CHAPTER 5.0 SHORT-TERM IMPACTS AND MITIGATION MEASURES

This chapter describes the short-term impacts of the proposed alternatives for the ACWRP. Possible mitigation measures for the impacts are also discussed. Because this is a Programmatic EIS and the details of construction and project implementation are not known, short-term impacts are discussed in general terms. Alternatives or components of alternatives may be required to undergo additional environmental review to identify specific short-term impacts.

The scale of short-term impacts would vary depending on the alternative implemented. Water conservation measures such as the installation of on-farm conservation improvements and fish screens would have limited impacts over short periods of time. Impacts would largely be confined to the property where the construction is occurring. Larger scale conservation projects such as piping conveyance lines would require more construction time and could cause impacts to the surrounding area. Habitat restoration projects could also range in scale and potential impacts. Small riparian vegetation restoration projects would have limited impacts, largely confined to the site. Larger streambank restoration projects that would require heavy equipment would generate more off-site impacts. Conservation and restoration projects would likely require permits and some may require separate environmental review.

The most extensive short-term impacts would be associated with construction of a storage reservoir and associated conveyance facilities. A reservoir would be a major construction project requiring road construction for access roads, operation of heavy equipment, the import of large quantities of fill material for the earthen dam, and pouring of concrete for the dam spillway. Off-site impacts such as noise and increased traffic on area roadways would occur.

5.1 Earth

5.1.1 Alternative 1 – No Action

Short-term earth-related impacts under Alternative 1 would be minimal because no major construction is proposed. Construction associated with the individual water conservation and habitat restoration projects would disturb the ground and expose soils, resulting in the potential for erosion and delivery of sediments to Ahtanum Creek; however, impacts would likely be minor. These projects would not be part of a coordinated watershed restoration program.

5.1.2 Alternative 2 – Watershed Restoration Program with Storage

The greatest short-term impacts associated with Alternative 2 would be related to the construction of the reservoir. Construction would result in excavation of the reservoir area and development of new roads to access the site, all of which would disturb the ground and expose soils, resulting in the potential for erosion and delivery of sediments to Ahtanum Creek. Many of the soils in the proposed reservoir area have high erosion potential (Dames and Moore, 1999a). Since the proposed reservoir site is not located on or adjacent to Ahtanum Creek, the potential for the delivery of sediments is less than if the site were on the creek or a tributary;

however, sediment transport could still occur. According to preliminary designs (Dames and Moore, 1999c), reservoir construction would require the import of 4 to 5 million cubic yards of materials for the earthen dam. The fill materials would be from an approved source and would meet the requirements of the state Model Toxics Control Act (RCW 70.105D).

Construction associated with the water conservation and habitat restoration projects could also pose short-term impacts to soils. This could result in the potential for erosion and delivery of sediments to Ahtanum Creek. The habitat restoration projects would generally be located adjacent to the creek. New roads could be required to access canals for lining or piping.

This alternative would result in the highest level of construction and associated earthwork, and therefore presents the greatest potential for short-term impacts to earth.

5.1.3 Alternative 3 – Watershed Restoration Program without Storage

Impacts under Alternative 3 would be similar to those of the water conservation and habitat restoration projects described in Alternative 2. No reservoir would be constructed, so there would be no reservoir-related impacts. Therefore, there would be substantially lower short-term impacts.

5.1.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts of Alternative 4 would be similar to those of Alternative 2 with the reservoir construction. Because no coordinated habitat restoration measures would be implemented, existing streambank erosion would continue in places similar to Alternative 1.

5.1.5 Mitigation Measures

Contractors would be required to implement construction best management practices to minimize sediment production and delivery to stream channels. Best management practices could include the use of straw bales or silt fending to trap sediments. Temporary Erosion and Sedimentation Control plans in accordance with Yakima County and/or Ecology requirements would be developed for construction projects. The dam for Pine Hollow Reservoir would be designed to prevent erosion and would be planted with native grasses or constructed with a rock face, as appropriate. Requirements for erosion control would be defined for each project through review by state and local regulatory agencies. The larger the construction project, the more significant the mitigation measures that would need to be implemented.

Pine Hollow Reservoir would undergo further design and geotechnical review and additional project level environmental review prior to construction to assess the suitability of the site for a reservoir. The dam would be designed in accordance with Ecology dam safety guidelines (see Section 6.12.2.3 for additional information).

5.2 Surface Water

Construction activities that require earthwork near surface water channels may result in a temporary increase in localized erosion as noted in Section 5.1, Earth. A temporary increase in erosion would add to the sediment being transported in surface waters and increase turbidity. The level of impact on the quality of surface water would vary, depending on the volume of earthwork, proximity to a water body, condition of surrounding vegetation, and the mitigation measures implemented.

Construction activities may also result in short-term impacts on irrigation water supply. These impacts would include interruptions in water supply that might be needed to move water from an existing distribution or irrigation facility to a newly constructed facility. The level of impact would vary based on the scheduling and duration of interruptions. It is anticipated that interruptions could be limited to a few days or a few hours.

5.2.1 Alternative 1 – No Action

No direct short-term impacts to surface water are anticipated under the No Action Alternative. Any construction activities associated with individual water conservation or habitat improvement projects could result in increased erosion and sedimentation and interruptions in water supply as described above.

5.2.2 Alternative 2 – Watershed Restoration Program with Storage

In addition to the construction associated with water conservation and habitat restoration projects, Alternative 2 would require construction of the Pine Hollow Reservoir. Because the reservoir site is not adjacent to Ahtanum Creek, the potential for increased turbidity in the stream would be limited. There would be a potential for increased turbidity in Ahtanum Creek when the diversion channel connecting the reservoir to Ahtanum Creek is constructed, however. The habitat restoration projects would be located adjacent to the stream and have more potential to cause increased stream turbidity. Construction of new conveyance lines could require short-term disruptions in water supply.

5.2.3 Alternative 3 – Watershed Restoration Program without Storage

Short-term surface water impacts from Alternative 3 would be similar to those from Alternative 2 without the storage reservoir. Coordinated water conservation and habitat restoration projects could result in increased erosion and sedimentation to Ahtanum Creek and disruptions in water supply.

5.2.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts to surface water associated with Alternative 4 would be similar to Alternative 2, except there would be no coordinated habitat restoration projects near Ahtanum Creek, similar to Alternative 1.

5.2.5 Mitigation Measures

Mitigation for short-term impacts to surface water from construction activities would be similar to those described in Section 5.1.5. To mitigate any short-term interruptions in surface water irrigation supply due to construction activities, the AID and WIP would coordinate with water users and construction personnel to ensure that construction activities are scheduled to minimize interruptions. To the extent possible, conveyance construction would be done outside the irrigation season.

5.3 Groundwater

5.3.1 Alternative 1 – No Action

Short-term impacts associated with the No Action Alternative would reflect current management conditions in the project area. No short-term impacts to groundwater are likely.

5.3.2 Alternative 2 – Watershed Restoration Program with Storage

Short-term impacts associated with Alternative 2 would include temporary, localized impacts to groundwater quality and quantity related to the groundwater monitoring system installation, or potentially abandonment of existing wells. Construction dewatering, if required, would temporarily reduce groundwater levels and availability in the alluvial aquifer and/or sedimentary aquifer system.

No short-term impacts to groundwater are likely from construction of water conservation or habitat restoration features. No short-term impacts to groundwater are likely from surface water or groundwater right transfers.

5.3.3 Alternative 3 – Watershed Restoration Program without Storage

No groundwater impacts are likely from construction of water conservation or habitat restoration features under Alternative 3.

5.3.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Short-term impacts associated with Alternative 4 could include those related to reservoir construction and groundwater monitoring activities similar to those described for Alternative 2. No groundwater impacts are likely from construction of water conservation features.

5.3.5 Mitigation Measures

For all alternatives, impacts to groundwater could be mitigated by conducting appropriate hydrogeological studies prior to construction. The degree of study required would depend on the type of construction being undertaken. Construction of a reservoir would require the highest level of study. Conservation projects such as canal lining would require study to determine the effects on groundwater recharge. Habitat restoration projects, such as those that only require vegetation planting or repairs to streambanks would not require hydrogeologic studies. These studies could identify activities that could impact groundwater so that those activities could be avoided. Construction and abandonment of monitoring wells would be done according to Chapter 173-160 WAC to minimize impacts to groundwater resources.

5.4 Plants and Wildlife

5.4.1 Alternative 1 – No Action

The No Action Alternative would not result in direct impacts to plants or terrestrial wildlife in the Ahtanum Creek Watershed. Some of the individual construction projects for water conservation or habitat restoration projects could require removal of vegetation or could result in temporary displacements of wildlife.

5.4.2 Alternative 2 – Watershed Restoration Program with Storage

Construction of the Pine Hollow Reservoir would require the removal of vegetation in the dam area. Because the existing vegetation in the reservoir area consists primarily of grasses, it is unlikely that any vegetation removal would be required. Vegetation would likely have to be removed along conveyance lines, including along Johncox Ditch. Construction of water conservation or habitat restoration projects could result in temporary impacts to existing vegetation. Habitat restoration projects would likely include the removal of non-native vegetation.

Any existing wildlife in the reservoir area, such as birds and small mammals, would be displaced by construction. Wildlife in the vicinity of the project would likely be temporarily displaced by the noise and construction activities. The restored riparian areas should provide improved habitat for non-fish wildlife species.

5.4.3 Alternative 3 – Watershed Restoration Program without Storage

Alternative 3 would result in similar impacts to vegetation and terrestrial wildlife as Alternative 2, but the reservoir site would not be impacted. There would be no displacement of wildlife due to reservoir construction.

5.4.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts under Alternative 4 would be similar to those under Alternative 2, but no coordinated habitat restoration projects would be undertaken. Impacts of habitat restoration projects undertaken by individual agencies or entities would be similar to Alternative 1.

5.4.5 Mitigation Measures

Habitat restoration projects are expected to be an overall benefit to vegetation and wildlife. Where possible, vegetation that is removed for construction would be replanted. No mitigation is proposed for the temporary displacement of wildlife because this is expected to be a minor impact and wildlife is likely to return following construction, except at the reservoir site.

5.5 Fish

5.5.1 Alternative 1 – No Action

Under the No Action Alternative, conservation or restoration projects, including fish passage and screening improvements, shoreline bank stabilization projects, and riparian restoration actions, could impact fish habitat in the short-term. These activities, along with new residential development projects, could require clearing along stream banks, grading of soils, and diverting water within the work area. Soils disturbed by grading could increase sedimentation if not properly stabilized following the restoration activity.

Sedimentation is a concern because it can degrade fish spawning habitat, increase stream channel scour potential, degrade rearing habitat, and alter riparian vegetative structure. Turbidity does not cause direct salmonid mortality unless extremely high levels occur (NOAA Fisheries, 1999). However, moderately increased turbidity and sedimentation may cause some downstream displacement of juvenile salmon because they instinctively avoid turbid water. The removal of trees and other vegetation along stream banks would result in a reduction of stream shading that could adversely impact stream temperature and shading habitat used by fish.

Larger-scale watershed improvement projects may require temporary dewatering of stream channels, which could potentially have an adverse impact on fish habitat if not properly conducted. For example, fish in a dewatered stream section could die if not moved or could be harmed during removal. These types of projects would be subject to environmental review on an individual basis; all review would be conducted by the entity proposing the activity.

Although not likely, accidents such as spills of hazardous materials (e.g., cement, fuel, or hydraulic fluid) could occur that would degrade water quality and/or be toxic to fish.

5.5.2 Alternative 2 – Watershed Restoration Program with Storage

Short-term impacts associated with Alternative 2 would be similar to those described for the conservation and restoration project described for Alternative 1. In addition, Alternative 2 would require excavation in the Ahtanum Creek channel to accommodate the diversion canal that would connect the reservoir to Ahtanum Creek. Short-term pulses of turbid water would occur as excavation occurs directly within the Ahtanum Creek channel. These turbidity pulses could adversely affect fish habitat several hundred feet downstream of the construction site in the same manner as described for the No Action Alternative.

Reservoir construction would require significant amounts of soil disturbance as described in Sections 5.1 and 5.2. Since the reservoir location is not on or adjacent to Ahtanum Creek, the potential for sedimentation in Ahtanum Creek would be reduced.

5.5.3 Alternative 3 – Watershed Restoration Program without Storage

Short-term construction impacts associated with Alternative 3 would be less than those discussed for Alternative 2 because construction-related impacts associated with reservoir construction would be eliminated.

5.5.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Short-term impacts associated with Alternative 4 would be similar to those discussed for Alternative 2. Similar to Alternative 2, the greatest potential impact to fish habitat would be associated with construction in the Ahtanum Creek stream channel to construct the canal that would connect the stream to the reservoir. The short-term impact of construction related to habitat restoration would be similar to Alternative 1.

5.5.5 Mitigation Measures

Mitigation measures to minimize impacts to fish would include measures to reduce erosion and sedimentation as described in Sections 5.1.5 and 5.2.5. In addition, projects would meet all permit requirements, including appropriate fish windows for construction dates. Spill control plans would be developed to identify emergency measures to be employed in case of any spills of hazardous materials.

If stream dewatering were required, fish would be removed from the stream section prior to dewatering in accordance with WDFW guidelines.

5.6 Scenic Resources and Aesthetics

Impacts to scenic resources and aesthetics in the Ahtanum Creek Watershed that could result from construction activities include increased noise and dust from construction equipment.

5.6.1 Alternative 1 – No Action

Under Alternative 1, there would be no impacts to scenic resources or aesthetics.

5.6.2 Alternative 2 – Watershed Restoration Program with Storage

Construction of the reservoir under Alternatives 2 would have the greatest potential short-term impacts to scenic resources and aesthetics in the watershed. Reservoir and conveyance line construction would generate dust and noise that would affect the aesthetics of the construction area. Impacts are not anticipated to be significant, however, because of the limited number of people who view the site and the lack of uniqueness associated with the scenic resource.

5.6.3 Alternative 3 – Watershed Restoration Program without Storage

Alternative 3 would result in minimal impacts to scenic resources in the Ahtanum Creek Watershed. There would be no reservoir construction, and impacts associated with watershed restoration measures would be minor.

5.6.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Under Alternative 4, impacts to scenic resources and aesthetics would be generally the same as those described for Alternative 2.

5.6.5 Mitigation Measures

Specific mitigation measures would be developed for individual construction projects within the Ahtanum Creek Watershed. The projects would comply with local noise ordinances and meet the dust control requirements of the Yakima Regional Clean Air Authority.

5.7 Land and Shoreline Use

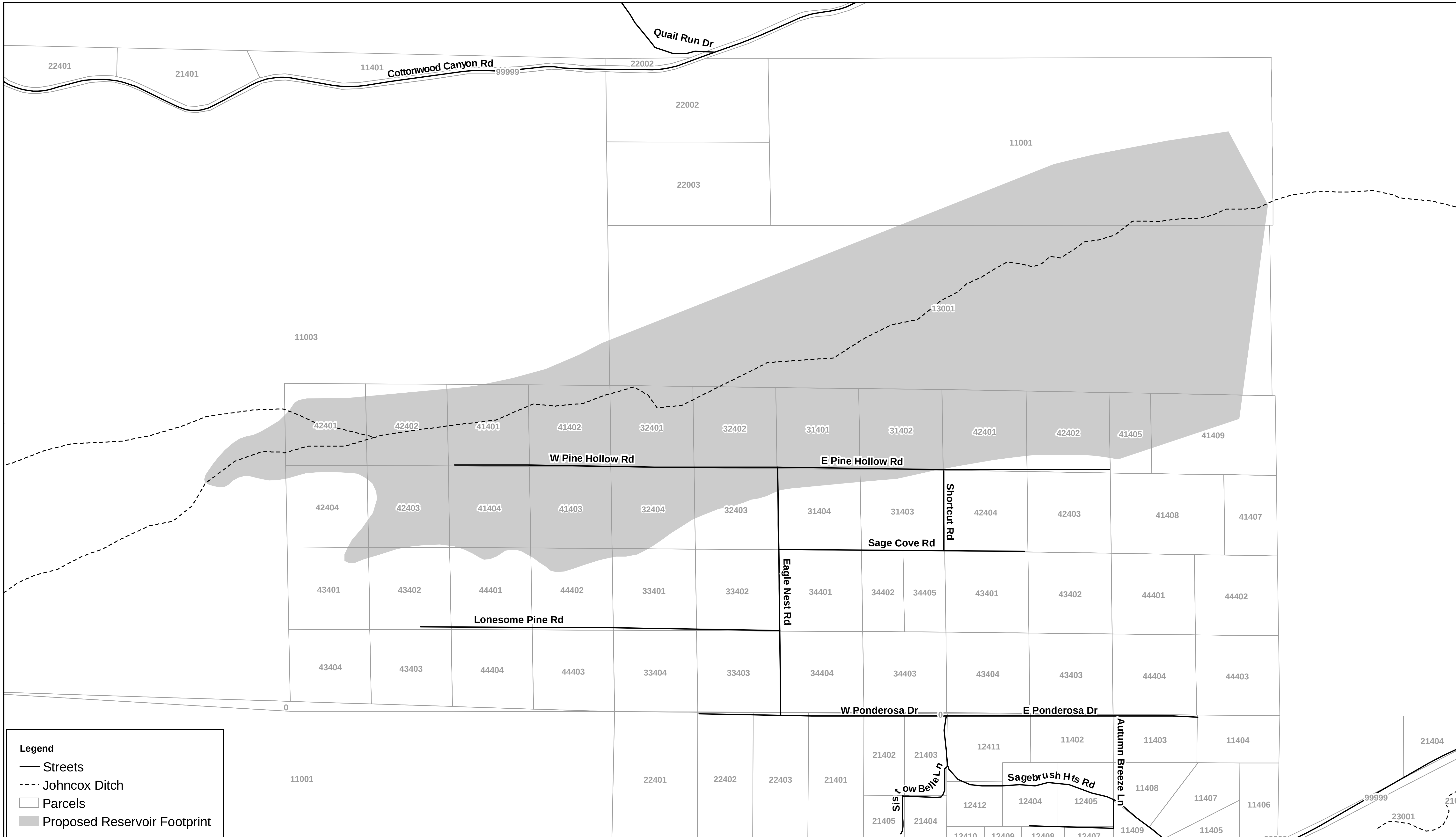
5.7.1 Alternative 1 – No Action

No direct short-term impacts to land use within the Ahtanum Creek Watershed are anticipated from implementation of the No Action Alternative. Any individual water conservation or habitat restoration projects undertaken would be consistent with local land use plans and regulations.

5.7.2 Alternative 2 – Watershed Restoration Program with Storage

Under Alternative 2, the coordinated water conservation project and habitat restoration projects would be consistent with local land use plans and regulations and would not result in any short-term impacts to land use. The proposed Pine Hollow Reservoir would fall within unincorporated Yakima County in an area zoned as Valley Rural (VR). Table 15.18 in the Yakima County Code designates allowable development by each zoning type in unincorporated areas. Utility services, including reservoirs, are permitted in areas zoned as Valley Rural.

Construction of the reservoir would result in the conversion of land currently occupied by pasture and residences into a dam and reservoir site. The exact number of parcels that would need to be acquired for dam and reservoir construction are not currently known. Figure 5-1 shows which parcels would be impacted under the maximum footprint of the reservoir. Additional properties may be required for dam construction and access.



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Date last updated: 1/31/05

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Scale: 1:9,000
1 inch equals 750 feet

0 375 750 1,500 Feet

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

ADOLFSON

FIGURE 5-1

PINE HOLLOW RESERVOIR AND COUNTY PARCEL DATA - MAXIMUM FOOTPRINT

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

In addition, right-of-way may be required for conveyance lines. Property acquisition would be conducted on a case-by-case basis, with negotiations occurring between the AID and the individual property owners according to state law. These uses are primarily grazing and residential. The exact number of residential displacements is not known at this time. There are approximately 15 houses in the reservoir area. Displaced residents would be provided with relocation assistance. The economic impact of these relocations is discussed in Section 6.10.

5.7.3 Alternative 3 – Watershed Restoration Program without Storage

The coordinated water conservation and habitat restoration projects under Alternative 3 would be consistent with local land use plans and policies. The construction of lined or piped conveyance systems could require acquisition of right-of-way, which would be undertaken in accordance with Washington state law as described for Alternative 2.

5.7.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Short-term land use impacts under Alternative 4 would be similar to those described for Alternative 2, except there would be no coordinated habitat improvement projects similar to Alternative 1.

5.7.5 Mitigation Measures

All property acquisitions in the Ahtanum Watershed would be in accordance with the Washington State law covering property acquisition by a private corporation (Chapter 8.20 RCW). Property acquisition would be negotiated with each property owner on a case-by-case basis, and every attempt would be made to minimize adverse impacts to property owners. Further property acquisition procedures would be coordinated with other appropriate entities in the Ahtanum Creek Watershed, including the United States and Washington State.

