Predicting Summer Elk Habitat Potential in Section 17
Technical Memo
Version 1

To Ben Alworth, Wheeler Ridge, LLC

From: Charity Duffy & Hans Shepard, SCJ Alliance

Date: September 3, 2018

Subject Predicting Summer Elk Habitat in Section 17

Summary

The Washington State Department of Fish and Wildlife's (WDFW) Priority Habitat and Species (PHS) database indicates Section 17 provides habitat for elk. Wheeler Ridge, LLC is proposing to convert 250 acres within 640 acres of a historical working forest within Section 17 to orchard development on Wheeler Ridge, Chelan County outside of hydrological buffers (Figure 1). Orchard development includes harvesting timber from a historical working forest, orchard planting, a 9.9-acre-foot reservoir, seasonal agricultural worker support facilities, and other necessary structures such as fuel stations and spray sheds. Improvement of 2.3 miles of an existing Chelan County Road and relocation of ¾ of a mile is also an element of this proposed project (Section 16 and Section 17).

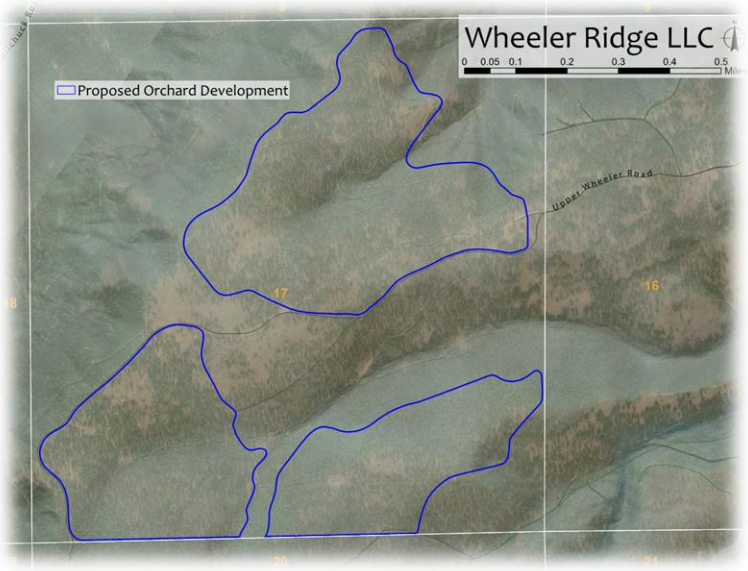

FIGURE 1. PROPOSED 250 ACRES OF ORCHARD DEVELOPMENT ON SECTION 17, WHEELER RIDGE, CHELAN COUNTY.

Wildlife habitat enhancement project elements are within Section 17 and are outside the orchard development including wetland-meadow habitat protection and restoration, seasonal water conveyance to the perennial stream in spring and summer months for wildlife, enhancement of natural drainage

patterns, restoring areas heavily impacted by illegal user-built roads, dispersed camping, and mud bogging, establishment of wildlife corridors that connect to larger, adjacent habitat concentrations, and retention of 390 acres of forest tree stands and forage areas.

In 2017, the Washington State Department of Fish and Wildlife (WDFW), Chelan County Natural Resources Department, and the Sportsman Association expressed concerns about orchard development on Section 17 to the proportion of the Colockum elk herd on Wheeler Ridge during the summer months (June – August). WDFW primarily expressed concerns with summer cow elk habitat impacts because the elevation is likely too high for winter range elk habitat.

The purpose of this technical memo is to provide literature generally consulted and GIS methods used to illustrate predicted summer elk habitat potential in Section 17. Information provided in this technical memo is intended to:

(1) Consult literature to identify habitat attributes that are consistent predictors of summer elk habitat potential;

(2) Create a simplified habitat characteristic scheme with quantitative ranges in GIS to identify areas within Section 17 that may provide, low, medium, and high summer elk habitat potential; and

(3) Identify areas within Section 17 to target for suitable habitat enhancements, restoration, and protection in summer months for elk and recommendations to avoid, reduce, or mitigate impacts to elk and their habitat during spring and summer months.

Lands adjacent to the proposed project area owned by WDFW and Washington State Parks and managed for fish, wildlife, habitat and public recreational uses. The Chelan County Road is used to access public lands. Existing operating orchards are also adjacent to the project.

Study Area

The study area is located on Wheeler Ridge, in Chelan County (Figure 2). The study area is primarily forested with open prairie, dominated by ponderosa pine and a small mix of Douglas fir. The understory of the ponderosa pine ecosystem includes native plants such as lupine and balsamroot. The proposed orchard development is in an area designated by the Nature Resources Conservation Service as "*Farmland of Statewide Importance.* Logging activity in this area seized in 1996, however relic logging roads are abundant and serve as unnatural drainage corridors for seasonal run-off. WDFW and the Washington State Department of Natural Resources (WDNR), in cooperation with private landowners

FIGURE 2. VICINITY OF STUDY AREA, SECTION 17.

manage a Chelan County "green-dot[1]" road system located within portions of the study area. Because sections of this road have not been maintained, several unauthorized user-built roads have been created to" bypass" impassable sections or access private lands. User-built roads, along with mud bogging and dispersed camping has caused negative habitat impacts on Section 17. Illegal activities have also caused the streams to be re-routed away from its natural drainage channel.

The Colockum Wildlife Area is adjacent to Section 17 and includes 105,662 acres managed by WDFW (Figure 3). WDFW recently purchased Section 16 and Section 22 from WDNR for the protection[2] of *Oncorhynchus mykiss* (wild steelhead), habitat for the Endangered Species Act (ESA) Listed Gray Wolf and their prey species mule deer and elk and to protect suitable habitat for ESA Listed Northern Spotted Owls. This newly acquired area totals 1,200 acres and has been incorporated into the Colockum Wildlife Area (Colockum Wildlife Area 2017 Management Plan Update, WDFW).

Enhanced recreational opportunities are being planned for these areas per the *Draft* Stemilt-Squilchuck Recreation Plan (2018). This is not a formal plan but is intended to provide a framework for focuses recreation in the Stemilt Basin. WDFW provided technical guidance and "critical evaluation of impacts of recreation" to wildlife. The geographical scope of the Plan includes the various landownerships in the Upper Stemilt and Squilchuck watersheds. Recreational actions are primarily proposed to occur on WDFW and Chelan County lands adjacent to the proposed orchard development. Recreational elements in the Plan include providing recreational access and opportunities within the Wheeler Ridge, LLC proposed project area. Wheeler Ridge, LLC is not contemplating recreational access and/or opportunities as an element of the proposed project area to avoid recreational impacts to habitat, elk, and other wildlife. Actions proposed in the Recreation Plan that may affect this proposal are unknown. The Plan ensures impacts to fish, wildlife, and their habitat associated with these enhanced uses will be avoided, reduced or mitigated by WDFW with special attention given to the Colockum elk herd and Northern spotted owl.

FIGURE 3. COLOCKUM WILDLIFE AREA, MANAGED BY WDFW.

[1] The "green dot" system is actually a Chelan County road which "provides access for camping, hunting, wildlife viewing, and ATV and off-road vehicle riding, while protecting sensitive habitat from damage caused by motorized vehicles (WDFW, 2018).

[2] Methow Phase 8 Section 6 Proposal, 2008. Washington State Department of Fish and Wildlife.

