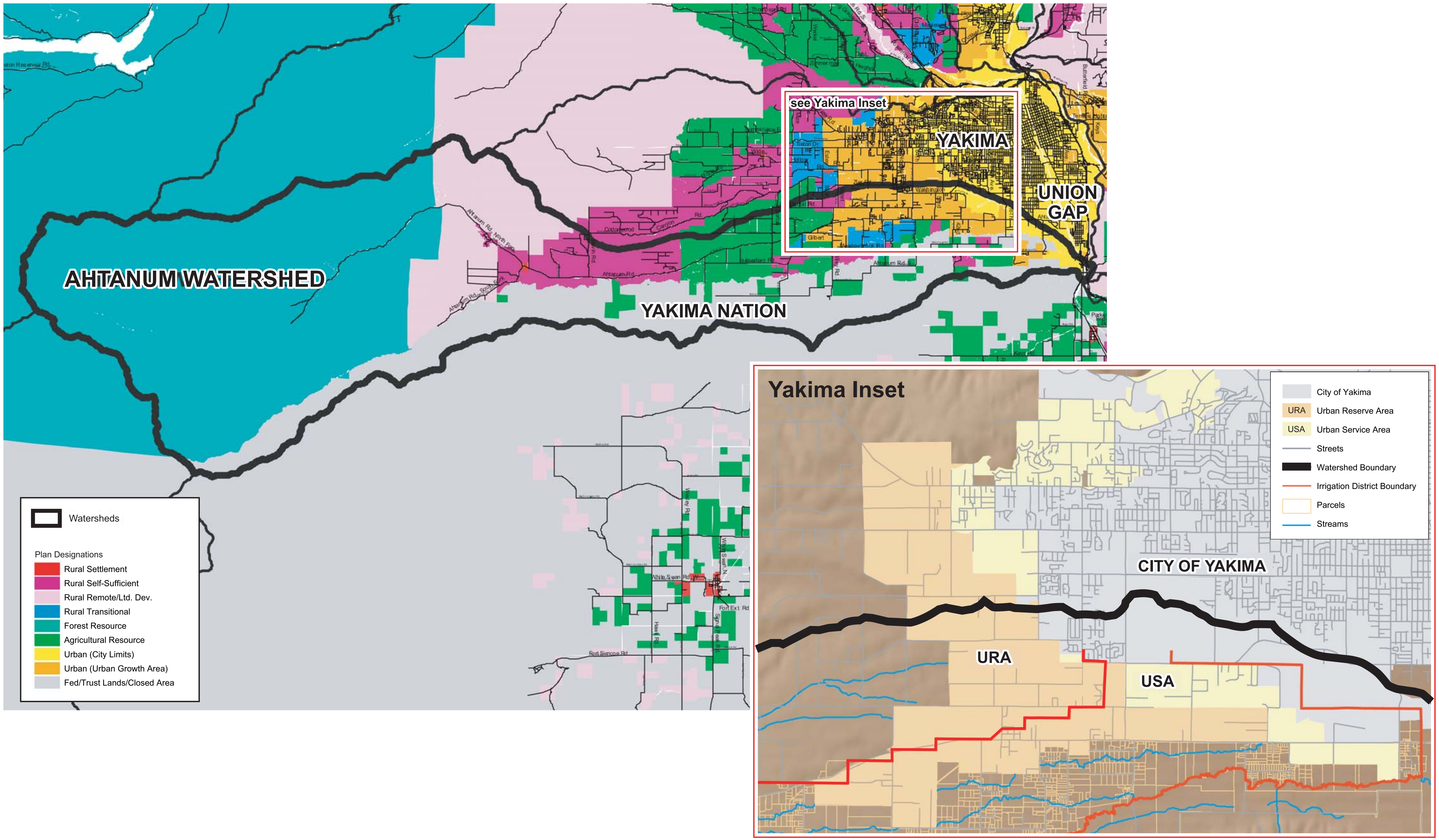
Goals and policies from the Yakima County *Plan 2015* relevant to the proposed project include:

- Promote the use of open space for agriculture, retention of critical area features, forestry for passive recreation, forestry, or passive recreation, using the special tax assessment programs as incentives (Policy LU-R 1.2); and
- Recognize agriculture as an important economic activity within designated rural areas (Goal LU-R 2).

Urban Lands

Yakima County's Urban designation is intended to include land that is characterized by urban growth or will be needed for urbanization, consistent with forecasted population growth and the ability to extend urban services. In accordance with Washington State's Growth Management Act's Planning Goal 1, "Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner," UGAs have been established throughout the County. The cities of Union Gap and Yakima have established their own respective UGA boundaries; however, the County has established goals and policies in the County's *Plan 2015* to separate rural and urban development practices. The UGA designation is intended to establish the area within which each of Yakima County's 14 incorporated cities and towns may grow and annex over the next 20 years. The following Urban Area goal from Yakima County's *Plan 2015* relates to the proposed project:

- Recognize the right to farm and farm use as a legitimate activity within the Urban Growth Area prior to conversion of property to urban use (Goal LU-U 4);
- Allow agriculture and farming operations as a permitted use on existing parcels within the UGA (Policy LU-U 4.1).



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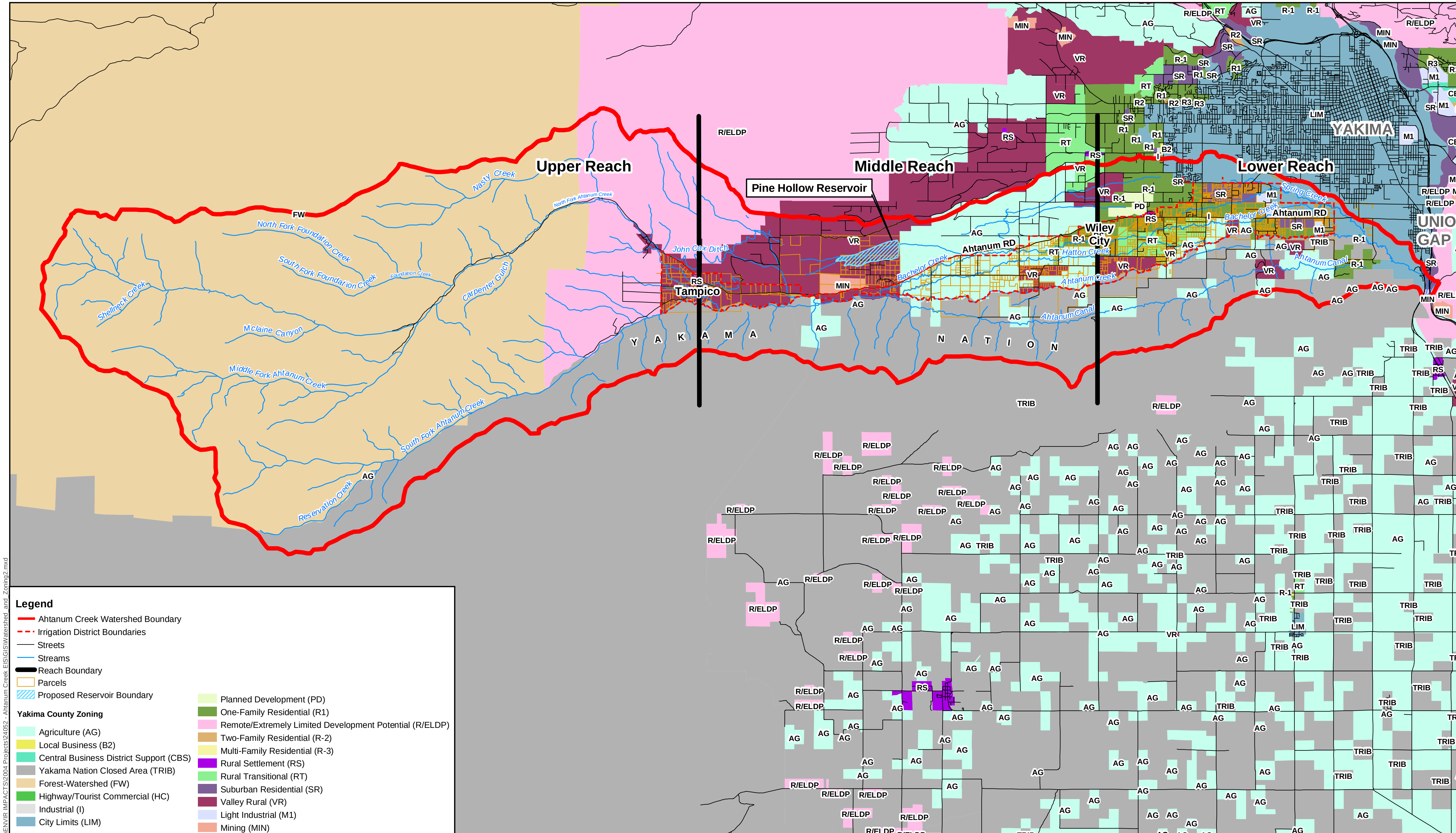
SOURCE: Yakima County GIS, 2004