5.8 Transportation

5.8.1 Alternative 1 – No Action

There would be no short-term impacts to transportation in the Ahtanum Creek Watershed associated with implementation of Alternative 1.

5.8.2 Alternative 2 – Watershed Restoration Program with Storage

Alternative 2 represents the greatest potential short-term impacts to transportation of the alternatives considered because it would result in the most significant level of construction. Based on preliminary designs, 4 to 5 million cubic yards of material would be required to construct the earthen dam. This would require a range of 200,000 to 425,000 dump truck trips to deliver the earth material, depending on the final size of the dam and whether pony (trailer) trucks are used. This number of truck trips would be a significant impact to traffic on Ahtanum

Road and result in occasional localized traffic congestion and delays during the duration of the construction period. Reservoir construction is estimated to last approximately 2 years, but traffic impacts would not last the full length of the construction period. Proposed habitat enhancement measures include potential roadway relocations and/or drainage improvements, which could result in localized detours and accompanying delays. If this alternative were to be selected for implementation, additional site-specific studies would be conducted to ensure that access is maintained and avoidable delays are minimized throughout the construction period.

5.8.3 Alternative 3 – Watershed Restoration Program without Storage

Under Alternative 3, potential short-term traffic impacts would result if roadway relocations occur associated with proposed habitat enhancement. All relocations would be coordinated closely with the roadway manager or owner, depending on whether the roadway is public or private.

5.8.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts to traffic under Alternative 4 would be similar to those described for Alternative 2. Impacts associated with road relocations would not occur because no relocations are planned under Alternative 4.

5.8.5 Mitigation Measures

Construction traffic would be routed through the project areas in the Ahtanum Watershed in accordance with applicable requirements imposed by Yakima County. Any roadway relocations would be conducted following site-specific evaluation and compliance with all applicable roadway design requirements, including stormwater management requirements.

5.9 Recreation

Short-term impacts to recreation in the Ahtanum Creek Watershed would generally be the same for all alternatives evaluated. There would be minimal impact to recreation opportunities associated with construction of any of the alternatives; therefore no mitigation would be required.

5.10 Economics

All of the alternatives include some construction that would result in increases in construction employment and expenditures in the region. These increases would be largest for Alternatives 2 and 4, which include reservoir construction. Potential impacts to the local economy are discussed in Section 6.10. No short-term adverse impacts to socio-economics are anticipated; therefore, no mitigation would be required.

5.11 Cultural Resources

5.11.1 Alternative 1 – No Action

Under the No Action Alternative, water conservation and habitat restoration projects would be undertaken independently without coordination. Identification of potential cultural resources in the Ahtanum Creek Watershed would probably not occur in a coordinated manner and could reduce the opportunity for inter-government and interagency (e.g., Yakama Nation, WDFW) consultation regarding any resources that could be present in the ACWRP project areas.

5.11.2 Alternative 2 – Watershed Restoration Program with Storage

Ground disturbance activities could result in short-term impacts to cultural resources under Alternative 2 . Impacts to any cultural resources that may be present could occur at the location and in the vicinity of the construction site for the reservoir and any new conveyance systems, as well as any staging areas. Ground-disturbing impacts could also occur at locations of riparian and floodplain restoration and enhancement, streambank stabilization, and on any new properties acquired. Possible impacts could occur to any historic structures that might be present on acquired properties.

5.11.3 Alternative 3 – Watershed Restoration Program without Storage

Impacts to cultural resources under Alternative 3 would be similar to the Alternative 2 watershed restoration components,.

5.11.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Short-term impacts associated with Alternative 4 would be similar to those described for the reservoir construction activities under Alternative 2. Impacts from habitat restoration measures would be similar to Alternative 1.

5.11.5 Mitigation Measures

The construction of the Pine Hollow Reservoir would require additional environmental review, after which the exact mitigation measures would be developed in coordination with the OAHP Yakama Nation. Mitigation measures could include archaeological monitoring during construction. Construction contracts would require that if any archaeological material is encountered during construction, construction activities in the immediate vicinity would halt, and the OAHP and a professional archaeologist would be contacted for further assessment prior to resuming construction activity in that area.

5.12 Public Services and Utilities

Construction associated with any of the alternatives could result in short-term disruptions to public services and utilities in the Ahtanum Creek Watershed. Potential impacts would be greatest under Alternatives 2 and 4 because of the substantial amount of construction required. Utility lines could require relocation. Construction activities would be coordinated with public services and utilities providers to identify the location of all utilities prior to construction and ensure that disruptions would be minimized.

5.13 Existing Water Rights

No short-term impacts to water rights are anticipated as a result of any of the Watershed Restoration Program alternatives. As discussed in Section 5.2, construction activities could result in short-term disruptions to water supplies, but these disruptions are not expected to last long enough to impact water rights. The AID and WIP would coordinate with water users and construction personnel to ensure that construction activities are scheduled to minimize interruptions to water deliveries.

CHAPTER 6.0 LONG-TERM IMPACTS AND MITIGATION MEASURES

This chapter discusses the long-term impacts that could result from the proposed ACWRP alternatives. Long-term impacts are those that would occur as a result of implementing the selected alternatives. This chapter also includes a discussion of mitigation measures for the potential impacts, cumulative impacts, and significant unavoidable impacts.

6.1 Earth

This section describes the long-term impacts to earth resources associated with each of the alternatives. Because earth resources vary in each of the three reaches of the watershed, the potential impacts to each reach are described.

6.1.1 Alternative 1 – No Action

6.1.1.1 Upper Reach

If Alternative 1 is selected, future land use development within the upper reach of the Ahtanum Creek Watershed would remain largely consistent with current development conditions and land use management. Roads associated with forest management and housing access would continue to have the potential to generate and deliver sediments to stream channels.

6.1.1.2 Middle Reach

Under the No Action Alternative, it is likely that agricultural lands that are not currently in active production or adequately serviced by irrigation would come under additional pressure to be converted to residential development. Increased development would result in ground disturbance within and near housing sites and the development of new access roads. Construction of new housing and associated roads would disturb the ground and expose soils, resulting in the potential for erosion and delivery of sediments to Ahtanum Creek and tributary streams. Increased sediment would be caused by ongoing road drainage and a reduction in riparian vegetation. A reduction in riparian vegetation through increased housing development could also impact streambank stability, leading to increased bank erosion and channel instability along Ahtanum Creek and tributary streams.

6.1.1.3 Lower Reach

Under the No Action Alternative, future development could accelerate in unincorporated areas in Yakima County and the UGAs of the cities of Yakima and Union Gap as agricultural lands that are not currently in active production or adequately serviced by irrigation are converted to residential development. Refer to Section 6.7, Land Use, for a discussion of anticipated land use impacts under the No Action Alternative. All of these actions would lead to earth-related impacts similar to those discussed above for the middle reach of the watershed, including chronic increased sediment production and delivery to stream channels due to ongoing road drainage and reduction in riparian vegetation.

6.1.2 Alternative 2 – Watershed Restoration Program with Storage

6.1.2.1 Upper Reach

The proposed watershed restoration measures under Alternative 2 could potentially reduce sediment transport to Ahtanum Creek. If Alternative 2 is implemented, future land use development within the upper reach would remain generally consistent with what would occur under Alternative 1, resulting in roughly comparable potential to generate sediment within the upper reach. Roads associated with forest management and housing access would continue to have the potential to generate and deliver sediments to stream channels. Watershed restoration actions such as plantings on exposed streambanks and improving drainage culverts would counter and minimize the current and future generation and delivery of sediment to stream channels

6.1.2.2 Middle Reach

The primary earth-related impact from Alternative 2 in the middle reach would result from the construction of the Pine Hollow Reservoir and the associated improved irrigation system. There is the potential for some long-term increases in sediment associated with drainage from the new access roads to the reservoir and operation of the reservoir; however, these increases would be expected to be minor because the road would be constructed with provisions to minimize sediment transport. The flushing of deposited sediment on the reservoir bed could potentially deliver sediment to Ahtanum Creek over more concentrated time periods than currently.

With improved irrigation, the pressure to convert agricultural land to residential land would likely be reduced, thereby reducing the potential for increased sedimentation from roads, housing construction and reduced riparian vegetation associated with development. Refer to Section 6.7 for a discussion of land use impacts. Conversion of pasture lands to higher value orchards or other crops would also reduce sediment delivery associated with grazing activity in pasture areas, particularly for those areas in proximity to stream channels. Watershed restoration actions would further reduce future generation and delivery of sediment to stream channels. These restoration activities would occur within both the middle and upper reaches, where land use activities can generate sediment that is routed through stream channels into lower reaches of Ahtanum Creek.

6.1.2.3 Lower Reach

Under Alternative 2, future development within Yakima County and the UGAs of the cities of Yakima and Union Gap would likely occur as projected in adopted land use plans and policies, with a reduced pressure for the conversion of agricultural lands to residential development. Irrigation improvements would slow or reduce the amount of agricultural lands converted to other land uses, thus reducing the potential for increased sediment delivery associated with housing construction and roads. Restoration actions that emphasize decreased sediment production in the upper, middle, and lower portions of the watershed would substantially reduce sediment routing and deposition in the lower reaches of Ahtanum Creek.

6.1.3 Alternative 3 – Watershed Restoration Program without Storage

6.1.3.1 Upper Reach

If Alternative 3 is implemented, future land use development within the upper reach would remain consistent with that described for Alternative 1. Roads associated with forest management and housing access would continue to have the potential to generate and deliver sediments to stream channels. Watershed restoration actions would reduce the generation and delivery of sediment to stream channels similar to Alternative 2.

6.1.3.2 Middle Reach

As with Alternative 1, roads associated with increased housing development and access would continue to have the potential to generate and deliver sediments to stream channels in the middle reach of the watershed. Watershed restoration actions would reduce the generation and delivery of sediment to stream channels similar to Alternative 2.

6.1.3.3 Lower Reach

Under Alternative 3, development could accelerate in Yakima County and the UGAs of the Cities of Yakima and Union Gap as agricultural lands that are not currently in active production or adequately serviced by irrigation are converted to residential development. Accelerated development in the lower reach of the watershed would lead to increases in sediment production and delivery to stream channels due to increased road drainage and a reduction in riparian vegetation. Watershed restoration actions that emphasize decreased sediment production in the upper, middle, and lower portions of the watershed would significantly reduce sediment routing and deposition within the lower reach of Ahtanum Creek similar to Alternative 2.

6.1.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

6.1.4.1 Upper Reach

Long-term impacts under Alternative 4 would be similar to those discussed for Alternative 1 in the upper reach.

6.1.4.2 Middle Reach

Long-term impacts in the middle reach of the watershed would be similar to those discussed for Alternative 2. Ongoing watershed restoration measures would continue to minimize sediment production and delivery to stream channels, but the benefits would not be as significant as under

Alternative 2 without the coordinated habitat restoration effort. Implementation of irrigation conservation measures (e.g., development of conservation plans and on-farm system improvements) would reduce some sedimentation impacts.

6.1.4.3 Lower Reach

Long-term impacts in the lower reach of the watershed would be similar to those discussed for Alternative 2; however, a lack of reliable irrigation supply could result in land development pressures to convert agricultural lands to residential development. Ongoing watershed restoration actions would continue to minimize sediment production and delivery to stream channels, but the impacts would not be as significant as under Alternative 2 without the coordinated habitat restoration effort. Implementation of irrigation conservation measures would reduce some sedimentation impacts.

6.1.5 Mitigation Measures

Mitigation measures to reduce sediment production and delivery from new roads and residential development would include proper design of new roadways, enforcement of stream buffer requirements in the local Critical Areas Ordinance, and compliance with stormwater requirements. Proper road construction would include appropriate spacing of drainage. Proper culvert placement can minimize sediment delivery to the stream system. When culverts are properly located and spaced at regular intervals along the roadside drainage ditch, sediment is reduced by dispersing sediment laden water onto vegetated slopes that filter the water before it reaches the stream. Enhancement of riparian vegetation could also reduce sediment delivery to streams.

6.1.6 Cumulative Impacts

Cumulative earth-related impacts from any of the ACWRP alternatives would include the potential for increased sediment production and delivery from new roads and residential development.

6.1.7 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse earth-related impacts were identified.

6.2 Surface Water

The potential impacts to surface water from implementation of the ACWRP are described in this section. Evaluation of the impacts associated with reservoir operation under Alternatives 2 and 4 required modeling, the results of which are described in Appendix D.

6.2.1 Alternative 1 – No Action

Alternative 1 does not include a coordinated restoration program for the watershed but does include continued conservation and habitat restoration efforts by individual entities and agencies that have jurisdiction over portions of the Ahtanum Creek Watershed. These efforts may be coordinated to some degree under other programs or processes but would not be subject to a coordinated watershed-wide implementation effort. However, for the purposes of this programmatic evaluation, it is assumed that implementation of this alternative would not have a significant impact on surface water supply and stream flows.

Problems that affect the beneficial uses of surface water, such as insufficient flow for fish habitat and unreliable water supply for irrigation, will continue until significant conservation and habitat restoration efforts are implemented.

It is assumed that the current level of surface water use would continue and that there would be no effect on Ahtanum Creek flow entering the Yakima River or TWSA (the amount of water available for Reclamation to allocate to its water users). If trust water rights were created and dedicated to instream flow, there could be an increase in water in Ahtanum Creek that could increase the TWSA.

6.2.2 Alternative 2 – Watershed Restoration Program with Storage

Alternative 2, which includes the construction of a 24,000 acre-foot surface water reservoir at Pine Hollow, is intended to increase the reliability of surface water supply and supplement instream flows in the mainstem of Ahtanum Creek. If implemented, this alternative would result in the most significant long-term impacts to surface water supply and stream flows of all the alternatives. Implementation of Alternative 2 would result in the storage and distribution of approximately 15,000 acre-feet (on average) of surface water annually to meet irrigation demand and augment instream flows. Alternative 2 represents an improvement in irrigation reliability, most significantly because it would provide these flows after July 10. This alternative, however, still would not provide an adequate irrigation supply for the entire AID and WIP. Secondary water sources would still be required.

Operation of a reservoir for Alternative 2 was evaluated using the flow routing model developed for the *Ahtanum Creek Watershed Assessment* (Golder, 2004). The model and analysis are described in Appendix D of this EIS. The model included the operational conditions described in Section 2.4. The model assumed that instream flow targets would be met using water from the reservoir. These instream flow targets were based on input from the Ahtanum Core Group and are shown in Table D-1 of Appendix D. The temperature output of the reservoir was also modeled as shown in Figure D-4. The modeling indicates that implementation of Alternative 2 would have the following long-term impacts on surface water supplies in the Ahtanum Creek Watershed.

- Improvements in efficiency resulting from conservation measures, including installation of a piped distribution system and more efficient on-farm irrigation systems, could reduce the total amount of water needed annually to approximately 33,100 acre-feet. This represents a reduction of approximately 29 percent from the “current” annual demand, of

46,400 acre-feet, which was estimated in the *Ahtanum Creek Watershed Assessment* based on 2002 cropping and irrigation data. This also represents an increase in on-farm efficiency from approximately 70 percent to 82 percent, and an increase in conveyance efficiency from approximately 75 percent to 95 percent. More efficient conveyance and irrigation systems would require that less water be diverted from the stream and withdrawn from wells to deliver the same amount of water to the crops. However, implementation of conservation measures would also reduce seepage from the canals and streams currently used to convey irrigation water, which may impact local groundwater recharge.

- For the purpose of the reservoir analysis done for this EIS, it was estimated that approximately 19,600 acre-feet of the total 33,100 acre-feet of water needed for irrigation would be supplied by surface water. Pine Hollow Reservoir would have the capacity to meet the surface water demand and supplement stream flows to meet instream flow targets with a reliability of approximately 72 percent. The reservoir would supply 15,000 acre-feet per year, on average, to augment instream flows and meet irrigation demands.
- Pine Hollow Reservoir would permit both the AID and the WIP to divert water for irrigation between April and October directly from the reservoir. However, the ability of the reservoir to deliver surface water in the late summer and early fall would be limited during average and drier than average years.
- On average, the reservoir would be able to augment instream flows and provide surface water to meet most of the demand for surface water in the AID and the WIP during the spring and early summer. During the late summer and early fall, the reservoir would be drawn down and would not be able to supply as much of the irrigation demand. Groundwater or other water sources would still be needed to meet demands in late summer and early fall.
- During a wet year, the reservoir would remain nearly full and would supply all surface water demands. Very little supplementation of natural instream flows would be required to meet instream flow targets.
- During a very dry year, the reservoir would not be able to fill because water would be left in the stream to meet instream flow targets on the North Fork. As a result, the reservoir would remain drawn down throughout most of the year and would have little capacity to meet irrigation demands or supplement instream flows. If the dry year were preceded by an above average year, some water could be available from the reservoir to provide irrigation water and instream flows. A detailed analysis of instream flow targets was not performed for this programmatic EIS, but should be included as part of a project-level EIS (if Alternative 2 or 4 is selected as the preferred alternative) to optimize the distribution of surface water, particularly during dry conditions.

Implementation of Alternative 2 would also result in the following long-term impacts on the flow of surface water through the Ahtanum Creek Watershed.

- Flows in the lower portion of the North Fork and in the mainstem of Ahtanum Creek would generally decrease during the winter and spring, when flow would be diverted to fill the reservoir. The number of days with flows exceeding the minimum channel-forming flow (350 cfs) would be reduced. However, the diversion would be operated to maintain channel-forming flows when appropriate conditions exist.

- The diversion constructed to divert water from the North Fork to the proposed reservoir would be set up with controls so that established instream flow targets on the North Fork would be met. The evaluation indicates that implementation of instream flow targets equal to those outlined in Appendix D would reduce the number of days with average flows less than 20 cfs on the North Fork of Ahtanum Creek to match natural flow conditions. Use of the reservoir to augment instream flows in the mainstem of Ahtanum Creek would also reduce the number of days with average flows less than 20 cfs on Ahtanum Creek to more closely match natural flow conditions.
- Piping of the AID irrigation water conveyance and distribution facilities, along with the elimination of direct diversions from Ahtanum Creek, would divert surface water that is currently present in Bachelor and Hatton Creeks. As a result, flows in Bachelor and Hatton Creeks would mostly be reduced to runoff and return flows. If instream flows were maintained in Bachelor and Hatton Creeks, it would be to the detriment of flows in the mainstem of Ahtanum Creek. Flows in the mainstem downstream of the current diversion to Bachelor and Hatton Creeks would be reduced by any diversion needed to maintain instream flows in Bachelor and Hatton Creeks.
- Temperature modeling indicates that water released from the reservoir would exceed 16°C, the temperature standard for salmon and trout spawning, during August and September. The reservoir temperature analysis is included in Appendix D.

An analysis of the potential effect on TWSA indicates that Alternative 2 would result in an increase of approximately 2,700 acre-feet for average flow conditions and a loss of 600 acre-feet in a dry year such as 1977 (see Appendix B for the details of the TWSA analysis). The potential effect on TWSA would be very small (much less than 0.1 percent) and would not be measurable by Reclamation. In addition, most of the flow reduction would occur during the time that the Yakima Project is not on storage control and flows from July through October would be increased under all alternatives.

An analysis of the potential effect on Reclamation operations outside of the irrigation season was performed. Reclamation operates the Yakima Project on a year-round basis to provide irrigation water supply, fisheries flow, power generation and carryover storage. Modeling performed indicates Alternative 2 would cause a slight and not measurable reduction of flow in the Yakima River during winter (November to February) for average water years. During dry water years when Yakima River flows are much less, Alternative 2 would slightly increase flow during winter.

Water from unregulated tributaries not captured by Reclamation is used as a water supply prior to the time when contract obligations are met out of TWSA (April). That water, called flood water, is used to prime canals and provide frost water and some early season water to irrigators. The irrigation districts with flood water claims located downstream of Ahtanum Creek are the Sunnyside Division and the Wapato Irrigation Project. Alternative 2 would cause a slight and not measurable reduction of flow in the Yakima River during average water years during the March time period. During dry water years when Yakima River flows are much less, the alternative would slightly increase flow.

6.2.3 Alternative 3 – Watershed Restoration Program without Storage

The impacts on surface water supply described for Alternative 2 relating to conservation measures would be the same under Alternative 3. These impacts would include increased efficiency, reduced demand for surface and groundwater supplies, and increased reliability of these supplies. The biggest difference between Alternatives 2 and 3 is that Alternative 3 would not substantially improve irrigation reliability after July 10 each year. Since no reservoir would be constructed, this alternative would not affect TWSA.