Literature Consulted

Managing summer and fall range is an important factor for long-term sustainability of the Colockum elk herd (Bernatowicz, 2006). Bernatowicz prepared the Washington State Elk Herd Plan for the Colockum Elk Herd for WDFW. Because of a dramatic increase in recreation, the Colockum elk herd distribution likely has been negatively influenced, including from traditional hunting and antler shed hunting. Other human disturbances include timber harvest and grazing livestock. Disturbances may force elk to move to less concentrated areas in remote areas or onto agricultural lands within the Colockum Wildlife Area. Bernatowicz found impacts from ORVs and high vehicle use roads were the greatest negative impact, further citing Powell and Lindzey (2003) who found "elk avoid areas within 1.2 miles of major roads in summer and 0.6 miles in winter in open habitat in Wyoming." Only 20% of the winter range available for the Colockum elk herd is in private ownership and winter use near Mission Ridge may not impact elk (Bernatowicz, 2006). The Colockum Elk herd ranges over 1,660 square miles between the Columbia River to the east of the crest and U.S. Highway 2 to the north and Interstate 90 to the south. The elk herd populations have been estimated at 5,600 animals and WDFW reports elk utilize habitat in the Stemilt Basin for seasonal migration, calving, and summer range.

The Pacific Northwest Research Station, March 2006 Science Update provide results from the Starkey Project's first decade (1989-1999) of research. During that decade, the project revealed four consistent themes within the Starkey Experimental Forest and included: (1) roads and traffic, (2) timber production and thermal cover, (3) competition with cattle, and (4) breeding efficiency of male elk. Key findings from that study have been excerpted from the Science Update below:

- *"Elk avoid roads open to motorized traffic, and their avoidance increases as the rate of traffic increases. Mule deer avoid elk and thus can be displaced into areas least used by elk, such as areas near roads with traffic.*
- *Elk do not benefit from homogeneous stands of thermal cover; a mix of open – and closed – canopy habitats is optimal for elk.*

In that same 2006 Science Update, road density was investigated with over 70 traffic counters being installed throughout the area. Results indicated "when elk were unable to avoid roads and trails, subsequent studies showed that animals increased their movement rates, which can increase energy expenditures." Elk were strongly influenced by road density. Wisdom reported "Elk response was affected by traffic rates, amounts of forest cover near roads, and the type of road (traffic rates). Once the elk were farther away from the roads, they were more influenced by other factors such conditions affecting forage."

In 2008, CORE GIS and the Trust for Public Lands, facilitated by the Chelan County Natural Resources Department modeled and published summer elk habitat potential in the Stemilt Basin on lands proposed for WDNR ownership, which are now owned and managed by WDFW (Figure 4). A total of 5,000 acres were modeled by CORE GIS to illustrate areas elk may prefer during summer months (June-August) based on slope, proximity to water, and cover. Model attributes were not verified with field observations to assess accuracy of the model to predict elk habitat use, duration, and distribution. WDFW is currently working on an additional elk analysis expected to be completed in 2019 or 2020. However, elk were not sampled in the Stemilt Basin and it is unknown at this time if WDFW plans on sampling additional elk as an element of the analysis.

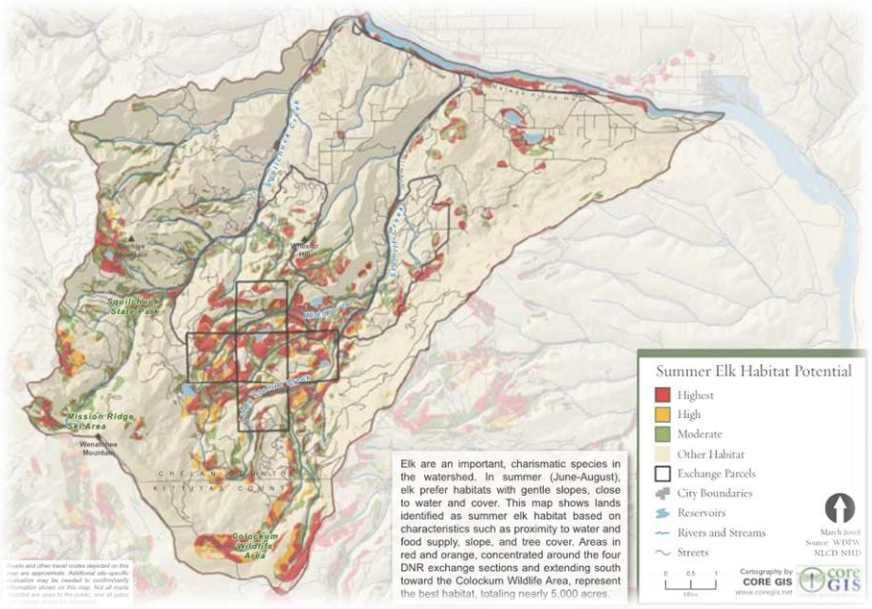

FIGURE 4. PREDICTING SUMMER ELK HABITAT POTENTIAL ON STATE LANDS (CORE GIS, 2008).

Rowland, M., et al, (2000), included road locations, slope and canopy cover as variables and tested their association among them to predict Habitat Effectiveness (HE). Results indicate elk continually select areas away from roads. Results from this study indicate elk stress level increase as road density increases and as hunting pressures increase. Rowland, M. et al report it remains unclear for what duration elk are impacted by roads and road use, therefore using a Habitat Effectiveness (HE) model can provide land managers a tool for elk management. HE scores range from 0-1 in most models, with standard HE ranges from 0.62-0.70 to maintain elk habitat use. This study reported exceeding road densities of 1.5 miles per square mile in elk summer and winter range should receive a HE score of 0. Using distance bands from a linear feature like roads or cover can be used to calculate HE (Rowland et al., 2005) to better predict if an elk will go to an area or avoid it.

Rowland, M., et al. (2005) found frequency of human road use and forest canopy along roads influence elk distribution. *Human Disturbance and the Physiological Response of Elk in Eastern Washington* (2015) by Jachowski, D.S., et al. (2015) provides evidence of "the importance of human disturbance as a primary source of stress in wildlife populations and suggests that researchers should be cautious in interpreting the relative importance of stressors when site-specific effects of stressors might override normal patterns." Habitat predictability power using habitat attributes consistently recognized in literature may not accurately predict habitat potential but provides a baseline to which better understanding where elk are, when, and why.

In 2004, Benkobi et al. refined use of the Arc-Habcap Model to predict habitat effectiveness for elk in summer months using forage-cover only. Model results illustrate good, fair, and poor summer elk habitat potential in Custer State Park in South Dakota. Elk were later collared with radio-telemetry elk locations in the park to validate the model's effectiveness to predict habitat potential (Figure 5). Results indicated elk were found low, fair, and good with the highest concentrations in fair and good.

