Final

JEFFERSON COUNTY
CRITICAL AREAS ORDINANCE UPDATE

Best Available Science Report

Prepared for
Jefferson County

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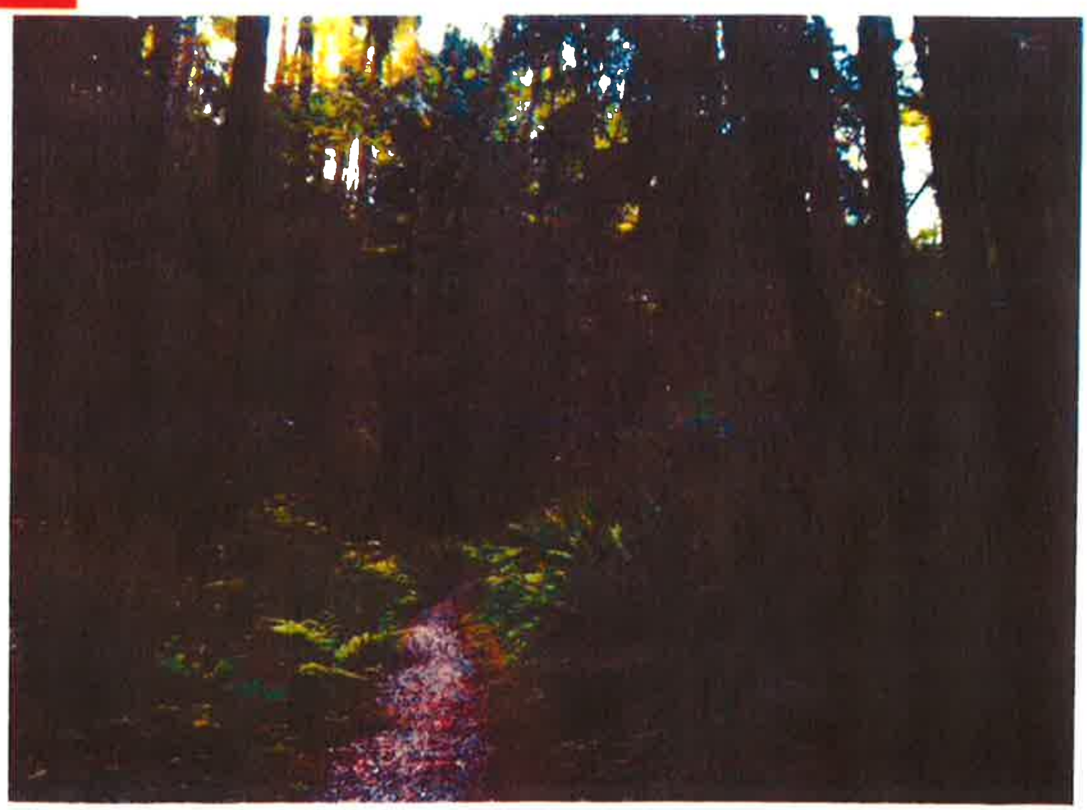
ESA



CHAPTER 6. AGRICULTURAL ACTIVITIES IN AND NEAR CRITICAL AREAS

This chapter summarizes the scientific literature concerning critical areas located within and adjacent to land used for agricultural purposes and how they can affect or be affected by agricultural uses. The discussion focuses on multiple critical areas including wetlands, frequently flooded areas, and fish and wildlife habitat conservation areas. The purpose of this chapter is to establish a basis for reviewing agricultural activities provisions of County code to protect critical areas and agricultural uses.

6.1 Agriculture and Critical Areas in Jefferson County

Most of the agricultural uses and farmland are located in eastern Jefferson County. Figure 6-1 represents the most recent agricultural census data for the County, which has nearly 221 farms totaling over 15,000 acres with the majority being small farms (70 acres on average) (USDA, 2012). From 2007 to 2012 the county has experienced a shifting trend in farm size, with 20% less farms 1 to 9 acres in size and more farms ranging between 10 and 500 acres in size (Figure 6-2). Only two farms in the County are over 500 acres and there are no farms over 1,000 acres (USDA, 2012). The number of cattle and calves sold between 2007 (549) and 2012 (1, 216), has increased approximately 50 percent. Farming remains a significant agricultural economic base and contributes to the rural character valued by County residents.

Figure 6-1. Farms by size in Jefferson County using 2012 USDA Census of Agriculture data (USDA, 2012).