A reduction in the demand for surface water supplies would also result in improved instream flows. This alternative assumes that the AID and WIP would continue to divert surface water for irrigation directly from the mainstem of Ahtanum Creek. Reducing surface water demand due to improved efficiency would result in reduced diversions and more water remaining in the stream for instream flows.

However, improved efficiency may cause some users to convert from groundwater to surface water diversions since more surface water would be available to meet crop water demand. Therefore, diversions from the creek would not necessarily be reduced as a result of conservation measures.

6.2.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

The long-term impacts on surface water supply and flows that were described for Alternative 2 would apply to Alternative 4 as well. The effects of Alternative 4 on TWSA would be the same as described for Alternative 2.

6.2.5 Mitigation Measures

6.2.5.1 Alternative 1 – No Action

The most significant impact of Alternative 1 is that it offers no coordinated watershed-wide plan to improve current conditions. The best long-term mitigation measure would include coordination of surface water conservation and habitat restoration activities under other plans or programs.

6.2.5.2 Alternative 2 – Watershed Restoration Program with Storage

Implementation of Alternative 2 is expected to benefit surface water resources over the long term and is considered to function as mitigation for current water supply problems. It is important that the reservoir function efficiently to address water supply issues. The following measures are recommended to ensure that operation of the Pine Hollow Reservoir would achieve the anticipated results.

- Consistent review of the operation and management of the proposed reservoir by the AID and WIP or an oversight group composed of water users and fisheries agency representatives to optimize the multiple uses of storage, while giving priority to maintenance of instream flow targets and channel-forming flows.
- Detailed, coordinated water conservation planning, carried out in accordance with Ecology or Reclamation standards to address the continued problem of surface water supply shortages during drought years.
- To reduce elevated temperatures in water discharged from the reservoir, the water could be infiltrated to allow cooling before recharging Ahtanum Creek.
- The reservoir and ditches would be patrolled periodically to prevent unauthorized diversions.

6.2.5.3 Alternative 3 – Watershed Restoration Program without Storage

Alternative 3 is expected to benefit surface water resources, although not to the same level as Alternative 2. No mitigation measures are proposed beyond the habitat restoration measures included in the alternative. In order to maximize the benefits from conservation measures, detailed, coordinated conservation planning should be conducted to address the continued problem of surface water supply shortages during periods of low stream flow. Conservation planning should lead to a coordinated approach regarding maintenance of instream flows to ensure that some of the water savings resulting from conservation efforts is retained in the stream to enhance instream flows.

6.2.5.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

The mitigation measures associated with Alternative 4 and long-term impacts on surface water supply and flows would be the same as described for Alternative 2. Additional measures would be required to address flow elements relating to fish habitat.

6.2.6 Cumulative Impacts

6.2.6.1 Alternative 1 – No Action

The continued lack of reliability of surface water supply and low seasonal flows are likely to result from the No Action Alternative. The No Action Alternative may result in agricultural properties that are not productive being developed as residential property, as discussed in Section 6.7.

6.2.6.2 Alternative 2 – Watershed Restoration Program with Storage

The reservoir would not have the capacity to provide reliable surface water supply to all agricultural properties within the AID and WIP. The cost of constructing conveyance facilities and distribution laterals, in combination with the size and priority of water rights, would likely prevent some properties from accessing surface water from the reservoir. Those properties would likely be of less value for agriculture and may be more likely to develop as residential property as urbanization extends west into the Ahtanum Creek Watershed.

6.2.6.3 Alternative 3 – Watershed Restoration Program without Storage

Implementing the ACWRP without storage would likely improve the efficiency of surface water use. However, land owners with agricultural lands that are not producing sufficient income may decide that implementation of conservation measures would not add value to their land, especially if they are required to fund a portion of those improvements. As a result, the value of the land for potential residential uses may become more attractive.

6.2.6.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

The cumulative impacts resulting from Alternative 4 would be similar to those listed for Alternative 2.

6.2.7 Significant Unavoidable Adverse Impacts

With any of the alternatives, groundwater use would still be required to meet crop water demands. None of the alternatives would significantly reduce flooding, and drought would still impact instream flows and water supply and reliability.

6.3 Groundwater

This section describes the potential impacts to groundwater resources in the Ahtanum Creek Watershed from implementation of the ACWRP alternatives.

6.3.1 Alternative 1 – No Action

Under Alternative 1, future groundwater demands for out-of-stream (primarily irrigation) uses might not be met in the Ahtanum Creek Watershed. With regard to water quantity, taking no action would leave many resource management concerns unanswered for the sustainability and future availability of groundwater withdrawal from deep aquifers and ineffective management of groundwater resources. Groundwater declines were apparent in the 1950s, 1970s, and 1980s. No data are available to conclusively attribute long-term changes in deep aquifer groundwater levels to climate trends or to changes (reductions) in groundwater withdrawal rates. Suburbanization of the Ahtanum Creek Watershed could lead to a proliferation of exempt wells with consequential overuse of groundwater. The magnitude of potential groundwater impacts would depend on current aquifer recharge, the existing quantity and pattern of groundwater use, future population growth, and the effectiveness of existing water management efforts.

6.3.2 Alternative 2 – Watershed Restoration Program with Storage

Each of the components of Alternative 2 would have different impacts on groundwater. The impacts of these components, such as the reservoir, water conservation, and transferring water rights, are described separately.

6.3.2.1 Pine Hollow Reservoir

Of the alternatives evaluated, Alternative 2 has the greatest potential to redistribute groundwater recharge patterns in the Ahtanum Creek Watershed. The storage of surface water in the reservoir and implementation of conservation measures could reduce potential recharge to the shallow alluvial aquifer, resulting in localized impacts.

Implementation of this alternative could significantly increase groundwater levels near the reservoir. The magnitude of this potential impact would depend on the size, depth, and permeability of the reservoir and on the properties of the soil and underlying aquifers. To comply with dam safety regulations, an inspection program would be required to monitor seepage near the reservoir. This activity, which would occur over the life of the structure, would involve the installation and maintenance of permanent and temporary piezometers, observation wells, and seepage galleries, as well as geotechnical soil and rock borings and excavated test pits. Based on a soil permeability estimate of 1×10^{-6} centimeters per second (cm/sec) (Dames & Moore, 1999b), the annual leakage from the reservoir is estimated as 100 acre-feet/year, which would recharge groundwater under and near the reservoir. Assuming that the reservoir would lie on or near the groundwater divide between Ahtanum Creek and Cottonwood Canyon, one-third to one-half of this leakage could potentially discharge to the north into the Cottonwood Canyon basin and out of the Ahtanum Creek watershed. Dames & Moore (1999b) estimated that approximately 300 acre-feet/year of the stored water in the reservoir could evaporate during the year and be lost from the watershed. The water lost to evaporation and leakage out of the watershed would be diverted during the winter, spring, and summer. This diverted and lost water would otherwise flow in Ahtanum Creek and potentially recharge the alluvial aquifer.

Groundwater quality could be affected if the reservoir is built at a location where local soils and/or geology contain contaminants that could leach to groundwater. These contaminants could have been introduced to the groundwater system through past land use practices, such as agricultural chemical applications or septic tanks, for example. The impact would depend on the amount of potential contaminants, the ability of underlying soil and aquifer materials to absorb contaminants, and the hydraulic connection with underlying aquifers. Potential contaminants include natural elevated concentrations of salts, agricultural chemicals (pesticides, fertilizers, petroleum products), and domestic or agricultural wastes (onsite sewage systems, disposal pits, manure). Changes in water quality could potentially impact domestic water use near the reservoir and surface water quality at the point of groundwater discharge to streams. Mixing and dilution of impacted groundwater within the aquifers before discharge could naturally mitigate any surface water impacts.

A secondary impact to groundwater relates to the potential for mitigating the impact of stream flow augmentation. If the water released from the reservoir is determined to be too warm for stream augmentation, the warm water could be cooled by infiltration before it enters the stream.

This mitigation approach could potentially flood areas or create new wetlands at the infiltration location.

6.3.2.2 Water Conservation

Section 6.2, Surface Water Impacts, indicates a potential reduction in demand of 13,300 acre-feet through efficiency improvements. A portion of this 13,300 acre-feet of water is currently lost through evaporation and infiltration to groundwater. Implementation of Alternative 2, therefore, could decrease artificial recharge to groundwater along reaches of canals and ditches that currently leak irrigation water to the subsurface or in inefficiently irrigated areas. Reducing or eliminating leakage would lower water tables near currently leaking structures, thereby potentially reducing groundwater availability in the alluvial aquifer. A secondary impact could include a reduction in groundwater discharge back into streams along the lined canal. In particular, lining the WIP canal would reduce leakage that currently drains back to the Ahtanum Creek mainstem and could reduce baseflows in the creek. The location and magnitude of water table decline would depend on the location of improvements, the hydrogeologic conditions underlying the structures, the number and size of irrigation canals and ditches, the percent reduction of leakage, the depth to the water table, and the rates of groundwater withdrawal. Magnitudes of groundwater decline would range from one to several feet, which could potentially reduce baseflow in streams during low flow periods. The potential impact to base flow to the stream would be offset by the reduction of diversion from stream flow due to increasing water use efficiency

Some of the leakage is currently taken up by phreatophytes (plants with roots deep enough to reach the water table), a portion of which would die and no longer withdraw soil moisture and groundwater along the leaking structures. The reduction in phreatophyte consumption would offset some of the groundwater level decline. In addition, lining and piping the irrigation conveyance system would reduce the current evaporative losses from open canals and ditches, resulting in a general increase in total water in the watershed.

Installing, operating and maintaining water quantity monitoring devices such as meters and gauges would improve the management of surface water and groundwater resources to the extent that groundwater consumption could potentially shift in duration, magnitude, or timing. A better understanding of water use could reduce waste through leakage and improve irrigation application efficiency. The impacts of efficient water use would potentially affect the distribution of groundwater recharge and discharge and, subsequently, the amount of baseflow discharging to streams. An awareness of use patterns and identification and reduction of delivery system losses could reduce groundwater demand and subsequently increase the groundwater levels availability, primarily in the deeper aquifers. Reductions in deep aquifer withdrawal likely would not significantly impact groundwater distribution in the watershed. However, by improving irrigation efficiency, infiltration to groundwater would decline and groundwater levels in the alluvial aquifer could decrease, thus resulting in decreased discharge to streams.

Reducing irrigation supply leakage to the alluvial aquifer would decrease the amount of seasonal storage that accumulates in the aquifer during the irrigation season. The reduction in storage would create an indirect or secondary impact by proportionally reducing groundwater discharge from the alluvial aquifer to streams in the lower reach of the watershed.

It is likely that changes in water chemistry due to leaching of natural compounds from soil would dissipate over time as the soil and aquifer materials reach a new equilibrium with stored water.

6.3.2.3 Transferring Surface Water Rights

Transferring the beneficial use of existing out-of-stream water rights by changing the point of diversion or place of use would alter the current distribution of groundwater recharge from streams in the service area. Changing the location and timing of groundwater recharge potentially would increase or decrease the groundwater levels at the point of diversion and/or use depending on the location and magnitude of change. No out-of-basin transfers are included in Alternative 2; therefore, in-basin transfers are not expected to significantly change the watershed water balance.

Available stream gauge data suggest that the lower reach of the North Fork of the Ahtanum Creek above the North and South Forks confluence and the mainstem just below the confluence would lose water by seepage into the alluvial, sedimentary, and basalt aquifers. Flow in the North Fork would be diverted to fill the reservoir during the winter and spring, when the rate of stream loss is at maximum levels. Consequently, reducing the stream flow along these losing reaches would reduce groundwater recharge in these areas. Conversely, applying transferred water onto areas currently not irrigated could adversely impact groundwater by raising groundwater levels to unacceptable levels.

Reducing or eliminating creek diversions within the reservoir service area would potentially raise alluvial aquifer groundwater levels along reaches downstream of diversions. The additional water flowing in the creeks would either recharge groundwater along these reaches or reduce the amount of groundwater discharging to these reaches.

6.3.2.4 Transferring Groundwater Rights

A more reliable surface water supply could result in a reduced use of privately held groundwater wells. Transferring the beneficial use of existing groundwater rights by reducing groundwater withdrawals for irrigation use in exchange for receiving reservoir water would alter groundwater levels at the larger irrigation wells. Most groundwater used for irrigation derives from the sedimentary and basalt aquifers. A small percentage (less than 10 percent) of groundwater used for irrigation derives from wells tapping the alluvial aquifer. Reducing groundwater withdrawal from deep wells will ~~primarily~~ increase the groundwater levels in the deeper aquifers and alter the vertical groundwater gradient~~. The impact of rising groundwater levels may potentially increase vertical groundwater flow from~~ between the deeper aquifers and~~to~~ the alluvial aquifer. The resulting change in groundwater flow between the aquifers will depend on the amount of the reduction of the withdrawal and the vertical permeability of geologic units separating the deeper and alluvial aquifers near the deep wells.~~, although it is not likely that this impact would be significant; the small increase in vertical gradient would likely be widely distributed around the area surrounding the off-line irrigation wells.~~

It could be perceived that reducing groundwater withdrawal would increase the availability of groundwater for other uses. However, long-term groundwater level data suggest that groundwater levels in the deeper aquifers have declined over the last several decades. Reducing groundwater withdrawal for irrigation may reduce, halt, or reverse this decline, depending on the amount of reduction.

6.3.2.5 Stream Flow Augmentation

The Ahtanum Creek Watershed currently has been effectively closed to new appropriation of groundwater ~~from the alluvial aquifer~~ while the hydraulic continuity between the aquifer and Ahtanum Creek is being studied (see Section 4.13.2). ~~Groundwater development is therefore restricted to deep aquifers that are not directly connected hydraulically to surface water.~~ Using reservoir water to augment stream flows would essentially transfer a portion of surface water flow from winter to summer. ~~A secondary impact of this transfer would include changing the natural pattern to groundwater recharge at the point of diversion (Johncox Ditch) in the winter and spring and changing groundwater discharge at the point of augmentation from the reservoir.~~ Using reservoir water to augment stream flows diverts a portion of winter surface water flow into storage. This diversion reduces the amount of water in the stream available to recharge groundwater at the point of diversion near Johncox Ditch. The augmentation to the stream would increase stream flow and potentially increase alluvial aquifer recharge at the point of augmentation. A change in the groundwater recharge-discharge patterns would impact groundwater levels and local availability of groundwater in the alluvial aquifer. The magnitude of impacts would depend on the timing, location, and magnitude of the diversion and augmentation, the local hydraulic characteristics of the stream, the local hydrogeologic characteristics of the underlying alluvial aquifer, and the local groundwater demand. The magnitude of the impact would not likely be significant; streams that would benefit from augmentation would not lose water at rates sufficient to impact groundwater.

6.3.2.6 Habitat Restoration

Under Alternative 2, in-channel habitat improvement projects (modification of stream topography, roughness, and vegetation) would reduce surface water flow velocity. Out-of-channel habitat improvements could include expansion of floodplains and creation of side channels or ponds. These actions potentially would create infiltration basins that could promote groundwater recharge of the alluvial aquifer. The magnitude of this effect would depend on the relative area of additional floodplain created by the relocation of the dikes and the degree to which surface water from this area would infiltrate to groundwater.

In the lower (gaining) reach of the watershed, the increased area of surface water alterations could potentially promote and increase the rate of groundwater discharge to surface water where construction of the new areas expose the surface waterbodies to high permeability zones of the alluvial aquifer. Alternatively, additional ponds and side channels could detain stormwater and reduce flooding potential.

6.3.3 Alternative 3 – Watershed Restoration Program without Storage

The potential impacts under Alternative 3 would be the same as those components of Alternative 2 associated with water conservation and habitat restoration components. No reservoirs would be constructed so there would be no reservoir-related impacts.

6.3.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

The potential impacts under Alternative 4 would be the same as the reservoir and conservation components described for Alternative 2.

6.3.5 Mitigation Measures

6.3.5.1 Alternative 1 – No Action Alternative

The No Action Alternative assumes that groundwater quantity would continue to be managed through the existing framework of federal, state, local, and tribal programs, and water user practices. There would be no direct impacts to groundwater; therefore, no mitigation is proposed.

6.3.5.2 Alternative 2 – Watershed Restoration Program with Storage

Similar to the impacts section, the mitigation measures for the individual components of Alternative 2 are discussed separately.

Pine Hollow Reservoir

Potential unacceptable changes in groundwater levels as a result of the Pine Hollow Reservoir could be avoided by conducting appropriate hydrogeological studies to predict any adverse effects prior to final design and construction. In cases where such impacts would be likely, the location, depth, size, and design of the storage facility could be modified as needed. The hydrogeologic studies would include monitoring well construction in the alluvial aquifer and sedimentary aquifer system along the Ahtanum Road south of the reservoir. Changes in seepage to Bachelor Creek could be monitored at the Bachelor Creek gauge at Carson Road.

A potential reduction in groundwater quality beneath the reservoir caused by leaching and migration of natural or artificial contaminants could be avoided by assessing and removing manmade sources of contamination (if present) before filling the reservoir. Assessing the chemistry of reservoir site soils (and determining the likely groundwater flow from the reservoir) would indicate the potential for natural contamination sources such as increased salinity or dissolved solids in groundwater. Natural mixing and dilution of groundwater may sufficiently mitigate changes to groundwater quality.

Water Conservation

To mitigate for any potential decrease in groundwater levels resulting from the lining of irrigation canals and ditches, appropriate hydrogeological studies could be conducted to predict any adverse effects prior to construction. If any adverse groundwater effects were predicted as a result of the studies, then construction or design of the canals could be adjusted to reduce the effects. Available water level data are not sufficiently detailed and precise to assess the current amount of leakage from irrigation canals and ditches, the artificially elevated groundwater levels due to leakage, and the artificially elevated groundwater discharge to streams resulting from increased alluvial aquifer storage. These studies would include measuring surface water and groundwater levels in and next to the open irrigation structures before lining to determine the current leakage rate, then estimating the potential change in groundwater level decline with the loss of leakage. In areas where undesirable impacts could occur, lining activities could be avoided or limited, while other measures, such as artificial recharge, could be considered.

Increased water efficiency would locally reduce groundwater recharge to the alluvial aquifer, reduce groundwater levels, and reduce stream baseflow downstream of leaky irrigation canals or inefficiently irrigated areas. Adverse decreases in groundwater levels could be avoided by conducting appropriate hydrogeological studies to estimate the impact of irrigation reduction on groundwater levels. The studies would include seasonal monitoring of current groundwater levels near areas of significant irrigation. The monitoring results would be used to estimate the impacts of changes in water use on groundwater levels. For areas where declining groundwater levels would reduce baseflow or impair habitat (wetlands), the timing or magnitude of the decrease in groundwater levels could be avoided or other measures such as artificial recharge could be considered.

Transferring Surface Water Rights

Negative impacts to groundwater recharge patterns from change in water use or diversion could be avoided by conducting appropriate hydrogeological studies to predict any adverse effects prior to implementation of the changes; this would allow the implementation of appropriate mitigation measures. At present, available water level data are not sufficiently detailed, continuous, and precise to assess the current amount of recharge and discharge along the reaches of streams.

Hydrogeological studies would include seasonal monitoring of current groundwater levels near current and anticipated points of water diversion and use. The monitoring results would be used to estimate the impacts of changes in use or diversion on groundwater levels. For areas where groundwater level would be impacted, the timing or magnitude of the changes in water use could be avoided or other measures, such as artificial recharge or withdrawal, could be considered.

Transferring Groundwater Rights

Reducing groundwater withdrawals would cause an increase in groundwater levels, which is considered a benefit to the groundwater system with no significant impacts; therefore, no mitigation is warranted.

Stream Flow Augmentation

Potential negative impacts on groundwater from stream flow augmentation could be mitigated through the measures described above for water conservation and transferring surface water rights. Hydrogeologic characterization and hydrologic monitoring would provide data to estimate the potential impact on groundwater levels and availability.

Habitat Restoration

Mitigation of any unacceptable modification of groundwater recharge and discharge, with associated changes in water levels, caused by habitat restoration projects would involve characterizing hydrogeologic conditions and analyzing the hydrology of modified areas in order to estimate potential changes in groundwater exchange with surface water. Hydrogeologic studies would resemble those described above under the Pine Hollow Reservoir and Water Conservation mitigation subsections; the studies would estimate the magnitude of potential impacts based on the hydrogeologic characteristics of modified streambeds and floodplains. The projects could be modified to reduce impacts to groundwater.

6.3.5.3 Alternative 3 – Watershed Restoration Program without Storage

The mitigation of potential groundwater impacts under Alternative 3 would the same as described for the Alternative 2 conservation and habitat restoration components.