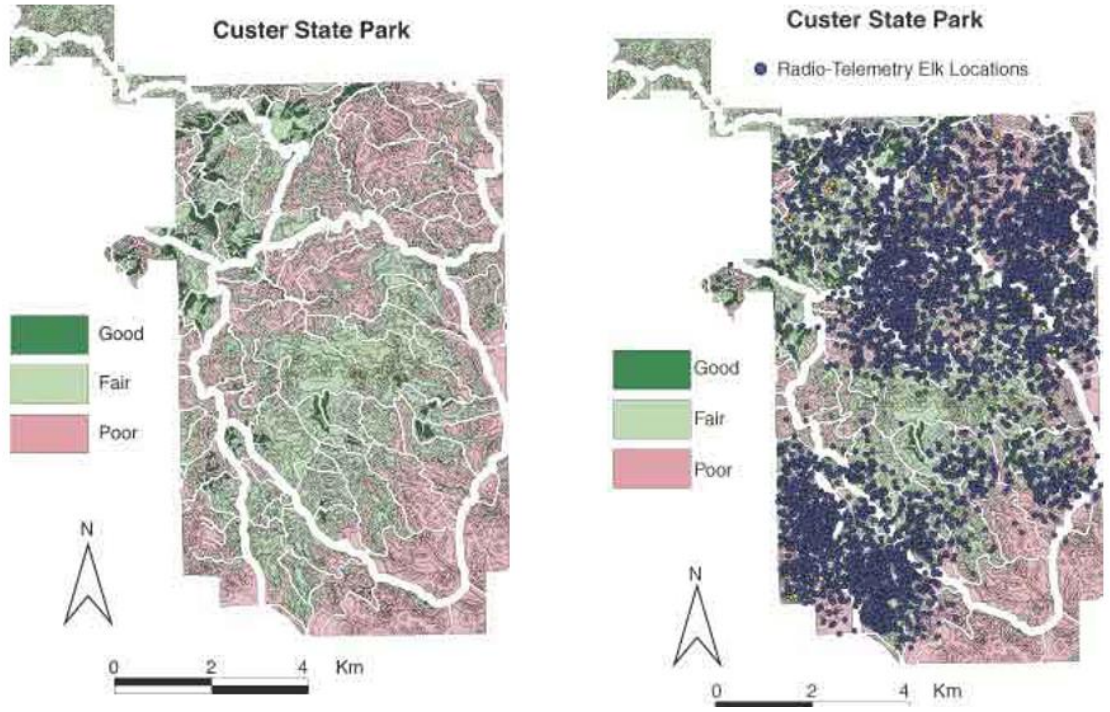

FIGURE 5. ARC-HABCAP MODEL PREDICTIONS OF SUMMER FORAGE EFFECTIVENESS FOR ELK IN CUSTER STATE PARK; THE ILLUSTRATION ON THE RIGHT PROVIDES RESULTS FOR SPATIAL DISTRIBUTION OF RADIO-TELEMETRY COLLARED ELK IN THE SUMMER.

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In 2003, Gaines et al. assessed cumulative effects of linear recreation routes on wildlife habitat by conducting a robust literature review. The assessment chose elk as a wildlife focal species because they are sensitive to habitat modification and human disturbances. A primary objective of their paper was to develop assessment processes and GIS models to evaluate cumulative effects of recreation on wildlife habitat, including roads and trails. The paper identified several variables the model should include such as spatial extent of the effect, level of intensity of human disturbance, and human influences on wildlife habitats necessary for elk such as recreation trail distance to water resources. Gaines et al. also compared classification schemes used to describe the effects of recreation and assigned a numerical rating of 1-3 for disturbance type. A rating of 3 “involves human actions in which there is a direct and damaging contact with the animal (Liddle, 1997)”.

TABLE 1. CLASSIFICATION SCHEME, DISTURBANCE TYPES, AND DESCRIPTION OF DISTURBANCE TO DESCRIBE EFFECTS OF RECREATION ON WILDLIFE APPLICABLE WITHIN THE PROPOSED PROJECT AREA.

Classification Scheme	Disturbance Type (1-3)	Description
Displacement or avoidance	Type 1	Spatial shifts in populations or individual animals away from human activities on or near roads, trails, or networks.
Habitat loss and fragmentation	Type 2	Loss and resulting fragmentation of habitat owing to the establishment of roads, trails, or networks, and associated human activities.
Edge effects	Type 2	Changes to habitat microclimates associated with the edge induced by roads or trails.
Snag or downed log reductions	Type 2	Reduction in density of large snags and downed logs owing to their removal near roads as facilitated by road access.
Disturbance at a specific site	Type 1	Displacement of individual animals from a specific location that is being used for reproduction and rearing of young.

Type 1: sees, hears, smells but not human contact
Type 2: habitat is changed

Gaines et al. reported winter recreation has the "potential to be the most detrimental (Canfield et al. 1999) to elk". During the winter, elk are at a lower elevation and interactions with humans recreating increases. GIS layers illustrating ski trails and snowmobile routes were used to calculate the proportion of elk winter range influenced by recreation. For roads, 800 meters on each side of a plowed road was determined as the "zone of influence" to elk and ski trails were 200 meters. These activities are likely to occur on adjacent WDFW lands and not within the proposed orchard development, therefore will not be discussed in this paper.

Water resources are necessary for elk. Increases in human activities within riparian habitats have a negative impact on wildlife (Gaines et al. 2003). Their assessment describes environmental measures to proactively address wildlife concerns such as developing facilities to connect habitats and the use of GIS modeling to apply adaptive management. Gaines et al. concluded monitoring can help validate assumptions to continue learning how wildlife (elk) and human activities such as winter recreation influence spatial distribution.

Elk respond to timber harvest activities by shifting distribution and elk thrive in early-seral forests because the highest level of forage available is under an open canopy (Wisdom et al. 2004). Timber harvest is considered a short-term disturbance. Converting forests is a long-term impact because habitat is no longer available. Wisdom et al. found effects to elk increase if human access increases to areas elk utilize. Elk will avoid areas with increased human access activities but found "no evidence elk avoided the cut units or the mainline roads during and after timber harvest" but elk did shift distribution during timber harvest activities.

In 2013, Scott M. McCorquodale, Ph.D. at WDFW published *A Brief Review of the Scientific Literature on Elk, Roads, & Traffic.* Key points in this review include (1) Stankowich (2008) found evidence that elk avoid areas where there is human activity and was higher in open habitats; (2) Cole et al. 1997 found elk moved across a landscape less following a reduction in road density and use; (3) Preisler at al. (2006) determined elk would avoid OHVs even when an OHV was at distances of 1,000 meters; (4) Perry and Overlay (1977) found elk use areas near roads less than other areas determined by quantity of elk pellets; road densities above 2 miles per square mile decreased HE; (5) Coe (2007) and Coe el al. (2011) compared results from a model to predict potential elk habitat with observed habitat use. They found the model was good at predicting elk use and that in both the model and observations roads were the most consistent predictor of elk presence/lack of presence; and (6) Kuck et al. (1985) found "elk

cow/calf pairs readily abandoned traditional calf-rearing areas when faced with repeated disturbance from people."

In 1987, Marcum et al. used a computer model to evaluate elk hiding cover needs. A result of that model indicated elk require 90% cover to hide (Thomas et al. 1979), which included both tree canopy and large shrubs. Marcum et al. recommend leaving 200-400 yards of stands of trees adjacent to clear cuts and wildlife corridors. Within that paper, they report per Thomas e al. (1979) that "cover should occupy at least 40% of optimal elk habitat" but should be larger in areas during the hunting season (Peek et al, 1982).

WDFW (2013) presented results of The *Colockum Elk Study II: 2008-2012* to a group of interested stakeholders. The primary objectives of that study included" (1) Quantifying space-use and movements of Colockum cow elk, (2) Assess distributional relationship (i.e. connectivity between core area and Parke Creek elk sub-herds), (3) Explore effects of disturbance, weather, and habitat features on Colockum elk movements and distribution, (4) Estimate survival, productivity, and condition of cow elk, and (5) Evaluate whether the Whiskey Dick winter access closure has potential management value." Elk were collared with a GPS unit and all GPS collar "fixes" were tracked and archived for analysis. Staff indicated disturbance on public lands are influencing elk to move onto private lands for refuge. Movements and Space use was also a topic of discussion, with WDFW recording 417,995 GPS collar elk fixes. Results from summer collared cow elk indicate they did not migrate to Wheeler Ridge; however, the sample size was only 372 and the Stemilt herd was not targeted.

In 2018 the Chelan County Natural Resources Department submitted the Stemilt-Squilchuck Recreation Plan (Draft). That plan reports "heavy vehicle uses in spring, summer, and fall, and snowmobile use (including extensive groomed snowmobile trail system) in the winter, with fishing, camping, hunting, wildlife viewing, hiking, horseback riding, recreational driving, and snowmobiling" on WDFW lands. In 2007, traffic counters were installed on the Chelan County Road (aka green dot road). Vehicle use increased in the late spring and fall with the month of May having the highest traffic counts at 3,073 (Stemilt Vision Document). WDFW provided technical guidance and "critical evaluation of impacts of recreation" to wildlife. Elk habitat potential mapping was completed by CORE GIS in 2008 as incorporated into the 2006 Stemilt Vision Document (Figure 6). Results from this mapping exercise identify critical potential elk habitat within and along the heavily used Chelan County Road. The Plan does acknowledge results do not account for disturbance to elk from vehicle traffic and high recreational use.

