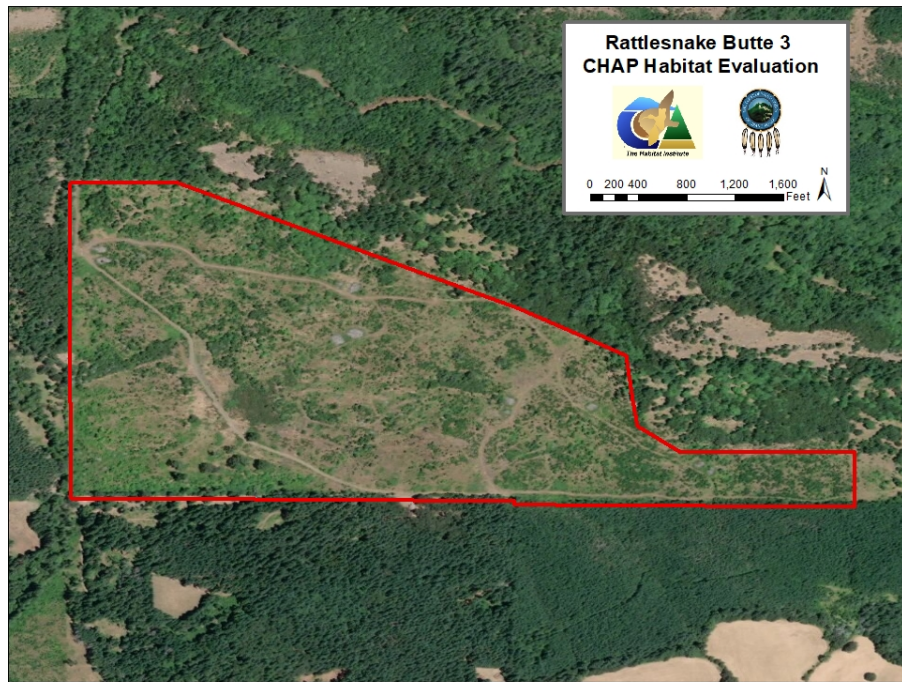# Rattlesnake Butte 3
CHAP Ecological Assessment of
Baseline and Restoration Conditions
Final Report

for
The Confederated Tribes of Grand Ronde

Report and Analysis by
The Habitat Institute

January 5, 2022

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CHAP
Habitat Assessment of
Rattlesnake Butte 3

Executive Summary

The habitat assessment of the Rattlesnake Butte 3 restoration study encompasses 173 acres (70 ha) and evaluates 20 polygons. This report discusses baseline conditions prior to any restoration activity. Baseline condition consists of three different habitat types that can describe the site, and they are Westside Oak and Dry Douglas-fir Forest and Woodlands, ponds, and Westside Grasslands. The number of fish and wildlife species that are potentially associated with the project is 191. The existing baseline conditions assessment shows a total of 2,271 habitat units for the project area.

Section I: Baseline Conditions

Introduction

In 2018, *The Habitat Institute* (THI) was contracted by the *Confederated Tribes of Grand Ronde* to assess wildlife habitat value on the Rattlesnake Butte 3 Property in Lane County, Oregon. The assessment was performed prior to any restoration actions performed on the site. The method employed to conduct the appraisal is the Combined Habitat Assessment Protocols (CHAP), which is a habitat evaluation approach that assesses wildlife habitat components at a site and is capable to render a habitat quality value for wildlife. This approach involves a triad assessment of habitat, species, and functions (O'Neil et al., 2005; O'Neil et al. 2008), and can provide assessments at multiple scales (O'Neil and Bohannon 2014). The CHAP method generates habitat units (HUs) by using a patented algorithm (O'Neil 2010) based on an assessment of multiple species (that potentially can occur at a site), habitat features, and functions by habitat type. Habitat is frequently viewed in conjunction with species information to gain insight to various uses, structures, and functions existing within a landscape or site. Determining habitat structure and functional integrity of an area is supportive of an ecosystem management approach. Habitat Units (HUs) are the currency CHAP uses to appraise habitats. Unlike many other previous efforts to calculate the fish and wildlife habitat value on a piece of land, the CHAP approach is accounting based. That is, it inventories habitat components that can be associated with species using wildlife habitat relationships to derive at an intrinsic value. Thus, it is based first and foremost on standardized field inventory of existing conditions within a framework that allows visual presentation of the information. For western Oregon, the *Integrated Biodiversity Information System* (IBIS) is the wildlife-habitat relationships database for this region.

The overall goal of the Rattlesnake Butte 3 study was to evaluate existing habitat conditions at a fine level of resolution within an ecosystem restoration context. To do this, conditions were evaluated prior to any restoration actions. An ecosystem context is more holistic than assessing just a few individual species (Perkins, 2002) especially with Federal or stated listed taxa; it calls for a multiple species framework that includes an evaluation of ecological functions. The approach reported herein depicts the wildlife habitat existing at a fine resolution or site level-scale; uses multiple species and their habitat functions in its evaluation; and accounts for actual habitat types, structural conditions and key environmental correlates within the Rattlesnake Butte 3 Area, based on a field inventory of these habitat components.

In addition to the CHAP analysis photos were taken of every polygon. Other metrics were also calculated including percent cover of grass, shrub, and tree canopies, tree species composition, down wood abundance, snag abundance, and oak abundance.

Study Site

The Habitat Institute (THI) conducted a wildlife habitat assessment at Rattlesnake Butte 3 site located in Lane County, Oregon in December 2018. The habitat assessment was conducted at the site level scale. Twenty polygons were identified within the Rattlesnake Butte project boundary (Figure 1). These polygons were determined by delineating the different habitat types that occur within the project area, which were: Westside Oak and Dry Douglas-fir Forest and Woodlands, Ponds, and Westside Grasslands (also see Appendix E Figure 1).
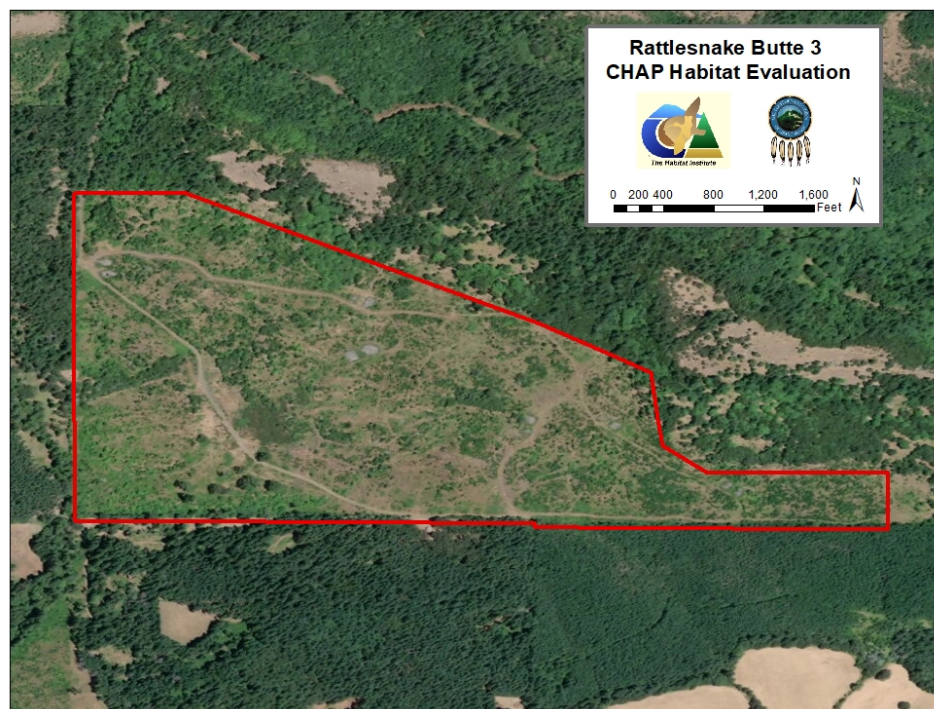
Figure 1. Rattlesnake Butte 3 CHAP Baseline Habitat Assessment Project Boundary

Methods

Existing Conditions

CHAP's habitat valuing system produces Habitat Units (HUs) for baseline and alternative future scenarios. When talking about HUs it is good to clarify (especially for a non-ecologist) that CHAP's habitat values are not the same as those obtained using USFWS's Habitat Evaluation Procedures or HEP. CHAP assesses condition and function by incorporating multiple species, habitat components and functions into the analysis. When attempting to compare HUs between CHAP and HEP one would immediately see a magnitude of higher habitat values using CHAP approach. This is because CHAP

evaluates all potential species at a site (191) not just a few, produces an unbiased habitat quality value using all potential species, habitat components and functions at a sites rather than using subjective judgement to determine habitat quality, as HEP does.

The CHAP approach is visually based because it develops maps that identify all IBIS habitat types by polygon located within the Rattlesnake Butte project boundary. Wildlife species associated with these habitat types are linked in THI's IBIS data system[1] (Johnson and O'Neil 2001) in order to establish the key environmental correlates (KECs) and key ecological functions (KEFs) for each species (for species list see Appendix A). KECs represent habitat elements (physical and biological) that are thought to most influence a species distribution, abundance, fitness, and viability. KEFs refer to the principal set of ecological roles performed by each species or correlates in its ecosystem, or the main ways organisms use, influence, and alter their biotic and abiotic environments. The KECs and KEFs are key components in determining the wildlife habitat unit values. For a more detailed background and description of the method see O'Neil (2015).

A site level-scale CHAP analysis was used to calculate the habitat value calculations for the Rattlesnake Butte polygons. The CHAP approach involves four components: 1) preliminary mapping, 2) field inventory, 3) species list, 4) data compilation and analysis, and 5) conversion to Habitat Units (HUs).