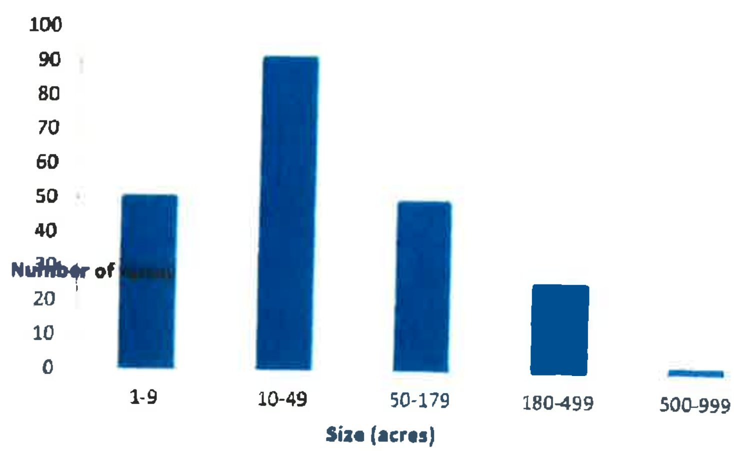
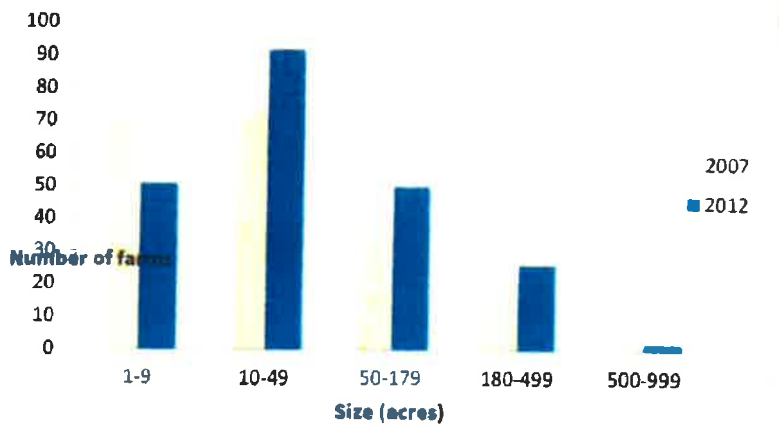


Figure 6-2. Farms by size for 2007 and 2012 using USDA Census of Agriculture data (USDA 2007, 2012).



The *Jefferson County Farmer Survey 2012 Report* (CLF, 2012) provides a summary of information and data collected from interviews with farmers in Jefferson County as part of a comprehensive farm survey. The interviews and survey report were completed by an ad-hoc committee of county citizens, called "Citizens for Local Food (CLF)". The CLF was organized in response to the Jefferson County Planning Commission's desire to make changes in the Jefferson County comprehensive plan to provide greater support for local farmers and farm land. To encourage the Planning Commission's interest, the CLF took on four projects to achieve their goal, one of which was the farm survey.

A total of 57 farms out of 87 identified by the CLF were interviewed as part of the survey. The majority of surveyed farms were located in the southern portion of eastern Jefferson County near the towns of Chimacum, Quilcene, Brinnon, Port Ludlow, and Coyle. The western portion of Jefferson County was not surveyed by the CLF as its focus was entirely in eastern Jefferson County since it is more densely populated. Farmers were asked a variety of questions, including whether critical areas were located on their property. The report found that a majority (56%) of farms surveyed had critical areas on their property, with many stating they had made improvements to protect critical areas (e.g. reforestation, fencing, bridges). The farmer survey report noted that there is a high level of voluntary stewardship exhibited by Jefferson County farmers that are protecting streams and riparian areas through installation of protective plant hedges along streams and pumping of water for livestock. In conclusion, the report provides recommendations regarding stream buffer widths and clarifying the permit process.

In the Chimacum Creek watershed, the major impacts of agriculture on fish and wildlife habitat have been the channelization of Chimacum Creek, removal of riparian vegetation; draining of wetlands; bank erosion due to livestock access, and introduction of reed canarygrass to the watershed (Latham, 2004). Since the 1970's, efforts by individual landowners, agencies and community groups have had positive impacts on fish and wildlife habitat within the watershed. As mentioned previously, the application of common agricultural BMPs is a long-standing practice on many farms in Jefferson

County. In cooperation with the local conservation district, farmers in the county have worked to develop and implement BMPs and farm plans. Most streams and ditches have been fenced to exclude livestock from the stream and stream banks; best management practices such as roof water management systems, pasture management, and livestock waste management have been implemented in a way that improved water quality in the County.

6.1.1 Regulations and Best Management Practices

Agriculture is addressed in multiple sections of Jefferson County's critical areas regulations and specific provisions for agricultural activities and accessory uses occur in JCC 18.20.030. Existing and ongoing agricultural use is considered exempt and is not subject to land use permits or approvals provided the activities follow the requirements provided in JCC 18.20.030(2). However, new agriculture, defined as activities proposed or conducted after April 28, 2003 and that are not considered existing or ongoing agriculture is subject to critical areas regulations including standard stream and wetland buffers. Existing and ongoing agriculture is exempt from these provisions provided it is related to cultivating crops and grazing livestock and the land preparation associated with those agricultural activities, as stated in JCC 18.20.030(2)(b)(B).