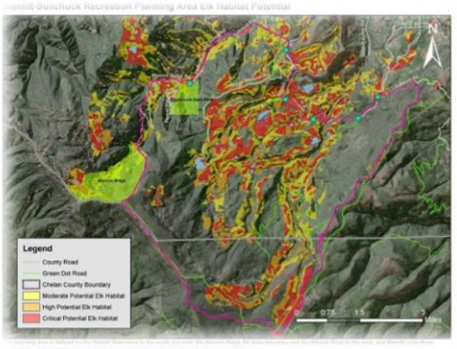

FIGURE 6. ELK HABITAT POTENTIAL (CHELAN COUNTY NATURAL RESOURCES DEPARTMENT, 2018).

"The following excerpt from WDFWs review of the elk collar data in terms of recreation planning provides context on how this data can be used to assess overall elk use in the basin" (Chelan County Natural Resources Department, 2018): "*The Bull Elk Use within the Stemilt Basin Planning area depicts all the collar location data collected during the bull study from 2013-2017. The Bull Elk During the Rut data only includes collar data from Aug 15-Oct 15. As we have no cow data from this area we will use the bull rutting season information as surrogate data to illustrate probable cow summer ranges. Data from the 2008-2012 Colockum Cow and 2013-2017 Colockum Bull studies indicates Bulls move in to cow*

summer ranges for the breeding season (rut), therefore we can conclude these areas are highly probable cow elk summer ranges as well. Cow elk will be on summer range from potentially calving, mid-May to mid-June, throughout the summer to the end of the rut in mid-October. Given the more specific Rut Collar Data and the fact that Zone 3 has fewer roads, lakes, camps, etc. that attract people and the associated disturbance we feel that it's important to limit development of trails and roads in this area and protect it as "core elk summer habitat." (Maps and excerpt from personal communication with WDFW wildlife biologists; Chelan County Natural Resources Department 2018). WDFW (2018), provided bull elk maps to be included in the Stemilt-Squilchuck Recreation Plan (2018). Data illustrates bull elk use during the summer and bull elk use during the fall rut in the Stemilt Basin (Figure 7; Figure 8).

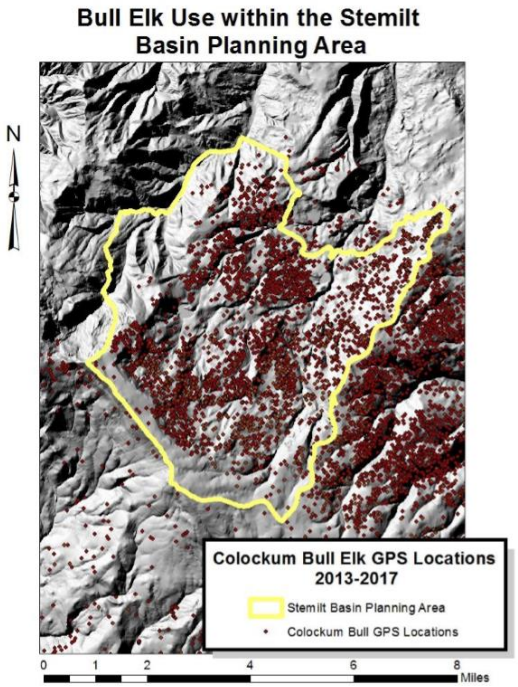

FIGURE 7. WDFW BULL ELK GPS LOCATIONS, STEMILT BASIN (AS PROVIDED BY CHELAN COUNTY NATURAL RESOURCES DEPARTMENT 2018).

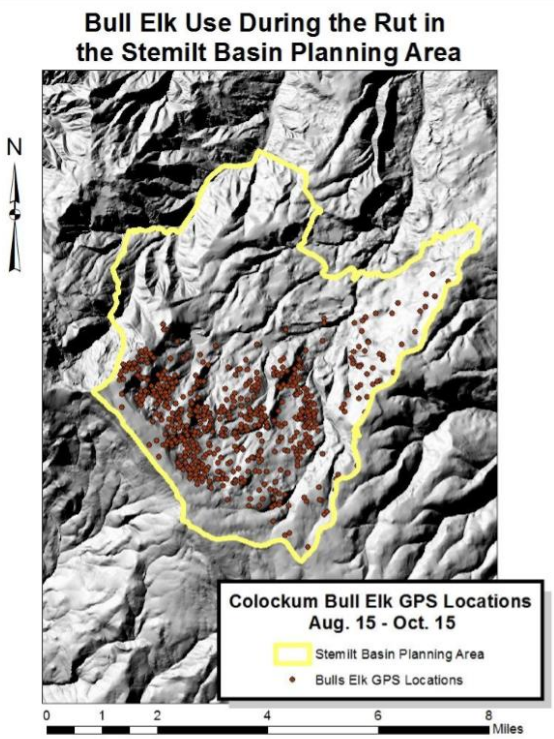

FIGURE 8. BULL ELK USE DURING THE RUT (AS PROVIDED BY CHELAN COUNTY NATURAL RESOURCES DEPARTMENT, 2018).

Innes, 2011 report elk generally prefer moderate slopes around 40% and used steeper slopes less. If not too steep, elk with use drainage bottoms to look for water and for late-summer food. In the summer, elk tend to use north-facing slopes because it provides cooler habitat and the most-succulent, high quality forage. It should be noted that in the spring, elk may prefer south-facing slopes because the snow melts and provide foods/water.

Literature consulted served as the basis to generally understand potential summer elk habitat on Section 17. Wheeler Ridge, LLC did not evaluate how management actions occurring outside of Section 17, including traffic counts influence summer elk behavior. For this technical memo, it is assumed elk avoid areas with heavy vehicle use. Attributes acknowledged by the Starkey Project and other literature referenced provided parameters to perform a predictive exercise in GIS. Long-term monitoring of summer cow elk within the Colockum Wildlife area and adjacent lands may validate habitat attribute assumptions to predict summer elk habitat potential.

Methods

Literature was consulted to develop habitat classification scheme/habitat attributes to predict potential summer elk habitat within Section 17. A subset of habitat characteristics was given quantitative ranges based on a set of known variables known to influence elk behavior (Table 2). Classification schemes were assigned a value of low (0), medium (.5), and high (1.0) (i.e. intensity value) and then geolocated using GIS. Habitat attributes used to predict summer elk habitat potential included (a) distance to roads, (b) slope facing direction, (c) slope (degrees), and (d) percent canopy cover; these attributes were the most consistent in the literature with roads determined to be the most consistent predictor of habitat elk use/nonuse.

Classifications were assigned a color gradient to a raster where the cell color is based on clustering of habitat classification schemes to create a heat map. The purpose of the heat map developed in GIS is to illustrate the highest concentrations of potential elk habitat selection criteria within the proposed project area. The color gradient is a range of color from red to green representing the occurrence of a selected habitat feature (i.e. slope). As the concentration of points are greater in an area, the darker the green; the darker the color the higher likelihood potential summer elk habitat may exist.

Field investigations were conducted in spring of 2018 to verify water resources within the proposed project area. Staff went to sites within the project area identified by WDNR hydro-layers and water maps. Site investigations confirmed several of the WDNR hydro-layers had incorrectly identified streams which were instead swales naturally occurring from a low tract of land during winter run-off. Temporary drainages not meeting stream characteristics went through WDNR water typing modifications and have been removed from the water resource GIS layers. Current hydrologic conditions indicate water is not available during summer months, therefore would not be adequate predictor of summer elk habitat potential.