FIGURE 4-10

YAKIMA COUNTY COMPREHENSIVE PLAN LAND USE DESIGNATIONS

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON



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SOURCE: SOURCE: Ahtanum EIS, 2004; USGS topographic map, 1995

0 6,250 12,500 25,000 37,500 50,000 Feet

1:150,000
1 inch equals 12,500 feet

FIGURE 4-11

ZONING MAP

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

Yakima County regulates shoreline environments in the Critical Areas Ordinance of the Yakima County Code (Title 16A). Conservancy and Rural designated shorelines of Ahtanum Creek are located within the project area. The Critical Areas Ordinance states that management objectives in Conservancy Environments are oriented toward establishing a balance between sustained-yield natural resource utilization and low density recreational uses in this environment, with restriction of development in hazardous areas. The management objective of the Rural Environment is to protect agricultural land, maintain open space, and provide for recreational uses compatible with agricultural production (YCC 16A.02.357) (Yakima County, 2004).

Yakima County is currently in the process of updating its Critical Areas Ordinance and Shoreline Master Program. The County anticipates adopting a revised Critical Areas Ordinance/Shoreline Master Program in March 2006 (Yakima County Planning Department, 2004). Future development along stream shorelines would be subject to policies and regulations established in the updated County regulations.

4.7.1.2 City of Yakima

The city of Yakima's *Comprehensive Plan* (1997) establishes general goals, policies, and objectives relevant to development. Although the *Comprehensive Plan* acknowledges some of the land within the Yakima UGA is currently used for agriculture, under definitions of the state Growth Management Act, no agricultural lands within the UGA have been designated as agricultural lands of "Long Term Commercial Significance." The city of Yakima UGA also includes an Urban Service Area and Urban Reserve Area (Figure 4-10 insert). The city of Yakima Urban Service Area is composed of 34 square miles and includes a variety of land uses and residential densities. The Urban Reserve Area provides land for phased, future development that will be incorporated into the city of Yakima Urban Service Area. As of the adoption of the current city of Yakima Comprehensive Plan in 1997, detailed land use and facility planning for infrastructure and urban services had not been completed for the Urban Reserve Area. Future land use planning in the Urban Reserve Area will be conducted through coordination between Yakima County and the cities of Yakima and Union Gap (City of Yakima, 1997).

The following general development goals, policies, and objectives from the Action Plan section of the city of Yakima's *Comprehensive Plan* are relevant to the proposed Ahtanum Creek Watershed Restoration Program because they regulate agricultural activity within the City's UGA and call for growth in areas served by existing infrastructure:

- Recognize the right to farm and existing farm use as a legitimate activity within the urban growth area prior to conversion of property to urban use (Policy G5.2);
- Plan for the integration of local water, sanitary sewer, storm sewer, and street infrastructure with metropolitan-wide facilities (Policy G6.2);
- Encourage economic growth which minimizes the public's share of infrastructure costs (Objective G7); and
- Direct development in planned areas where infrastructure is either present or can be easily extended (Policy G7.1).

Several objectives listed in the city of Yakima's *Comprehensive Plan* (1997) relate to the protection of the natural environment, in particular, to surface water features:

- New developments should be encouraged to locate in areas that are relatively free of environmental problems relating to soil, slope, bedrock, and water table (Objective E1);
- Preserve and enhance the City's shoreline areas (Objective E3) and shoreline uses and activities should be located to ensure the preservation and protection of the shoreline (Policy E3.1). The City requires review of flood and zoning ordinances to ensure protection of shoreline areas and resources and that actions meet minimum federal requirements;
- Development patterns and densities on lands adjacent to shorelines should be compatible with shoreline resources, and reinforce the policies of the Shoreline Management Act and City / County Shoreline Master Program (Policy E3.2);
- Native riparian vegetation in shoreline areas should be maintained (Policy E3.3);
- Identify and protect fish and wildlife habitat areas (Policy E4.1);
- Restrict development that is incompatible with protection of wildlife habitat (Policy E4.2);
- Protect water resources from contamination by establishing high standards for sewage treatment, industrial and agricultural practices (Policy E6.1);
- Establish improved watershed surface and groundwater management programs (Policy E6.2);
- Encourage coordination between governmental agencies and other major water providers for better water resource management (Policy E6.4); and
- Ensure development compatibility with the floodplain and frequently flooded areas (Objective E7).

4.7.1.3 City of Union Gap

Similar to Yakima County and the city of Yakima, the city of Union Gap's Comprehensive Plan is intended to guide future decisions related to development, capital facilities, transportation, and utilities. Primary goals related to the proposed project include protecting the environment and ensuring public facilities and services are adequate to serve future development.

The city of Union Gap has established general goals and policies that focus on preserving agricultural land use; protecting sensitive environmental features, including stream habitat and floodplains; and acknowledging the city's desire to explore additional water source options. The following goals and polices from the city of Union Gap *Comprehensive Plan* (1999) are relevant to the proposed project:

- Development outside of Union Gap's urban centers should be compatible with the distinctive features of the Valley's open spaces, orchards, and agricultural establishments (Pol. LU 1.8);

- Preserve the rural landscape of the agricultural uses near Union Gap (Goal AG 1);
- Where possible and compatible, preserve some land for agricultural activities (Pol. AG 1.1);
- Protect and enhance Union Gap's environmental quality, including surface water, wetlands, floodplain, groundwater, and wildlife habitat resources (Goal ES 1);
- Maintain the City's rivers, creeks, and intermittent stream courses in their natural state whenever feasible (Pol. ES 1.1);
- Develop land use controls that establish setbacks along all waterways to retain and enhance the natural vegetation for infiltration, maintenance of wildlife habitat, and retardation of runoff and erosion (Pol. ES 1.2);
- Implement surface water management systems which protect natural features whenever possible (Pol. ES 1.16);
- Implement a public information and involvement program to encourage and promote water resources and stream corridor protection (Pol. ES 1.18);
- Maintain and enhance the natural drainage systems to protect water quality, reduce public costs, and prevent environmental degradation (Pol. ES 1.22); and
- Pursue options for the development of additional water sources, including the potential for joint source development with adjacent water purveyors (Pol. CF 8.5).