JCC 18.20.030(2)(b)(ii)(C) provides that "*in exchange for this exemption from standard stream and wetland buffers, the agricultural communities in each Jefferson County watershed are expected to establish and implement appropriate agricultural best management practices (BMPs) in order to protect wetlands and fish and wildlife habitat areas from adverse impacts related to the practice of agriculture.*" Agricultural BMPs are meant to protect the existing functions and values of critical areas (primarily fish and wildlife habitat, wetlands, and streams) from harm or degradation. In response to legal settlement agreement with the Washington Environmental Council in 2002, Jefferson County funded a watershed-level plan to provide protection of critical areas as required under the GMA and accommodate existing and ongoing agriculture that is conducted adjacent to streams. The plan was developed by the Jefferson County Conservation District (JCCD) who collaborated with agricultural stakeholders in the Chimacum Creek watershed and completed in 2004.

The *Chimacum Watershed Agriculture, Fish & Wildlife Habitat Protection Plan* (Latham, 2004) lays out a framework for voluntary protection and improvements to fish and wildlife habitat on agricultural land that is compatible with maintaining agricultural capability. It establishes a "no harm or degradation" standard for landowners and operators to follow and describes agricultural protection standards for stream protection, or BMPs, for existing agricultural activities. The conservation district relies on NRCS Conservation Practice Standards as distributed in local Field Office Technical Guides (FOTGs). Conservation practice standards include information on why and where a practice is applied and sets forth the minimum quality criteria required during application of that practice for it to achieve its intended purpose. The state FOTGs are the primary scientific references for determining NRCS standard practices. They contain technical information about the conservation of soil, water, air, and related plant and animal resources. FOTGs are specific to the geographic area for which they are prepared.

The BMPs described in detail in the Chimacum Watershed plan are the same as those in JCC 18.20.030(2)(b)(iii). According to the plan, BMPs should address five management areas:

(I) Livestock and dairy management

(II) Nutrient and farm chemical management
(III) Soil erosion and sediment control management
(IV) Operation and maintenance of agricultural drainage infrastructure
(V) Riparian management

Landowners and operators are expected to use BMPs and meet the standards described through voluntary compliance. A plan for compliance and non-compliance is established in the plan that relies on the JCCD Surface Water Quality Monitoring Program to detect trends or conditions considered detrimental to fish and wildlife. Lastly, the plan includes descriptions and a set of habitat improvement recommendations for each stream reach of Chimacum Creek. The reach descriptions mention restoration efforts to date and potential sources of funding for the recommended improvements.

6.1.2 Voluntary Stewardship Program

In 2011, Washington state adopted the Voluntary Stewardship Program (VSP) (RCW 36.70A.705 - 904). The purpose of the VSP is to protect natural resources, including critical areas, while maintaining and enhancing the state's agricultural uses. It encourages voluntary local stewardship efforts as an alternative to critical areas regulation under the GMA. Counties are not required to implement the VSP until adequate state funding is available.

Jefferson County considered the VSP program over a series of meetings with County staff, County Commissioners, stakeholders (agricultural, environmental, and tribal entities), and the public in 2011 and 2012. The commissioners held a public hearing and various avenues of public comment were made available. In 2012, the BOCC ultimately decided not to participate in the program and published a letter explaining the rationale behind the decision (Jefferson County BOCC, 2012). The BOCC stated a concern for unknowns and risks with program implementation, but noted positive value in the goals offered by the VSP such as the balance between protection of critical areas and maintaining the long-term viability of agriculture in the County and a focus on voluntary incentive programs that encourage stewardship. They also recognized the use of best management practices and farm plans, coupled with watershed-wide restoration efforts to protect critical areas and sustain agricultural activities. They noted that the County uses many of these same tools and approaches at a local level and in partnership with local stakeholders. The BOCC stated a willingness to consider the program in the future after funding is made available and if another opt-in period was made available to Washington communities.

6.2 Potential Agricultural Impacts and Effectiveness of Existing BMPs

Like other types of land uses, farming and agricultural uses can have impacts on critical areas. These potential impacts fall into three general categories:

- Impacts on water quality;
- Impacts on hydrology (movement of water); and
- Impacts on wildlife habitat.

The following discussion first describes the types of impacts in each category (water quality, hydrology, and habitat) and the types of agricultural activities most likely to cause each type of impact (summarized in Table 6-1). It then describes the BMPs listed in JCC 18.20.030 that address each of these potential impacts and evaluates the consistency of these BMPs with the best available science for protection of wetlands, FWHCAs, and floodplains. BAS references for Table 6-1 include additional BAS reviews and guidance documents, including the Whatcom County Critical Areas Ordinance – Best Available Science Review and Recommendations for Code Update (Whatcom County, 2005), and Pierce Conservation District *Tips on Land & Water Management for Puget Sound Rural Living (*2013*)*.