6.3.5.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

The mitigation of potential groundwater impacts under Alternative 4 would be the same as those described for Alternative 2, except without the habitat restoration measures.

6.3.6 Cumulative Impacts

6.3.6.1 Alternative 1 – No Action

Under Alternative 1, the cumulative impacts of taking no action on groundwater management could lead to further decline or uncertainties in availability of groundwater.

6.3.6.2 Alternative 2 – Watershed Restoration Program with Storage

Operating a new reservoir would result in permanent changes to local groundwater recharge and groundwater elevations in the alluvial aquifer near the reservoir. These changes would depend on reservoir operations that affect the rate and timing of irrigation water transfer and stream augmentation, and hydrogeologic characteristics of the alluvial aquifer and sedimentary aquifer system underlying the reservoir and areas receiving irrigation or stream augmentation water.

Implementation of Alternative 2 may result in permanent reductions to stream flow in the upper and middle reaches of Ahtanum Creek where water is diverted to fill the reservoir. The stream flow reduction consequently would decrease groundwater levels in the aquifers near the points of diversion and downstream of the diversion due to loss of recharge. Implementation of Alternative 2 may affect shallow groundwater withdrawal near streams. However, if appropriate mitigation measures are implemented for each diversion and transfer of water, cumulative impacts and significant unavoidable adverse impacts on groundwater levels are unlikely.

Lining/piping irrigation distribution systems and repairing leaky structures in the watershed may reduce groundwater recharge along the structures and gradually lower the water table in the alluvial aquifer. The decline in groundwater recharge is not expected to impact shallow irrigation well operation, except for dug wells constructed next to canals. Dug wells may experience declines sufficient to dry up the wells. Secondary long-term cumulative impacts may include the costs associated with deepening shallow dug wells.

Water use efficiency would reduce groundwater recharge and may have a cumulative, unavoidable, adverse impact by reducing groundwater levels in irrigated areas. The cumulative and significant unavoidable adverse impacts on water resources would be changes to local groundwater levels and recharge rates.

Implementation of Alternative 2 could reduce irrigation demand, improve groundwater availability, and potentially reverse the current declining trend of water levels in deeper aquifers. Implementation may increase stream baseflow if groundwater withdrawn from the alluvial aquifer for irrigation is transferred in exchange for use of reservoir water.

Habitat restoration could have a cumulative impact by raising groundwater levels in the alluvial aquifer along reaches of Ahtanum Creek where infiltration is increased at ponds and side channels. In some areas, this could be an adverse impact, but in other areas, depending upon land use, it could be a beneficial impact.

6.3.6.3 Alternative 3 – Watershed Restoration Program without Storage

Cumulative impacts for Alternative 3 would be similar to Alternative 2, except for the impacts related to the reservoir.

6.3.6.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Cumulative impacts under Alternative 4 would be similar to those of Alternative 2, except no habitat restoration would be undertaken.

6.3.7 Significant Unavoidable Adverse Impacts

As noted in Section 6.3.6, unavoidable adverse impacts could include localized reductions in groundwater levels, thus resulting in increased costs associated with deepening wells.

6.4 Plants and Wildlife

This section describes the potential impacts to plants and wildlife that could result from implementation of the alternatives proposed for the ACWRP.

6.4.1 Alternative 1 – No Action

No direct impacts to plants or terrestrial wildlife are anticipated under the No Action Alternative. It is expected that various agencies and entities would continue habitat restoration actions that could include riparian vegetation improvements. However, these measures would not be conducted on a comprehensive, watershed-wide basis. The improvements would likely include removal of non-native vegetation and planting with native plants. Improved riparian vegetation could improve habitat for birds and terrestrial species.

6.4.2 Alternative 2 – Watershed Restoration Program with Storage

Habitat restoration measures under Alternative 2 would include improvements to riparian vegetation. The riparian restoration projects would be similar to those described for Alternative 1, but would be coordinated as part of the overall watershed restoration plan. Improved riparian habitat could increase wildlife numbers in riparian areas.

Construction of the storage reservoir in Pine Hollow would result in flooding of the grassy vegetation and replacing that area of disturbed shrub-steppe vegetation with an artificial lake. The reservoir would be drawn down during the summer, leaving exposed mud flats at the upstream end of the reservoir. It is likely that a mix of native and non-native vegetation, including smartweed (*Polygonum sp.)* and cocklebur (*Xanthium sp*.), would colonize the mud flats during the summer. The dam would be earthen and initially be exposed soil. The dam would be planted with native vegetation. Insects, including mosquitoes could breed in the mud flats areas. The mosquitoes could carry diseases, including the West Nile virus.

The reservoir would likely provide habitat for waterfowl species, especially during spring and fall migration. Shorebirds may be attracted to the mud flat areas during fall migration.

The riparian vegetation that has established along the Johncox Ditch would be removed when the ditch is widened to accommodate diversions into the reservoir. The diversion would be lined or piped and therefore it would be unlikely for vegetation to reestablish along the ditch. Lining or piping conveyance lines would deprive phreatophytes of their water source and the plants would die and not be able to reestablish. This would result in less protective vegetation cover for prey species such as small mammals, birds, and reptiles. The movement of small mammals and reptiles could also be blocked or altered by the new access roads and pipelines.

6.4.3 Alternative 3 – Watershed Restoration Program without Storage

Alternative 3 would result in improvements to riparian vegetation similar to those described for Alternative 2. No reservoir would be constructed, so there would be no disturbance to vegetation in the Pine Hollow area. Irrigation system improvements could include the construction of conveyance pipes that would require removal of existing vegetation.

6.4.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts under Alternative 4 would be similar to those under Alternative 2. However, there would be no coordinated habitat restoration program. Riparian restoration measures would likely be conducted as described for Alternative 1.

6.4.5 Mitigation Measures

The riparian restoration programs that would be implemented under Alternatives 1, 2, and 3 are expected to result in an overall improvement in riparian functions in the Ahtanum Creek Watershed and would not require mitigation. For Alternatives 2 and 4, construction of the reservoir and accompanying conveyance systems would impact vegetation. The earthen dam would be planted with native vegetation to control erosion and replace lost vegetation in the area. Areas surrounding the reservoir that are disturbed during construction would be planted with native vegetation. A noxious weed and insect control program would be developed to control mosquitoes and any noxious weeds that could establish in the reservoir area. No mitigation is proposed for areas that would be inundated by the reservoir.

6.4.6 Cumulative Impacts

The habitat restoration projects, especially the coordinated projects under Alternatives 2 and 3, would improve riparian conditions and could increase the occurrence of local wildlife.

6.4.7 Significant Unavoidable Adverse Impacts

Under Alternatives 2 and 4, the reservoir area would be flooded, which would result in a permanent loss of vegetation and related habitat in the Pine Hollow area.

6.5 Fish

Potential impacts to fish from implementation of the ACWRP are discussed in this section. The results of the EDT model are included for each of the alternatives.

6.5.1 Alternative 1 – No Action

Alternative 1 would not include a coordinated restoration program for the watershed but would include continued conservation and habitat restoration efforts by individual entities and agencies that have jurisdiction over portions of the Ahtanum Creek Watershed. These efforts may be coordinated to some degree under other programs or processes but would not be subject to a coordinated watershed-wide implementation effort. However, for the purposes of this EIS, it is assumed that implementation of this alternative would not have a significant impact on stream habitat or instream flows.

To evaluate potential salmonid fish population impacts under Alternative 1, all habitat-related impacts to fish production were quantitatively assessed with the EDT model (Lestelle et al., 1996). For bull trout, the QHA (Qualitative Habitat Analysis) tool was used to diagnose environmental limiting factors instead of the EDT model. Unlike the EDT model, quantitative analysis of the impact of the actions is not possible in QHA. However, QHA was used to qualitatively discuss the relationship of the alternatives to the environmental factors that currently limit bull trout population performance in the Ahtanum Creek Watershed. QHA does not predict future biological performance, but only diagnoses limiting factors.

For the EDT model simulation, it was assumed that the major factor affecting fish production and fish habitat under Alternative 1 would be continued residential development. In review of adopted land use plans and discussions with the Ahtanum Core Group, it was determined that other forms of development (e.g., agriculture or forestry) were unlikely to change significantly in the immediate future and that their current impacts could be expected to continue. The time horizon for estimating impacts under existing policies was set at 30 years. Thirty years was selected based on three of the major limiting factors for fish in the Ahtanum Watershed: excessive sediment/bank instability, riparian vegetation, and excessive water temperature. Thirty years is sufficient time for locally native trees (black cottonwood and various species of willow) to reach a size capable of providing ample shade for a stream as small as Ahtanum Creek, thereby lowering water temperature and also filtering sediment from the stream and providing structural integrity to the streambanks. It is also a long enough time period to allow for significant fish population growth.

For the No Action Alternative (or scenario, in EDT terms), the EDT modeled environmental conditions over a 30-year time period from the present, assuming that current land use and management policies and practices would remain consistently in effect. This scenario includes three specific elements: 1) negative impacts associated with growth, 2) positive elements deriving from the enforcement of existing regulations, and 3) positive impacts attributable to "long-maturing" restoration projects. Recently implemented restoration projects were used for projecting impacts into the future. These actions included recently completed riparian fencing and side channels recently reconnected to Ahtanum Creek. Habitat restoration projects of this type require considerable time (approximately 30 years) before they are capable of yielding meaningful environmental benefits. For example, it takes a number of years for riparian vegetation to respond to fencing, and longer for fish populations to respond to the improved environment (e.g., decreased water temperatures and reduced sedimentation). For a full description of the assumptions used to develop the restoration scenarios, see Table C-11 in Appendix C.

Recently completed enhancement projects were included in the No Action Alternative, including roughly 6 miles of recent riparian exclosures and 0.8 mile of newly reconnected side channel (Rogers, personal communication, 2004). Of the riparian exclosures, 4.7 miles are distributed throughout the mainstem and 1.3 miles are in the South Fork of Ahtanum Creek. It was assumed they would contain trees 40 to 45 feet tall after 30 years. The shade these trees would produce was assumed to restore about 11 percent of the historical/normative maximum water temperature to affected areas (see below and Appendix C for details of rationale). The same magnitude of benefit was assumed for fish pathogens and predation risk since they increase along with temperature. The trees in these exclosures were also assumed to restore 22 percent of the historical value for riparian function and to filter out enough sediment to restore sediment ratings by 18 percent relative to the historical inputs (see Appendix C for details of rationale).

The restored side channels included in the No Action Alternative are located in the upper Ahtanum Creek mainstem between the upper WIP diversion and the confluence of North and South Forks. The constructed side channels were conceived as having fully vegetated banks (from riparian plantings) after 30 years, and to contain optimal quantities of large woody debris (LWD) installed after construction. The benefits of reconnecting these side channels included an absolute increase in habitat area of 10.5 percent and a 10.5 percent restoration of the historical quantities of LWD. Finally, the net confinement in the reach caused by human actions was assumed to decrease by 19 percent, which represents the relative length of the side channels in the reach.

The impacts specifically attributable to land use development in the Ahtanum Creek Watershed were addressed as follows. Because the major impact expected over this time period is residential growth, existing zoning regulations play a major role. The lower 6.8 miles of Ahtanum Creek fall within the UGA for Yakima County, while the rest of the watershed falls within a mixture of agricultural and rural classifications that generally restrict residential growth and/or subdivision. Therefore, the conditions predicted for the portion of the watershed within the UGA differ significantly from those further upstream. In accordance with adopted land use plans and policies, over the 30 years, residential growth within the UGA is estimated to be much higher than growth in the upper reach of the watershed. Refer to Section 6.7, Land and Shoreline Use, for additional discussion of projected growth in the watershed.

Reasonably predictable relationships exist between the degree of residential development and the specific impact on environmental variables for fish (May et al., 1997). The relationships described in May et al. were used, with modifications appropriate to an eastern Washington setting, to predict the impact of development on key aquatic habitat parameters. Zoning regulations were also used to predict specific environmental trends over time, some of which can be favorable even in the face of substantial growth. For example, current and future zoning regulations are assumed to result in improved riparian vegetation over time. On the other hand, sediment delivery to stream channels is expected to increase with increased development over time. The impact of development and zoning regulations on major environmental variables in the Ahtanum Watershed is summarized in Table 6-1. These relationships were the foundation for the EDT model simulations of the land use element of the No Action Alternative.

Table 6-1. Expected Impact of Residential Development on Major Environmental Variables in the Ahtanum Watershed

Attribute	Degradation Percent Relative to Percent Development	Comments
Anthropogenic Confinement	100% above UGA, 30% improvement within UGA	Expect 30% improvement in UGA, but 1:1 degradation above
Flashy Flow Impacts	10%	Minimal impacts because most drainage systems designed for infiltration
Harassment	100%	Harassment always directly correlated with population density.
Backwater Pools	100%	Residential development usually reduces log jams, the source of backwater pools
Beaver Ponds	100%	Flooding from beaver dams usually results in beaver relocation
Off-channel Habitat	100%	Moot; very little off-channel habitat to speak of except for Spring Creek
Heavy Metals	100%	Expected consequence of increased population density
Miscellaneous Toxicants	100%	Expected consequence of increased population density
Nutrient Enrichment	50%	Not worse because conversion is from agriculture to residential
Upwelling/Springs/Seeps	0%	No impact expected
Large Woody Debris	100%	Expected given current practices regarding perceived "flood hazards"
Benthic Production and Diversity	100%	Expected consequence of increased population density
Riparian Function	100% above UGA, 30% improvement within UGA	Expected 30% improvement in UGA, but 1:1 degradation above
Primary Pools	0%	No impact because additional channel straightening not anticipated anywhere in drainage
Fine Sediment, Embeddedness and Turbidity	10% in UGA, 25% above	For fines, embeddedness and turbidity, assume 10% of development increase within UGA, but 25% above UGA
Fish Pathogens	20%	Mainly temperature-based
High Temperature	10% improvement within UGA, no change above	Assume a 10% improvement from current conditions within UGA and no change above because conditions have already come to equilibrium at their worst possible state
Low Flow Impacts	No impact within UGA, 10% above	No impact in UGA, but an impact 10% of the growth rate expected upstream
Peak Flow Impacts	0%	No meaningful impacts anywhere in drainage because road density already as high as it is likely to get

The results of the EDT model simulation of the No Action Alternative are summarized in Table 6-2, which presents a summary of the performance of coho, spring Chinook, and steelhead populations in terms of life history diversity, productivity, carrying capacity, and mean abundance. The population performance parameters are summarized under current conditions, the No Action Alternative (30 years into the future with current land use trends and the implementation of current restoration projects), and historical conditions scenarios. For clarification, the column labeled Diversity Index in Table 6-2 denotes the proportion of life history patterns that are self-sustaining (result in at least one returning adult per spawner), while the Productivity column denotes the maximum number of returning adults per spawner. The Capacity column denotes the maximum number of adults the stream can support, and the Abundance column denotes the expected average number of returning adults.

Table 6-2. Predicted Impacts of the No Action Alternative on Production of Coho, Steelhead, and Spring Chinook Populations in the Ahtanum Creek Watershed

Population	Scenario	Diversity Index	Productivity	Capacity	Abundance
Ahtanum Coho	Current without harvest	1%	1.5	188	59
	No Action	1%	1.5	192	67
	Historic potential	98%	5.0	3,830	3,065
Ahtanum Spring Chinook	Current without harvest	4%	1.3	118	26
	No Action	6%	1.6	151	56
	Historic potential	100%	8.8	2,653	2,353
Ahtanum Steelhead	Current without harvest	2%	1.30	753	174
	No Action	2%	1.26	758	157
	Historic potential	97%	10.1	5,672	5,113

The results are derived from the EDT simulation

In general, there will be relatively little change in fish populations if current policies are continued for 30 years while existing restoration projects mature (Table 6-2). The small net change in fish population performance over time with the No Action Alternative is probably due to offsetting trends in watershed conditions. Improvements in aquatic and riparian habitat from current restoration and land management regulations are countered by impacts from future residential development. The productivity for all three species listed in Table 6-2 remains low under the No Action Alternative, ranging from 1.26 to 1.6 returning adults per spawner. These are very low productivity values, indicating that the populations have a low probability of persisting into the future (see Section 4.5). In terms of mean abundance, the steelhead population is predicted to fall by 9.7 percent while the coho and spring Chinook populations increase by 13 and 115 percent, respectively. In assessing the benefits to coho and spring Chinook abundance, it is essential to bear in mind that these values apply to populations with current estimated productivities of just 1.5 and 1.6, respectively. It is also important to note the extremely low life history diversity values for the three species, both under Current and No Action scenarios. These figures range from 1 to 6 percent, indicating that from 94 to 99 percent of all biologically possible life history patterns are not self-sustaining in the habitat available.

Alternative 1 is expected to have generally, but not exclusively, negative impacts on bull trout populations. Continued development of the Ahtanum Creek Watershed and expanded urbanization would likely add to the pollutant problems identified as a limiting factor for bull trout. Habitat diversity is expected to decline further due to the removal of large wood and additional confinement of the channel. However, a small improvement is expected in the reduction of high summer water temperatures, especially in the urbanized lower reaches, resulting from riparian restoration and improved management practices over time.

6.5.2 Alternative 2 – Watershed Restoration Program with Storage

Alternative 2 would consist of a coordinated attempt to restore aquatic habitat limiting factors in critical reaches combined with the operation of the Pine Hollow Reservoir.

6.5.2.1 Comprehensive Watershed Restoration Impacts

The habitat restoration component of Alternative 2 would address the major identified fish population limiting factors. It is assumed that restoration actions would be focused in the most critical reaches—the reaches with the greatest restoration potential in terms of the EDT analysis outlined in Section 4.5. The factors most responsible for limiting the production of salmon and steelhead in the Ahtanum Creek Watershed are fine sediment, excessive temperature, a lack of key habitat (especially pools and off-channel habitat), channel instability, a lack of habitat diversity associated with very low quantities of in-channel LWD, and fish passage barriers. Accordingly, the restoration actions incorporated into the EDT model simulation for the evaluation of Alternative 2 included the following measures intended to address these specific limiting factors:

- Riparian planting (improves shading/temperature, riparian function, and related variables);
- Road relocation and related measures to reduce sediment delivery to streams (reduces sediment input to stream channels within the upper watershed);
- Engineered channels with meanders and graded, bioengineered banks (reduces sediment input to middle and lower reaches of the watershed, while increasing bank stability and decreasing bed scour);
- Addition of large wood to stream channels (adds habitat diversity and key habitat, especially pools);
- Removal of barriers to valuable, cool-water habitat in the lower drainage (lower Bachelor and Spring Creeks); and
- Reconnection of historical side channels (decreases bed scour, increases channel stability, and adds habitat diversity).

In general, operation of the proposed Pine Hollow Reservoir would not significantly affect the limiting factors for fish in the Ahtanum Watershed, particularly in the short term. These factors would be more effectively addressed through implementation of comprehensive watershed restoration measures. However, overall trends over the long term associated with implementation of Alternative 2 appear to be positive. Appendix C provides detailed information on the restoration actions used for the EDT simulation. Following is a discussion of projected impacts associated with Alternative 2, based upon EDT results. As with all modeling, results are based upon assumptions used to build the model and should be considered a "snapshot" of input factors and conditions used in the model.

Riparian Planting

The primary objective of riparian planting under Alternative 2 is to provide more shade over stream channels and thereby lower water temperatures. Additional benefits would include a reduction in sediment input to stream reaches and improvements in riparian function, particularly long-term inputs of large wood. Minor benefits were hypothesized for in-channel large wood, bed scour, pool frequency, and off-channel habitat as well.

A large proportion of the watershed is targeted for riparian plantings. Targeted areas include the North Fork of Ahtanum Creek, from its mouth to Foundation Creek; the South Fork from its mouth to the steelhead access limit (RM 6.3); Bachelor Creek from its mouth to Spring Creek; and the mainstem of Ahtanum Creek from its mouth upstream to the confluence of the North and South Forks (Ahtanum Creek Reaches 1 to 7 on Figure 4-9).

The water temperature impacts of riparian plantings were estimated by applying the Stream Segment Temperature Model (SSTEMP) (Bartholow, 1997) to the targeted reaches. It was assumed that the cooling effect of 30 years of tree growth would be attributable exclusively to increased shading. The SSTEMP model accounts for the water-cooling impact of riparian shading by incorporating values for vegetation height, crown diameter, distance from the stream margin, and percent vegetation coverage. On the basis of published accounts of growth rates of black cottonwood and various willow species, it was conservatively estimated that successfully established willows and cottonwoods would reach a height of 40 to 45 feet and have a crown diameter of 30 to 35 feet after 30 years of growth. Distance from the stream margin was assumed to be 2 feet, and coverage density was assumed to be 100 percent (i.e., all of the streambank was assumed to be covered by trees)[1].