4.7.2 Property Acquisition Regulatory Requirements

Irrigation districts are given the authority to acquire property through purchase or condemnation for the purposes of the irrigation district by RCW 80.03.140. Property can be acquired for canals, ditches, and reservoirs. The AID would be responsible for acquiring property for the Pine Hollow Reservoir and any land or right of way needed for water conveyance. Property acquisition would be done in accordance with RCW 8.20 for condemnation by a private corporation. Property acquisition would be done on a case-by-case basis following detailed project design and all necessary environmental documentation. The details of the condemnation process and coordination with other entities in the Ahtanum Creek Watershed, including federal, state, and tribal governments, would be fully examined prior to land acquisition.

The organization formed to coordinate the ACWRP would be established through a Joint Operating Agreement and may not have the authority to acquire property through condemnations. For any conservation or restoration project that would require property acquisition, such as road relocations, the organization would likely have to rely on the condemnation authority of the county or cities with jurisdiction over the area if it does not have that authority itself. In cases where there was no authority for condemnation, the ACWRP organization would have to negotiate for purchase of property.

4.7.3 Generalized Land Use and Shoreline Development

The following section describes the existing land and shoreline use within the Ahtanum Creek Watershed based on the three reaches of Ahtanum Creek shown in Figure 1-2. The upper reach is characterized by managed, forested land owned mostly by seven public and private entities. The middle reach largely includes agricultural use, with some single-family residential uses. Agricultural production in the Ahtanum Creek Watershed, which mostly includes irrigated cropland and non-irrigated pasture and range, combines to account for an estimated 27,199 acres. Approximately 14,000 acres of land are irrigated. The lower reach is characterized by urban areas, including portions of the cities of Yakima and Union Gap. The majority of the approximately 2,730 acres of residential and commercial use in the watershed is located in the lower reach (Golder, 2004). The Yakama Reservation extends throughout the southern portion of the watershed (Figure 1-2).

Yakima County and the cities of Union Gap and Yakima have established general goals and policies to guide future development in compliance with the Washington State Growth Management Act. The cities of Union Gap and Yakima have established UGAs aimed at preserving rural land uses from extensive development. Yakima County establishes similar development goals for unincorporated areas, with a high value placed on the preservation of agricultural uses.

Based on current trends, Yakima County estimates developable space will be available within the western portion of the city of Yakima's UGA through 2025. By 2035, the County estimates the UGA west of the city of Yakima will be subdivided and transformed to urban use. Yakima County estimates there is an approximately 70-year supply of buildable land available throughout the entire county based on current development rates (Hoge, personal communication, 2004).

4.7.3.1 Upper Reach

Land use in the upper reach is generally a mix of managed forest lands, agriculture, and sparse low-density residences. The upper reach of the Ahtanum Creek Watershed is located within unincorporated Yakima County except for the southern portion located on the Yakama Reservation. Seven public and private entities claim ownership to large sections of land throughout most of the upper reach including the AID, WDNR, Plum Creek Timber Company, Boise Cascade, Herke, Layman, and the Bureau of Land Management (BLM). The land ownership pattern in the upper watershed is a checkerboard of alternating public and private land, with most entities owning entire 640-acre sections. The WDNR, which occupies approximately 38 sections (approximately 24,320 acres), owns a majority of the land in the upper reach, followed by Plum Creek Timber Company (approximately 15 sections or approximately 9,600 acres) and Boise Cascade (approximately 13 sections or 8,320 acres). In addition, the Yakama Reservation, located along the southern boundary of the upper reach, occupies approximately 47 percent of the total area in the upper reach. Because ~~state,~~ federal, and tribal jurisdiction supercede local jurisdiction, lands owned by these entities are not subject to Yakima County land use or zoning regulations. State lands are subject to local land use regulations unless used for forest practices under the Forest Practices Act.

The Yakima County *Plan 2015* Comprehensive Plan Map designates the upper reach mostly as Economic Resource Land, comprised of lands designated as Forest and Agricultural Resource Lands (Figure 4-10). Forest Resource Lands are those areas primarily useful for growing trees for commercial purposes and also include areas for stock grazing, farming, recreation, and limited housing and commercial activities. Agricultural Resource Lands are those primarily devoted to or important for the long-term commercial production of horticultural, viticultural (grape cultivation), floricultural, dairy, apiary (bee hive management), vegetable, or animal products, or livestock. ~~In 1982,~~ Yakima County created two zones to protect agricultural lands: Exclusive Ag and General Ag. Generally, lands characterized as Exclusive or General Ag can be considered resource lands of long-term commercial significance (Yakima County, 1997). Various designated zoning and land uses occupy the upper reach, with zoning mostly consisting of Forest Watershed, followed by Remote/Extremely Limited (R/ELDP) and Valley Rural zoning. Parcels zoned Remote/Extremely Limited occupy a minimum of 40 acres whereas parcels zoned Valley Rural may vary in size (Yakima County, 2004). Zoning patterns in Yakima County generally follow the *Vision 2015* Existing Land Use Map designations; however, land use categories show specific types of land uses in the zoning areas. For example, land in the lower reach zoned as R/ELDP is attributed with various land use designations by the County that include State Lands, Agriculture, and Forestry land use designations (Yakima County, 1997).

Several shorelines along Ahtanum Creek within the upper reach of the Ahtanum Creek Watershed are regulated as Shorelines of the State under the SMA: North Fork Ahtanum Creek and a small portion of the South Fork Ahtanum Creek (Figure 1-2). Areas within 200 feet of these streams are designated as Conservancy in the Yakima County Code. The Yakima County Code defines shoreline environments in the Critical Areas Ordinance (Title 16A). A Conservancy shoreline designation is defined as an environment characterized by very low-intensity land uses primarily related to natural resources use and disperse recreational development, relatively low land values, minor public and private capital investment, and/or relatively major biophysical development limitations (YCC 16A.02.357).

According to the Yakima County Planning Department, extensive development is not anticipated in the upper reach (Hoge, personal communication, 2004). The County allows limited single-family development along stream reaches in compliance with the shoreline regulations established in the Yakima County Critical Areas Ordinance (YCC Title 16A).

4.7.3.2 Middle Reach

Similar to the upper reach, land uses in the middle reach of the Ahtanum Creek Watershed generally include large areas of undeveloped forested land, agricultural fields, and pasture land. Only a few small parcels are in public ownership in the middle reach. Rural property owners primarily use the land for individual farming operations. Agriculture in the middle reach is a mixture of livestock grazing and crop production.

The middle reach includes two small communities designated as Rural Settlements in the county Comprehensive Plan: Tampico and Wiley City. The county defines rural settlements as areas that have historically allowed small lot residential development, mixed-use commercial and resource-related industrial use. Rural settlements are generally small, unincorporated areas identified as communities located along State Routes, county collector, or arterial roads (Yakima

County, 1997). Tampico is located along Ahtanum Road at the western boundary of the middle reach and Wiley City, also along Ahtanum Road, falls within the city of Yakima's UGA on the eastern boundary of the middle reach.

The middle reach, similar to the upper reach, includes areas within unincorporated Yakima County (approximately 60 percent) and the Yakama Reservation on the south (approximately 40 percent). Lands within the middle reach are mostly designated as a mix of Forest, Agriculture Resource, and Rural Self-Sufficient lands according to Yakima County's *Plan 2015* (Figure 4-10). Valley Rural and Agriculture-zoned areas occupy most of the middle reach of the Ahtanum Creek Watershed. Other types of zoning in the middle reach include R/ELDP, Mining, Rural Transitional, and Single Family Residential (Figure 4-11).