Table 6-1. Types of Potential Impacts from Agricultural Activities

Type of Impact[1]	Agricultural Activities Potentially Resulting in Impact	Critical Areas Affected			References
		Wetlands	Floodplains	FWHCAs	
Water Quality					
Increased sediment in surface runoff	Tilling Grading	X		X	Sheldon et al., 2005 GEI, 2005
Pesticides and herbicides in surface runoff, erosion, subsurface drains, groundwater leaching, or airborne spray drift	Pesticide, herbicide application	X		X	Cornell, 2012 GEI, 2005
Excess nutrients in surface water or groundwater; potential eutrophication of wetlands (excess algal blooms and reduced oxygen in the water)	Fertilizers Runoff of animal waste	X		X	USGS, 2013 Burkart and Stoner, 2007 Smolders et al., 2007 GEI, 2005
Reduced opportunity for floodplain to provide water quality improvement functions due to faster surface water flow	Channelizing streams in floodplain areas		X		Whatcom County, 2005
Hydrology					
Changes in amount or timing of water within or feeding existing wetlands through modification of hydrologic regime or topography.	Irrigation Tilling	X			Sheldon et al., 2005
Reduction in floodplain capacity to store water	Filling for floodproofing		X		Whatcom County, 2005 PCD, 2013
Increased surface runoff and reduced infiltration	Paving Soil compaction Expansion or new (additional) agricultural			X	Whatcom County, 2005

Type of Impact[1]	Agricultural Activities Potentially Resulting in Impact	Critical Areas Affected			References
		Wetlands	Floodplains	FWHCAs	
	structures				
Restricted movement of water through floodplain areas	Constructing barriers (levees, embankments, bridges, culverts, walls)		X		Whatcom County, 2005
Fish and Wildlife Habitat					
Removal or fragmentation of wildlife habitat	Clearing of native vegetation	X		X	Sheldon et al., 2005
Conversion of wetlands to fields or pasture	Tilling Filling Draining Removal of wetland vegetation	X		X	Sheldon et al., 2005
Changes to the vegetation structure of riparian wetlands	Livestock grazing	X		X	Sheldon et al., 2005 PCD, 2013
Harm to aquatic species (e.g., amphibians) due to degradation of water quality	Pesticide, herbicide application Fertilizers Runoff of animal waste	X		X	De Solla et al., 2009 Zedler, 2003
Spread of nonnative invasive plant species (e.g., reed canarygrass, purple loosestrife) that can outcompete native plants and degrade wildlife habitat	Runoff from fields containing weeds Wheels from mechanized farm equipment transport weed seeds from infested areas to areas of native vegetation	X	X	X	Sheldon et al., 2005 Zedler, 2003 Jefferson County Noxious Weed Control Board (website)

Type of Impact[1]	Agricultural Activities Potentially Resulting in Impact	Critical Areas Affected			References
		Wetlands	Floodplains	FWHCAs	
Degradation of fish and wildlife habitat in floodplains	Channelizing streams		X	X	Whatcom County, 2005
Restricted movement of fish and wildlife, along with sediment and wood that help to form habitat features	Constructing barriers (levees, embankments, bridges, culverts, walls)		X	X	Whatcom County, 2005

[1] If BMPs are used these impacts would likely occur at reduced levels.

6.2.1 Water Quality

As shown in Table 6-1, the primary pollutants of concern for agricultural uses in Washington State reported in BAS documents are pesticides and herbicides, nutrients (e.g., nitrate), and sediment. Some of these can enter streams as well as wetlands. Water pollution can also have indirect negative effects on the functions of these critical areas. For example, excess sediment can accumulate in wetlands, reducing the ability of the wetland to store flood waters or filter surface runoff over time.

The use of agricultural buffers and vegetated filter strips has been well tested in the scientific literature. Numerous studies have confirmed that wetland buffers perform an important water quality function by trapping pollutants before they reach a wetland. In general, the wider the buffer, the more effective it is at protecting water quality. However, the width of a buffer is not the only factor that determines its effectiveness for protecting water quality functions. As discussed in detail in Chapter 3 Wetlands, the following additional factors contribute to the effectiveness of buffers to address water quality:

- Slope gradient and length
- Vegetation type, spacing, and density
- Soil type, geochemical and physical properties, infiltration rates, and soil water content
- Type and concentration of pollutants
- Flow path through the buffer (both surface and subsurface flow paths
- Adjacent land use practices

The agricultural BMPs provided in JCC 18.20.030 are focused on protecting water quality by controlling sources of pollution by covering nutrient storage areas and limiting livestock access to streams and avoiding excessive sediment contribution to streams through proper construction measures. In a recent comprehensive review of surface water monitoring since the implementation of BMP, as summarized in detail in the following section (Section 6.2), the JCCD concluded that many of the BMPs have been successful at improving water quality and salmonid habitat (Gately et al. 2015).