The SSTEMP model was used to estimate total shade levels (83 percent in the mainstem and 85 percent in the lower North Fork) and mean water temperatures (15.6^{o}C in the mainstem, 12.6^{o}C in the lower North Fork) for the month of August under the future, fully shaded scenario just described. The model was then used to estimate *current* stream temperatures (18.5^{o}C in the mainstem, 15.2^{o}C in the lower North Fork) given *existing* shade levels (33 percent mainstem, 37 percent lower North Fork). Existing shade levels were estimated from 1996 aerial photographs, and shade estimation protocols developed by the Washington State Timber, Fish and Wildlife group (WDNR, 1997b). The relative values of the mean temperature estimates ("future shaded scenario" to "current poorly shaded scenario") provided the basis for the assumed water-cooling effect of riparian growth[2]. For the EDT model simulation, it was assumed that successful riparian plantings along the targeted reaches would result in a 29 percent restoration of historical August temperatures in the mainstem, and a 7 percent restoration of historical August temperatures in the lower North Fork and South Fork.

[1] The SSTEMP model includes other parameters not described in this report. In an attempt to explain the essential features of the temperature modeling process, only the key parameters were described. For a full description see Bartholow (1997).

[2] The bi-hourly temperature observations for the years 2001 to 2004 were multiplied by a fraction represented by the ratio of future-shaded to the current mean August temperatures. The adjusted temperature dataset was then re-rated for the EDT maximum temperature index value.

The assumptions for the other (non-thermal) aquatic habitat benefits of riparian plantings were as follows. The percent restoration of historical/normative conditions for fish pathogens and predation risk were the same as temperature (29 percent and 7 percent for the mainstem and the North and South Forks, respectively). Pathogens and predation increase with increasing water temperatures. Percent restoration for riparian function and fine sediment was set at 40 percent and 20 percent, respectively. Minor benefits (5 percent restoration) were assumed for large wood in the channel, bed scour, pools, and off-channel habitat.

Road-related Actions

Sediment reduction activities in the upper watershed (South Fork, North Fork, and North Fork tributaries) would focus on reducing the delivery of road-generated fine sediment to stream channels. Sediment delivery would be reduced through improved road management and selective road relocation. Improved road management would include measures such as placement of road drainage structures (e.g., culverts) and other actions such as limiting road access during wet weather. The road relocation element consists of relocating (moving upslope) and obliterating selected heavily used roads within 200 feet of the lower and middle North Fork, the lower and middle South Fork, the lower Middle Fork, and lower Foundation Creek. Again, the primary purpose of road relocation is to reduce fine sediment input to the upper Ahtanum Watershed (North and South Forks and several North Fork tributaries).

The rationale for road relocation is as follows. The Ahtanum Watershed Analysis (WDNR, 1997a) included estimates of background sediment input, road-related sediment input, sediment input attributable exclusively to stream crossings, and total sediment input. These estimates were made for the middle and lower North Fork, Foundation Creek, and the lower Middle Fork. It was estimated that roads within 200 feet of an active channel cause sediment input to exceed background levels by 83 percent in the lower North Fork, 66 percent in the middle North Fork, 55 percent in Foundation Creek, and 67 percent in the Middle Fork. With one exception, these were the assumptions incorporated into the EDT model to estimate the impact of road relocation and other sediment control practices on fish production in the upper reaches of the Ahtanum Watershed. The South Fork was the exception. Although no analysis of sediment sources could be found, roads run parallel and close to the South Fork for much of its length. Therefore, it was assumed that streamside roads are also the major source of sediment for the South Fork, and that the mean figure for the North Fork and its tributaries (71 percent) could be used to represent the percent restoration of background sediment levels that would be achieved by road relocation and other sediment control practices along the South Fork.

Engineered Channels (Constructing Meanders and Regrading Banks)

Biologists familiar with Ahtanum Creek determined that approximately 5.5 miles of the mainstem have channelized stream segments that are subject to a substantial degree of incision and are contributing major quantities of sediment from bank sloughing. These unstable segments extend from a half-mile reach paralleling Fulbright Park, near the confluence with the Yakima River, to another half-mile reach between the Johncox Ditch and Shaw Knox diversions on the lower North Fork.

For the purpose of the EDT model simulation, it was conservatively assumed that constructing meanders and regrading the banks of the unstable stream segments would result in a 40 percent restoration of the historical fine sediment values in reaches below the Bachelor-Hatton Diversion. In addition, it was assumed that these benefits would propagate downstream at a diminishing rate, such that the reach immediately downstream of a targeted reach would have a 30 percent restoration value, the reach below it would have a 20 percent restoration value, and so on. The benefits of remeandering and regrading were not assumed to be so pronounced for the mainstem between the Bachelor-Hatton Diversion and the confluence of the North and South Forks, because a portion of the deposited sediment in this area is "imported" from upstream sediment sources. In this section of the mainstem (Ahtanum Reaches 6 and 7) (see Figure 4-9), the sediment-related benefits of constructing meanders in targeted reaches was estimated to be 20 percent of historical values.

Constructing meanders in of the creek channel was also assumed to have benefits unrelated to sediment inputs. Adding meanders to the channel would increase pool frequency and reduce bed scour. It was assumed that the reengineered stream reaches would include the historical quantity of pools, so the percent restoration for pool frequency in targeted reaches was established at 100 percent. A relatively minor benefit of 10 percent restoration was used for bed scour in targeted reaches.

Addition of Large Woody Debris

With the exception of the handful of reaches already relatively well stocked with large wood (the North Fork from the Middle Fork to the access limit for anadromous fish; the Middle Fork; and the South Fork from RM 2.0 to the access limit), the restoration simulation included adding large wood to most of the channels in the watershed. The stocking rate for each reach was one piece per channel width, with the exception of the mainstem between the upper WIP diversion and the confluence of the North and South Forks, which would receive two pieces per channel width because of its high-priority ranking for restoration potential.

Removing Barriers

Under Alternative 2, removing fish passage barriers is proposed to increase the quantity of good spawning and rearing habitat, with a particular focus on areas with relatively cool summertime water temperatures. The only candidate areas for this treatment are lower Bachelor Creek and its tributary, Spring Creek. This action would consist of moving the Bachelor Creek rack upstream to a point immediately above the Spring Creek confluence.

Reconnecting Side Channels

Under Alternative 2, reconnecting streamside channels would address a lack of habitat diversity, insufficient quantity of pools, limited rearing habitat, and excessive bed scour. The action would consist of creating 1.3 miles of new side-channel habitat in addition to the side channels just created and described under the No Action Alternative. The additional side channels are also located in the Ahtanum Creek mainstem between the upper WIP diversion and the confluence of the North and South Forks, Reach 7 (see Figure 4-9). Except for their relatively greater length, these additional side channels are functionally identical to the side channels described in the No

Action Alternative.

The projected benefits of reconnecting and engineering 1.3 miles of side channel in the targeted reach are as follows. The total fish rearing area would increase by 22.9 percent, and in-channel large wood loading would be restored to 22.9 percent of historical levels. Because the side channels would be engineered to contain 50 percent pool habitat, overall pool quantity in the reach would increase by 49 percent. In addition, channel confinement caused by human actions would decrease by 27 percent (the lineal proportion of side channel in the reach), and bed scour would be restored to 22.9 percent of historical values (within the proportion of the reach consisting of side channel).

6.5.2.2 Pine Hollow Reservoir Storage Impacts

Under Alternative 2, the evaluation of potential fisheries impacts from operating the Pine Hollow Reservoir was based on three considerations and assumptions. First, because seasonal stream flows are highly variable in a natural setting, it is difficult to model fish population performance under different flow regimes and develop conclusions about future status with a high degree of certainty. In unregulated watersheds, summertime stream flows, which are the most limiting to fish populations, are inherently variable, fluctuating widely from dry to wet years. For the purpose of the EDT model simulation, modeled stream flows, which represent what stream flow would have been between 1947 and 1984 under the estimated 2002 irrigation demands, were used as the baseline for comparison.

Second, according to flow simulations discussed in Section 5.2, the Pine Hollow Reservoir was assumed to cause a slight decrease in mean monthly flows in the mainstem (below the upper WIP Diversion) during the period of reservoir refilling (generally November to April) and during the months of June and August as well. When averaged over September and October, the two months of lowest mean flow, mean discharge between the reservoir intake and discharge points (Johncox Diversion on lower North Fork and Upper WIP Diversion on upper mainstem, respectively), would be approximately 1.3 cfs lower than current values. By contrast, mean discharge below the release point over this same time period would be from 0.7 to 3.4 cfs higher than under current conditions.

Finally, although these changes in stream flows are small, they not trivial. However, the wetted widths that would be associated with these new flows differ from current widths by 1 percent to 2 percent or less. Accordingly, the impact of Pine Hollow Reservoir operation was modeled exclusively in terms of the changes to baseflow and not wetted width. The assumed impacts to stream base flow are summarized in Table 6-3.

Based on these assumptions, a slight positive impact on the modeled fish populations results from Pine Hollow Reservoir operations for all reaches below the release point, while a slight negative effect would occur between the points of reservoir intake and release.

Table 6-3. Reach-Specific Impacts of Pine Hollow Reservoir Operation: Mean September and October Flows in Ahtanum Creek

Reach	Baseflow (percent change from Current)
Ahtanum Creek, mouth to Goodman Road	~~16.7~~14.1%
Ahtanum Creek, Goodman Road to Bachelor return	~~16.7~~20.8%
Ahtanum Creek, Bachelor return to 42nd Avenue	~~13.5~~13.9%
Ahtanum Creek, 42nd Avenue to Hatton return	~~13.5~~13.9%
Ahtanum Creek, Hatton return to lower WIP diversion	~~-13.0~~13.0%
Ahtanum Creek, Lower WIP Diversion to American Fruit Road	~~3.7~~13.0%
Ahtanum Creek, American Fruit Road to Marks Road	~~3.2~~3.7%
Ahtanum Creek, Marks Road to Bachelor-Hatton Diversion	~~3.2~~3.5%
Ahtanum Creek, Bachelor-Hatton Diversion to Upper WIP Diversion	~~-2.7~~3.0%
Ahtanum Creek, Upper WIP Diversion to forks	**-4.4%**
North Fork Ahtanum, Mouth to RM 2.0	**-5.7%**

The temperature of the water released from the reservoir to maintain instream flows was initially considered a potential issue in evaluating the impacts of reservoir operations. The temperature of the water released into Ahtanum Creek is not, however, an issue relative to fish response because so little water is actually released. The projected releases for the months of June through October are 1.8 cfs, 0.1 cfs, 0.0 cfs, 0.02 cfs, and 0.1 cfs, respectively. Estimated flow in Ahtanum Creek during these same months is at least 64 times the flow spilled into the creek. Moreover, the estimated temperature of water released during this period is not unusually high, ranging from 5.7^{o}C in June to 21.4^{o}C in September.

6.5.2.3 Combined Watershed Restoration with Storage Impacts

Table 6-4 summarizes the results of the Alternative 2 EDT simulation for the combined impact of watershed restoration and the operation of Pine Hollow Reservoir on Ahtanum coho, spring Chinook, and steelhead populations. The estimated impact of Alternative 2 clearly benefits the production potential of Ahtanum Creek Watershed fish populations. The mean abundance of coho and steelhead would nearly triple, while spring Chinook mean abundance would increase more than 700 percent. Perhaps more importantly, the productivity and life history diversity values of all populations would also increase substantially. Estimated productivity for both coho and steelhead is 1.9 returning adults per spawner, while life history diversity values are 20 percent and 29 percent, respectively.

Although these values represent major improvements over baseline conditions, they still suggest limited population resilience and stability. Nearly 70 percent of the possible life history patterns for steelhead are not self-sustaining, as are 80 percent of the life history patterns for coho. These numbers project that the survival of the population depends on a relatively limited number of reaches that fish must have access to at specific times. Similarly, the fact that the maximum reproductive rate (productivity) is only 1.9 returning adults per spawner means that relatively modest increases in mortality could cause the population to decline precipitously. Because of low productivity, these populations would recover fairly slowly from inevitable environmental fluctuations.

Table 6-4. Predicted Impacts of Alternative 2 on Production of Coho, Steelhead, and Spring Chinook Populations in the Ahtanum Creek Watershed

Population	Scenario	Diversity Index	Productivity	Capacity	Abundance
Ahtanum Coho	Current without harvest	1%	1.5	188	59
	Watershed Restoration and Pine Hollow Reservoir	21%	1.9	341	163
	Historic potential	98%	5.0	3,830	3,065
Ahtanum Spring Chinook	Current without harvest	4%	1.3	118	26
	Watershed Restoration and Pine Hollow Reservoir	36%	2.9	316	205
	Historic potential	100%	8.8	2,653	2,353
Ahtanum Steelhead	Current without harvest	2%	1.3	753	174
	Watershed Restoration and Pine Hollow Reservoir	29%	1.9	981	455
	Historic potential	97%	10.1	5,672	5,113

The results are derived from the EDT simulation

Spring Chinook are assumed to be restricted primarily to the mainstem of Ahtanum Creek, where most of the habitat restoration activities would occur. It is thus not surprising that spring Chinook would be the largest beneficiary of the proposed restoration actions. With a productivity of nearly three returning adults per spawner and 36 percent of the possible life history patterns being self-sustaining, it is likely that Ahtanum Creek could once again support a population of spring Chinook. However, the population would be small and precarious, dependent on a limited number of spawning reaches and outmigration patterns.

Based upon the QHA evaluation, the implementation of Alternative 2 would have the following positive impacts on the Ahtanum Creek bull trout populations:

- Improved riparian vegetation and cover from restoration actions would provide shade to reduce high water temperatures and would, over time, supply large wood to stream channels, thus increasing aquatic habitat diversity.
- Reducing road-related sediment would reduce pollutant levels and sediment inputs, both significant factors limiting bull trout populations.
- Engineering channels with meanders would improve aquatic habitat diversity and provide summer and winter rearing habitat for bull trout in the lower reaches of Ahtanum Creek.
- Adding large wood to channels would increase habitat diversity and increase pool habitat needed for juvenile rearing and adult holding.

- Reconnecting side channels would provide important summer and winter rearing habitat, thereby increasing juvenile bull trout survival.
- Decreased summertime flows in the lower North Fork and upper mainstem resulting from the reservoir could have negative impacts on the bull trout populations. These impacts would probably be minimal because there is very little summer use of the affected reaches by bull trout.

6.5.3 Alternative 3 – Watershed Restoration Program without Storage

Alternative 3 would be the same as Alternative 2 except that the Pine Hollow Reservoir would not be included. Table 6-5 summarizes the benefits of Alternative 3 on spring Chinook, coho, and steelhead populations, based on the EDT model simulation. Compared to Alternative 2, Alternative 3 would result in a slight decrease in the performance of these fish populations. While it is difficult to gauge the full impact of the proposed reservoir based on the EDT model simulation, the model clearly demonstrates that comprehensive watershed restoration has direct and lasting beneficial impacts on fish population performance.

Table 6-5. Predicted Impacts of Alternative 3 on Production of Coho, Steelhead, and Spring Chinook Populations in the Ahtanum Creek Watershed

Population	Scenario	Diversity index	Productivity	Capacity	Abundance
Ahtanum Coho	Current without harvest	1%	1.5	188	59
	Watershed Restoration	20%	1.9	333	159
	Historic potential	98%	5.0	3,830	3,065
Ahtanum Spring Chinook	Current without harvest	4%	1.3	118	26
	Watershed Restoration	32%	2.9	290	193
	Historic potential	100%	8.8	2,653	2,353
Ahtanum Steelhead	Current without harvest	2%	1.3	753	174
	Watershed Restoration	29%	1.9	972	452
	Historic potential	97%	10.1	5,672	5,113

The results are derived from the EDT simulation

6.5.4 Alternative 4 – Watershed Storage Program without a Habitat Restoration Component

Table 6-6 summarizes the benefits of Alternative 4 on spring Chinook, coho, and steelhead populations, based on the EDT model simulation. There would be essentially no difference in fish population performance between Alternative 4 and the No Action Alternative. This finding, and the conclusions from EDT model simulations and QHA findings for Alternatives 2 and 3, indicate that the reservoir alone would, within the uncertainties inherent in the model, have a slight positive impact on the coho, spring Chinook, and bull trout populations. There would be a small negative impact on steelhead population performance under Alternative 4. Significant benefits to all fish populations would accrue from the addition of the comprehensive habitat restoration component under Alternatives 2 and 3.

Table 6-6. Predicted Impacts of Alternative 4 on Production of Coho, Steelhead, and Spring Chinook Populations in the Ahtanum Creek Watershed

Population	Scenario	Diversity Index	Productivity	Capacity	Abundance
Ahtanum Coho	Current without harvest	1%	1.5	188	59
	Pine Hollow Only	1%	1.5	200	64
	Historic potential	98%	5.0	3,830	3,065
Ahtanum Spring Chinook	Current without harvest	4%	1.3	118	26
	Pine Hollow Only	6%	1.6	173	64
	Historic potential	100%	8.8	2,653	2,353
Ahtanum Steelhead	Current without harvest	2%	1.3	753	174
	Pine Hollow Only	2%	1.3	769	160
	Historic potential	97%	10.1	5,672	5,113

The results are derived from the EDT simulation

6.5.5 Mitigation Measures

None of the proposed program alternatives are expected to have an adverse impact on fish; therefore, no mitigation measures would be required. The ACWRP is proposed as mitigation for existing degraded habitat conditions.

6.5.6 Cumulative Impacts

The cumulative impacts of restoration projects and increased target flows from reservoir operations should be a benefit to fish in the Ahtanum Creek Watershed.

6.5.7 Significant Unavoidable Adverse Impacts

No significant unavoidable impacts to fish were identified under any of the alternatives.

6.6 Scenic Resources and Aesthetics

This section describes the potential impacts to scenic resources and aesthetics that could result from implementation of the alternatives proposed for the ACWRP.

6.6.1 Alternative 1 – No Action

The No Action Alternative is not expected to affect scenic and aesthetic resources. Irrigation conservation programs that could be implemented under the No Action Alternative could improve irrigation efficiency and change cropping patterns from primarily pasture to orchard or other crops, thus altering the view of agricultural areas in the middle and lower reaches of the Ahtanum Creek Watershed. Similarly, watershed restoration programs could increase riparian vegetation and change views of the creek. If no conservation or restoration programs were implemented, scenic and aesthetic resources in the watershed would remain largely unchanged. Additional agricultural lands in the lower reach of the watershed could be converted to housing development, altering views of those areas.

6.6.2 Alternative 2 – Watershed Restoration Program with Storage

The irrigation conservation and watershed restoration projects that would be implemented under Alternative 2 would result in similar changes to views of agricultural lands and the riparian area as the No Action Alternative.

Construction of the Pine Hollow Reservoir would alter the appearance of the Pine Hollow area. A portion of the grassy, rocky canyon area would be converted to a reservoir with an earthen dam at the eastern~~western~~ end. The earthen dam is expected to be approximately 180 feet tall and nearly 0.5 mile long. The dam would be angled back to the west on the north and south ends to contain the reservoir. The dam would be planted with native vegetation and could resemble a rolling hill. The dam would block views from the surrounding ridges down Pine Hollow.

The reservoir would be approximately 1.5 miles long, narrowing from the dam to the western end. When full, the reservoir would resemble a lake that would contrast with the surrounding arid area. The reservoir would be filled starting in late winter or early spring and be drawn down for irrigation starting in April. The reservoir would be expected to reach its driest point in August and September. At that time, the reservoir size would be reduced and the areas covered by the reservoir during full pool would be exposed. On the steep north and south sides of the reservoir, a “bathtub ring” would develop. This ring would consist of a band of white mineral deposits on the side of the reservoir. On the upstream (western) end of the reservoir, mud flats could be exposed. The reservoir, bathtub ring, and mud flats would be visible to residents in the Pine Hollow area until the reservoir is refilled in late winter/early spring.

The appearance of the Johncox Ditch area would also be altered by the reservoir. The ditch would be used to fill the reservoir and would need to be widened to convey adequate flows to fill the reservoir. Widening would likely require removal of most of the vegetation along the ditch. The conveyance system for the reservoir water would be piped; therefore, pipes would be constructed from the reservoir to the irrigated lands. These pipes would be visible on the landscape. In addition, the WIP canal that provides water to irrigate lands on the Yakama Reservation would be piped. This would result in a visible pipe running along the lower portion of Ahtanum Ridge.

6.6.3 Alternative 3 – Watershed Restoration Program without Storage

The irrigation conservation and watershed restoration programs that would be implemented under Alternative 3 would result in similar changes to views of agricultural lands and the riparian area as the No Action Alternative. Since no reservoir would be constructed, there would be no aesthetic impacts to the Pine Hollow area. Agricultural conservation improvements could include piping portions of the irrigation systems, resulting in similar visual impacts to Alternative 2.