TABLE 2. DEVELOPING HE VALUES TO IDENTIFY HE VALUES USING DISTANCES AND RANGES; HABITAT FEATURES DERIVED FROM CONSULTING LITERATURE – THE RANGES WERE DEVELOPED TO PROVIDE A TOOL TO GAINING A BETTER UNDERSTANDING OF POTENTIAL AREAS WITHIN SECTION 17 ELK MAY PREFER BASED ON HABITAT ATTRIBUTES PRESENT.

Habitat Classification Scheme for Section 17, Wheeler Ridge

Distance Bands/Ranges for Predicting Summer elk habitat potential within the proposed project footprint

Elk Habitat Features	**HE 0 (Low)**	**HE .5 (Medium)**	**HE 1 (High)***
Distance to Roads	1.2 miles	1.21	1.22+
Slope Facing	South-West	East	North
Slope (Degrees)	21+	12-20	0-11
Percent Canopy Cover	0-19%	20-39%	40%
Tree Stand Cover (yards)	0-99	100-199	200+

*High included optimal and preferred; medium is suitable; low is unlikely.

Results and Discussion

Results displayed in GIS by SCJ Alliance were similar to CORE GIS (2008) results (Figure 9), despite using varying habitat attributes to predict summer elk habitat potential on Section 17. Both CORE GIS (2008) and SCJ Alliance (2018) results indicate areas adjacent to roads were given a “high” valued for predicting habitat potential, however areas near roads may incorrectly depict illustrate favorable summer habitat attributes in summer months because elk are expected to avoid areas of heavy human disturbance.

The Chelan County Road is actively used year around for recreation, hunting, camping, ATVs, and mud bogging. As noted above, Rowland, M., et al. (2005) found frequency of human road use and forest canopy along roads influence elk distribution, indicating elk stress level increase

with road density and hunting pressures increases. The Colockum elk herd distribution, behavior, and stress-levels may already be negatively influenced from heavy vehicle and recreational uses on adjacent lands and from active use of the Chelan County Road. Figure 10 illustrates current motorized use roads within or adjacent to Section 17 and orchard development locations. As the map indicates, the area is currently heavily impacted by existing motorized uses and human disturbance. Removing roads would have a benefit to elk and other wildlife in Section 17.

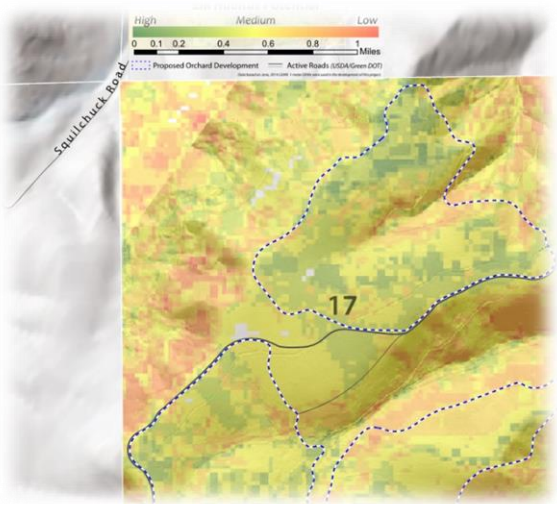

FIGURE 9. PREDICTED SUMMER ELK HABITAT POTENTIAL IN SECTION 17 IN AND OUT OF PROPOSED ORCHARD DEVELOPMENT.

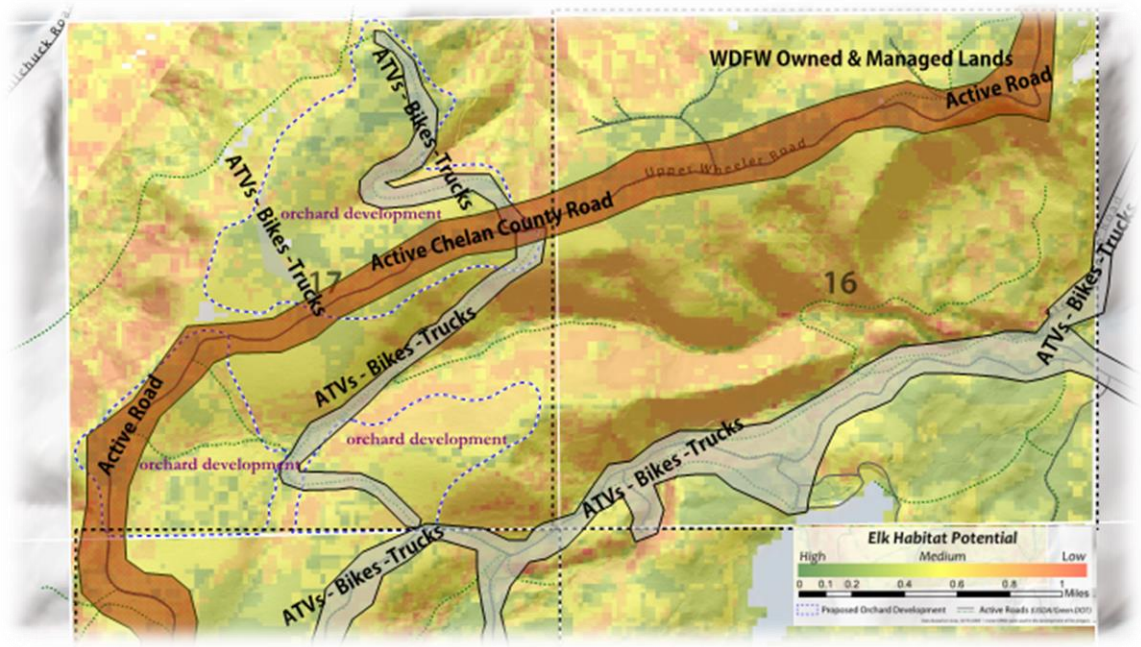

FIGURE 10. CHELAN COUNTY ROAD AND OTHER ROAD USES WITHIN PREDICTED SUMMER ELK HABITAT POTENTIAL AREAS WITHIN SECTION 17.

Habitat attributes displayed independently varied (Figures 11; 12; 13; 14). Results from habitat attributes displayed collectively are vastly different than when displayed independently (Figure 9). Association among habitat attributes, including traffic may be an important element of predictive modeling. Areas proposed in Section 17 are surrounded by heavy vehicle and recreational uses. Except for the Chelan County Road, roads within Section 17 currently being used for public recreational access will be removed, restored, and public access will be restricted. This habitat enhancement action is expected to improve habitat conditions for elk and other wildlife, as well as greatly reduce human disturbance to elk during peak vehicle and recreational uses.

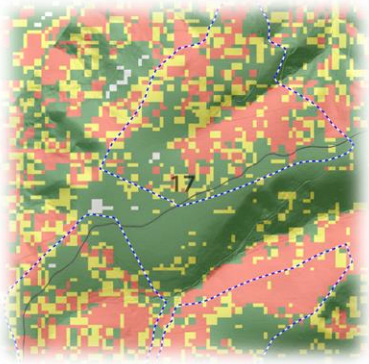

FIGURE 11. % CANOPY COVER WITHIN THE PROJECT AREA INDICATES HIGH ELK SUMMER HABITAT POTENTIAL.

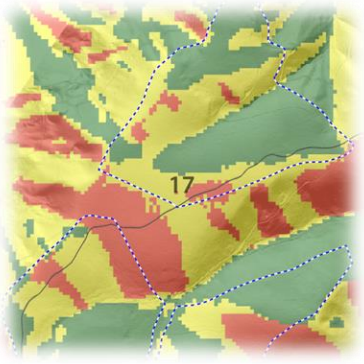

FIGURE 12. SLOPE ASPECT WITHIN THE PROJECT AREA INDICATES A RANGE OF ELK SUMMER HABITAT POTENTIAL.