Similar to the R/ELDP-zoned areas, the areas zoned as Agriculture occupy a minimum of 40 acres. ~~However, Yakima County will allow owners of land zoned for agriculture to subdivide into two properties after 5 years; in another 15 years, the property can be subdivided again.~~Yakima County allows owners to subdivide parcels zoned as agricultural every 15 years, provided a home built on the property to be subdivided has been established at least 5 years. Yakima County may permit modification of existing agricultural lands into ~~ranchettes in the future. Ranchettes are~~ small ranches or hobby farms occupying between 5 to 10 acres (Hoge, personal communication, 2005). However, zoning regulations restrict development outside UGAs by public water supply and wastewater system availability. For example, in Rural Settlement zoned areas (i.e., Wiley City and Tampico), the Yakima County Code permits varying lot sizes and densities based on water and sewer service availability. A lot that uses an individual well and sewage system (e. g., septic systems) with a minimum lot size of 43,560 square feet is permitted a maximum density of 1 unit per acre, whereas a lot serviced by public water and public sewer with a minimum lot size of 7,200 square feet is allowed 4 units per acre (YCC 15.37.030) (Yakima County, 2004).

Yakima County estimates that by 2035, areas zoned as Rural Transitional in the middle reach will become part of the City of Yakima UGA. The Wiley City community, located on the eastern portion of the middle reach, has expressed interest in obtaining wastewater service due to groundwater contamination. As a result of high groundwater levels, septic systems in the area experience a high rate of failure and may be contaminating groundwater (Hoge, personal communication, 2004).

The reach of Ahtanum Creek that extends through the middle reach of the watershed is designated as a Shoreline of the State, with the exception of the shorelines on the south side of the creek on the Yakama Reservation. The shoreline west of the west line of Section 15, Township 12 North, Range 17 East is designated Conservancy. West of this area to Ahtanum Creek's confluence with the Yakima River is designated as a Rural Environment (see Figure 1-2). The County defines Rural Environments as those characterized by intensive agricultural and recreational uses, moderate land values, lower public and private capital investment, and/or some biophysical development limitations (YCC 16A.02.357).

4.7.3.3 Lower Reach

The cities of Yakima and Union Gap and portions of unincorporated Yakima County occupy the lower reach of the Ahtanum Creek Watershed. The lower reach is characterized by considerably more development compared to the upper and middle reaches of the Ahtanum Creek Watershed. The portion of the city of Union Gap within the lower reach is mostly characterized by single-family residential development and pasture. Currently, residential development in Union Gap has reached capacity based on existing zoning. The city of Union Gap anticipates the build-out of industrial-zoned property over the next 10 years (Rathbone, personal communication, 2004). The lower reach portion within Yakima city limits is mostly characterized by single-family residential development. Agricultural lands in the cities of Yakima and Union Gap and their respective UGAs have historically been used for pasture. These lands are currently becoming fragmented by industrial and residential development. The Yakama Reservation occupies approximately 10 percent of the lower reach's total area, south of Ahtanum Creek.

Due to the proximity of the cities of Union Gap and Yakima, Yakima County's *Plan 2015* Comprehensive Plan Land Use Map (Figure 4-10) designates a large portion of unincorporated Yakima County in the lower reach as Urban. A few areas are designated as Agricultural Resource. Urban areas, defined as those portions of the watershed occupied by the cities of Yakima and Union Gap and portions of unincorporated Yakima County, make up approximately 4.9 percent (5,637 acres) and 1.9 percent (2,161 acres) of the lower reach, respectively. Single-family zoned areas occupy a majority of the incorporated areas within the lower reach (City of Union Gap, 1999; City of Yakima, 1997). In addition to residential development, pasture lands also occupy these areas zoned as single-family residential. Zoning designations from Yakima County and the cities of Union Gap and Yakima generally follow comprehensive plan land use map designations previously mentioned. Yakima County's Zoning Map (2004) shows several parcels zoned as Agriculture and Rural Transitional use throughout the unincorporated areas of the lower reach, whereas most parcels located in the cities of Yakima and Union Gap are zoned a mix of Suburban Residential and One-Family Residential (Figure 4-11).

Similar to the upper and middle reaches of the Ahtanum Creek Watershed, the portion of Ahtanum Creek that passes through the lower reach is designated as a Shoreline of the State, with the exception of the south shoreline on the Yakama Reservation. On the north side of Ahtanum Creek, the shoreline in the lower reach is designated as Rural Environment, limiting development to agricultural and recreational uses (Figure 1-2) (YCC 16A.04).

4.8 Transportation

Due to the primarily rural nature of the Ahtanum Creek Watershed and low-density development within the project area, the roadway network is limited outside the city limits of Yakima and Union Gap. Ahtanum Road is the primary road that extends through the entire Ahtanum Creek Watershed connected to a series of Yakima County roads and private roads that are used to access individual properties. Incorporated areas within the lower reach of the Ahtanum Creek Watershed rely on a roadway system that is more extensive and has a higher capacity compared to unincorporated areas of Yakima County. Yakima County is proposing to construct a new road to connect Interstate 82 with Highway 12 that is anticipated to be complete over the next 10 to 20 years (Hoge, personal communication, 2005). This new roadway would extend along the west perimeter of the city of Yakima and would fall within the Ahtanum Creek Watershed.

Yakima County does not currently offer a county-wide transit system. Yakima Transit offers several public bus routes that operate throughout the city of Yakima. Although the city of Union Gap does not currently provide public transit service, since May 20, 2002, the non-profit organization People For People has been operating a community connector transit route between the Yakima Transit Center and the cities of Union Gap and Selah. The transport vehicle conveys passengers from local stops to the Yakima Transit Center. No transit service is provided outside city limits.

4.9 Recreation

Recreation opportunities in the Ahtanum Creek Watershed are limited by the lack of access and limited public lands in the basin. Fishing opportunities in the basin are limited by restricted access to the creek in the lower and middle reaches. The DNR lands in the upper reach are accessible for recreation, but there are no developed recreational facilities. Access to Yakama Reservation lands is restricted to tribal members. The only developed recreational facilities along Ahtanum Creek are the Youth Activities Park and Fulbright Park in Union Gap. The Ahtanum Youth Park is located above the confluence with Bachelor Creek and has a variety of developed recreational facilities, including sports fields and an outdoor equestrian use area and barn. Fulbright Park is located near the mouth of Ahtanum Creek on both sides of the creek. The park has developed recreational facilities as well as a large, natural passive use area.

4.10 Economics

This section describes current economic conditions in the Ahtanum Valley area using available data. County-level data are the only reliable data for most economic variables because little data exist for the immediate project area. The variables discussed focus on population, employment, wages, and income.

4.10.1 Yakima County Population

Yakima County's population has grown by 60 percent to 225,000 since 1969, based on projections from U.S. Census Bureau calculations (see Section 6.10 for assumptions used to calculate population figures.)

No population data are available for the Ahtanum Watershed study area, but information for Yakima County has been extrapolated to the study area.

4.10.2 Economic Variables

Yakima County is one of the nation's richest agricultural counties and leads the state in apple, pear, peach, and grape production, while other agricultural specialties such as hops and mint also play a major role. Since the 1970s, agriculture has had an increasingly smaller role in the county's economy, while services, particularly health and government services, have grown markedly. The county's base in agriculture and extractive industries has shrunk and given way to Yakima's role as a service provider for the City of Yakima and a large, mostly rural area of eastern Washington consisting of Yakima, Kittitas, Grant, and parts of Franklin counties.