> **Preliminary Mapping:** The Rattlesnake Butte study site was refined by identifying and delineating polygons based on perceived differences in wildlife habitat types or structural conditions within a site. Habitat types were identified using visual differences in land formations, vegetation, and structural condition, as detected and interpreted in the imagery. Environmental Systems Research Institute's (ESRI) World Imagery was used for polygon identification and delineation.

> **Field Inventory:** There one field inventory (December 2018) conducted by THI staff. The first survey was to identify the baseline condition. The ocular surveys was done to: a) confirm the polygon delineations, b) identify and record habitat type, structural conditions, and key environmental correlates within each polygon, and c) note the amount of non-native plant species.

> **Species List:** IBIS database was used to produce a site-specific species list by considering ecological and geographical connections between species and the habitat types within the Study Area. Factors used to generate the species list are potential species linked to each of the habitat types and potential species linked to the Study Area based on species range maps and known existing conditions. That broad scale list was then reviewed and refined by a habitat evaluation team to create a fine scale list representative of the Study Area. The resulting species list is included (Appendix A).

> **Data Compilation and Analysis:** Data from the mapping and field inventory was used to generate two relationship matrices. The first is a potential species by function matrix and the second is a habitat by function matrix (see Figure 2). To create these matrices, the

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[1] The IBIS data system is a peer expert system that contains current ecological information on more than 1,000 fish and wildlife species.

species list was sorted by its association with the IBIS habitat types and the list of taxa was linked to their species functions or KEFs. This first matrix determines a functional per-acre value by creating a functional redundancy index (FRI), which is the mean number of species functions that are potentially performed in a habitat type within the project area. The FRI was calculated using the species list generated at the subwatershed level for the Rattlesnake Butte CHAP habitat evaluation. This species list was reviewed by Grande Ronde Tribal staff and THI.

The second matrix is based on the results of the field inventory of the project area and the list of habitat elements (KECs) observed within each CHAP polygon. The result of the second matrix is the number of species functions that are potentially supported by habitat elements (KECs) specific to that polygon. The second matrix also determines a per-acre value by creating a FRI for the site. This value reflects the mean number of species functions supported by KECs within a habitat type. The FRI was calculated using the species list generated at the watershed level for the Rattlesnake Butte CHAP habitat evaluation. This species list is reviewed by THI for obvious species that are not likely to be found in the project area.

Per-acre values were then computed for each polygon by adding the species-function matrix (FRI) value for the habitat type of the polygon and polygon specific habitat-function matrix value. In sum, for each polygon *species FRI + habitat FRI = Per-Acre Value*. The per-acre value represents the intrinsic worth of an area to fish and wildlife, determined by accounting for species, habitats, and functions. The per-acre value then was adjusted for the presence of invasive species. (For further details on the matrices see Appendix B and O'Neil 2015).

Conversion to Habitat Units (HUs): To determine HUs for a site baseline conditions, so that project alternatives can be compared and therefore inform the cost-benefit analysis, each polygon's per-acre value was multiplied by its acreage. These values were then summed across all polygons to calculate the total HUs for a particular condition or alternative scenario. In sum, for each polygon Per-Acre Value x Acres = HUs.

Figure 2. CHAP calculation to produce Functional Redundancy Value.

Results of the CHAP analysis are contained in this report, a GIS geodatabase (*RSB_3_baseline.gdb)* and Microsoft Excel spreadsheet (*RSB_3_HUs.xlsx*). GIS data fields depict the CHAP polygon ID, description, acreage, IBIS wildlife habitat type, structural condition, grass/forb invasive species, shrub invasive species, tree invasive species, CHAP invasive species deduction factors, per-acre habitat values, and Habitat Units (HUs) of each of the polygons. Supporting maps illustrate: a) Study Area boundaries; b) polygon numbering; c) per-acre habitat value (adjusted to account for invasive plant species); d) percentage of non-native plant species by polygon; and e) wildlife habitat types by polygon. The spreadsheet developed contains the CHAP habitat values and a table containing the KECs observed within each CHAP polygon.

Per-Acre Adjustment Value for Invasive Species
Within the Rattlesnake Butte 3 Project Area there is a large influence of invasive plant species. Prior to conversion to HUs, the per-acre baseline value of each polygon was adjusted based on the presence of invasive species. Each polygon was assigned an invasive plant value for each of three structural layers (grass/forb, shrub, and tree) based on the percent composition of invasive species in that layer, as documented in the field inventory. Because invasive species generally negatively influence ecosystem function, the per-acre values were then discounted for the presence of invasive plants, to arrive at a corrected per-acre value for each polygon. The value of discount applied for each layer based on presence of invasive species is described in Table 1. A deduction factor is then determined for the polygon by taking the geo-mean of the deduction factors for each of the three vegetative layers. A geo-mean is used to account for the possibility that a layer does not exist within a polygon (e.g. a polygon containing no trees). The polygon deduction factor was multiplied by the per-acre value to reach the corrected value. In sum, *per-acre value x deduction factor = corrected per-acre value*.

Table 1. Invasive species adjustment factors.

Invasive species cover	x
0-10%	1.0
11-35%	0.9
36-65%	0.7
66-90%	0.5
>90%	0.3

The invasive species cover by polygon can also be spatially displayed in a map to show their influence on the habitat value (Appendix E).

Vegetation Transects

Vegetation surveys are a further validation step that can be added to CHAP surveys to increase data confidence or to examine specific vegetation questions in greater detail. Depending on the motivation, different levels of surveys can be conducted. For this survey THI conducted shrub intercept, herbaceous plot surveys, snag intersect surveys, and percent canopy cover surveys. All of these surveys are conducted along a transect. Transects were 300' long. Four vegetation transects were conducted for the study (Appendix F). Vegetation transects were only performed for the baseline condition.

Transects are located such that they capture a stratified random sample. Transect start points are created randomly in ArcGIS, with a set number of waypoints weighted to appear in each of the desired habitat types. The number of transects depends on the level of surveying and the number of habitat types to be captured, but extra transect start points are generally created so that points can be discarded in the field if they are deemed to be poor representatives. In the field a GPS receiver is used to locate the start point to within 20 feet of accuracy. One end of the transect tape is secured, then a random azimuth is chosen. The tape is extended until the desired number of feet, or the edge of the habitat type has been reached. While extending the tape the surveyor tries to remain on the right side so as not to disturb the vegetation. Before surveying vegetation along the transect some basic transect information is recorded. This includes: UTM coordinates and accuracy according to the GPS, Random azimuth that was selected, and a brief description of the overstory, size class, canopy density, and species composition (Tables 2 and 3).

Once the transect has been established a modified line intercept technique is used when surveying for shrub canopy structure. Moving along the tape the surveyor records any shrub (up to 16 feet tall) that crosses over the transect at five foot intervals. If no shrub crosses the transect at that given interval a "miss" is recorded on the data sheet. If multiple shrubs cross the transect, they are recorded in order of height, from shortest to tallest. This helps to illustrate shrub canopy density and complexity. The results of these shrub intercept transects appear in Appendix E.

Herbaceous plot surveys are conducted along the same transect. The plot is a PVC rectangle that measures ½ meter by ½ meter a total of sample size of 1/4 meter. The plot is placed on the ground along the transect every 20 feet. The plot is then surveyed and all plant species are recorded in decreasing order of abundance. Additionally, % vegetation cover, % native vegetation, and % non-vascular vegetation are also estimated for the plot.

Percent Canopy Cover

Point Cloud LIDAR data was utilized to identify percent canopy cover for the 3 different strata of vegetation; grass/forb, shrub, and tree. Utilizing ArcGIS the percent cover was identified for the entire area and averaged for each polygon. These calculations were then verified during the field survey by visual estimate. Breakouts for the canopies were 0-1.5ft for grass/forb, 1.5-16ft for shrub, and over 16ft for trees.

Results

Wildlife Habitat Types

The 20 polygons in the Rattlesnake Butte 3 project area were determined by delineating the IBIS Habitat Types that occur within the Study Area, along with further splitting of polygons by structural condition within the same habitat type. Appendix E – Figure 1 shows a map representing the Habitat Types of each polygon.