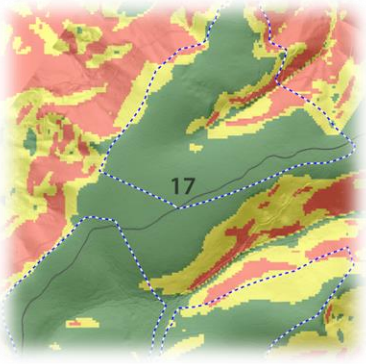

FIGURE 13. DEGREES SLOPE WITHIN THE PROJECT AREA INDICATED HIGH ELK SUMMER HABITAT POTENTIAL.

When predictive results were illustrated for low, medium, and high habitat potential with the parameter of 1.2 miles from roads, only a portion of all of Section 17 resulted in potential elk summer habitat with a valued of medium (Figure 14).

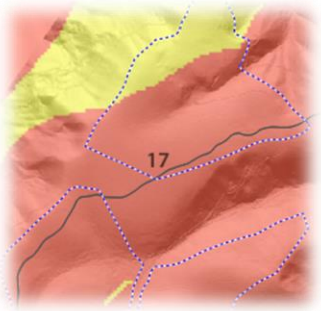

FIGURE 14. LANDS WITHIN 1.2 MILES OF A ROAD WITHIN SECTION 17.

In addition to using habitat characteristics schemes displayed in GIS to predict summer elk habitat potential in Section 17, Wheeler Ridge staff have observed elk and indications of elk presence on Section 17 and Section 16 for over 40 years of elk hunting and elk shed hunting (Figures 15; 16). Staff observations are summarized as *"In the spring time when the Bull Elk are in Section 16 and Section 17, they stay on the south side of the canyons in Section 16 and 17 in little benches about ¾ up the hillside, so the sun is shining on them. When the Bull Elk are in Section 16 and 17 they eat on the new green grass on the south side of the canyon in the spring. As it gets hotter, the Bull Elk move to the north side of the canyons in Section 16 and 17 to get shade and keep cool. The Bulls and cows move around a lot in the summer time going through Sections 9, 10, 11, 14, 15, 16, 17, 20, 21, 22 and 23. The majority of the cow Elk normally do not get into Section 17 until after calving, most of the cow Elk do their calving in sections 9, 10, 11, 14, 15, 16, 21, 22 and 23"* (S. Shiflett, 1978-2018). Compilation of data provided an improved understanding of areas within Section 17 and Section 16 elk prefer to go during spring and support months (Figure 14)

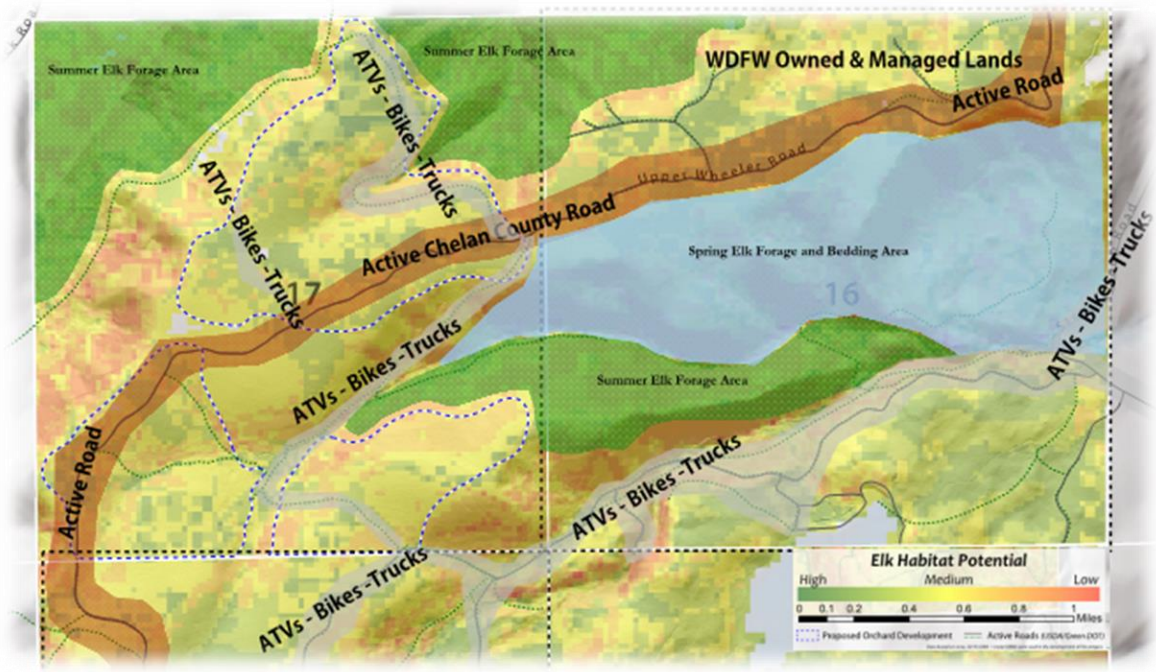

FIGURE 15. SPRING ELK FORAGE AND BEDDING AND SUMMER ELK FORAGE AREAS (SHIFILETT, 2018). PUBLIC ACCESS WILL BE RESTRICTED IN SECTION 17 TO PROTECT SPRING ELK FORAGE AND BEDDING AREAS AND SUMMER ELK FORAGE AREAS.

Shiflett (2018) has photographed elk foraging in both the spring and summer months, as well as bedding on the north facing slopes away from roads and human activity in summer months connecting Section 17 to Section 16 (Figures 16; 17).

FIGURE 16. PHOTOS OF BULL ELK ON SECTION 17 (SHIFLETT, 2017).

FIGURE 17. ELK BEDDING OBSERVED ON SECTION 16 IN SEPTEMBER OF 2018 (SHIFLETT, 2018).

Although both CORE GIS (2008) and SCJ Alliance (2018) had similar predictive habitat results, observations by staff provide field verifications of known presence of elk in spring and summer months within Section 17. Predicting summer elk habitat preference potential using GIS is a good tool gain a better understanding of where to start "looking" for elk in the absence of observational and/or radio-telemetry data. GIS predictive power using habitat attributes are constrained due to lack of understanding of how habitat attributes "associate" to indicate low, medium, and high summer elk habitat potential. Human disturbances may be the most consistent predictor of elk habitat preference, thus reducing the power of environmental variables to identify potential habitat (i.e. % canopy cover). Combing data sets or using other technologies such as Aerial drones may provide better information in the future to target specific herds behaviorally influences by its own unique set of pressures.

Summer Elk Habitat Recommendations – Enhancement, Restoration, Avoidance, Minimization, & Mitigation

The 250 acres of the 640 acres proposed for conversion to orchard development will no longer provide wildlife habitat and will be protected with an 8-foot deer fence. An element of the proposed project is to enhance and restore existing riparian wetland-meadow habitat and other habitats impacted by illegally uses, provide seasonal water to the perennial stream within the summer months, contribute to "green up" forage potential, and conserve forest tree stands for buffers and cover for wildlife (Figure 18). Habitat protection and enhancements within wildlife corridors are expected to be beneficial to wildlife and their habitat impacted from illegal access, illegal user-built roads, dispersed camping, and lack of water through summer months.

General Recommendations:

- Wheeler Ridge, LLC understands water resources are vital for elk and other wildlife during summer months. Seasonal water will be provided to the perennial stream during spring and summer moths for elk and other wildlife. Seasonal streams currently bifurcated should be conveyed back to perennial stream via an underground pipe to reduce further erosion and stream incision (Figure 19).
- It is encouraged to support additional studies and/or efforts to gain a better understanding of the Colockum Elk herd in the Stemilt Basin within the scope of orchard development on Section 17.