6.2.2 Hydrology

The primary hydrologic impacts that can result from agricultural activities reported in BAS documents are changes in the hydrologic characteristics within wetlands and streams, reduction in floodplain storage capacity, and blockage of water movement through floodplains (as summarized in Whatcom County, 2005 and Sheldon et al. 2005). In the Chimacum watershed of Jefferson County, the major agricultural impacts on streams and floodplains historically began when Chimacum Creek and its tributaries were channelized to allow for farming. Other activities such as tilling, soil compaction, irrigation, maintenance of drainage systems, and new fill or structures in the floodplain can contribute to ongoing impacts to the movement of surface water.

The BMPs specified in JCC 18.20.030 may help to protect the hydrology of wetlands, FWHCAs, or floodplains, but no specific scientific review has been conducted on this topic. In terms of buffers, some studies have concluded that buffers alone do little to protect the hydrologic functions of wetlands; the impacts of land uses in the surrounding drainage basin appear to be a greater influence on wetland hydrology (Sheldon et al., 2005; Hruby, 2013).

6.2.3 Fish and Wildlife Habitat

Fish and wildlife habitat can be directly impacted by agriculture through channelization of streams and removal of native vegetation. Indirect effects on habitat include, for example, blocking the natural movement of water through floodplain areas, which in turn prevents large wood (an important habitat structure) from reaching floodplain wetlands. As another example, infestation by nonnative invasive vegetation such as reed canarygrass can reduce the diversity of native plants that provide wildlife habitat. Conversely, a stream channel overgrown by reed canarygrass can impact agricultural activities by reducing field drainage capacity. Removal of native vegetation can lead to habitat fragmentation.

Agricultural practices have had an on-going impact on salmonid habitat in the Chimacum watershed as noted in the watershed characterization appendix of Latham (2004). Salmonids utilizing the watershed include summer chum, fall chum, pink, and coho salmon; steelhead, and cutthroat trout. The majority of salmonid use where agricultural uses are concentrated is juvenile rearing (not spawning). Factors affecting salmonids include the lack of riparian vegetation and associated high water temperature in the summer; lack of large woody debris and channel complexity, periods of low levels of dissolved oxygen, reed canargygrass infestations and reduced juvenile rearing habitat (from historic levels) (Correa, 2002). Specific salmonid species are affected differently, however, and the report states that impacts on summer chum by agriculture are minimal. Although summer chum are affected by high water temperature, the main limiting factor for this species is the high level of fines in the spawning gravel and it is unlikely that agricultural practices are responsible for this substandard condition (Latham, 2004).

The agricultural BMPs provided in JCC 18.20.030 directly benefit critical areas by protecting water quality in streams, in particular temperature. In Whatcom County, Benedict and Shaw (2012) evaluated whether buffer width of planted buffers on agricultural waterways influence water temperature. The study monitored air temperature and effective shade in five buffer areas with widths of 0, 5, 15, 35, and 180 feet at four different planted agricultural waterways. The results of the study indicated that narrow (5 foot and 15 foot), dense buffers were just as effective as wide (35 foot and 180 foot) buffers in lowering air temperature and generating effective shade.

In terms of protecting and maintaining riparian habitat for fish and wildlife, research in the past decade supports previous conclusions that larger, vegetated buffers are needed compared to those recommended for water quality improvement functions (as summarized in Hruby, 2013). The research also shows that there is a large variability in the habitat needs of species and that habitat needs are complex. Thus, while larger buffers are generally more effective to protect the habitat functions of wetlands, Hruby (2013) recommends a landscape-based approach, which incorporated other factors, would better protect wetland-dependent species and provide habitat corridors to other habitat types. See Chapters 3 and 5 for discussion of wetland buffers and wildlife habitat.

6.3 Additional Recent Scientific Literature

The following sections describe recent scientific studies published since the County's last BAS review in addition to those mentioned previously. These studies warrant a detailed description due to relevance to agricultural uses and critical areas in Jefferson County.

6.3.1 Washington Conservation Reserve Enhancement Program Monitoring Summary

The Conservation Reserve Enhancement Program (CREP) aims to restore and protect stream and riparian habitat for fish on agricultural land through financial incentives for farmers. About one third of salmon-bearing streams on private lands in Washington State cross through land used for agriculture. As an entirely voluntary program, farmers can be under a CREP contract up to 15 years to restore habitat and preclude agricultural activities in stream buffers. Administered by both the U.S. Department of Agriculture Farm Service Agency (FSA) and the Washington State Conservation Commission (WSCC), the CREP has been in service for about 14 years.