Three primary economic variables are used to describe the county-level base upon which impacts are assessed: employment, wages, and income. Table 4-4 presents total employment, wages, and number of firms in Yakima County. Agriculture and support services produce over 20 percent of the county's jobs but account for only 13 percent of wages. Broadly speaking, like much of the rest of the nation, Yakima's economy is best characterized as a service economy rather than an agricultural or manufacturing economy. The agricultural and manufacturing sectors produce approximately 35,740 jobs, or 38 percent of the total 93,309 jobs in the region. The preponderance of manufacturing jobs is in the food processing industries. The remaining 62 percent of jobs are in a range of services, the largest of which is the 16,250 jobs in the government classification.

The largest sources of wages are, in order: government, health care, agriculture, manufacturing, and retail trade. Major employers in the county are, in order: Yakima School District No. 7; Department of Social and Health Services Division of Vocational Rehabilitation; Tree Top, Inc.; Yakima County Government; Yakima Valley Memorial Hospital; Yakima Regional Medical and Heart Center; the city of Yakima; Washington Beef; and Yakima Community College. In 2004, the average per capita income was $24,972.

Table 4-4. Yakima County Number of Firms, Wages, and Employment, 2004

Industry	Firms	Wages	Jobs
Total	9,054	$2,381,660,620	93,309
Agriculture, forestry, fishing, and hunting	1,443	$314,359,780	18,979
Mining	4	$208,828	9
Utilities	13	$11,698,644	203
Construction	635	$77,102,741	2,730
Manufacturing	249	$306,977,333	9,594
Wholesale trade	257	$117,184,118	3,672
Retail trade	637	$206,898,218	9,240
Transportation and warehousing	196	$58,506,863	2,111
Information	39	$47,193,677	1,267
Finance and insurance	160	$64,554,005	1,637
Real estate and rental and leasing	203	$16,026,098	837
Professional and technical services	267	$50,177,078	1,915
Management of companies and enterprises	19	$26,509,246	537
Administrative and waste services	190	$39,641,585	2,227
Educational services	37	$21,011,041	880
Health care and social assistance	400	$325,157,687	10,596
Arts, entertainment, and recreation	68	$13,177,624	1,062
Accommodation and food services	389	$63,822,945	5,251
Other services, except public administration	3,722	$57,568,588	4,320
Government	135	$563,884,521	16,250

Source: Calculated from Washington State Employment Security, Labor Market and Economic Analysis Data available at: http://www.workforceexplorer.com/admin/uploadedPublications/1889_industry_current.xls

4.10.3 County Revenue

Yakima County receives approximately 46 percent of its total $122 million revenue from intergovernmental revenues, 24 percent from general property taxes, and 11 percent from fees for services. The remaining revenue is derived from a variety of sales and local taxes, other fees, and minor sources, according to information provided by the Washington State Auditor.

County property tax assessments currently average $12.36 per $1,000 of assessed valuation; this assessment is expected to fall in the future due to the restrictions that were imposed by State Initiative 747 (Cook, personal communication, 2004). The current rate of sales taxes collected in the county is 7.9 percent. Disbursement of this 7.9 percent tax rate is as follows: 6.5 percent to the State of Washington; 0.30 percent to Yakima City Transit; 0.85 percent to Yakima City General Fund; 0.15 percent to Yakima County; and 0.10 percent to Yakima City and County Court and Criminal Justice.

4.10.4 Relationship of County Data to the Ahtanum Watershed

As previously noted, economic data at the watershed level do not exist; however, there are still a number of means of qualitatively portraying the affected economic environment in the project area. Most of the land area in the Ahtanum Creek Watershed is currently in agricultural and range use. As noted on the zoning map (Figure 4-11), the majority of the watershed is zoned Agriculture, Rural Transitional, or Valley Rural. The exceptions are: 1) 2,162 acres of the watershed (1.9 percent) within the city limits of Union Gap; 2) 4.9 percent of the watershed within the planning jurisdiction of the City of Yakima; and 3) existing residential development in Tampico, Ahtanum, Wiley City, and rural parts of the watershed.

Table 4-5 presents the current cropping pattern of the 11,000 acres potentially impacted by the reservoir-related alternatives (Alternatives 2 and 4). Less than a quarter of the project area is currently in orchard production. Hay production accounts for a quarter of use. The remainder of the potentially affected land, except for the 83 acres of sweet corn, is in pasture. Irrigators have chosen pasture over higher value crops because of the lack of reliable water supply (Golder, 2004). Much of the area's hay harvest is limited to two cuttings because of the unreliability of the water supply.

Table 4-5. Current Cropping Pattern in the Ahtanum Watershed

Crop	Acres
Apple	1,898
Sweet cherry	260
Pear, bartlett and winter	484
Hay, alfalfa and other	2,916
Pasture	5,460
Sweet corn	83
Total	**11,101**

Source: Golder, 2004.

4.11 Cultural Resources

For this analysis, the study area for cultural resources is defined as the proposed construction footprint of any ground-disturbing activities that would be associated with the conservation or restoration projects or the reservoir and related facilities. Cultural resources that could potentially be present within the study area could be expressed by any of a number of physical property types and landscape elements directly associated with past and present human behavior. These property types could include buried archaeological deposits and above-ground, built features such as rock cairns; landscape characteristics important to traditional Native American subsistence, spiritual, and religious practices; structures related to recent historic agricultural and industrial developments; and other features that are potentially significant to the construction of a social group's ethnic identity.

Archaeological deposits could potentially range in age from the early Holocene (the last 11,000 years) to about 1800 and include pre-modern historic features. Based on existing data for this region, the types of archaeological materials that might be present and visible on the ground surface could include lithic (stone tool) scatters and evidence of seasonal camps and trails or similar features that could represent a range of residential, hunting, plant gathering, and ceremonial activities. Historical archaeological resources could include intact elements of historic buildings and engineering structures, such as orchard workers' cabins and irrigation canals.

The project area is part of a larger Mid-Columbia and Plateau subregion that is the traditional territory of speakers of the Sahaptin language family (Teit, 1928). It lies within the ceded lands of the Yakama Nation, which is composed of members of 14 bands and tribes. Ethnographic (e.g., Ray, 1936; Spier, 1936) and archaeological (e.g., H. I. Smith, 1910) studies conducted in the first half of the twentieth century documented the history and endurance of Yakama and Mid-Columbia Indian traditions in an era of increased stresses of acculturation.

Yakama villages prior to the reservation era may have typically consisted of 5 to 15 multifamily lodges or longhouses (Schuster, 1998). Many Yakama villages were located in the region of the modern city of Yakima (Schuster 1998:329), and the fishery at the junction of Wenas Creek and the Yakima River was reputed to be one of the largest in the area (Lothson, 1994). Spier (1936) indicated that a Yakama band known as *Ä'tănŭm-'lĕma* lived along Ahtanum Creek in the vicinity of the project area.

Traditional land use within the general vicinity of the project area may have included hunting of large and small game such as deer, elk, and mountain sheep, and root collecting during seasonal occupation at optimal locations. Specialized fishing for salmon and steelhead, using platforms, traps, prongs, and dip nets was done in the Yakima River (Hunn et al., 1990); scaffolds were still in use in the Yakima River in the 1990s near Union Gap (Schuster, 1998). Anadromous fish found in creeks would likely have been taken using weirs and willow and stone traps. In the more recent historic era, Indian families used grasslands in the valley to pasture herds of cattle and horses.