- It is encouraged to work collaboratively with WDFW to discuss ways to maximize benefits to elk, while simultaneously reducing human – elk conflict.
- It is recommended to continue to collect observation data, including but not limited to GPS locations, photos, and any information on duration, population, and notably resources (i.e. water availability and temperature) and share with WDFW biologists.
- Wheeler Ridge, LLC should collaborate with local, state, and federal agencies to ensure efforts to enhance and restore habitat or reduce impacts to elk from existing disturbance maximize benefits to wildlife and long-term sustainability of habitat quantity and quality.
- Public access should be restricted from Section 17 to reduce impacts that may be negatively impacting elk and other wildlife, particularly to reduce the amount of area elk are moving to avoid human disturbances.
- Wheeler Ridge, LLC should ensure all mitigation plans, restoration efforts, and improved drainage is done in consultation with permitting agencies. Including the installation of a catch basin to reduce sediment transport form seasonal streams heavily incised to the perennial stream.

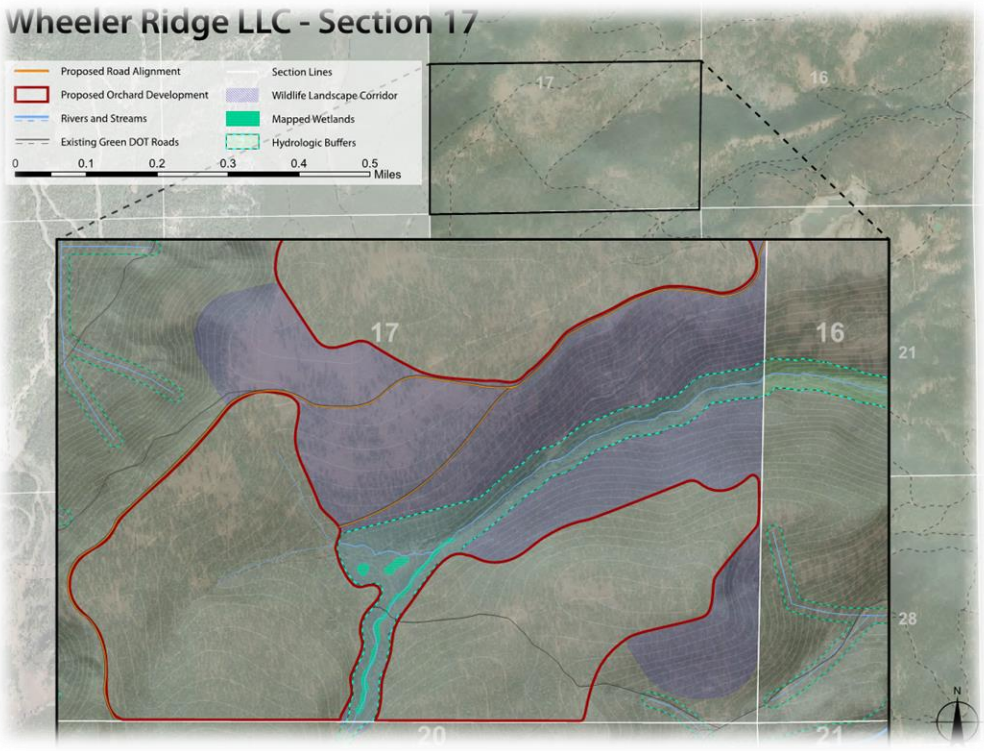

FIGURE 18. REMOVAL OF ROADS, WETLAND AND RIPARIAN BUFFERS, AND LANDSCAPE CORRIDORS FOR WILDLIFE, SECTION 17.

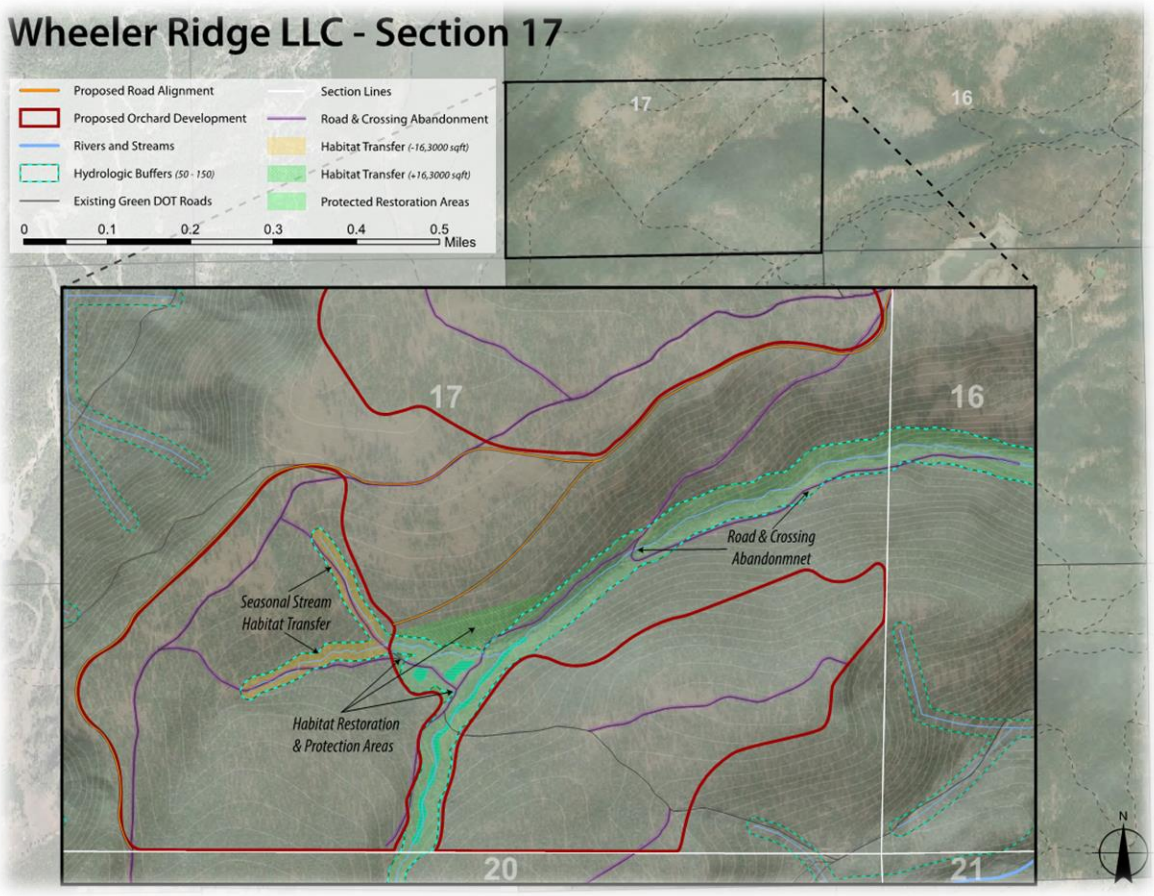

FIGURE 19. WETLAND AND STREAM BUFFERS, SEASONAL STREAM HABITAT CONVEYANCE, AND RESTORATION AREA ON SECTION 17.

Specific measures to avoid, minimize, and mitigate include the following:

- 390 acres of the 640 acres will be preserved to provide wildlife habitat and wildlife corridors to connect to larger, protected landscapes adjacent to the proposed project. The area proposed for orchard development was originally platted for residential development which would have provided minimal forest habitat for elk and other wildlife.
- Wetlands and riparian areas will be avoided by assigning standard buffers (Figure 20).
- Public access to Section 17 will be restricted to avoid further degradation of habitat currently occurring from user-built roads, mudbogging, and dispersed camping.
- New roads are not proposed within wetland or riparian buffers; old damage from user-built roads from mudbogging and dispersed camping will be repaired in consultation with permitting agencies as described below.
- An 8-foot deer fence will be installed around the orchard development to ensure wildlife are safely directed to wildlife corridors for protection and forage opportunities.
- Orchard operations are seasonal.
- Provide wildlife corridors that connect to larger habitats and concentration areas; primarily on adjacent WDFW lands purchased using Section 6 funds.
- Reduce and restore roads to habitat using native flora and restrict public access within the proposed project area.