6.6.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts to scenic resources and aesthetics would be the same under Alternative 4 as described for Alternative 2. Since no coordinated habitat restoration component would be included in this alternative, the condition of riparian vegetation is unlikely to improve and views of the creek area would not be changed.

6.6.5 Mitigation Measures

Alternatives 1 and 3 are not expected to result in impacts to scenic and aesthetic resources in the Ahtanum Creek Watershed. Construction of the reservoir under Alternatives 2 and 4 would result in aesthetic impacts to the Pine Hollow area. The earthen dam would be planted with native vegetation to help blend it into the surrounding area. No mitigation is proposed for the scenic impacts of the reservoir. Conveyance pipes would be located to minimize their visibility from public areas such as Ahtanum Road.

6.6.6 Cumulative Impacts

No cumulative impacts to scenic resources or aesthetics are anticipated in the Ahtanum Creek Watershed as a result of any of the proposed alternatives.

6.6.7 Significant Unavoidable Adverse Impacts

Construction of the reservoir would permanently alter the aesthetics of the Pine Hollow area by replacing the open shrub-steppe area with a dam and reservoir.

6.7 Land and Shoreline Use

The potential impacts of the ACWRP to land and shoreline use are discussed in this section. The impacts to the three watershed reaches are discussed separately because of the different land uses in the reaches.

6.7.1 Alternative 1 – No Action

With selection of the No Action Alternative, existing agricultural properties in the Ahtanum Creek Watershed that do not have a reliable irrigation supply would likely come under additional pressure to be converted to residential uses. This trend toward conversion of agricultural land to residential land is already occurring, and is likely to continue to occur regardless of irrigation availability, but the continued lack of reliable irrigation would likely contribute to the trend. Refer to Section 6.10, Economics, for additional discussion of this potential trend. Continued or accelerated conversion from agricultural to residential development would not be consistent with the local comprehensive plan goals and objectives listed in Section 4.7.2 developed to preserve and enhance agricultural properties.

Although a coordinated watershed planning process would not occur with the No Action Alternative, individual watershed management efforts would continue to occur. Individual agencies or entities would continue to undertake individual conservation or restoration actions or programs. These programs would be carried out in compliance with local plans, policies, and permit requirements. The lack of a coordinated watershed restoration program would likely result in less improvements to the reliability of the water supply since the actions undertaken would be done on an individual basis.

6.7.1.1 Upper Reach

If the No Action Alternative were selected, future land use development within the upper reach would be expected to occur in a pattern consistent with current development conditions. Forest management practices and logging operations would continue to occur in areas within the upper reach, and single-family housing development would occur along streams in the lower portion of the upper reach, in accordance with regulations established in the Yakima County Code. Table 15.18, Allowable Land Uses, in the Yakima County Code indicates that various types of single-family residential development are permitted in areas zoned Remote/Extremely Limited Development Potential and Agricultural (Yakima County, 2004).

6.7.1.2 Middle Reach

Under the No Action Alternative, it is likely that agricultural lands that are not currently in active production or adequately serviced by irrigation would be converted to residential development in accordance with adopted land use plans/zoning (e.g., Yakima County Code, Table 15.18). Increased residential development would also occur in the Wiley City community, which is located within the city of Yakima's Urban Reserve Area (inside the UGA). Yakima County is proposing to extend wastewater service to Wiley City to solve existing sewer problems. This action would be consistent with city of Yakima *Comprehensive Plan* (1997) Policy G10.4: "Through land use controls, prevent conversion of land in the urban reserve area to uses/densities that cannot be urbanized [by]…requiring connection to public water and sewer systems where available, including interim systems or facilities where feasible." The new sewer system would accommodate future residential development. Neither the Yakima County nor city of Yakima comprehensive plans discuss the possibility of extending public water or sewer service to Tampico in the near future.

6.7.1.3 Lower Reach

Future development in unincorporated areas of Yakima County would occur in a pattern similar to conditions described for the middle reach in accordance with adopted land use plans and policies. The lower reach has the highest level of existing developmental density, and would be expected to continue to increase in density as in-filling of properties occurs.

Future expansion of the city of Union Gap in the watershed is limited (City of Union Gap, 1999). In 1992, the city of Union Gap established five potential annexation areas that could be included in the Union Gap's UGA based on the draft Yakima County Countywide Planning Policy. Two of the identified UGAs were annexed by the city of Yakima, two of the UGAs fall within the Yakama Reservation, and most of the fifth UGA extends into the Urban Reserve Area identified by the city of Yakima, limiting future expansion by the city of Union Gap. However, the city of Union Gap may consider proposing incorporation of some of the long-term deeded lands (inholdings) on the Yakama Reservation (Rathbone, personal communication, 2004).

With the availability of land and expected increase in population anticipated in the city of Yakima and its associated UGAs, new development is anticipated in the lower reach portion of the Yakima city limits and UGB, as designated in the city of Yakima, *Yakima Urban Area Comprehensive Plan* (City of Yakima, 1997). Currently, the western portion of the city of Yakima, which occupies the lower reach, is the fastest growing area within city limits. The city of Yakima expects that agricultural lands that are not currently productive and not serviced by irrigation would be converted to new development first. The city of Yakima's Urban Reserve Area (URA), which extends west of the city limits within the city UGA, is expected to reach development capacity between the years 2020 to 2040, assuming the wastewater system extends to at least 50 percent of the URA (Leung, personal communication, 2004).

6.7.2 Alternative 2 – Watershed Restoration Program with Storage

The greatest potential long-term land use impact associated with Alternative 2 would result from operation of the Pine Hollow Reservoir located in the middle reach. Improved irrigation reliability would result in reduced uncertainty for agricultural practices in the area, and could contribute to continued agricultural land uses, thereby adhering to local comprehensive plans' agricultural preservation goals listed in Section 4.7.2. Refer to Section 6.10 for additional discussion of economic considerations associated with Alternative 2.

Impacts associated with property acquisition and displacements that would result from the reservoir are described in Short-Term Impacts, Section 5.7.

6.7.2.1 Upper Reach

Development in the upper reach would be unaffected by the reservoir since water stored in the reservoir would not be available to property owners in the upper reach. Future development in the upper reach as a result of Alternative 2 would be similar to conditions described in the upper reach discussion for Alternative 1.

6.7.2.2 Middle Reach

The new reservoir would be constructed on privately owned property, resulting in property acquisition of approximately 30 parcels in the middle reach of the Ahtanum Watershed Basin (Figure 5-1). Impacts of the reservoir on private property are discussed in Section 5.7.

The new reservoir would result in an overall improved irrigation system in the AID. By improving irrigation in the area, agricultural fields currently occupied by open pasture or otherwise not currently productive could be converted into orchards or used for cultivation of other higher value crops. The improved reliability of irrigation could be expected to reduce pressures to convert agricultural land to residential land, because of potential for improved economic viability associated with agriculture. This development would be consistent with Yakima County Comprehensive Plan goals and policies described in Section 4.7.2 that emphasize the importance of maintaining and enhancing agricultural lands. The reservoir could permit the irrigation of more acreage within the AID than currently occurs. This new irrigation would take place on lands that are zoned for agriculture.

6.7.2.3 Lower Reach

The lower reach would experience the same level of urbanization as described under the No Action Alternative discussion on the lower reach; however, Alternative 2 could reduce the pressure for increased conversion of agricultural land to other land uses. The lower reach is likely to be subject to the highest level of pressure to convert agricultural lands to residential or higher density uses, because it is closest to the urban centers of Union Gap and Yakima. Land designated for residential use would experience continued residential development.

6.7.3 Alternative 3 – Watershed Restoration Program without Storage

Land use impacts for Alternative 3 would be similar to those discussed for Alternative 1 except that the watershed conservation and restoration programs would be coordinated throughout the watershed. The coordinated ACWRP would be more likely to improve irrigation reliability through a coordinated water conservation program; however, irrigation reliability improvements would not be as substantial as those achieved under Alternative 2. The improved irrigation reliability would reduce the potential for agricultural lands to be converted to residential uses to the extent that it continues to provide adequate irrigation supplies.

6.7.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

With the development of a reservoir, land use impacts associated with Alternative 4 would generally be similar to those discussed for Alternative 2. However, Alternative 4 would not include coordinated habitat restoration measures. Pine Hollow Reservoir would improve the reliability of the irrigation water supply and potentially reduce the pressure for conversion of agricultural lands to residential uses.

6.7.5 Mitigation Measures

Selection of either Alternative 2 or 4 would result in construction of a reservoir and subsequent property acquisition to accommodate the new facility. Property acquisition would occur in accordance with Title 8.20 of the RCW for property condemnation by a private corporation as discussed in Section 5.

Individual projects undertaken in the Ahtanum Creek Watershed based on this EIS would be required to follow local, state, and federal approvals and permit conditions prior to initiation.

6.7.6 Cumulative Impacts

There are currently no other large-scale watershed related projects proposed in the Ahtanum Creek Watershed, that when combined with the proposed action, would result in cumulative impacts to land and shoreline use. Land use trends within the watershed will largely occur in accordance with adopted land use plans and policies. A long-term lack of irrigation reliability could contribute to increased pressure to convert agricultural lands to residential or other uses.

6.7.7 Significant Unavoidable Adverse Impacts

Construction of the reservoir would result in a change of land use in the Pine Hollow area. However, a reservoir is a permitted land use in that area.

6.8 Transportation

The potential impacts to transportation resources are included in this section, including the potential impacts associated with roadway relocations to improve stream habitat.

6.8.1 Alternative 1 – No Action

Under the No Action Alternative, existing and proposed improvements to roadways in the Ahtanum Creek Watershed would continue as currently planned.

6.8.2 Alternative 2 – Watershed Restoration Program with Storage

Construction of a Pine Hollow Reservoir would require the construction of an access road to the reservoir and service roads along the new irrigation conveyance lines. Access to the service roads would be restricted to AID personnel. The access road would be gated to prevent access to the dam area. None of the alternatives are expected to generate significant amounts of new traffic and would not impact any roads in the area.

Some of the habitat enhancement measures that could be constructed under Alternative 2 could affect local public and private roadways. These measures could include localized roadway relocation, improved culverts and drainage systems, and roadway modifications to reduce sediment transport in runoff. Any proposed roadway modifications would be undertaken following coordination with property owners or jurisdictions to ensure that access is maintained.

Some enhancement measures may result in changes to roadway maintenance practices, which would involve close coordination with maintenance providers relating to funding, implementation, and long-term maintenance practices.

6.8.3 Alternative 3 – Watershed Restoration Program without Storage

Impacts to transportation under Alternative 3 would be similar to those for the watershed enhancement measures described for Alternative 2. No reservoir would be constructed under this alternative; therefore, no access roads would be required.

6.8.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts to transportation under Alternative 4 would be similar to those for Alternative 2 except no coordinated roadway improvements would be undertaken.

6.8.5 Mitigation Measures

The new reservoir access road and service roads constructed for either Alternatives 2 or 4 would be designed in accordance with roadway design standards for Yakima County and the *Stormwater Management Manual for Eastern Washington* (2004). Access to the service road would be restricted to AID personnel. Any modifications to existing private or public roads associated with proposed watershed enhancement measures would comply with all applicable design standards for roadway design and construction as well as stormwater facilities.

6.8.6 Cumulative Impacts

None of the proposed alternatives are anticipated to cause cumulative impacts to transportation in the Ahtanum Creek Watershed. For Alternatives 2 and 4, cumulative construction-related traffic impacts would depend on the timing of other individual transportation projects that may occur in the vicinity of the proposed reservoir access road. The reservoir would not result in an increase in vehicle traffic because residents currently use local roads to access the area.

6.8.7 Significant Unavoidable Adverse Impacts

No significant unavoidable impacts to transportation were identified for any of the alternatives.

6.9 Recreation

Potential impacts to recreational resources are described in this section.

6.9.1 Alternative 1 – No Action

No direct impacts to recreation in the Ahtanum Creek Watershed are anticipated as a result of the No Action Alternative.

6.9.2 Alternative 2 – Watershed Restoration Program with Storage

Under Alternative 2, construction of Pine Hollow Reservoir would have an impact on available recreation. The plans for recreational use of the reservoir are not known at this time; however, it is expected that non-motorized boat use would be allowed on the reservoir and the reservoir may be stocked with fish to allow for recreational fishing. The AID, in cooperation with the Yakama Nation, WIP, and WDFW, would decide about access and operational conditions at the reservoir. It is anticipated that these entities would develop a Joint Operating Agreement to establish operational protocols, including public access and use of the reservoir. Boating and fishing activities would be subject to water availability and generally be permitted during spring and early summer. A gravel parking lot and boat launch would be provided adjacent to the reservoir. The boat launch facility would be accessed from the reservoir access road. The restriction of non-motorized boating and the limited facilities at the reservoir are expected to limit the number of people using the reservoir and the related impacts of traffic, noise, and littering.

6.9.3 Alternative 3 – Watershed Restoration Program without Storage

No impacts to recreation are anticipated under Alternative 3. No reservoir would be constructed under this alternative.

6.9.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts to recreation would be similar to those described for Pine Hollow Reservoir under Alternative 2.

6.9.5 Mitigation Measures

No negative impacts to recreational resources would occur in the Ahtanum Watershed under any of the alternatives; therefore, no mitigation would be required.

6.9.6 Cumulative Impacts

The ACWRP would have no cumulative impacts on recreational facilities or resources. Recreational use of the reservoir could increase traffic, littering, and related impacts in the area. However, restricting the reservoir to non-motorized boats and limiting access should limit these impacts.

6.9.7 Significant Unavoidable Adverse Impacts

No significant unavoidable impacts to recreation were identified resulting from the ACWRP.

6.10 Economics

This section describes the economic impacts of the proposed ACWRP alternatives. While not an element required under SEPA, this analysis is included in this EIS to provide a general understanding of the potential economic impacts of the watershed restoration alternatives being considered. More detailed economic evaluations would be conducted when an alternative is selected for implementation, including a cost benefit analysis on a reservoir if either Alternatives 2 or 4 are selected. This analysis is intended to describe the general types of impacts that could result, how these impacts differ among the alternatives considered, and the potential range of impacts.

6.10.1 Economic Modeling

The first step in the evaluation process was to develop a baseline model, which is a projected portrayal of the economy of the potentially affected area as it would develop without the project. The baseline model is described below in Alternative 1, the No Action Alternative. This dynamic baseline is, in turn, used as a backdrop to describe changes to economic factors resulting from implementation of other project alternatives. Baseline projections at a county level were constructed from projections made by the Washington State Labor Market and Economic Analysis Branch (Washington State Auditor, 2005). Those projections were modified to develop a baseline for the Ahtanum Creek Watershed. The impacts of the alternatives, described below, were then compared by sector to the baseline model to give a measure of relative impact.

There are three types of economic impacts that could result from the proposed program: direct, indirect, and induced. Each of these types of impacts captures one facet of change in regional economic activities. Direct impacts refer to the initial expenditures or purchases within an economy that result from project activities. Direct impacts of the ACWRP would include expenditures stemming from construction, operation, and maintenance associated with each of the action alternatives. Indirect impacts refer to the production and sales of goods and services that result from direct impacts requiring inputs from other business sectors. The changes in employment in industries that experience both direct and indirect impacts result in changes in income that are spent in the region to purchase consumer goods and services. This income effect is the source of induced impacts. The total economic impact is determined by considering all three levels of impact for each sector of the local economy.

To estimate direct, indirect, and induced impacts to a region's economy, input-output models can be used. An input-output model simulates the relationships of an economy and is used to evaluate changes in inter-industry flows of goods and services and resulting changes in output, employment, and income. For this evaluation, the US Forest Service IMPLAN (Impact Analysis for Planning) model was used, with data derived in the analysis of a similar project in Yakima County (Mack and Robison, 1995; Bruckner et al., 1987). A more complete discussion of the input-output model, along with model results, is included in Appendix E.

As explained in Section 4.10, economic data do not exist at the watershed level. Therefore, direct quantification of impacts must be based on county-level effects. However, there are a number of ways to broadly and qualitatively portray the economic impacts of the alternatives on the immediate watershed environment. The most relevant would be how the different alternatives would affect the productivity and value of agricultural lands, which in turn would affect the conversion of lands from agricultural to residential uses.

6.10.2 Alternative 1 – No Action

Under the No Action Alternative, there would be no direct economic impacts. Economic development in the region would proceed in accordance with factors independent from watershed restoration enhancements and improved irrigation reliability; therefore, other factors would determine regional growth.

6.10.2.1 Population Projections

Yakima County population has increased by 60 percent since 1969. Population projections are provided in Table 6-7 for 2005 and at 10-year intervals between 2010 and 2040, covering the 30-year timeframe for analysis in this EIS. Population projections are based on calculations from the U.S. Census Bureau and Washington State. Assumptions used to calculate Yakima County population include:

- Major growth, both in terms of numbers and rates, will occur through expansion within the city of Yakima and its UGA.
- The growth rate within the city of Yakima's UGA is twice that of the surrounding county in Model 2 (see discussion of Model 2 in the following paragraph).
- Expansion will likely occur along existing and future infrastructure alignments, such as major roads and sewer lines, and their service areas.
- Zoning will dictate where growth occurs and is not expected to change dramatically from the current situation; build-out will occur in most of the city of Yakima UGA by 2040.
- Agricultural lands within the city's UGA will convert to urban uses. Non-irrigated agricultural lands in the county will be affected by urban expansion, while irrigated agricultural lands will generally remain in agricultural use.

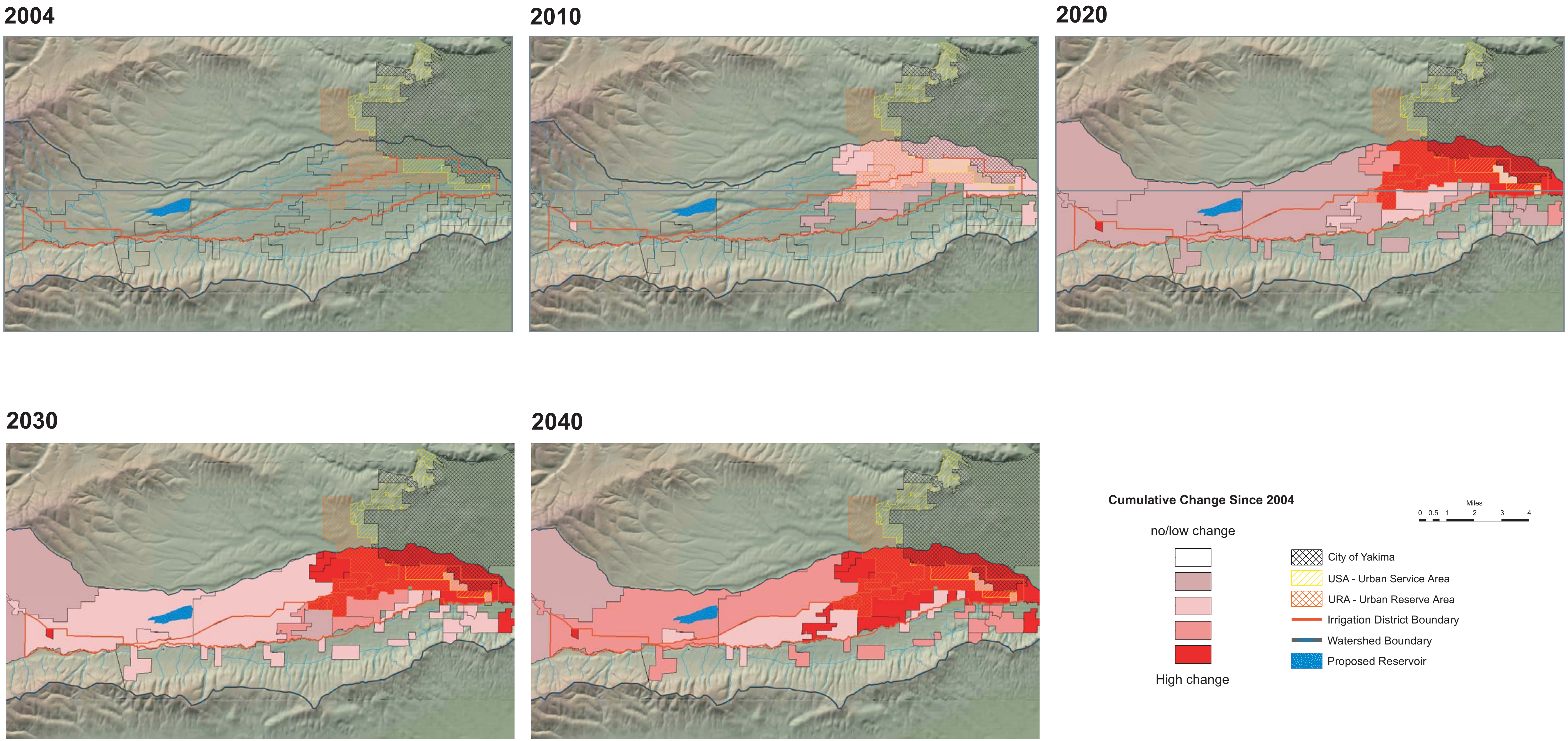
Model 1 assumes that the population growth is linear, and the city of Yakima maintains one-third of the total growth while the other two-thirds is in unincorporated Yakima County. Model 2 shows the growth rate in the UGA at twice that of the county, with two-thirds of all additional population growth occurring within the city and the county growing at a slower rate. For purposes of this evaluation, Model 2 was used for population projections, under the assumption that overall county population growth of 75,000 over the next 35 years would mostly be distributed within the UGA, consistent with the GMA. The implication for the Ahtanum Creek Watershed is that growth would generally proceed from the eastern third of the study area to the west, filling in first the residentially zoned areas, the majority of which are located in the eastern third of the study area. The areas of existing settlement, including Wiley City and Tampico, would also increase in density.