Jefferson County farmers have established CREP buffers along Chimacum Creek since 2002 (Gately et al. 2015). Under CREP, a landowner is paid rent for land put into riparian buffers. Buffers can vary in width from 35 feet to 180 feet. Streams that have an ordinary high water level less than 15 feet wide and that flow into a fish bearing stream qualify for a 15-foot wide hedgerow buffer. Based on soil productivity, a landowner receives about $300 per acre per year for land installed in CREP. As a result of CREP, riparian restoration in Jefferson County has accelerated substantially (Gately et al. 2015).

Restoration and protection methods implemented on CREP sites include buffers along streamside wetlands, installation of fencing and livestock watering facilities, and planting of native trees and shrubs. To ensure these methods are followed and become successful, WSCC monitors CREP sites by annually collecting data on acres treated, stream miles restored, number of contracts, feet of fencing installed and number of plants installed. Stream and riparian functions and conditions are monitored as well and include: plant survival, buffer plant diversity, canopy cover, bank erosion, and non-native species cover.

In 2012, the WSCC provided the report, 2012 Implementation and Effectiveness Monitoring Results for the Washington Conservation Reserve Enhancement Program (CREP): Plant and Buffer Performance (Smith, 2012). Results from the report found that over 1,000 total contracts had been implemented since the program began, with most using the riparian forest buffer practice (with an average buffer width of 143 feet) followed by wetland enhancement and riparian hedgerow practices. The percent canopy cover found in CREP sites with longer (5-10 year) contracts was greater (approx. 72%) than those sites with shorter (1-4 year) contracts. Invasive species cover was also found to be low in CREP sites, ranging from 1 to 3 percent. Based on these results and others included in the report, WSCC determined that the CREP is a successful and growing program in restoring and protecting riparian areas on agricultural lands.

6.3.2 Washington Agricultural Caucus Riparian Buffer Review

In 2002 and 2005, the Washington Agricultural Caucus, Washington Hop Commission, and the Ag Fish Water Process funded research analyzing the implications of mandated fixed-width riparian buffer zones on existing agricultural lands in Washington State for the protection of listed anadromous salmonids. The research was documented in two stages, Efficacy and Economics of Riparian Buffers on Agricultural Lands - State of Washington, Phase I and II (GEI, 2002 and 2005). The Phase I report reviewed and summarized BAS literature on agricultural buffer recommendations and riparian buffer zones. Findings from the Phase I review determined that proposed widths of agricultural riparian buffer zones have been mostly based on a set of timber harvest models and regulations and are not applicable to agricultural lands. Riparian buffer zones used to mitigate for timber harvest impacts may be wider (300 feet or more) than required for agriculture lands as research indicates narrower buffers (5 to 30 meters) were just as effective for water filtration, sediment reduction, animal exclusion, shade, nutrient removal, and bank stabilization of agricultural streams (GEI, 2002). Based on its findings, the Phase I report concluded that instead of a fixed-width buffer for all agricultural streams, widths for riparian buffers should be site-specific and based on BAS specific to existing agricultural lands and uses that focus mainly on water quality protection.

The Phase II report is a continuation of Phase I with a BAS literature review of additional scientific literature on buffer effectiveness and other BMPs. The report provides recommendations for BMPs applications specific to Washington agriculture and Appendix III of the report includes suggestions for minimum riparian buffers ranging between 25 and 60-feet for three different conditions within an existing agricultural settings. These three conditions are:

- Farms demonstrating BMPs implementation on slopes less than 7 percent in drier areas (18 inches of average annual precipitation) of the state to have a minimum vegetated riparian buffer width of 25-feet;
- Farms demonstrating BMPs implementation on slopes 7 percent or greater in wetter areas (more than 18 inches of average annual precipitation) of the state to have a minimum vegetated riparian buffer width of 35-feet;
- Farms that do not implement BMPs to have a minimum vegetated riparian buffer width of 60-feet.

Several of the suggested BMPs from the Phase II review support the findings of the Phase I report and reduce the need for a wide-set buffer width. Some of these BMPs include: slope management, contouring, avoiding use of steep slopes, and proper irrigation techniques to filter runoff and/or stabilize streambanks (GEI, 2005). The report determined that BMPs to improve livestock management and reduce impacts resulting from grazing were dependent upon site conditions and the kinds of grazing management practices in place. Several studies supported site specific grazing plans that:

1) Include sufficient timing for vegetation re-growth;
2) Retain sufficient vegetation during peak flows to protect stream banks;
3) Limit grazing time and intensity; and
4) Create appealing areas for food, water, and rest away from streams, stream banks, and riparian vegetation with or without fencing (GEI, 2005).