Table 2. IBIS Habitat Types by Acreage and Proportion of Project Area

IBIS Habitat Type	Sum of Acres	Proportion of Project Area
Lakes, Rivers, Ponds, and Reservoirs	0.1	<1%
Westside Grasslands	4.1	2%
Westside Oak and Dry Douglas-fir Forest and Woodlands	167.8	97%
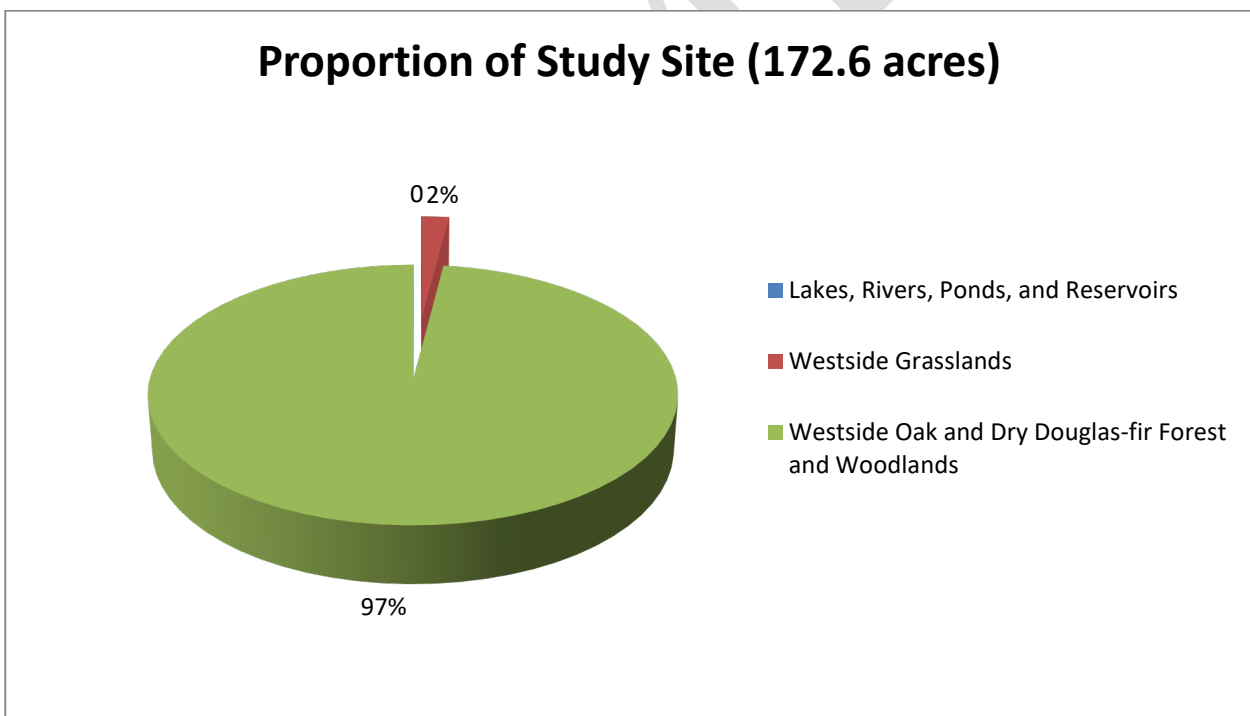
Figure 3. Proportion of Total Acreage by IBIS Habitat Type

Habitat Units

The habitat assessment shows eight habitat types currently existing within the CHAP Study Area, totaling 172.6 acres. The baseline existing condition assessment calculated that these acres have a total existing

CHAP habitat value of 2721.3 HUs. The HU value of each CHAP polygon is depicted in Appendix D, and contained in the GIS geodatabase.

Per-acre value or simply HUs/acre is a good way to compare the habitat value of CHAP polygons within the project site to see the highest and lowest functioning areas without any polygon size bias (Appendix E. Figure 2)

Table 3. Existing Conditions Average Habitat Value of Each Habitat Types.

Oregon WHR Habitat Type	Average Per-acre CHAP Habitat Value	Sum of CHAP Habitat Units (HUs)	Proportion of Total HUs
Lakes, Rivers, Ponds, and Reservoirs	14.7	1.6	0.1%
Westside Grasslands	10.1	41.2	1.5%
Westside Oak and Dry Douglas-fir Forest and Woodlands	16.0	2678.5	98.4%

Vegetation Transects

Data from vegetation transects was collected and summarized. This information is utilized to verify other information and can be used to inform management decisions. The transect data can be analyzed to create a species list for the property and to determine relative species abundance and to inform other management decisions. The results of the herbaceous plot surveys appear in Appendix F.

Table 4: Vegetation Transect Locations

Transect Start Point Location		
Transect	**UTM 10 Coordinates**	**Azimuth**
301	UTM 0473040, 4900796	63 Degrees
302	UTM 0472942, 4901141	340 Degrees
303	UTM 0473551, 4901011	270 Degrees
304	UTM 0473963, 4900895	340 Degrees

Percent Canopy Cover

Average canopy cover was calculated per polygon (table 5) along with calculating canopy cover on a 5 meter grid. Maps showing both calculations can be found in Appendix E, Figure 6 & 7.

Table 5: Percent Canopy Cover

Polygon ID	Percent Grass/Forb Canopy Cover	Percent Shrub Canopy Cover	Percent Tree Canopy Cover
RSB_301	66%	10%	13%
RSB_302	57%	27%	43%
RSB_303	61%	9%	28%
RSB_304	62%	13%	30%
RSB_305	64%	18%	14%
RSB_307	27%	24%	87%
RSB_308	51%	31%	52%
RSB_309	77%	4%	1%
RSB_310	56%	36%	44%
RSB_311	60%	26%	26%
RSB_312	35%	55%	86%
RSB_313	63%	16%	19%
RSB_314	54%	14%	33%
RSB_315	65%	11%	25%
RSB_316	66%	10%	8%
RSB_317	68%	6%	2%
RSB_318	68%	17%	29%
RSB_319	61%	15%	29%
RSB_301A	64%	14%	4%
RSB_306	57%	35%	16%

Additional Metrics

Additional metrics including tree species composition, invasive shrub composition, amount of and size of down wood, and percent native vegetation can be found in the excel file RSB_3_data.xlsx.

Section II: Restoration

Introduction

After the baseline conditions were evaluated restoration of the Rattlesnake Butte 3 site began. Restoration occurred in many of the areas studied in the baseline condition period. The treatment for the area involved removing non-native shrubs and trees and removal of some established trees and saplings. Details for specific treatments can be found in the Rattlesnake Butte 3 Wildlife Area Site Management Plan (CTGR 2018).

Evaluation of restoration occurred at two different times. In 2019 an assessment was done of restoration activities up to that point in time. In 2021 the entire area was assessed again to capture additional restoration activities that occurred after the 2019 assessment. The area assessed in 2021 was larger than the 2019 area, however all areas assessed in 2019 were within the 2021 area and are included in the 2021 results.

Methods

CHAP per acre habitat values for each polygon are derived by summing two matrices: a species/function matrix that relates all potential species at a site to the Key Ecological Functions (KEFs) provided by those species and the ecology of a site; and a habitat/function matrix which relates the Key Environmental Correlates (KECs) to the KEFs. Species/function matrix values are altered when the species list changes or there is a conversion of habitat type. Habitat/function values are altered when KECs are added or removed. This allows analysis of habitat value for all above ground ecology.

There was no change to the species list for this project. Based on the specific area of restoration different changes were input into CHAP. The main change was a reduction in the invasive shrub adjustment. This change can be seen in the maps in Appendix E. The reduction in the invasives creates an increase in HUs. There was an increase in KECs in some of the polygons which also accounted for an increase in Hus. There were two different habitat types in the restoration area, Westside Oak and Dry Douglas-fir Forest & Woodlands and Westside Grasslands. There was a habitat type change in some of the Westside Oak and Dry Douglas-fir Forest & Woodlands to Westside Grasslands and there was no habitat change for the Westside Grasslands. Both habitat types had reductions in invasive species. The largest change was based on the thinning and removal of shrubs and trees, with an additional change based on herbicide application leading to a reduction in invasive shrubs and grasses/forbs. The IBIS database contains data connecting management activities to changes in KECs. This data is from peer reviewed sources and has been reviewed. There was an increase in KECs in some of the polygons which also accounted for an increase in HUs. Based on the restoration activities the selected KECs were also input into CHAP. These included KECs such as down wood, snags, seedlings, etc.

Post Restoration Assumptions

It is assumed that the removal of invasive plants will be maintained. In some areas it is likely that the invasives will naturally grow back. Without continued management the wildlife habitat value could decrease.

Comparison to Baseline Habitat Value

CHAP is spatially based, and ties to GIS. Data is input based on field surveys and KECs were applied based on the survey and IBIS management activity links. Species/function matrix and Habitat/function matrix

values can then be calculated for each polygon, allowing the calculation of CHAP HUs for the spatial extent of the restoration.

Once the post restoration Habitat Units have been calculated, comparing those values to the baseline values is a simple exercise in ArcGIS. The *Clip* analysis tool is used to cut the baseline GIS layer to the exact extent of the alternative layer. Once that is complete the acres field is recalculated for each polygon within the baseline layer. Finally the acres field is multiplied by the per-acre value field to obtain updated baseline habitat values based on the exact extent of the restoration alternative being evaluated.

Adjustment Value for Invasive Species
Prior to conversion to HUs, the per-acre baseline value of each polygon was adjusted based on the presence of invasive species. Each polygon was assigned an invasive plant value for each of three structural layers (grass/forb, shrub, and tree) based on the percent composition of invasive species in that layer, as documented in the field inventory. Because invasive species generally negatively influence ecosystem function, the per-acre values were then discounted for the presence of invasives, to arrive at a corrected per-acre value for each polygon. The value of discount applied for each layer based on presence of invasive species is described in Table 6. A deduction factor is then determined for the polygon by taking the geo-mean of the deduction factors for each of the three vegetative layers. A geo-mean is used to account for the possibility that a layer does not exist within a polygon (e.g. a polygon containing no trees). The polygon deduction factor was multiplied by the per-acre value to reach the corrected value. In sum, per-acre value x deduction factor = corrected per-acre value.

Table 6. Invasive species adjustment factors.

Invasive species cover	x
0-10%	1.0
11-35%	0.9
36-65%	0.7
66-90%	0.5
>90%	0.3

Results

2019 Assessment

Wildlife Habitat Types
8 Polygons were identified within the restoration areas for the Rattlesnake Butte project area. There was a varying degree of restoration in these polygons so they were sub-divided into 12 polygons to better evaluate the restoration. Of the 8 polygons 1 had a habitat type change from Westside Oak and Dry Douglas-fir Forest & Woodlands to Westside Grasslands. The other polygons remained their baseline habitat type. The acreage by habitat type and restoration area is shown in table 7. Appendix E contains maps representing the Habitat types of each polygon.

Table 7. IBIS Habitat Types by Acreage and Proportion of Restoration area.

IBIS Habitat Type / Restoration Area	Sum of Acres	Proportion of Restoration Area
Westside Oak and Dry Douglas-fir Forest & Woodlands / oak release	84.5	93%
Westside Grasslands / oak release	5.9	7%

Habitat Units
The entire restoration area had an increase in Habitat Units. The increase can be attributed to a decrease in invasive plants and an increase in structural elements. To easily understand the increase in HUs it is beneficial to review both the per-acre increase and the overall increase in HUs. These increases are shown in Table 8, on maps in Appendix C, and are contained in the GIS Geodatabase. Appendix E contains maps representing the per-acre value and HU increase of each polygon.