Table 6-7. Yakima County Population Projections

	2005	2010	2020	2030	2040
County Totals (including city)	**225,000**	**235,710**	**257,130**	**278,550**	**300,000**
Total change		10,710	21,420	21,420	21,450
Model 1					
City population	76,500	80,141	87,424	94,707	102,000
County population	148,500	155,569	169,706	183,843	198,000
Total	**22,5000**	**235,710**	**257,130**	**278,550**	**300,000**
Model 2					
Added from city		7,176	14,351	14,351	14,372
Added from county		3,534	7069	7,069	7,079
City total	76,500	83676	98,027	112,379	126,750
County total	148,500	152,034	159,103	166,172	173,250
Total	**225,000**	**235,710**	**257,130**	**278,550**	**300,000**

The Ahtanum Watershed would be impacted by significant expansion of residential development. Over the 35 years being considered in this analysis, the development would generally extend from east to west. Figure 6-1 shows a qualitative interpretation of projected urban growth in the Ahtanum Watershed for the years 2010, 2020, 2030, and 2040, cumulative from 2004. The interpretation was projected based on discussions with planners from the cities of Union Gap and Yakima and Yakima County (Rathbone, personal communication, 2004; Leung, personal communication, 2004; Hoge, personal communication, 2004). The first likely trend would be the “filling in” of appropriately zoned and of already platted acreage, particularly in the eastern end of the valley, and in the settlement areas of Tampico and Wiley City. These changes over the first 10 to 15 years would likely be followed by gradual changes in comprehensive plan designations and zoning that would first encompass the Rural Transitional areas and then gradually the Valley Rural zones, converting their zoning to Single-Family Residential. Some of these areas will be rezoned as Two-Family Residential and Multi-Family Residential.

All three county and city planners consulted noted that long-term conversion of agricultural uses to residential uses would, if other parameters such as roads, power, sewer and water access remained the same, occur first on non-irrigated acreage and subsequently on marginally irrigated acreage. The progression on Figure 6-1 shows that it is highly likely that the eastern half of the watershed would be almost fully residential by 2040. Those areas of lesser change in the center of the watershed are currently zoned as Agriculture.



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SOURCE: Central Washington University and Yakima County GIS, 2004

FIGURE 6-1

PROJECTED POPULATION CHANGES IN YAKIMA COUNTY AND LOWER AHTANUM CREEK WATERSHED

AHTANUM CREEK WATERSHED RESTORATION PROGRAM EIS

AHTANUM, WASHINGTON

Some agricultural landowners would likely seek permission to subdivide, particularly in the case of lands that are currently zoned as Agriculture but are either not being used for agriculture or are in low productivity uses, such as pasture and grazing. Specifically, non-irrigated areas and areas with unreliable water supplies would be the primary agricultural areas to be developed for residential use. Areas with more reliable water and accordingly higher valued crops would tend to remain in agricultural use and would retain the Agriculture zoning designation. Over the long term of the baseline analysis, land use change in the Ahtanum Valley would be a function of sewer and water capacity as well as the construction of major access roads into the area. The two most likely changes in vehicular access are the continued widening of Ahtanum Road and the long-term possibility of an arterial connection from Ahtanum Road north to State Route 12.

6.10.2.2 Economic Projections

Baseline projections at a county level to the years 2010, 2020, 2030, and 2040 were constructed from projections made by the Washington State Labor Market and Economic Analysis Branch (Washington State Auditor, 2004). The long-term projection rates were used to extrapolate geometrically into the four target dates. Table 6-8 presents the projections by broad economic sectors.

As shown in Table 6-8, the largest areas of projected increase would be in the professional services sector, which is expected to nearly quadruple in growth by 2040. This is followed by health care, construction, and retail sales, which are projected to approximately double by 2040. Government jobs are projected to double by 2040, comprising the largest projected job source in 2040. Agriculture, which currently represents the largest sector of employment, is projected to stay relatively flat in growth over the next 35 years, slipping to the third largest source of employment in 2040.

A second and expanding use of the affected land area is residential. As discussed in Section 6.9, Land and Shoreline Use, it is expected that lands within the cities of Union Gap and Yakima UGAs will continue to be developed for residential use over the 30-year projected period of this analysis. The effect of the conversion of agricultural uses to residential uses would be an increase in land value and consequently property tax revenue.

Economic growth in the agricultural sector would remain very similar to current levels in the future throughout the county, based on projections from the Washington State Employment Security, Labor Market and Economic Analysis Data (2004). Existing market trends in the Ahtanum Creek Watershed relating to agriculture would continue.

6.10.3 Alternative 2 – Watershed Restoration Program with Storage

Alternative 2 would result in the highest level of direct economic impact compared to the other alternatives, associated with creation of construction-related jobs and long-term operation of the watershed restoration and storage program. Construction of Pine Hollow Reservoir would result in the creation of between approximately 177 and 183 jobs, including all aspects of construction and services such as hotels and restaurants, to support the construction. Appendix E includes a more detailed description of the projected jobs to be created.

Table 6-8. Yakima County Projections to Years 2010, 2020, 2030, and 2040; Number of Jobs and Wages by Sector in 2004 Dollars

Industry	2004		2010		2020		2030		2040	
	Wages	Jobs	Wages	Jobs	Wages	Jobs	Wages	Jobs	Wages	Jobs
Total	$2,381,660,620	93,309	$2,624,262,039	102,553	$3,088,517,544	119,901	$3,666,865,922	141,529	$4,394,095,767	168,713
Agriculture	$314,359,780	18,979	$323,602,728	19,537	$325,875,096	19,674	$328,163,421	19,812	$330,467,814	19,951
Mining	$208,828	9	$208,828	9	$208,828	9	$208,828	9	$208,828	9
Utilities	$11,698,644	203	$11,698,644	203	$11,698,644	203	$11,698,644	203	$11,698,644	203
Construction	$77,102,741	2,730	$86,830,209	3,074	$105,845,541	3,748	$129,025,123	4,568	$157,280,906	5,569
Manufacturing	$306,977,333	9,594	$322,010,106	10,064	$348,718,367	10,899	$377,641,873	11,802	$408,964,362	12,781
Wholesale trade	$117,184,118	3,672	$128,134,184	4,015	$148,704,952	4,660	$172,578,168	5,408	$200,284,009	6,276
Retail trade	$206,898,218	9,240	$231,633,759	10,345	$279,604,202	12,487	$337,509,137	15,073	$407,405,957	18,195
Transportation	$58,506,863	2,111	$58,506,863	2,111	$58,506,863	2,111	$58,506,863	2,111	$58,506,863	2,111
Information	$47,193,677	1,267	$51,603,608	1,385	$59,888,094	1,608	$69,502,578	1,866	$80,660,579	2,165
Finance and insurance	$64,554,005	1,637	$70,586,142	1,790	$81,918,099	2,077	$95,069,299	2,411	$110,331,802	2,798
Real estate	$16,026,098	837	$17,523,629	915	$20,336,887	1,062	$23,601,787	1,233	$27,390,838	1,431
Professional services	$50,177,078	1,915	$65,343,608	2,494	$101,476,625	3,873	$157,590,096	6,014	$244,732,599	9,340
Management	$26,509,246	537	$34,521,934	699	$53,611,508	1,086	$83,257,032	1,687	$129,295,625	2,619
Administrative services	$39,641,585	2,227	$45,972,085	2,583	$58,848,156	3,306	$75,330,615	4,232	$96,429,555	5,417
Educational services	$21,011,041	880	$24,366,366	1,021	$31,191,008	1,306	$39,927,128	1,672	$51,110,099	2,141
Health care	$325,157,687	10,596	$366,180,367	11,933	$446,371,825	14,546	$544,124,763	17,732	$663,285,050	21,615
Arts, entertainment, and recreation	$13,177,624	1,062	$14,753,064	1,189	$17,808,365	1,435	$21,496,408	1,732	$25,948,230	2,091
Accommodation and food	$63,822,945	5,251	$72,724,746	5,983	$90,404,734	7,438	$112,382,873	9,246	$139,704,080	11,494
Other services	$57,568,588	4,320	$66,761,913	5,010	$85,460,892	6,413	$109,397,168	8,209	$140,037,623	10,509
Government	$563,884,521	16,250	$631,299,255	18,193	$762,038,857	21,960	$919,854,119	26,508	$1,110,352,302	31,998

Source: Calculated from Washington State Employment Security, Labor Market and Economic Analysis, 2004.

An estimated $15 to $16 million in annual direct expenditures during the construction period would occur under Alternative 2, which represents about $12 million spent in the construction industry. When compared to the projected $86 million construction industry in Yakima County in 2010 (Washington State Employment Security, Labor Market and Economic Analysis, 2004), this activity represents a 14 percent increase, a substantial beneficial impact. The mining industry would be the only other major sector that could potentially be beneficially affected. This would be due to mining as the source of building materials for the reservoir. The extent of this impact would depend on the amount of on-site materials used in the reservoir. However, impacts on the construction and mining sectors of the economy would be substantial under Alternative 2.

In addition to direct impacts, indirect impacts would accompany construction of the reservoir. Impacts to the local economy would vary depending on whether the contractor is local or out of the area, but modeling results indicate that indirect impacts could result in a multiplier as high as 1.75 times the direct impacts. In other words, if approximately $6.3 million were generated in direct impacts, as much as $4.7 million in indirect impacts could be generated as a result of Alternative 2, for a total economic impact ranging from $11.0 to $11.3 million from 2007 to 2015. As many as 130 additional jobs could be created in retail, wholesale, and other service sectors, for a total of between 301 and 311 total new jobs. Alternative 2 represents the highest potential for direct economic increases because jobs would be created during construction of the reservoir and habitat enhancement projects, as well as over the long term, due to operation and maintenance of the reservoir and enhancement projects.

If the operational economic impact of Alternative 2 is considered along with the impact of additional incomes that result from the significantly increased farm profits, area earnings would increase by as much as $5.3 million dollars per year in 2003 dollars[3]. When farm profits are added into this analysis, as many as 230 additional jobs could be created following completion of the reservoir.

Construction of the reservoir, and the accompanying improved reliability of irrigation supply, would alter the agricultural patterns and crops grown within the reservoir service area. Table 6-9 shows the changes in crops that could occur with implementation of the reservoir (Golder, 2004.) The major shifts portrayed are the conversion of acreage previously used as pasture into higher valued uses, particularly into hay, sweet corn, and wine grapes. These shifts in cropping patterns are the basis for the $13.1 million increase in revenues in the affected area that would result in a potential profit increase of $5.3 million. This profit increase assumes that the capital costs of the reservoir and related projects would be borne by institutions other than the farmers, such as the federal or state government. With the over 70 percent reduction of acreage dedicated to pasture, livestock production in the watershed would be reduced. This change would reduce livestock production from the primary to the third highest agricultural use in the watershed. The

[3] Prediction of farm profits is speculative. Because of the vagaries of responsibility for covering capital costs, farm profits should not be a component of the main body of the analysis. This is particularly the case because of their magnitudes. At $5.3 million per year, if this analysis were to include these speculative profits, they would dwarf those categories of economic flows that are far more probable.

conversion from livestock to higher value crops would increase property values. This would result in a continued trend away from the ranching culture in the watershed and surrounding area.

Table 6-9. Projected Cropping Patterns Before and After Pine Hollow Reservoir Construction

Crop	Before	After
	acres	
Apple	1,898	1,779
Sweet Cherry	260	485
Pear, Bartlett & winter	484	821
Hay, alfalfa & other	2,916	3,695
Pasture	5,460	1,589
Sweet corn	83	920
Wine grape	0	1,183
Blueberry	0	628
Total	**11,101**	**11,100**

Source: Golder, 2004.

The improved reliability of the water supply and the resultant conversion to more productive and profitable cropping patterns would likely result in more land remaining in agricultural uses in the watershed. There would be less pressure to convert agricultural lands to residential uses.

Implementation of the ACWRP could also result in changes in property values and accompanying changes to tax revenues. Property tax-based revenue flows can be conceptually linked to increases in property values due to the increased number of acres irrigated and the increased intensity/reliability of irrigation. The Golder (2004) study derived values that ranged from $500 to $2,100/acre for the increase in property value per acre due to irrigation. This range depended on whether the property was being brought into irrigation or whether the water was used to improve the reliability of irrigation; the range also was dependant on the location and size of the parcel. This EIS analysis assumes $1,500 per acre, the median of the range of values, as the average increase in the value of land that is attributable to the project.

Property tax assessments vary on a district basis depending upon local levies. In addition, there are uncertainties over the rate constraints imposed by State Initiative 747. After discussion with the Yakima County Assessor's Office, a rate of $10 per thousand was chosen for this analysis (Cook, personal communication, 2004). Property tax revenue increases only apply to the operations period, after construction is completed. Property tax revenue increases from increased crop values associated with Alternative 2 would be approximately $165,000 per year; however, when evaluated against the loss of property taxes from lands used to construct the reservoir, the net effect would be an increase of approximately $140,000.

As noted in the Golder (2004) report, it is redundant when conducting a benefit/cost analysis to consider as benefits both the increase in the value of crops and the resulting increases in land value. However, in an EIS it is appropriate to use both measures to calculate impacts. Accordingly, the effect of potential increases of $5.3 million annually in farm profitability on regional income, employment, and tax revenues were considered, as well as the potential for higher land values. The increase in the value of $1,500 per acre for the impacted 11,000 acres was the basis for the property tax calculations above. It should be noted here that both of these impacts would be localized, accruing to owners of the irrigated acres.

Construction activities would cause the most significant economic impacts across the 35 years of the analysis. Impacts from the reservoir operations after construction is completed in 2010 would have significantly fewer financial impacts than construction impacts. The largest source of economic activity contributed by reservoir operation would relate to farm profits.

Construction associated with habitat and stream channel improvements would require a 10-year period to complete and extend beyond 2010, the projected completion date of the reservoir. The nature of work involved with this category combines some activities that are clearly construction oriented, such as relocating roads, with activities that are very labor intensive and so resemble operations and maintenance functions. These activities would create between 7 and 13 jobs over the course of the 35-year project period analyzed.

Economic impacts associated with increased recreation could occur. At the time of this analysis, there was not sufficient information on the planned reservoir recreation facilities, including stocking for sport fisheries, to be able to estimate recreational impacts with any degree of confidence. However, the economic benefits of any proposed recreation at the reservoir are expected to be small. The recreational impacts that could result from habitat improvements along the creek would likely be very small. Although the restoration measures would result in increases in fish populations, it is unlikely that sport fishery for listed species such as steelhead would be permitted within the timeframe of this analysis.

6.10.4 Alternative 3 – Watershed Restoration Program Without Storage

Direct economic impacts associated with Alternative 3 would be considerably less than those described for Alternative 2 because the major construction associated with the reservoir would not occur. Modeling results indicate that 8 to 14 additional jobs would be created as a result of implementation of habitat enhancement components, with $.68 to $1.2 million in direct expenditures. Indirect impacts would increase this number to as many as 22 additional jobs. Additional operational income would occur from approximately 2014 and beyond, ranging from a total of $215,000 to $358,000 and creating as many as 13 jobs. Agricultural jobs under Alternative 3 would not increase by nearly the level discussed for Alternative 2, under the assumptions used for the input-output model. Economic impacts associated with farm profits would be substantially lower than would occur with Alternatives 2 and 4 because while irrigation reliability would be improved through conservation, it would not improve to the extent associated with the reservoir. Total annual increased earnings, including farm profits, would range from approximately $455,000 to $807,000.

While some improvements to system reliability would occur in association with conservation and other programs, they would not be at the level described for Alternative 2. Therefore, the pressure to convert to residential development would likely continue, and income from agriculture and farm profits would be reduced. The conversion to residential uses would increase tax revenues.

Economic impacts associated with habitat enhancements are difficult to project, as described above. It can be assumed that some level of economic benefit could occur associated with improved recreational opportunities, improved water quality and aesthetics, and improved habitat value in the creek, but that benefit cannot be quantified.

6.10.5 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Direct economic impacts under Alternative 4 would be similar to those described for Alternative 2; however, they would be reduced slightly without the construction-related impacts associated with coordinated habitat restoration. Indirect impacts would be similar, although slightly less than those described for Alternative 2. In general, impacts in terms of increased earnings associated with Alternative 4 would be approximately 90 percent of the values discussed for Alternative 2.

6.10.6 Mitigation Measures

Compliance with adopted land use plans and policies will help to minimize unwanted economic impacts associated with any of the alternatives. The addition of new jobs would likely be seen as a positive economic impact, not warranting mitigation. Economic impacts associated with the acquisition of private property would be mitigated by compliance with all applicable property acquisition requirements as described in Section 5.7.

6.10.7 Cumulative Impacts

Implementation of the No Action Alternative would result in a continuation of current trends, with no influence from modifications to irrigation availability or improved habitat conditions. This alternative could contribute to an increasing trend away from agriculture and toward suburban residential development.

Alternatives 2 and 4 would improve reliability of irrigation and allow the potential for increased economic activity associated with construction and operation of the reservoir as well as reducing economic uncertainty for some agricultural activities.

Alternative 3 would be similar to Alternative 1 in terms of cumulative economic impacts.

6.10.8 Significant Unavoidable Adverse Impacts

There would be no significant unavoidable adverse economic impacts associated with any of the alternatives.

6.11 Cultural Resources

Assessment of impacts begins with the identification of cultural resources and historic properties within a project area, an evaluation of the significance of such properties, and then consideration of the scope of potential short-term and long-term impacts. Cultural resources may be protected by law and must be considered for special management or mitigation of adverse impacts if they are identified and evaluated as of particular significance, as defined by federal and state guidelines. Under SEPA, the Office of Archaeology and Historic Preservation (OAHP) is the sole state agency with technical expertise with regard to cultural resources. Under the National Historic Preservation Act, federal agencies must consider cultural resources in all licensing, permitting, and funding decisions. Agencies must consult with OAHP to ensure that cultural resources are identified. Federal agencies must obtain the formal opinion of OAHP as regards each site's significance and the potential impacts of agency actions on the site. Under SEPA, OAHP provides formal opinions to local governments and state agencies about a site's significance and the potential impacts of proposed projects.

Resources are typically defined as significant or potentially significant if they are identified as of special importance to an ethnic group or Indian tribe; or if the resource is considered to meet certain eligibility criteria for local, state, or national historic registers, such as the National Register of Historic Places (NRHP). The NRHP assessment criteria were developed by the National Park Service (NRHP, 1991). Resources may qualify for NRHP listing if they:

- Are associated with events that have made a significant contribution to the broad patterns of our history; or
- Are associated with the lives of persons significant in our past; or
- Embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- Have yielded, or may be likely to yield, information important in prehistory or history.

According to the NRHP guidelines, the "essential physical features" of a property must be intact for it to convey its significance, and the resource must retain its integrity, or "the ability of a property to convey its significance." There are seven aspects of integrity, including location, design and setting.

There are also criteria used for assessment of potential eligibility for the Washington Heritage Register, similar to NRHP criteria. These include age of at least 50 years, integrity, and historical significance.

The exact nature of impacts to cultural resources from the alternatives cannot be determined without additional details on the proposed projects. The assessment of impacts to cultural resources would require the identification of cultural resources and historic properties within the project area, evaluation of the significance of such properties, and consideration of the scope and potential impacts. This assessment would take place at the project design stage and be included as part of any project level environmental assessment of the proposed ACWRP. However, it is possible to discuss the types of impacts that could result and provide a general assessment of potential impacts.