Like the Phase I report, the Phase II report highlights Jefferson County as an example of successful narrow buffer zone application and agricultural livestock management BMPs implementation that has improved water quality (reduced fecal coliform levels) in Chimacum Creek.

The Natural Resource Conservation Service (NRCS) Field Office Technical Guides (FOTGs) are described in the Phase II report as BMPs practiced in Washington and support the agricultural BMPs listed in JCC 18.20.030(2) .The reports highlights key methods and management options beyond those provided by FOTGs in a NRCS review completed in 1997 that are specific to Washington agriculture. The key management options cover primarily water quality goals such as: soil erosion and sedimentation control; keeping nitrogen and chemicals out of streams; animal waste management; pesticide field losses and residues; water diversion and distribution systems; water application systems and efficiencies; active water application research and development; water management and cultivation-horticulture practices; and water management – fish and wildlife programs.

6.3.3 Chimacum Watershed Water Quality and Fishes Report

The JCCD recently completed a comprehensive review of surface water monitoring since the implementation of BMPs to improve water quality and salmonid habitat in agricultural areas of the Chimacum watershed (Gately et al. 2015). Several monitoring parameters were assessed as part of the review and included: fecal coliform, temperature, dissolved oxygen, nitrate, pH, phosphorous, turbidity, and conductivity, as well as salmon and beaver presence. The majority of monitoring was conducted at twenty-eight stations throughout the watershed by the JCCD while some monitoring was completed by local groups, such as Chimacum High School and the North Olympic Salmon Coalition. Monitoring stations were located downstream and upstream of agricultural lands near the main stem of Chimacum Creek as well as its eastern fork. Key findings from the review include improving trends in fecal coliform concentrations, stream temperatures, dissolved oxygen and salmon returns.

Although concentrations of fecal coliform in the last year of monitoring (2012) failed the Washington Department of Ecology (Ecology)'s "extraordinary contact" standard at 25 of 28 monitoring stations, concentrations have declined over time since monitoring first began in 1988. In addition, human fecal coliform was more commonly detected in samples from monitored stations than ruminant fecal coliform. Over half of the stations monitored for temperature failed the 7-day average of the daily maximum temperature (16° as designated by USEPA Region 10 (2003)) standard in 2013. However, there has been a decreasing trend in temperature since monitoring started in 1998. Stream temperatures have dropped 1 degree Celsius in the main stem of Chimacum Creek and 2 degrees in the east fork of the creek. Similarly, many of the monitoring stations failed the 1-day minimum 9.5 mg/L standard for dissolved oxygen.

With regards to fecal coliform, the report concludes that meeting Ecology's standard is challenging in the Chimacum watershed due to the combination of high survival and growth of fecal coliform bacteria in stream sediment, algae, soil, and animal manure; the capability of bacteria to infiltrate groundwater and be transported to surface water; and the variety of fecal sources, including human and wildlife. These factors also make it difficult to demonstrate improvements resulting from BMPs as distinguished from other pathways.

Despite not meeting many of the above water quality standards set by Ecology, according to the JCCD's review, the Chimacum watershed experienced record returns of summer chum and coho salmon. From 2001 to 2013 Chum salmon returns ranged from 558 to 3,066 adults; and Coho returns ranged from 333 to 3,539 (JCCD, 2015). The watershed has also seen an increasing trend in juvenile coho abundance in restoration sites. Similarly, beaver activity has been increasingly witnessed by the JCCD in the watershed, especially in forested buffers.

Based on the findings from the review, the JCCD concluded that many of the BMPs as well as CREP buffers created by farmers have been successful at improving water quality and salmonid habitat, but improvements could still be made. Suggested improvements include off-channel watering facilities for livestock, and more funding/incentives for landowners to adopt CREP buffers and BMPs.

6.3.4 Working Buffers on Agricultural Lands Paper

In cooperation with the NOAA Restoration Center and the Puget Sound Partnership, the Snohomish Conservation District (SCD) issued the paper: *The Working Buffer Opportunity: A Proposal for Ecologically Sound and Economically Viable Riparian Buffers on Agriculture Lands* (Dittbrenner et al., 2015). The paper promotes a more site-specific, integrated design of riparian buffers to improve riparian management in agricultural lands. The authors conclude that efforts to improve riparian management in these areas have been unsuccessful largely because of the conventional, "one-size-fits-all" approach to riparian buffer design. Instead, they propose a design with an inner riparian buffer zone bordered by an outer working buffer zone in combination with on-farm runoff management.