Table 8. Habitat Unit (HU) Increase

Restoration Area	Average Per-acre CHAP Habitat Value	Sum of CHAP Habitat Units (HUs)	Average Per Acre HU Increase	HU Increase	Percent Increase
Rattlesnake Butte 3	16.8	1573.9	2.2	296.8	23%

2021 Assessment

Wildlife Habitat Types

13 Polygons were identified within the restoration areas for the Rattlesnake Butte project area. There was a varying degree of restoration in these polygons so they were sub-divided into 23 polygons to better evaluate the restoration. Of the 23 polygons 1 had a habitat type change from Westside Oak and Dry Douglas-fir Forest & Woodlands to Westside Grasslands. The other polygons remained their baseline habitat type. The acreage by habitat type and restoration area is shown in table 9. Appendix E contains maps representing the Habitat types of each polygon.

Table 9. IBIS Habitat Types by Acreage and Proportion of Restoration area.

IBIS Habitat Type / Restoration Area	Sum of Acres	Proportion of Restoration Area
Westside Oak and Dry Douglas-fir Forest & Woodlands / oak release	123.3	95%
Westside Grasslands / oak release	6.9	5%

Habitat Units

The entire restoration area had an increase in Habitat Units. The increase can be attributed to a decrease in invasive plants and an increase in structural elements. To easily understand the increase in HUs it is beneficial to review both the per-acre increase and the overall increase in HUs. These increases are shown in Table 10, on maps in Appendix C, and are contained in the GIS Geodatabase. Appendix E contains maps representing the per-acre value and HU increase of each polygon.

Table 10. Habitat Unit (HU) Increase

Restoration Area	Average Per-acre CHAP Habitat Value	Sum of CHAP Habitat Units (HUs)	Average Per Acre HU Increase	HU Increase	Percent Increase
Rattlesnake Butte 3	23.3	3029.0	8.6	1122.2	59%

Citations

Johnson, D. H., and T.A. O'Neil, (managing directors). 2001. Wildlife-Habitat Relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR. pp. 736

Mayer, K.E., W. Laudenslayer (editors). 1988. A guide to Wildlife Habitats of California. California Department of Forestry and Fire Protection. Sacramento, CA. pp.166.

O'Neil, T. 2015. General Documentation Combined Habitat Assessment Protocols (CHAP) – A Biodiversity Accounting & Valuing System. Northwest Habitat Institute, Corvallis, OR. 50 pp.

O'Neil, T., and J. Bohannon. 2014. Conservation Framework and Assessment. Southern California Association of Governments. Los Angeles, CA. 126 pp.

O'Neil, T. 2010. System for Assessing Habitat Value, Patent No. US 7,681,531. Office of Patents and Trademarks, Washington, DC.

O'Neil, T.A., C. Langhoff, and A. Johnson. 2008. Mapping with a Consistent Wildlife Habitat Classification to Improve Transportation & Conservation Planning. Transportation Research Record: Journal of the Transportation Research Board, No. 2058 - Environment and Energy, Transportation Research Board of the National Academies, Washington D.C. pp. 115-124.

O'Neil, T., B.G. Marcot, and P. Paquet. 2005. The habitat-species-function triad: a planning framework for ecoprovinces and subbasins. Northwestern Naturalist, 86(2): 111.

Perkins, J.P. Like a cool drink of water. Conservation Biology, 16(3):852-853. USACE. 1999. Pamphlet No. 1165-2-502 30 September 1999, Water Resources Policies and Authorities Ecosystem Restoration Supporting Policy Information.

Appendix A: CHAP Assumptions

Purpose: CHAP's foundation comes from the concept and application of wildlife-habitat relationships, whereby, species information can be linked to wildlife habitat types, structural conditions, and management activities. CHAP is backed by an extensive fish and wildlife information system but also can rely on and utilize other information at hand. CHAP should be viewed as a comparative tool that can evaluate different baseline and future restoration actions and can produce outputs that are meaningful to management. The CHAP metric produces species functional redundancy values that can be viewed as an indicator of the overall integrity of the ecosystem being assessed. CHAP method also offers a common basis for habitat evaluation by providing an explicit and repeatable approach to evaluating functional patterns of species and communities, and their potential influences from management activities. Thus, CHAP can deliver an assessment of both impacts (debiting) and enhancements (crediting) that can be used in the planning and regulatory process.

Strengths: The strengths of CHAP are that it provides an ecosystem scale approach that is capable of: a) including both fish and wildlife species, b) applying to all habitats at a site, c) evaluating multiple species concurrently, d) generating a functional assessment, e) determining baseline conditions, f) being spatially explicit, and, g) evaluating multiple management actions so various future conditions could be assessed. By doing this, CHAP allows us to evaluate different management options from an ecosystem perspective rather than single-species management. CHAP is best viewed as an accounting system that derives a functional assessment based on the potential (and actual if known) species, known habitat components and associated functions that can occur at a site or area.

What CHAP is:

A tool to evaluate habitat and restoration alternatives coming from a community ecology perspective thereby evaluates 100s of species, habitat components, and function concurrently.

A method that looks through the eyes and lives of fish and wildlife to determine an ecological value for habitat.

A method based on the premise that higher functional redundancy is directly related to higher resiliency.

Maps an area or site by delineating polygons based on their habitat type and structural condition;

Uses state or regional peer reviewed species range maps to initially determine a species list; this list is reviewed by local state, federal, tribal and interested stakeholders for appropriateness and linked to appropriate habitat types associated with a site or area; this produces a presence/absence species list for the site;

Does field inventory of a site or area to confirm habitat type(s), structural condition(s) and key environmental correlates (fine featured habitat elements) for each polygon;

Records percent species composition of invasive plants within a polygon because of their ability to reduce diversity and prevent complete use of a site or area by species;

Discounts the functional per-acre value score for invasive plant species based on there percent composition within a polygon;

Determines a new dimension of performance based on the functional redundancy of species and habitat components (KECs) to support species functions; the metric is derived by combining the species matrix with the habitat matrix to produce a per-acre value;

Presents baseline values for species and concerns along with how they are influenced by different alternative management scenarios;

Functional redundancy per-acre value is a metric that is developed absence of size, whereby smaller areas can have higher values than larger areas, and can allow for smaller areas to have higher value when size is accounted for as well.

What CHAP is not:

CHAP's functional assessment does not identify every specific functional trait of a species, but only the key ones. The term key ecological functions (KEFs) refer to the principal set of ecological roles performed by each species in its ecosystem that is the main ways organisms use, influence, and alter their biotic and abiotic environments;

Species functions are generally categorical and thereby overlap with other species;

Species abundance is not included into the functional assessment because restoration is habitat based not species abundance based; species abundance information is not available for most projects; abundance information is usually single species driver and CHAP is a multi-species approach. If the user has abundance data then it can be included like it was in San Francisco Bay. If the user desires an empirical based abundance metric, then the user may want to look at another approach;

CHAP is not designed or intended to qualify the total frequency, rate or abundance of ecological functional activities (i.e. total number of seeds dispersed per unit time and unit area summed over all individual organisms performing this function);

CHAP's key ecological functions have two categories that need strengthening and they are nutrient cycling relations and disease vector;

CHAP does not deal with nonlinear relationships;

CHAP matrices are developed on potential occurrence so functional redundancy values may error on the side of commission of functions rather than omission;

CHAP does not include plant functions but rather the ecological analyses are based on wildlife-habitat relationships and how plants or vegetation types contribute to species, and the functions they provide. If plant functions are desired, this is currently a limitation;

CHAP Assumptions:

Species presence/absence information is presented on face value (1 – present/ 0- absent) (it should not be viewed as a weighting scheme);

Species list are for the potential occurrence of those species to be present within the habitat, it does not rely on actual occurrence data unless available;

Current unoccupied species habitat within a watershed may have the potential to be occupied in the future; thereby it is counted as though it was occupied;

Management alternatives assume that they are unlikely to change the relative contribution of plant functions;

Functional redundancy per-acre value is a performance metric that represent the ecological integrity or health of a site.

Management alternative assessments assume all performance measures are met and that adaptive management strategies will be incorporate to meet the restoration management goals through time.

With a greater composition of invasive plant species comes a greater loss of native biodiversity and species utilization of fine featured habitat components that result in a loss of potential functions performed or supported at a site.