- Reconnect seasonal streams which have been re-routed outside of its channel from user-built roads and mudbogging; replace existing culvert(s) to support this effort as determined by permitting agencies.
- Wheeler Ridge, LLC is providing wildlife corridors and seasonal water in perennial stream areas for elk and other wildlife during spring and summer months; the stream typically goes dry in late May.
- Enhance and protect wildlife access to seasonal stream and meadow habitat with forest stand buffers, critical area buffers, habitat protection signage, and restricted public access.
- Protect and restore 48 acres of wetland- meadow habitat and other habitat that has be degraded from illegal, user-built roads, mud bogging, dispersed camping, and relic logging roads.
- Wheeler Ridge, LLC will consult with WDFW wildlife biologists to ensure use of appropriate native plant species where habitat enhancements are proposed to maximize wildlife benefits/protect forage base for wildlife.
- In consultation with WDFW, restore areas to optimize “green up” areas for elk and wildlife within Section 17.

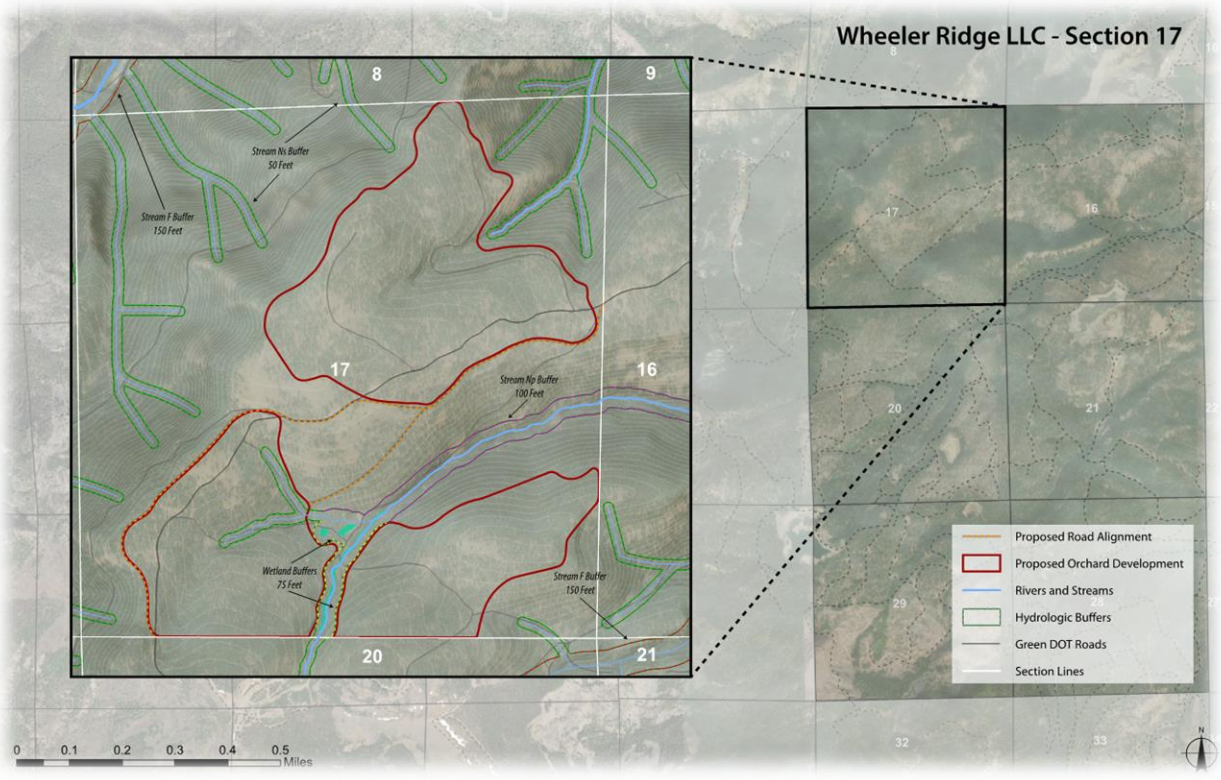

FIGURE 20. STANDARD WETLAND AND RIPARIAN BUFFERS FOR LOW-INTENSITY USE ON SECTION 17.

Future (Potential) Off-Site Mitigation Measures:
If the 250 acres planted are successful at producing fruit, Wheeler Ridge, LLC may pursue an additional 110 acres of orchard development. Wheeler Ridge, LLC intends to coordinate with WDFW to exchange 218 acres of habitat in Section 21 (owned by Wheeler Ridge LLC) (Figure 21) for 160 acres of land adjacent to other orchard development in Section 16 (owned by WDFW). Of the 160 acres proposed for a land exchange with WDFW, only 110 acres would be orchard development to provide a 50-acre buffer for wildlife. This exchange would provide 218 acres of habitat connectivity to larger, habitat concentrations in Stemilt Basin managed and owned by the State.

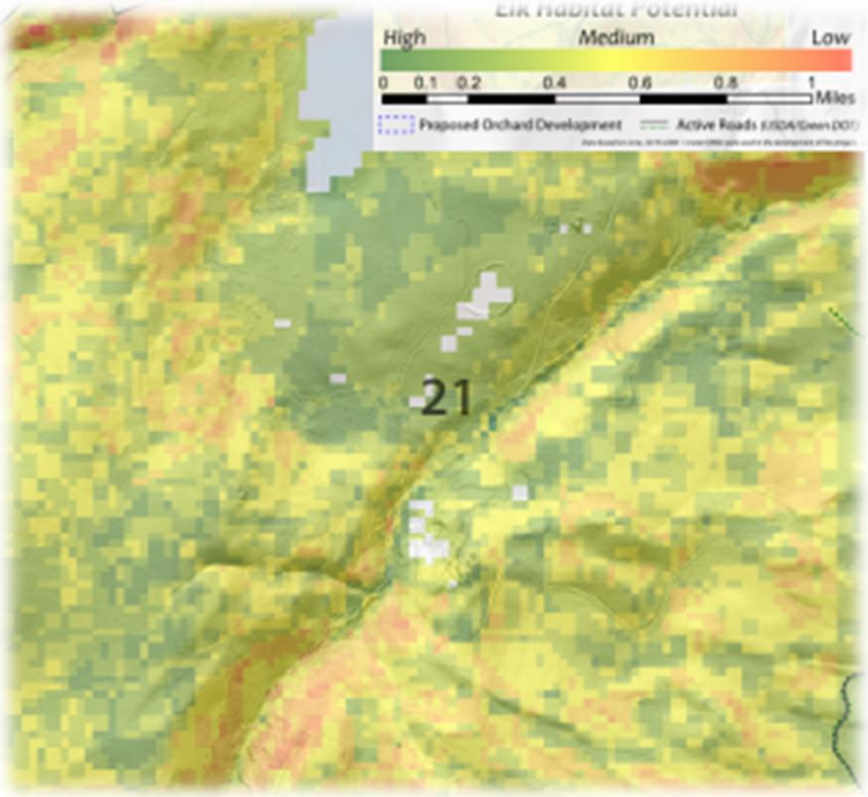

FIGURE 21. SUMMER ELK HABITAT POTENTIAL ON SECTION 21 (SCJ ALLIANCE, 2018).

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