Euro-American settlement in the general project area began in the early nineteenth century as explorers and traders traversed the Yakima River region. Miners, sheepherders, and missionaries migrated through the area by the mid-1800s. By the early 1840s, Yakama families had obtained longhorn cattle from the Hudson's Bay Company. A Catholic mission was founded between 1849 and 1852 in the middle reach along Ahtanum Creek. The missionaries purposely situated the chapel near the summer campgrounds of Yakama leader Kamiakin. Originally known as Sainte-Croix d'Ahtanum, the mission and its resident priests were "instrumental in helping the Yakima [sic] adapt to the changes rapidly taking place around them" (Lentz, 1976). Following its establishment, many Yakama obtained seeds and plants from the Ahtanum mission, as well as from the Hudson's Bay Company, and began to cultivate gardens, raising foods such as potatoes, squash, and barley (Schuster, 1990). Kamiakin was reputed to have one of the largest gardens of the Yakama and is known as the first to dig extensive irrigation ditches from the creek to water the gardens (Schuster, 1990; Splawn, 1980). Treaties that had been negotiated during the first half of 1855 between a confederation of Yakama leaders and the federal government supporting passage and settlement in the area were in dispute later the same year. The original mission buildings were destroyed by troops of the Puget Sound and Oregon Volunteers during the "Indian War" of 1855; the present day log chapel building was built in 1869 and thereafter known as Saint Joseph's Mission.

In the 1850s, several skirmishes were fought between the Yakama and the U.S. Army. By the early 1860s, many Yakama had been relegated to the newly created reservation lands. The first permanent white settlers arrived in Yakima County between 1861 and 1862. Grasslands used by the Yakama as forage for their horses and cattle were appropriated by recent immigrants for their own homesteads and herds; these immigrants soon realized the economic potential of the climate and soil. Hops were grown by 1872 and interest in this crop matched the interest in growing fruit orchards. During the winter of 1880-1881, over 100,000 and possibly as many as 150,000 cattle in the Yakima Valley froze to death or starved. Thereafter, the future of the Valley's economy belonged to the farmer and orchardist (Splawn, 1980).

The population of Yakima County as recorded by the United States Census in 1870 was 132 persons, and by 1880 this number had grown to 2,811 (Hellend, 1983). By the early 1880s, news of the coming Northern Pacific Railroad inspired speculation and growth in the little settlement of Yakima City (present-day Union Gap). But in 1884, railroad officials announced that they intended to build a station and new town four miles north of the town. In 1885, the Northern Pacific land commissioner convinced many businesses to relocate to the new site, called North Yakima (present-day Yakima). By 1890, arrival of the Northern Pacific Railroad had enabled Euro-American settlement and irrigation in much of the Yakima Valley. Residential and urban settlement was concentrated near the expanded railroad line, while the Ahtanum Valley west of Yakima remained largely used for agriculture and sheep pasture. The floodplain contributed to the high potential for agriculture in the area, but also threatened the stability of permanent structures in its path. From the beginnings of Euro-American settlement in the Ahtanum Valley, frequent high water in the creeks and in the Yakima River damaged and eroded bridges, cemeteries, and structures. By the mid twentieth century, local employment was concentrated in fruit, agriculture, lumber, and manufacturing industries. By the mid-1970s, the cities of Yakima and Union Gap were able to annex large tracts west of their city limits, attracting businesses such as meat packing and industrial manufacturing to the area.

Ancient land use in the project area may have consisted primarily of subsistence activities such as hunting, plant gathering, fishing, and, more recently, horse and livestock husbandry. Lithic procurement areas (areas where stone was gathered for tools) might be present in the general area where the appropriate rock deposits and landforms are located. The creeks in the Ahtanum Creek Watershed might have supported opportunities for fishing using weirs and stone traps, although it is likely that such efforts were concentrated along larger channels. Later periods of riverine settlement would have seen continued use of wetland environments along the creek, although settlement and main activity areas would likely have been located outside of lands prone to flooding. Historic maps and primary and secondary sources suggest that the project area was not densely settled and was used generally for pasture and agriculture since the initial period of Euro-American settlement.

As of November 2004, few archaeological or historical sites have been recorded in the immediate vicinity of the project area. Most archaeological sites nearer to the Yakima River have been identified as a result of specific projects and regulatory-driven surveys; and few such projects have been conducted along the Ahtanum Creek watershed. Two recorded historic properties are in the general vicinity of the proposed Pine Hollow Reservoir and are listed on the National Register of Historic Places. Saint Joseph's Mission (45YA362) and Kamiakin's Gardens (45YA363H) are located in the middle reach of the Ahtanum Creek Watershed.

A very limited effort at identifying potential cultural properties that may be present in the proposed reservoir location has occurred (Yakama Nation Cultural Resources Program, 1999). In 1999, the Yakama Nation Cultural Resources Program conducted a pedestrian survey of the proposed Pine Hollow Reservoir site, included in the technical assessment of the reservoir (Dames and Moore, 1999a). Ground surface visibility did not permit archaeologists to attain the desired level of survey coverage. Additionally, the planned engineering redesign of the nearby Johncox Ditch, from which the new facility was to be filled, was not available at that time, and so this proposed ditch alignment was not located or surveyed.

The survey noted that one historic property listed on the National Register of Historic Places (NRHP) is located the project area. Kamiakin's Gardens is located approximately 2.9 miles from the reservoir. This site represents the location of domestic cattle operations and pasturage in the Ahtanum watershed begun by Kamiakin within an area that is traditional homeland to families of native Yakamas. The broad spectrum of subsistence activities at the site included diverting springs by ditch to irrigate gardens, as well as retaining water to support seasonal salmon runs; and, "as an anadromous fish bearing stream, this tributary held importance as a weir bearing or aboriginally dammed stream that attracted early non-Indians to the area who wrote about its capacity to supply fish." It was then noted that Indian allotments dating from the nineteenth century are leased to non-Indians today, "although until recently successful Indian cattle and horse operations were resident in the basin" (Yakama Nation Cultural Resources Program, 1999).

4.12 Public Services and Utilities

This section discusses existing public services and utility providers in the Ahtanum Creek Watershed. Public services include educational facilities, fire and police protection, emergency medical response services, religious and social institutions, military facilities, and public transit. Utilities discussed include water, wastewater, solid waste, electricity, and natural gas services. Information was gathered from local jurisdictions' comprehensive plans and Yakima County's online GIS mapping service.

4.12.1 Public Services

Since four~~three~~ separate jurisdictions occupy the Ahtanum Creek Watershed (Yakima County, the Yakama Nation, City of Yakima, and City of Union Gap), there are numerous public service providers in the watershed. Table 4-6 identifies public service providers for Yakima County and the cities of Yakima and Union Gap~~each jurisdiction~~ in the Ahtanum Creek Watershed. Police, fire, and emergency response services sometimes respond to emergency calls outside their jurisdiction because Yakima County and the cities of Yakima and Union Gap are members of the Yakima County Mutual Aid System that allows nearby jurisdictions to assist in emergencies. Three schools are located within the Ahtanum Creek Watershed: Ahtanum Valley Elementary School, West Valley High School, and West Valley Junior High School. These three schools are located within the Yakima city limits. Public transportation services are further described in Section 4.8, Transportation.