Appendix B: Species List

Rattlesnake Butte
CHAP Habitat Evaluation
Potential Species List (191 Total)

Common Name	Scientific Name
Oregon chub	Oregonichthys crameri
Longnose sucker	Catostomus catostomus
Green sturgeon	Acipenser medirostris
White sturgeon	Acipenser transmontanus
Mountain whitefish	Prosopium williamsoni
Rainbow trout	Oncorhynchus mykiss gairdneri
Westslope Cutthroat trout	Oncorhynchus clarki lewisi
Coastal Cutthroat trout	Oncorhynchus clarki clarki
Coho salmon	Oncorhynchus kisutch
Northwestern Salamander	Ambystoma gracile
Long-toed Salamander	Ambystoma macrodactylum
Rough-skinned Newt	Taricha granulosa
Ensatina	Ensatina eschscholtzii
Clouded Salamander	Aneides ferreus
Pacific Chorus Frog	Pseudacris regilla
Bullfrog	Rana catesbeiana
Snapping Turtle	Chelydra serpentina
Painted Turtle	Chrysemys picta
Western Pond Turtle	Clemmys marmorata
Northern Alligator Lizard	Elgaria coerulea
Southern Alligator Lizard	Elgaria multicarinata
Western Fence Lizard	Sceloporus occidentalis
Western Skink	Eumeces skiltonianus
Rubber Boa	Charina bottae
Racer	Coluber constrictor
Sharptail Snake	Contia tenuis
Ringneck Snake	Diadophis punctatus
Gopher Snake	Pituophis catenifer
Northwestern Garter Snake	Thamnophis ordinoides
Common Garter Snake	Thamnophis sirtalis
Western Rattlesnake	Crotalus viridis
Great Blue Heron	Ardea herodias
Green Heron	Butorides virescens
Turkey Vulture	Cathartes aura
Canada Goose	Branta canadensis
Western Canada Goose	Branta canadensis moffitti
Wood Duck	Aix sponsa
Mallard	Anas platyrhynchos
Blue-winged Teal	Anas discors
Cinnamon Teal	Anas cyanoptera
Green-winged Teal	Anas crecca
Hooded Merganser	Lophodytes cucullatus
Common Merganser	Mergus merganser
Osprey	Pandion haliaetus

White-tailed Kite	**Elanus leucurus**
Bald Eagle	**Haliaeetus leucocephalus**
Northern Harrier	**Circus cyaneus**
Sharp-shinned Hawk	**Accipiter striatus**
Cooper's Hawk	**Accipiter cooperii**
American Kestrel	**Falco sparverius**
Ring-necked Pheasant	**Phasianus colchicus**
Blue Grouse	**Dendragapus obscurus**
Wild Turkey	**Meleagris gallopavo**
California Quail	**Callipepla californica**
Virginia Rail	**Rallus limicola**
Sora	**Porzana carolina**
American Coot	**Fulica americana**
Killdeer	**Charadrius vociferus**
Spotted Sandpiper	**Actitis macularia**
Rock Dove	**Columba livia**
Mourning Dove	**Zenaida macroura**
Barn Owl	**Tyto alba**
Western Screech-owl	**Otus kennicottii**
Great Horned Owl	**Bubo virginianus**
Northern Pygmy-owl	**Glaucidium gnoma**
Spotted Owl	**Strix occidentalis**
Barred Owl	**Strix varia**
Short-eared Owl	**Asio flammeus**
Northern Saw-whet Owl	**Aegolius acadicus**
Common Nighthawk	**Chordeiles minor**
Common Poorwill	**Phalaenoptilus nuttallii**
Vaux's Swift	**Chaetura vauxi**
Anna's Hummingbird	**Calypte anna**
Rufous Hummingbird	**Selasphorus rufus**
Acorn Woodpecker	**Melanerpes formicivorus**
Red-breasted Sapsucker	**Sphyrapicus ruber**
Downy Woodpecker	**Picoides pubescens**
Hairy Woodpecker	**Picoides villosus**
Northern Flicker	**Colaptes auratus**
Pileated Woodpecker	**Dryocopus pileatus**
Olive-sided Flycatcher	**Contopus cooperi**
Western Wood-pewee	**Contopus sordidulus**
Willow Flycatcher	**Empidonax traillii**
Pacific-slope Flycatcher	**Empidonax difficilis**
Western Kingbird	**Tyrannus verticalis**
Cassin's Vireo	**Vireo cassinii**
Hutton's Vireo	**Vireo huttoni**
Warbling Vireo	**Vireo gilvus**
Red-eyed Vireo	**Vireo olivaceus**
Blue Jay	**Cyanocitta cristata**
Western Scrub-Jay	**Aphelocoma californica**
American Crow	**Corvus brachyrhynchos**
Horned Lark	**Eremophila alpestris**
Purple Martin	**Progne subis**
Northern Rough-winged Swallow	**Stelgidopteryx serripennis**
Black-capped Chickadee	**Poecile atricapillus**
Chestnut-backed Chickadee	**Poecile rufescens**

Bushtit	Psaltriparus minimus
Red-breasted Nuthatch	Sitta canadensis
White-breasted Nuthatch	Sitta carolinensis
Brown Creeper	Certhia americana
House Wren	Troglodytes aedon
Winter Wren	Troglodytes troglodytes
Marsh Wren	Cistothorus palustris
American Dipper	Cinclus mexicanus
Golden-crowned Kinglet	Regulus satrapa
Western Bluebird	Sialia mexicana
Townsend's Solitaire	Myadestes townsendi
Swainson's Thrush	Catharus ustulatus
Wrentit	Chamaea fasciata
European Starling	Sturnus vulgaris
Cedar Waxwing	Bombycilla cedrorum
Orange-crowned Warbler	Vermivora celata
Yellow Warbler	Dendroica petechia
Yellow-rumped Warbler	Dendroica coronata
Black-throated Gray Warbler	Dendroica nigrescens
Hermit Warbler	Dendroica occidentalis
Common Yellowthroat	Geothlypis trichas
Wilson's Warbler	Wilsonia pusilla
Yellow-breasted Chat	Icteria virens
Western Tanager	Piranga ludoviciana
Chipping Sparrow	Spizella passerina
Vesper Sparrow	Pooecetes gramineus
Savannah Sparrow	Passerculus sandwichensis
Song Sparrow	Melospiza melodia
White-crowned Sparrow	Zonotrichia leucophrys
Dark-eyed Junco	Junco hyemalis
Black-headed Grosbeak	Pheucticus melanocephalus
Lazuli Bunting	Passerina amoena
Red-winged Blackbird	Agelaius phoeniceus
Western Meadowlark	Sturnella neglecta
Brewer's Blackbird	Euphagus cyanocephalus
Brown-headed Cowbird	Molothrus ater
Bullock's Oriole	Icterus bullockii
Purple Finch	Carpodacus purpureus
House Finch	Carpodacus mexicanus
Red Crossbill	Loxia curvirostra
Pine Siskin	Carduelis pinus
Lesser Goldfinch	Carduelis psaltria
American Goldfinch	Carduelis tristis
Evening Grosbeak	Coccothraustes vespertinus
House Sparrow	Passer domesticus
Baird's Shrew	Sorex bairdi
Shrew-mole	Neurotrichus gibbsii
Townsend's Mole	Scapanus townsendii
Coast Mole	Scapanus orarius
California Myotis	Myotis californicus
Yuma Myotis	Myotis yumanensis
Little Brown Myotis	Myotis lucifugus
Long-legged Myotis	Myotis volans

Fringed Myotis	**Myotis thysanodes**
Long-eared Myotis	**Myotis evotis**
Northern Long-eared Myotis	**Myotis septentrionallis**
Silver-haired Bat	**Lasionycteris noctivagans**
Big Brown Bat	**Eptesicus fuscus**
Townsend's Big-eared Bat	**Corynorhinus townsendii**
Brush Rabbit	**Sylvilagus bachmani**
Eastern Cottontail	**Sylvilagus floridanus**
Snowshoe Hare	**Lepus americanus**
Black-tailed Jackrabbit	**Lepus californicus**
Mountain Beaver	**Aplodontia rufa**
Townsend's Chipmunk	**Tamias townsendii**
California Ground Squirrel	**Spermophilus beecheyi**
Western Pocket Gopher	**Thomomys mazama**
Camas Pocket Gopher	**Thomomys bulbivorus**
American Beaver	**Castor canadensis**
Deer Mouse	**Peromyscus maniculatus**
Dusky-footed Woodrat	**Neotoma fuscipes**
Bushy-tailed Woodrat	**Neotoma cinerea**
Western Red-backed Vole	**Clethrionomys californicus**
White-footed Vole	**Phenacomys albipes**
Red Tree Vole	**Phenacomys longicaudus**
Gray-tailed Vole	**Microtus canicaudus**
Townsend's Vole	**Microtus townsendii**
Long-tailed Vole	**Microtus longicaudus**
Creeping Vole	**Microtus oregoni**
Muskrat	**Ondatra zibethicus**
Norway Rat	**Rattus norvegicus**
House Mouse	**Mus musculus**
Pacific Jumping Mouse	**Zapus trinotatus**
Common Porcupine	**Erethizon dorsatum**
Nutria	**Myocastor coypus**
Coyote	**Canis latrans**
Raccoon	**Procyon lotor**
Ermine	**Mustela erminea**
Mink	**Mustela vison**
Western Spotted Skunk	**Spilogale gracilis**
Northern River Otter	**Lutra canadensis**
Bobcat	**Lynx rufus**
Roosevelt Elk	**Cervus elaphus roosevelti**
Black-tailed Deer	**Odocoileus hemionus columbianus**

Relationship Matrix Descriptions

MATRIX 1: Potential Species by Function Matrix

The potential species list generated by IBIS (see Appendix A) is aligned with Key Ecological Functions (KEFs) that could potentially be performed in the habitat type and structural condition represented by the polygon. For example, if the polygon represents a "shrub-steppe" habitat type, the KEFs thought to be performed in that habitat type by the potential species are included in the relationship matrix. This information is acquired from IBIS. The result of this matrix is the number of potential species performing key functions in that habitat type. Example follows:

Valley Foothill Riparian Habitat Type *Species Value (Potential)*	Function 1 *Secondary Consumer*	Function 2 *Breaks up Down Wood*	Function 3 *Primary Excavator*	Function 4 *Eats Terrestrial Insects*
Downey Woodpecker	0	1	1 (tree)	1
Bobcat	1	0	0	0
Belted Kingfisher	1	0	1 (burrows)	1
Great Blue Heron	1	0	0	1

MATRIX 2: Actual KEC by Function Matrix

In this matrix, the functions, or KEFs, are again related to Key Environmental Correlates (KECs), but this time the KECs are those actually present at the site (based on field data inventory). Because this is an actual account, those KEFs not correlated to an actual KEC are then removed. The result of this matrix is the number of KEFs characterized by KECs specific to that polygon. Example follows:

Valley Foothill Riparian Habitat Type *KEC Value (Potential)*	Function 1 *Creates Snags*	Function 2 *Breaks up Down Wood*	Function 3 *Primary Excavator*	Function 4 *Eats Terrestrial Insects*
KEC 1 down wood	0	1	0	1
KEC 2 snags	1	0	1	1
KEC 3 tree cavities	1	1	1	1
KEC 4 hollow living trees	0	1	0	1

Appendix D: CHAP Habitat Values by Polygon

(Specific locations of CHAP polygons can be obtained from the GIS geodatabase)

Table 1. Baseline Values

Polygon ID	Habitat Type	Acres	HUs
RSB_301	Westside Oak and Dry Douglas-fir Forest & Woodlands	67.6	994.8
RSB_302	Westside Oak and Dry Douglas-fir Forest & Woodlands	2.8	36.6
RSB_303	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.2	12.5
RSB_304	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.7	21.4
RSB_305	Westside Oak and Dry Douglas-fir Forest & Woodlands	33.2	664.5
RSB_307	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.3	29.8
RSB_308	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.6	38.0
RSB_309	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.8	17.0
RSB_310	Westside Oak and Dry Douglas-fir Forest & Woodlands	2.3	40.1
RSB_311	Westside Oak and Dry Douglas-fir Forest & Woodlands	3.4	64.7
RSB_312	Westside Oak and Dry Douglas-fir Forest & Woodlands	6.1	124.2
RSB_313	Westside Oak and Dry Douglas-fir Forest & Woodlands	3.9	47.3
RSB_314	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.8	33.3
RSB_315	Westside Oak and Dry Douglas-fir Forest & Woodlands	2.3	31.0
RSB_316	Westside Oak and Dry Douglas-fir Forest & Woodlands	9.5	115.0
RSB_317	Westside Oak and Dry Douglas-fir Forest & Woodlands	19.9	255.3
RSB_318	Westside Oak and Dry Douglas-fir Forest & Woodlands	0.7	10.6
RSB_319	Westside Oak and Dry Douglas-fir Forest & Woodlands	7.3	142.3
RSB_301A	Westside Grasslands	4.1	41.2
RSB_306	Lakes, Rivers, Ponds, and Reservoirs	0.1	1.6

Table 2. 2019 Post Restoration Values

Polygon ID	Habitat Type	Acres	HUs
RSB_301-L	Westside Oak and Dry Douglas-fir Forest & Woodlands	51.8	959.8
RSB_308-L	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.6	39.4
RSB_309-VL	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.8	25.4
RSB_313-L	Westside Oak and Dry Douglas-fir Forest & Woodlands	3.9	61.7
RSB_315-M	Westside Oak and Dry Douglas-fir Forest & Woodlands	2.3	39.0
RSB_305-L	Westside Oak and Dry Douglas-fir Forest & Woodlands	6.5	133.8
RSB_301-M	Westside Oak and Dry Douglas-fir Forest & Woodlands	12.1	224.8
RSB_301-VL	Westside Oak and Dry Douglas-fir Forest & Woodlands	0.5	9.1
RSB_301A-M	Westside Grasslands	1.2	18.0
RSB_317-M	Westside Grasslands	2.8	41.1
RSB_301A-L	Westside Grasslands	1.5	19.4
RSB_301AVL	Westside Grasslands	0.3	3.5

Table 3. 2021 Post Restoration Values

Polygon ID	Habitat Type	Acres	HUs
RSB_301_LR	Westside Oak and Dry Douglas-fir Forest & Woodlands	51.8	1353.9
RSB_301_MR	Westside Oak and Dry Douglas-fir Forest & Woodlands	12.1	317.1
RSB_301_VLR	Westside Oak and Dry Douglas-fir Forest & Woodlands	0.5	12.9
RSB_301A_LR	Westside Grasslands	1.5	24.5
RSB_301A_MR	Westside Grasslands	1.2	20.1
RSB_301AR	Westside Grasslands	1.0	15.6
RSB_301AVLR	Westside Grasslands	0.3	4.4
RSB_301R	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.5	37.9
RSB_302R	Westside Oak and Dry Douglas-fir Forest & Woodlands	0.6	8.8
RSB_303R	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.2	14.0
RSB_304R	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.7	23.9
RSB_305_LR	Westside Oak and Dry Douglas-fir Forest & Woodlands	6.5	149.6
RSB_305R	Westside Oak and Dry Douglas-fir Forest & Woodlands	8.2	189.1
RSB_307R	Westside Oak and Dry Douglas-fir Forest & Woodlands	0.9	22.5
RSB_308_LR	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.6	39.4
RSB_309_VLR	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.8	32.4
RSB_310R	Westside Oak and Dry Douglas-fir Forest & Woodlands	2.3	51.9
RSB_313_LR	Westside Oak and Dry Douglas-fir Forest & Woodlands	3.9	75.0
RSB_315_MR	Westside Oak and Dry Douglas-fir Forest & Woodlands	2.3	47.5
RSB_316R	Westside Oak and Dry Douglas-fir Forest & Woodlands	9.5	181.6
RSB_317_M2R	Westside Oak and Dry Douglas-fir Forest & Woodlands	1.9	37.2
RSB_317_MR	Westside Grasslands	2.8	50.6
RSB_317R	Westside Oak and Dry Douglas-fir Forest & Woodlands	15.2	320.2

Appendix E: CHAP Habitat Evaluation Maps
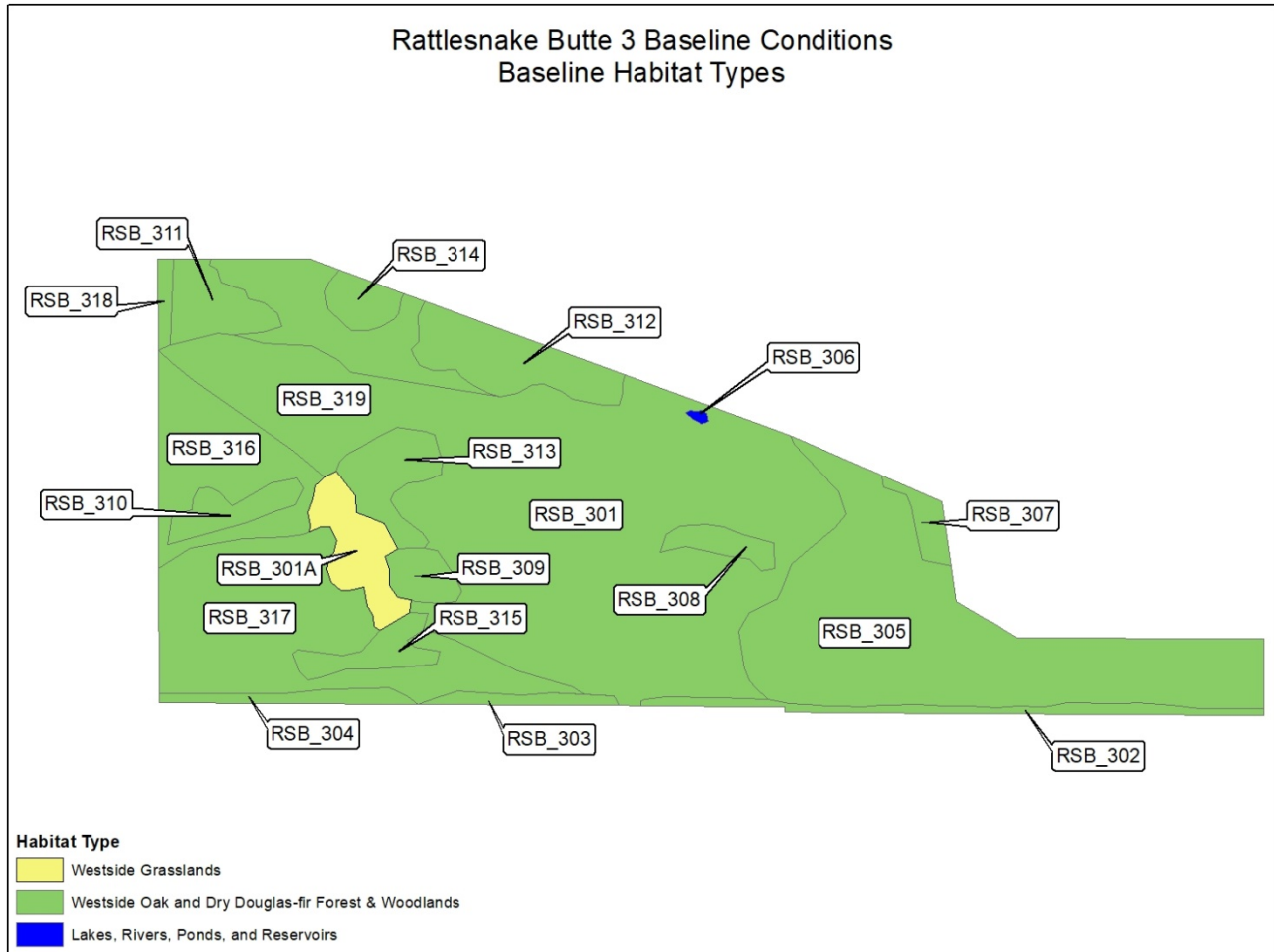
Figure 1. Baseline Habitat Types
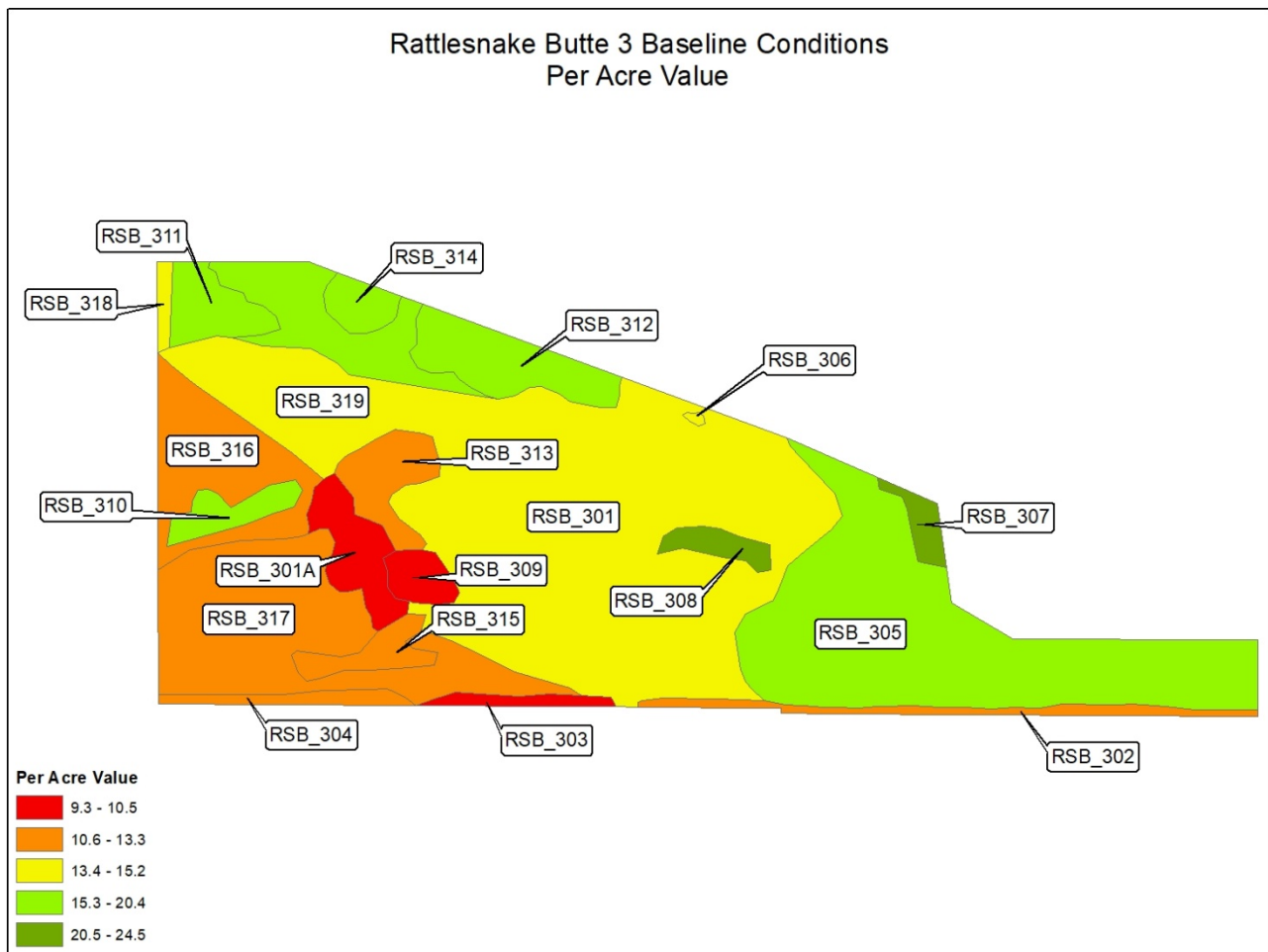
Figure 2. Baseline Per-Acre Value