As part of the design, buffer widths would remain flexible and site-specific to accomplish certain water quality or habitat functions. The "inner riparian buffer" zone would be used primarily to enhance stream habitat but could also be used for some low impact harvest practices (e.g. small fruit, wild greens, boughs, mushrooms). The outer "working buffer" zone would protect stream functions and mitigate water quality from on-farm runoff, while also incorporating agroforestry practices as a source of revenue to landowners. Figure 6-1 is a conceptual model of an integrated design using a riparian buffer zone, a working buffer zone, and integrated runoff management.

Figure 8-1. Figure 4: Conceptual model of integrated design using a Riparian Buffer Zone, Working Buffer Zones, and integrated runoff management (from Dittbrenner et al., 2015)

Agroforestry in the working buffer zone that is well-designed and integrated with runoff management practices can increase buffering functions on agricultural lands. Agroforestry is the incorporation of trees into crop or livestock farming to increase ecological functions, increase yield, and diversify farm income. Agroforestry systems can be designed to provide a mix of ecological services while allowing harvest. By implementing what we call "working buffers", the functional width of buffers can be increased while continuing to allow farmers to control and derive income from their land.

The suggested agroforestry practices are specific to floodplains and riparian corridors and include: forest farming, alley cropping, silvopasture, and/or short return biomass (see sidebar).

To encourage implementation of the working buffer concept, the SCD has created four templates that describe the agroforestry practices. The templates detail the ecological benefits provided by each practice, guidance for their prescription, and information on the installation and management of

Working Buffer Zone Agroforestry Practices

Forest Farming. *Cultivation of specialty crops (mushrooms, medical plants, nursery cuttings, and ornamental plants) under a forest canopy.*

Alley Cropping. *Growing an annual or perennial agricultural crop simultaneously with a long-term woody crop, both in rows, typically on contour*

Silvopasture. *The canopy is managed for timber or fruit/nut production while the understory is managed for seasonal and rotational livestock forage.*

Short Rotation Biomass. *Frequently harvest fast-growing trees or shrubs that stump-sprout (willow, cottonwood, or hybrid poplar) are harvested for biomass.*

appropriate plant species. Additional information about working buffers including the templates can be found at: https://salishsearestoration.org/wiki/Working_Buffer_Pilot_Project

Agroforestry practices have also been found to help mitigate the effects of climate change by sequestering carbon, reducing greenhouse gas emissions, allowing species migration, and increasing the resiliency of agriculture. This is especially important as climate models for the Pacific Northwest predict the area will see more intense and frequent flooding events in the winter as well as increased temperatures and less precipitation in the summer (CIG, 2013). Table 6-2 highlights how agroforestry practices can mitigate climate change effects (Schoenberger et al. 2012).

Table 6-2. Climate change mitigation benefits from agroforestry practices.

Climate change activity*	Major climate change functions	Agroforestry functions that support climate change mitigation and adaptation
Mitigation		
Activities that reduce GHGs in the atmosphere or enhance the storage of GHGs stored in ecosystems	Sequester Carbon	Accumulate C in woody biomass Accumulate C in soil
	Reduce GHG Emissions	Reduce fossil fuel consumption: Reduce equipment runs in areas with trees Reduce farmstead heating and cooling Reduce CO_2 emissions from farmstead structures Reduce N_2O emissions: By greater nutrient uptake through plant diversity By reduced N fertilizer application in tree component Enhance forage quality, thereby reducing CH_4
Adaptation		
Actions to reduce or eliminate the negative effects of climate change or take advantage of the positive effects	Reduce threats and enhance resilience	Alter microclimate to reduce impact of extreme weather events on crop production Alter microclimate to maintain quality and quantity of forage production Alter microclimate to reduce livestock stress Proved greater habitat diversity to support organisms (e.g. native pollinators, beneficial insects) Provide greater structural and functional diversity to maintain and protect natural resource services Create diversified production opportunities to reduce risk under fluctuating climate
	Allow species to migrate to more favorable conditions	Provide travel corridors for species migration

The working buffers paper concludes that the concept is not appropriate for all situations nor that the proposed agroforestry techniques will restore all ecological functions and resolve all conflicts, but rather it suggests working buffers can be "a vital component of a watershed strategy that could foster partnership between farmers in the business of growing food and public agents working to restore aquatic ecosystems."

6.4 Conclusions

Existing and ongoing agricultural uses and activities can have impacts on water quality, the flow of water, and wildlife habitat. Much of the impact can be minimized through application of agricultural BMPs used commonly on farms in Jefferson County and CREP buffers. The County's current agricultural BMPs provided in JCC 18.20.030 are generally focused on protecting water quality and maintaining riparian habitat for fish and wildlife. The level of protection afforded by BMPs will be evaluated in the watershed characterization phase of this project. Information from this report and the watershed characterization report will inform development of options and recommendations for improving critical areas protection in and near agricultural activities.