Table 4-6. Public Service Providers in the Ahtanum Creek Watershed[1]

Jurisdiction	Service Provided	Public Service Providers
Yakima County	Fire and Emergency Medical	Yakima Fire District No. 12 and Washington State Department of Natural Resources (Fire response only)
	Police	Yakima Sheriff's District No. 2
	Public Schools	West Valley School District and Wapato School District
	Public Transportation	None
City of Yakima	Fire and Emergency Medical	Yakima Fire Department
	Police	Yakima Police Department
	Public Schools	Yakima School District
	Public Transportation	Yakima Transit
City of Union Gap	Fire and Emergency Medical	City of Union Gap Fire Department
	Police	City of Union Gap Police Department
	Public Schools	Union Gap School District
	Public Transportation	People for People

[1] In addition, the Yakama Nation and United States government provide services to reservation lands in the watershed. No schools or other services other than transportation are located on the portion of the Reservation in the watershed.

4.12.2 Utilities

Similar to public services, since the Ahtanum Creek Watershed Basin encompasses four~~three~~ separate jurisdictions, several utility providers offer service in the project area. As shown in Table 4-7, utility providers may overlap in certain jurisdictions.

Irrigation water in the watershed is provided by the AID, WIP, and private systems (see Sections 1.1 and 3.2 for additional information). The Yakima-Tieton Irrigation District extends into the Ahtanum Creek Watershed but diverts its water from the Tieton River, outside the watershed.

Water and wastewater lines are generally concentrated in the incorporated areas of the cities of Yakima and Union Gap. In unincorporated areas, water and sewer systems are private wells and on-site sewage systems. As discussed in Section 4.7, the availability of water and sewer systems is a limitation on residential density in the county.

Table 4-7. Utility Providers in the Ahtanum Creek Watershed

Jurisdiction	Service Provided	Utility Provider
Yakima County	Water	Nob Hill Water Association; individual private wells
	Sewer	On-site systems (e.g., septic tanks and drain fields)
	Solid Waste, Recyclable	Yakima Waste Systems, Inc.; the Yakima Nation has a separate contract with Waste Management, Inc. for solid waste collection
	Flood Control and Stormwater	Yakima County
	Electricity	Pacific Power and Light
	Natural Gas	Cascade Natural Gas
City of Yakima	Water	City of Yakima
	Sewer	City of Yakima
	Stormwater	City of Yakima
	Solid Waste, Recycling	Yakima Waste Systems
	Flood Control and Stormwater	Yakima County
	Electricity	Pacific Power and Light
	Natural Gas	Cascade Natural Gas
City of Union Gap	Water	City of Union Gap
	Sewer	City of Yakima
	Stormwater	City of Union Gap
	Flood Control and Stormwater	Yakima County
	Solid Waste, Recycling	City of Union Gap
	Electricity	Pacific Power and Light
	Natural Gas	Cascade Natural Gas

4.13 Existing Water Rights

This section describes the status of key water rights held in the Ahtanum Creek Watershed that could be affected by the implementation of the ACWRP. The legal framework of water rights is more generally described in Chapter 3 and Appendix B.

Both surface water rights and groundwater rights are used in the Ahtanum Watershed. The surface water rights are currently the subject of a water rights adjudication in Yakima County Superior Court. The groundwater rights have not been adjudicated (see Section 3.2.1.5 for additional information on the adjudication process).

An adjudication is a statutory proceeding in which the extent, validity, and relative priority of the water rights in a defined area are determined (RCW 90.03.110-.245) (see Section 3.2.1.5). The Yakima Adjudication, which was begun in 1977, is a major undertaking in which all rights to surface water in the entire Yakima Basin are being adjudicated. The case has been divided into four pathways, including a Major Claimant Pathway for large entities and a Subbasin Pathway for individuals and smaller entities. At the end of the adjudication, Ecology will issue water right certificates for those water rights confirmed by the court. Water rights not confirmed by the court will be extinguished. The Ahtanum Watershed is one of 31 subbasins within the adjudication, and the court is considering the surface water rights of the major claimants and the subbasin claimants in the Ahtanum Watershed in a single subproceeding.

The Yakima County Superior Court issued a Report of the Court Concerning the Water Rights for Subbasin No. 23 (Ahtanum Creek), Ahtanum Irrigation District, Johncox Ditch Company and United States/Yakama Nation on January 31, 2002 (Report of the Court). The court subsequently issued a Memorandum Opinion Re: Ahtanum Creek Threshold Legal Issues (Memorandum Opinion) prior to holding an exceptions hearing on its Report of the Court. The exceptions hearing, during which the parties presented arguments on their objections to the Report of the Court and its Memorandum Opinion, was conducted between January 26 and February 27, 2004. The parties filed post-hearing, response, and reply briefs from July to October 2004. It is anticipated the court will issue a Supplemental Report of the Court in Spring 2005 in which the court will issue its decisions on the objections raised by the parties. Unless the court allows the parties to file further objections to its rulings, the court will issue a Conditional Final Order regarding the water rights in the Ahtanum Subbasin. The Conditional Final Order can be appealed to the state Supreme Court when it is issued by the Yakima County Superior Court or, arguably, at the conclusion of the adjudication when the court issues its order integrating all the water rights in the Yakima Basin.

The following discussion of existing surface water rights begins with background information on previous legal proceedings addressing the water rights in the Ahtanum Watershed, followed by a summary of the current status of the issues before the Adjudication Court. The discussion concludes with a consideration of the effect the court's ruling on the issues may have on a proposed storage project.

4.13.1 Previous Legal Proceedings in the Ahtanum Creek Watershed

The combination of water right claimants and the history of legal proceedings in the Ahtanum Creek Watershed create a complex scenario. The primary water right claimants are designated Southside water users and Northside water users. The Southside water users include the Yakama Nation, who claim a tribal federal reserved right to water for irrigation of the reservation lands to the south of Ahtanum Creek and who also share that water on a pro-rata basis with tribal allottees of land on the reservation and non-tribal successors to the lands of allottees. The Northside water users include the AID, Johncox Ditch Company, and individual water right holders. All water rights for out-of-stream uses are junior to the Yakama Nation's treaty right for fish and other aquatic life which has a priority date of time immemorial.

Water rights in the Ahtanum Watershed have been the subject of federal and state proceedings since 1908. As the court noted in its Report of the Court, quoting the Trial Brief of AID, "[t]he Ahtanum area has produced more litigation per gallon of water involved, than any other irrigation district in the State of Washington, maybe the United States" (Report at 35). In 1908, the Chief Engineer of the Bureau of Indian Affairs, W.H. Code, fashioned an agreement between the United States on behalf of the Yakama Nation, and the non-tribal landowners on the north side of the creek (the Code Agreement). The agreement called for the Northside water users to have 75 percent of the flow of Ahtanum Creek and the Yakama Nation to get 25 percent of the flow. In the mid-1920s, a state adjudication was conducted, *State of Washington v. Annie Wiley Achepohl, et al.* (*Achepohl),* to adjudicate the rights in the Ahtanum area under state law. In 1947, the United States, on behalf of the Yakama Nation, filed a lawsuit in federal court attempting to undo the 1908 Code Agreement and assert a right to more than 25 percent of the flow. The case was heard in federal District Court and was the subject of two opinions from the U. S. Ninth Circuit Court referred to as Ahtanum I (*United States v. Ahtanum Irrigation District,* 236 F.2d 321 (9th Cir. 1956)) and Ahtanum II (*United States v. Ahtanum Irrigation District,* 330 F.2d 897 (9th Cir. 1964)) (also known as the Pope Decree).