Impacts to cultural resources typically result from activities that occur in the vicinity of the resource. Adverse impacts to buried archaeological deposits could be the consequence of ground-disturbing, excavation, earth-moving, and construction activities. Adverse impacts to above-ground resources, such as historic structures, canals, and dams, can result from demolition, partial removal of structural elements, the addition of new features, and changes in the surrounding historical context of a resource. Traditional cultural properties should be identified in consultation with cultural specialists from the Yakama Nation, or other users, who could ascertain potential adverse impacts. Definition of adverse impacts to cultural resources should be conducted in consultation with OAHP.

The scope of adverse impacts is only properly defined in conjunction with adequate identification of cultural resources and historic properties. Identification efforts should typically include archival and historical research; review of project construction plans, drawings, and available geotechnical information; and subsequent on-site examination and field survey of project areas by an archaeologist and/or historian. Background research should include review of historical maps that date to 1907, which are archived by the AID; such maps provide information on historical ditch and channel locations and could suggest other features of historical relevance. Assessment of preferred alternative project designs would be necessary in order to identify potential impacts to existing irrigation systems (e.g., Johncox Ditch) that might be determined to be of historical significance.

Impacts to historic properties in the project vicinity that are presently listed on the NRHP would have to be determined. Two NRHP properties in the vicinity, Saint Joseph's Mission (45YA362) and Kamiakin's Gardens (45YA363H), appear to be located outside of the proposed reservoir construction area and would not likely be affected by construction activities. However, determination of long-term impacts to these properties, such as the security of water access to Saint Joseph's Mission, would have to be assessed in consultation with OAHP.

Field examination could include pedestrian surveys and visual reconnaissance, small-scale test excavations or other subsurface investigations, and inventory and documentation of cultural and historic properties. Field surveys should be designed to account for possible minor changes in project design. Field surveys could incorporate identification strategies developed from predictive models, based on the occurrence of archaeological materials within environments and on landforms near to the project area (e.g., CH2M Hill, 1982). Identification efforts should include consultation and review by OAHP and Yakama Nation cultural resources specialists.

The Yakama Nation Cultural Resources Program has indicated that the tribe will become more involved as the project is further defined, especially if Alternatives 2 or 4 are selected (Meninick, personal communication, 2005).

6.11.1 Alternative 1 – No Action

Under Alternative 1, construction of conservation and habitat restoration projects conducted by separate agencies or entities could result in the types of impacts to cultural resources described in the previous section. The agencies or entities implementing the projects would be required to comply with any applicable requirements to assess impacts to cultural resources prior to construction.

6.11.2 Alternative 2 – Watershed Restoration Program with Storage

Impacts from the construction of Pine Hollow Reservoir and the conservation and restoration projects under Alternative 2 would include the general impacts described above. The limited cultural resource survey undertaken by the Yakama Nation in 1999 noted that available geotechnical core samples indicated “quite deep sediment” in the Pine Hollow area, which also has seasonally high water flows. These conditions make it possible that deeply buried archaeological deposits could be present, although no evidence of these was identified in the initial survey. In order to support adequate identification of potential resources, and subsequent definition of impacts, the Yakama Nation recommended that a complete archaeological and cultural survey be completed following final project design and prior to any construction (Yakama Nation Cultural Resources Program, 1999).

In addition, impacts to water rights and the security of water access to Saint Joseph’s Mission after construction of the reservoir would have to be assessed in consultation with OAHP. In addition, tribal members could be adversely affected because access to lands in the inundated reservoir location would no longer be accessible for traditional activities.

6.11.3 Alternative 3 – Watershed Restoration Program without Storage

Under Alternative 3, impacts to cultural resources could occur as a result of construction associated with conservation and restoration projects and would be similar to those described for Alternative 1.

6.11.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts to cultural resources under Alternative 4 would be similar to those described for Alternative 2.

6.11.5 Mitigation Measures

Mitigation of adverse impacts as a result of the ACWRP would be determined in consultation with OAHP and appropriate stakeholders, such as the Yakama Nation, local governments, Saint Joseph’s Mission, and other users. Mitigation of adverse impacts to buried archaeological sites could typically include project redesign to ensure avoidance of ground-disturbing actions in locations of archaeological deposits; monitoring of construction excavation in the vicinity of a site; and archaeological recording, sampling, or large-scale excavation at a site. Mitigation of adverse impacts to above-ground resources, including historic structures, could include impact avoidance through redesign; construction monitoring; and documentation of the resource consistent with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) standards.

Yakama Nation cultural specialists could request that ground-disturbing construction activities in the vicinity of known or suspected resources be monitored by a qualified archaeological monitor with the authority to stop work. Mitigation measures should specify protocols to be followed in the event of an inadvertent discovery in the project area, both during construction and following implementation of project operations. The Yakama Nation Cultural Resource Program should be apprised of the construction schedule as soon as it is developed.

6.11.5.1 Alternative 1 – No Action

No direct impacts to cultural resources would result from Alternative 1; therefore, no mitigation would be required of the ACWRP. Agencies and entities implementing separate conservation or restoration projects could be required to implement mitigation measures.

6.11.5.2 Alternative 2 – Watershed Restoration Program with Storage

Construction of Pine Hollow Reservoir could impact cultural resources in the area. Mitigation for any identified impacts would vary based upon the nature of the identified resource and the potential impact; however, mitigation could include the measures described in Section 6.11.5. Mitigation measures could be prioritized. Mitigation of impacts to water rights and the security of water access to Saint Joseph's Mission following construction of the project would have to be ensured; consultation regarding this mitigation should involve OAHP.

6.11.5.3 Alternative 3 – Watershed Restoration Program without Storage

Under Alternative 3, mitigation measures similar to those described for the No Action Alternative would be appropriate.

6.11.5.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Mitigation measures for Alternative 4 would be similar to those developed for Alternative 2.

6.11.6 Cumulative Impacts

Cumulative impacts associated with the ACWRP could include the potential for inadvertent discovery of sites and artifacts of cultural significance during any future excavation. Cumulative impacts could include impacts from erosion and changes in land use, such as activities of introduced animals and the erosive actions of wind, water, and temperature on newly exposed sediments or excavated channels that might contain archaeological deposits. Land development could support an increased population and demands on existing irrigation systems and water resources, which could stimulate an increase in vandalism or other human behaviors that could affect cultural and historical sites. These activities could include agriculture and land clearing, grazing, reclamation and flood control, and construction of roads and public utilities. Cumulative impacts could also reasonably include adverse impacts to historical water management systems, such as canals or dams downstream from the project area, which could require modification to support changes in operating capacity. In addition, development could adversely affect the historical characteristics of a locality, as well as future access to lands by groups engaged in traditional activities.

6.11.7 Significant Unavoidable Adverse Impacts

There is not enough information on cultural resources in the Ahtanum Creek Watershed to determine if there would be any significant unavoidable adverse impacts. This would be determined through detailed field studies and investigations that would be conducted as part of the project level environmental analysis for the ACWRP.

6.12 Public Services

This section discusses the impacts to public services and utilities that could occur as a result of implementation of the watershed restoration alternatives. The discussion also includes operation of the reservoir, flood control, and safety issues related to the operation of the reservoir and dam.

6.12.1 Alternative 1 – No Action

No direct impacts to public services or utilities are anticipated as a result of the No Action Alternative. This alternative assumes that individual agencies and entities would continue to implement water conservation and habitat restoration projects. These projects could result in improved reliability of irrigation water supply and improved stream habitat, but are not expected to be as effective as measures that would be undertaken as part of a coordinated ACWRP. Without implementation of a coordinated ACWRP, the problems associated with floods, the reliability of surface water supply, and the quantity of surface water flow may not be addressed on a watershed-wide level. Alternative 1 may result in a lack of coordinated conservation efforts and may not have as significant an impact on these problems as a coordinated ACWRP would have.

6.12.2 Alternative 2 – Watershed Restoration Program with Storage

6.12.2.1 Public Utilities

The proposed Pine Hollow Reservoir would not produce electric power or provide a public drinking water supply. Reservoir operations, including pumps, if required, would require electric power, which would be provided through existing connections with Pacific Power and Light. The amount of electricity required is not expected to significantly impact the power supply in the area.

Water conservation projects, such as improved sprinkler systems and timing devices, could require electricity to operate and slightly increase the demand for electrical power in the area. The increased electrical demand is not expected to significantly impact the power supply in the area. None of the habitat restoration programs are expected to impact public utilities.

6.12.2.2 Public Services

The proposed Pine Hollow Reservoir would provide storage for surface water to be used for irrigation and augmentation of instream flows. The reservoir would not provide a drinking water supply and would not generate hydroelectricity. The reservoir would not provide significant flood control to the project area, but could provide a small reduction of flood flows during non-peak events. The reservoir would be an off-stream reservoir and would not be designed to provide storage of flood waters. The diversion and enlarged Johncox Ditch would operate during winter and spring high flows, and could divert up to 160 cfs. That could reduce flood flows during non-peak events. Peak flows during major flood events have exceeded 1,000 cfs. The reservoir and smart diversion would have to be operated for flood control in order to provide any such benefits.

Reservoir maintenance and operation would require a joint operating agreement between the AID and the WIP. It is anticipated that through the joint operating agreement, either the AID would assume responsibility for operating and maintaining the reservoir, or a contract would be established with an outside entity to perform those responsibilities. The reservoir would be operated to fill as much as possible during the winter and spring when flows are high and would empty during the summer and fall when flows are low and the demand for irrigation is high.

Pine Hollow Reservoir could indirectly lead to an increased housing density in the watershed. Although the reservoir would not provide drinking water, reservoir water could be used for lawn and garden watering in residential areas. If a separate water supply was available for lawn and garden watering, the amount of water needed to supply a subdivision would be reduced and the density of the subdivision could be increased. The subdivisions could increase the demand for public services in rural portions of Yakima County. This is not expected to be a significant problem in the Ahtanum Creek Watershed. The reservoir would provide additional water for crop irrigation, and it is possible that some of that water could be used for lawn and garden watering. However, the additional water from the reservoir would more likely be applied to irrigate crop lands.

6.12.2.3 Public Safety

The proposed Pine Hollow Reservoir could pose a safety hazard to the area downstream of the reservoir in the unlikely event of dam failure. This would place increased demands on public services in the watershed. The Department of Ecology regulates dam safety for reservoirs that impound more than 10 acre-feet and would therefore regulate Pine Hollow Reservoir. Pine Hollow Reservoir would impound approximately 24,000 acre-feet of water. The dam would be approximately 180 feet high; therefore, it would be required to meet Ecology's highest standards for design and monitoring. Ecology's dam safety regulations include requirements for dam design and assessing the consequences of dam failure and developing an appropriate emergency action plan (see the following mitigation section for additional discussion). Dam failures are relatively rare in Washington. Ecology lists 14 “notable dam failures” since 1907 on its web site (Ecology, 2004). These failures resulted in nine deaths, the most recent in 1976. Ecology’s dam safety regulations are intended to minimize the potential for dam failure by providing design standards and review, inspection procedures, and periodic inspection by Ecology.

In addition to the potential for dam failure, the reservoir would pose a safety risk to the public and livestock who might inadvertently fall into the impoundment. Residents or visitors to the area could fall into the reservoir from the steep banks or fall from the dam if they manage to obtain access to the area.

6.12.3 Alternative 3 – Watershed Restoration Program without Storage

The water conservation programs associated with Alternative 3 could result in a slightly increased demand for electrical power similar to what is described for Alternative 2. None of the habitat restoration programs would impact public services or utilities. Fish screens would require additional electricity. No reservoir would be constructed under Alternative 3; therefore, no reservoir-related public utilities or services impacts would occur.

6.12.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Impacts to public services and utilities in the Ahtanum Creek Watershed under Alternative 4 would be similar to those identified for the conservation measures and reservoir operation for Alternative 2.

6.12.5 Mitigation Measures

Specific mitigation measures for impacts to public services and utilities in the Ahtanum Watershed would be developed during the project level EIS analysis when the exact nature of impacts is known. General mitigation measures that could be included are described below.

6.12.5.1 Alternative 1 – No Action

The No Action Alternative is not expected to result in direct impacts; therefore, no mitigation is required. Water conservation and habitat restoration projects undertaken by individual agencies and entities could help mitigate existing conditions of unreliable water supply and degraded stream habitat.

6.12.5.2 Alternative 2 – Watershed Restoration Program with Storage

Alternative 2 is not expected to create significant impacts on public utilities; therefore, no mitigation is proposed for utilities.

Establishment of an oversight group is envisioned, that would consist of representatives from the water users (AID and WIP) and fisheries agencies. The oversight group would provide consistent evaluation of reservoir operations and management to optimize the multiple uses of reservoir storage.

To ensure public safety, the design and construction of Pine Hollow Reservoir would be done in compliance with the state of Washington dam safety requirements (RCW 90.03.050). As part of the compliance, the design would include an assessment of the consequences of dam failure on downstream areas. If those consequences meet certain criteria, the development of an emergency action plan would be required. The emergency action plan would include procedures for responding to a dam failure, including detection and warnings. The emergency action plan would be developed in coordination with representatives from local emergency services. In addition, monitoring devices would be installed to monitor the stability of the dam and monitor groundwater levels in the dam and adjacent to the reservoir. Monitoring would be performed in perpetuity.

The reservoir proponents would develop a plan to address safety issues related to the reservoir. These could include limiting public access through limited access roads to the reservoir, gating access roads and the dam area, and fencing in certain high-risk areas.

6.12.5.3 Alternative 3 – Watershed Restoration Program without Storage

No significant impacts to public services or utilities are expected to result from the implementation of Alternative 3; therefore, no mitigation is proposed.

6.12.5.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Mitigation measures for Pine Hollow Reservoir impacts to public services, utilities, and safety would be the same as those proposed for Alternative 2.

6.12.6 Cumulative Impacts

Continued conversion of agricultural lands to residential uses would place increased demands on public services and utilities outside UGAs in the Ahtanum Creek Watershed.

6.12.7 Significant Unavoidable Adverse Impacts

No significant unavoidable impacts to public services and utilities were identified.

6.13 Existing Water Rights

Potential impacts to existing water rights in the Ahtanum Watershed include damages to existing water rights from creation of new rights or changes to existing water rights.

6.13.1 Alternative 1 – No Action

Under the No Action Alternative, no new water rights or changes to existing water rights would be required and no impact on existing water rights would be anticipated. To the extent that individual entities continue to implement state or federally funded conservation measures, additional trust water rights would be created.

6.13.2 Alternative 2 – Watershed Restoration Program with Storage

Under Alternative 2, a 24,000 acre-foot Pine Hollow Reservoir would be constructed to supply water to holders of water rights within the Ahtanum Watershed. A new water right would be required for storage. The new water right would be a reservoir permit, which would authorize a right to divert and store water year-round. The minimum quantity of water required under the reservoir permit would be the total amount needed to supply water to the WIP, Johncox Ditch, and AID water users.

Under existing water rights, those water users receiving water from AID or Johncox Ditch (the Northside water users) must cease diverting water from Ahtanum Creek after July 10 of each year. The Yakima Basin Adjudication Court has yet to issue its final decision on two issues that will determine whether certain Northside water users will have a right to divert after July 10 and, if so, what quantity of water they would be entitled to divert. If the court rules that the Northside water users have no right to divert after July 10, the water users would have to obtain a new water right for the second half of the season and for the additional quantity of water diverted and beneficially used during that time period. Ecology would likely issue a new water right as long as the reservoir did not impair other surface or groundwater rights.

The reservoir would provide all out-of-stream water use within the reservoir service area for the entire irrigation season, and there would be no individual diversions within the service area. This unified approach to water use in the Ahtanum Watershed could be a benefit to water right holders in that they would be more likely to receive their full water right on a more consistent basis than is currently the case where the water users are dependent on the natural flow in the creeks. Depending on the new delivery system, this alternative would require at least some water right holders to obtain a change in point of diversion. In addition, any water users who change from using groundwater to using surface water delivered from the reservoir would need to obtain a change in their point of withdrawal.

Ecology may only issue a new water right or approve a change to an existing water right if there would be no injury to existing water rights. In making its decision on a water right application, Ecology must consider all existing water rights, including surface water and groundwater rights. For surface water rights, Ecology will have the necessary information to evaluate impacts on existing water rights from a new water right for storage or changes in existing water rights once the Adjudication Court issues a Conditional Final Order in the Ahtanum Subbasin. For groundwater rights, Ecology may need to gather additional information in the Ahtanum Watershed before it can make its determination on a new water right or water right changes.

As discussed in Section 3.2.2 and Appendix B, the Yakama Nation has a right to irrigation water for its practicably irrigable acreage (PIA). The Report of the Court on the Yakima Adjudication indicates that the Yakama Nation would have a right to irrigate additional PIA lands if storage water became available. Construction of the Pine Hollow Reservoir could provide a source of water for additional PIA lands on the Yakama Reservation, and the tribe could claim a portion of the water stored in the reservoir. One of the purposes of the reservoir is to improve the reliability of the water supply to WIP. The WIP canal would be lined or piped.

Operation of the reservoir would require delivery of water to the water users consistent with their water rights, including the Yakama Nation's senior right to instream flow for fish. Alternatives 2 and 4 include provision of target flows for fish. Delivery of water would likely be carried out under contracts between the water right holders and the owner(s) and operator(s) of the reservoir similar to the contracts between the water right holders and Reclamation in the Yakima Project. If insufficient water were delivered or delivered on a schedule that did not comply with a water users water right, injury (as defined by Ecology) could occur.

The final decision of the Adjudication Court regarding a requirement to maintain 0.25 cfs in the stream for non-diversionary stock water may make maintenance of flows a requirement for Bachelor and Hatton Creeks. This would result in reduced flows in Ahtanum Creek (see Section 6.2.2).

The conservation measures that would be a part of Alternative 2 include lining the WIP canal, lining and piping conveyance systems, and on-farm improvements. To the extent the conservation projects are funded by state or federal money, the net water savings would be transferred to the Trust Water Rights Program. Installation of water meters would allow better tracking of water use, enforcement against unauthorized water use, and protection of senior rights from impairment.

6.13.3 Alternative 3 – Watershed Restoration Program without Storage

Because Alternative 3 does not include a storage reservoir, no new water right or changes in water rights would be required. The impacts from watershed restoration and conservation measures under this alternative would be the same as those under Alternative 2.

6.13.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Habitat restoration projects are not expected to impact water rights; therefore, the impacts to water rights from Alternative 4 would be expected to be the same as those for Alternative 2.

6.13.5 Mitigation Measures

6.13.5.1 Alternative 1 – No Action

Under the No Action Alternative, no new water rights or changes in water rights would be required, no impact on existing water rights would be anticipated, and no mitigation would be required.

6.13.5.2 Alternative 2 – Watershed Restoration Program with Storage

Under Alternative 2, a new water right would be required for storage, and depending on the final ruling by the Yakima Basin Adjudication Court, new water rights would be required for irrigation by the AID and Johncox Ditch users after July 10. Changes in points of diversion of existing water rights and changes from groundwater to surface water rights may be required. Ecology may issue a new water right or approve changes only if there would be no injury to existing water rights. Mitigation may be proposed to address any potential injury identified by Ecology. Until Ecology determines there may be a potential injury to existing water rights, specific mitigation options cannot be identified.

Construction of a storage reservoir could be considered a source of stored water to meet the Yakama Nation’s PIA. The joint operating agreement that would be developed for the construction and operation of the reservoir would include provisions regarding the Yakama Nation’s water rights. The project’s provision of a more reliable water supply and improved delivery system would improve irrigation on the Yakama Reservation. Those improvements may permit the tribe to irrigate additional PIA acres without claiming additional water from the reservoir.

Operation of the reservoir would require delivery of water to the water users consistent with their water rights, including the Yakama Nation’s senior right to instream flow for fish. The target flows included in the operation of the reservoir are intended to meet the Nation’s right for instream flow for fish. If insufficient water were delivered or delivered on a schedule that did not comply with a water users water right, injury could occur and mitigation would be required.

6.13.5.3 Alternative 3 – Watershed Restoration Program without Storage

Because Alternative 3 would not include the storage reservoir, no new water right or changes to water rights would be required and no mitigation of impacts to water rights would be necessary.

6.13.5.4 Alternative 4 – Watershed Restoration Program without a Habitat Restoration Component

Possible mitigation under Alternative 4 would be the same as that discussed above for Alternative 2.

6.13.6 Cumulative Impacts

No cumulative impacts to water rights were identified as a result of the proposed ACWRP alternatives.

6.13.7 Significant Unavoidable Adverse Impacts

No significant adverse impacts to water rights were identified as a result of the proposed ACWRP alternatives.

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