The court in the ongoing Yakima Adjudication considered all of the historical proceedings and concluded that to receive a senior water right (a senior water right has an older priority date and receives its full irrigation allotment prior to water rights holders with a newer or "junior" priority date) in the current adjudication, a claimant must show that 1) a predecessor who owned the water right was a signatory to the Code Agreement; 2) a predecessor had the water right confirmed in *Achepohl;* and 3) the right was confirmed again in Ahtanum II. If all three of these factors are not satisfied, the claimant may still be confirmed a junior right (a junior water right has a newer priority date and only receives irrigation water when the allotments of all senior water rights holders have been met). The court has determined that it will award a junior right to a claimant who is a successor to a signatory to the Code Agreement and is in compliance with the *Achepohl* decree, but who was not properly included as a defendant in Ahtanum II.

Ever since the 1908 Code Agreement, a primary question regarding the water rights in the Ahtanum Watershed is how the available water in the creek is split between the Southside water users and the Northside water users. The key ruling on this issue is in Ahtanum II and reads as follows:

> [I.] b. To plaintiff [United States], for use on Indian reservation lands south of Ahtanum Creek, twenty-five percent of the natural flow of Ahtanum Creek, as measured at the north and south gauging stations; provided that when that natural flow as so measured exceeds 62.59 cubic feet per second, all the excess over that figure is awarded to plaintiff, to the extent that such water can be put to beneficial use.
>
> ***
>
> II. After the tenth day of July in each year, all the waters of Ahtanum Creek shall be available to, and subject to diversion by, the plaintiff for use on Indian Reservation Lands south of Ahtanum Creek, to the extent that said water can be put to beneficial use (330 F.2d 897, 915).

The primary issues remaining in the Ahtanum proceeding center on the interpretation of the quoted language from Ahtanum II. For a more complete discussion of the water rights legal issues, see Appendix B. How the court resolves each of the issues has potential implications for construction and operation of a storage reservoir.

Several central water rights issues involve excess water. The court defines excess water as water that exists prior to July 10 when the flow in Ahtanum Creek exceeds 62.59 cfs and 1) the on-Reservation water users are not using that excess water, and 2) the excess water is not being used to maintain fish life. The issues regarding excess water are whether it exists; if so, how it is to be calculated and who gets to use it. The issue of junior water rights is directly tied to that of excess water. Under the court's analysis, the water rights to the excess water would be junior to the Southside and Northside water users, whose water rights were confirmed in Ahtanum II.

The resolution of these issues bears directly on the Yakama Nation's water right for irrigation. The court has stated that the Yakama Nation's water right is for 3,306.5 historically irrigated acres plus 1,840.35 future acres for a Practically Irrigable Acreage (PIA) total of 5,146.85. The court has established a water duty, the amount of water necessary to irrigate an acre of land, of 4.4 acre-feet/acre. The total annual quantity of water to irrigate the PIA is therefore 22,646.13 acre-feet. The PIA total is based on the capacity of the WIP as designed in 1915, and the United States and the Yakama Nation assert there is no excess water because there is not enough water to irrigate all of the PIA. Further, they maintain that if the court awards the Northside water users a right to water in excess of that needed to meet project capacity, the United States must be allowed to make a claim to enlarge the PIA beyond the project capacity. The final quantity of water confirmed to the Yakama Nation and the Northside water users will affect how much water from storage will be available for additional water rights.

The Yakama Nation's water right for fish was previously confirmed by the Adjudication Court. The right is unquantified but is described as the minimum instream flow necessary to maintain fish life in Ahtanum Creek in light of prevailing conditions. This water right has a priority date of time immemorial and must be met before any other water rights are satisfied. If a storage reservoir is built, the prevailing conditions in Ahtanum Creek would change from those that presently exist, thus creating different conditions for determining the Nation's instream flow right for fish and other aquatic life.~~the natural flow regime. This could raise the issue of what minimum flow would be necessary to maintain fish life in light of the new conditions.~~

The Adjudication Court has also ruled that there is a non-diversionary stockwater right, which requires 0.25 cfs to be retained in the streams when naturally available. The U.S. and Yakama Nation assert that to keep 0.25 cfs in Bachelor and Hatton Creeks would require a diversion of 5 cfs from Ahtanum Creek and would shorten the Yakama Nation's irrigation season by 2 to 4 weeks. Resolution of this issue will have implications for how the proposed Pine Hollow Reservoir would be operated.

The fact that the surface water rights in the Ahtanum Subbasin have not yet been confirmed by the Adjudication Court creates uncertainty regarding the quantity of water from a new storage project that would be available for new water rights. The primary uncertainty is with respect to the extent of the Yakama Nation's water right for irrigation and the right of junior water right holders to excess water not currently used by the Yakama Nation. Resolution of these issues will clarify how much water the Yakama Nation and the junior users are entitled to and will affect how much of the water in the proposed reservoir is already appropriated. The unquantified nature of the Yakama Nation's water right for fish also creates uncertainty. This will not be resolved in the adjudication. Additional information on the adjudication is located in Appendix B.

4.13.2 Groundwater Rights

Estimating groundwater rights is more difficult than surface water rights. As with surface water rights, anyone who acquired a groundwater right prior to adoption of the Groundwater Code (Chapter 90.44 RCW) in 1945 has been required to file a water right claim, which is on record with Ecology. While helpful to a certain extent, these claims represent only what a water right user asserts is their water right; the rights have not been adjudicated and confirmed by a court. For groundwater rights acquired after 1945, Ecology has a record of certificates granted. For rights not yet perfected, Ecology has a record of permits issued. The core problem in adequately quantifying and cataloging existing groundwater rights is the statutory exemption discussed in Section 3.2.1.1 While anyone who constructs a well must file a construction notice with Ecology, there is very little information regarding the use of the exempt wells. Some exempt wells may no longer be used, and the amount of groundwater being withdrawn by those wells still in use is unknown.

The relationship between groundwater and surface water is important to managing the water resources and making decisions regarding potential impairment of existing rights by new rights. In areas where there is hydraulic continuity (an exchange of water) between a groundwater system and a surface water body, pumping groundwater may potentially reduce groundwater discharge into surface water, or in extreme cases, divert surface water into a groundwater system, thereby reducing flows in surface waters. This could affect surface waters with established water rights to the surface water source and instream flows for fish. In the few areas where hydraulic continuity does not exist, groundwater may be withdrawn with no effect on surface waters. Management of surface waters can also affect the groundwater supply. In areas where irrigation occurs, part of the return flow percolates into the ground and recharges the aquifers. If conservation measures are implemented, this may reduce the amount and/or location of recharge to groundwater. According to the *Ahtanum Creek Watershed Assessment* (Golder, 2004), data from 2002 suggest stream/shallow aquifer interaction throughout Ahtanum Creek, with variable exchange of groundwater and surface water between the shallow aquifer and streams.

According to the Ecology Water Rights Application Tracking System (WRATS) database, there are active groundwater rights to 58,221 acre-feet/year in the Ahtanum Basin, which equates to 50 million gallons per day (mgd) or 80 cfs year-round (Golder, 2004). The majority of the wells are located downstream of the AID and WIP diversions in the eastern portion of the watershed. Within the AID service area, it is estimated there are groundwater rights totaling 23,280 acre-feet. It is thought that only a small fraction of the wells are likely withdrawing directly from the alluvial aquifer; most use is from the deeper sedimentary and basalt aquifer systems (Golder, 2004).

In 1999 Ecology, Reclamation, and the Yakama Nation agreed to study the groundwater resources in the Yakima River Basin. The study is intended to better describe the groundwater-surface water link, help determine the potential impact on existing water rights when making water right decisions, support efforts to improve instream flows, and estimate when/where/how much groundwater pumping affects stream flows. Until the study is completed, Ecology is withholding permits on groundwater applications for new water rights. Ecology may make exceptions for transfers and changes of groundwater rights, public health and safety emergencies, and domestic use from exempt wells (Ecology, 1999).