Rattlesnake Butte 3 Baseline Conditions
Invasive Grass/Forb Percent Composition

RSB_311
RSB_314
RSB_318
RSB_312
RSB_306
RSB_319
RSB_316
RSB_313
RSB_310
RSB_307
RSB_301
RSB_301A
RSB_309
RSB_308
RSB_317
RSB_315
RSB_305
RSB_304
RSB_303
RSB_302

Invasive Percent Composition
- 0 - 10%
- 11 - 35%
- 36 - 65%
- 66 - 90%
- >= 90%
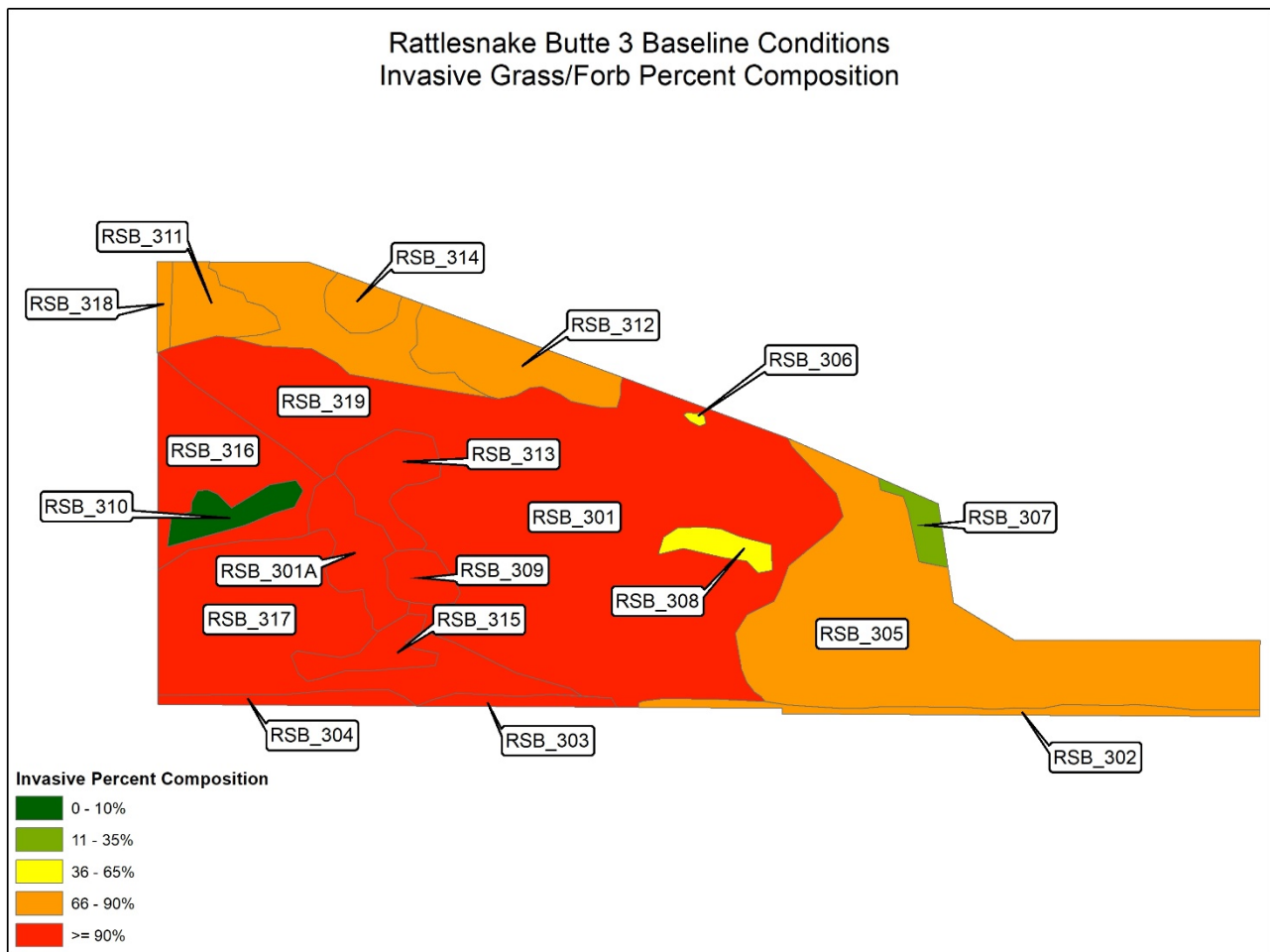
Figure 3. Baseline Invasive Grass/Forb
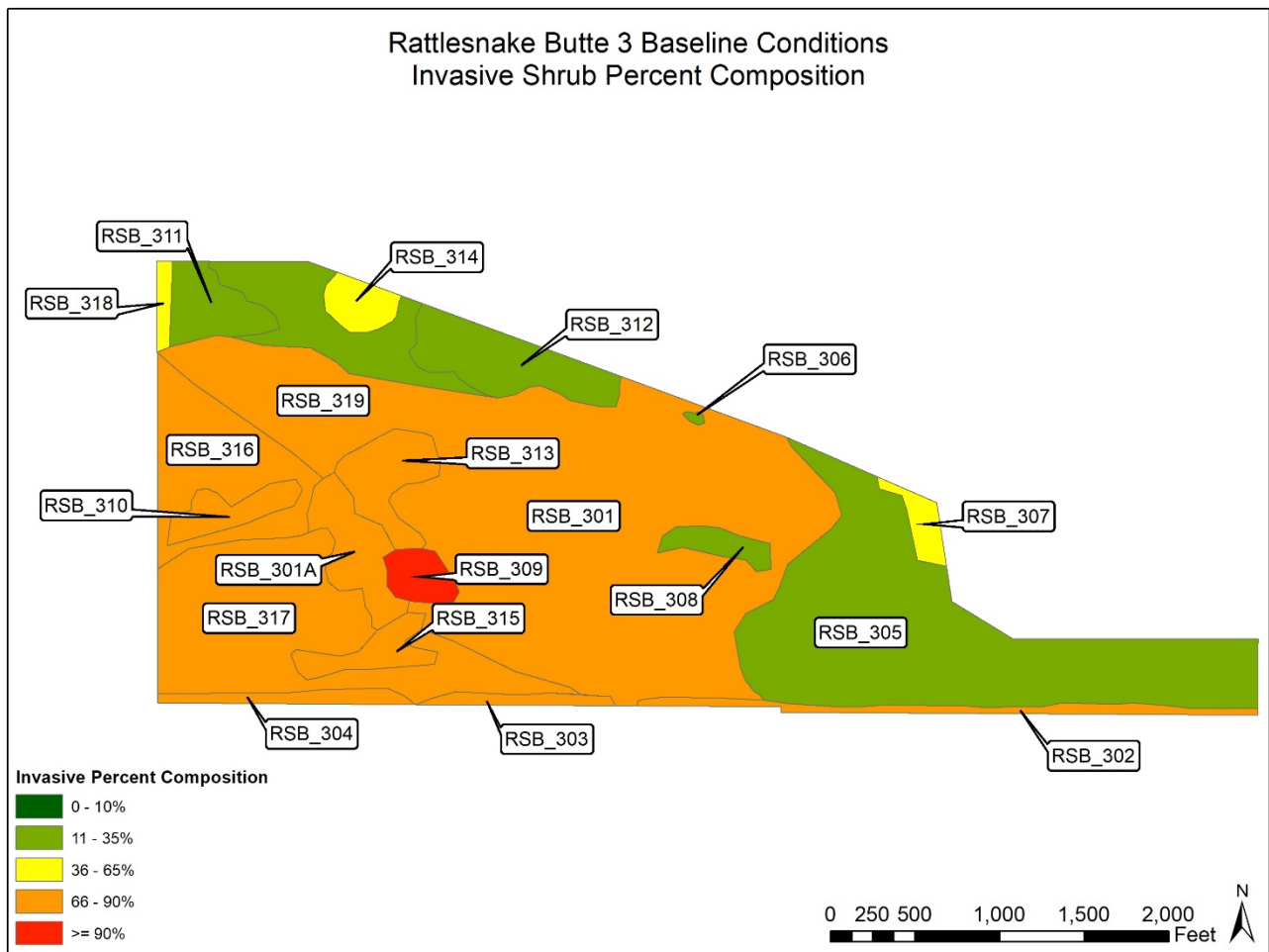
Figure 4. Baseline Invasive Shrub
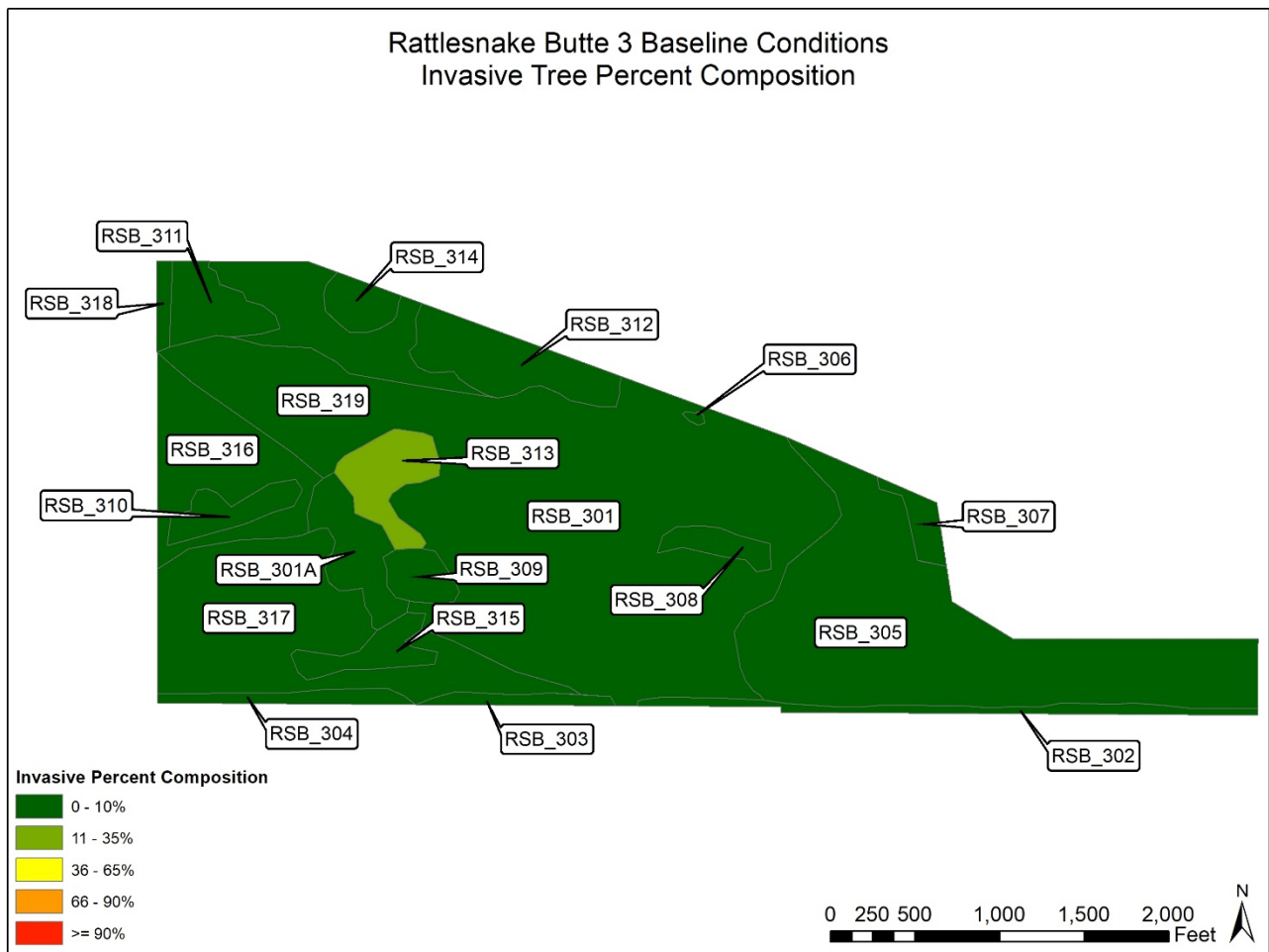
Figure 5. Baseline Invasive Tree
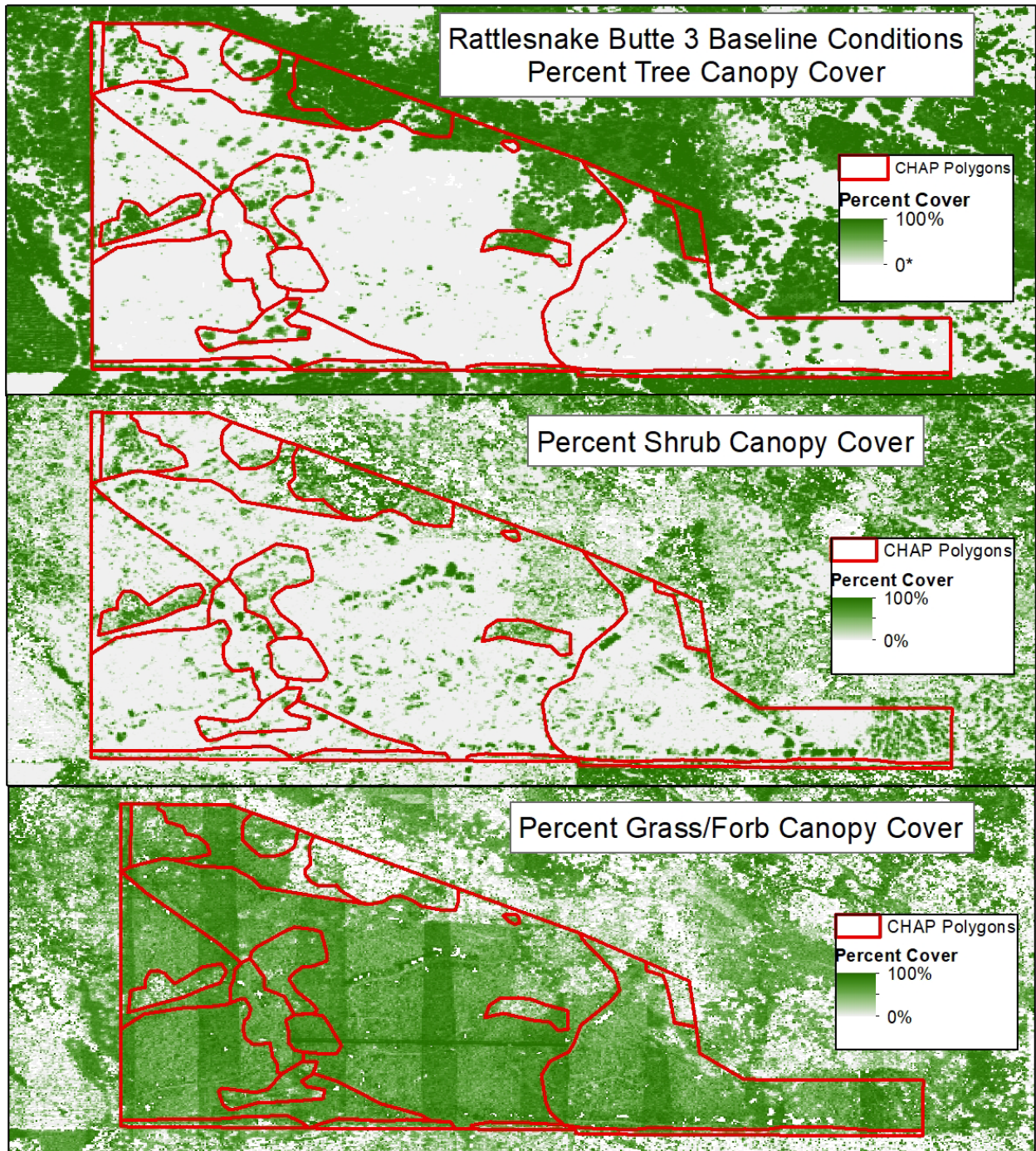
Figure 6. Baseline Percent Cover
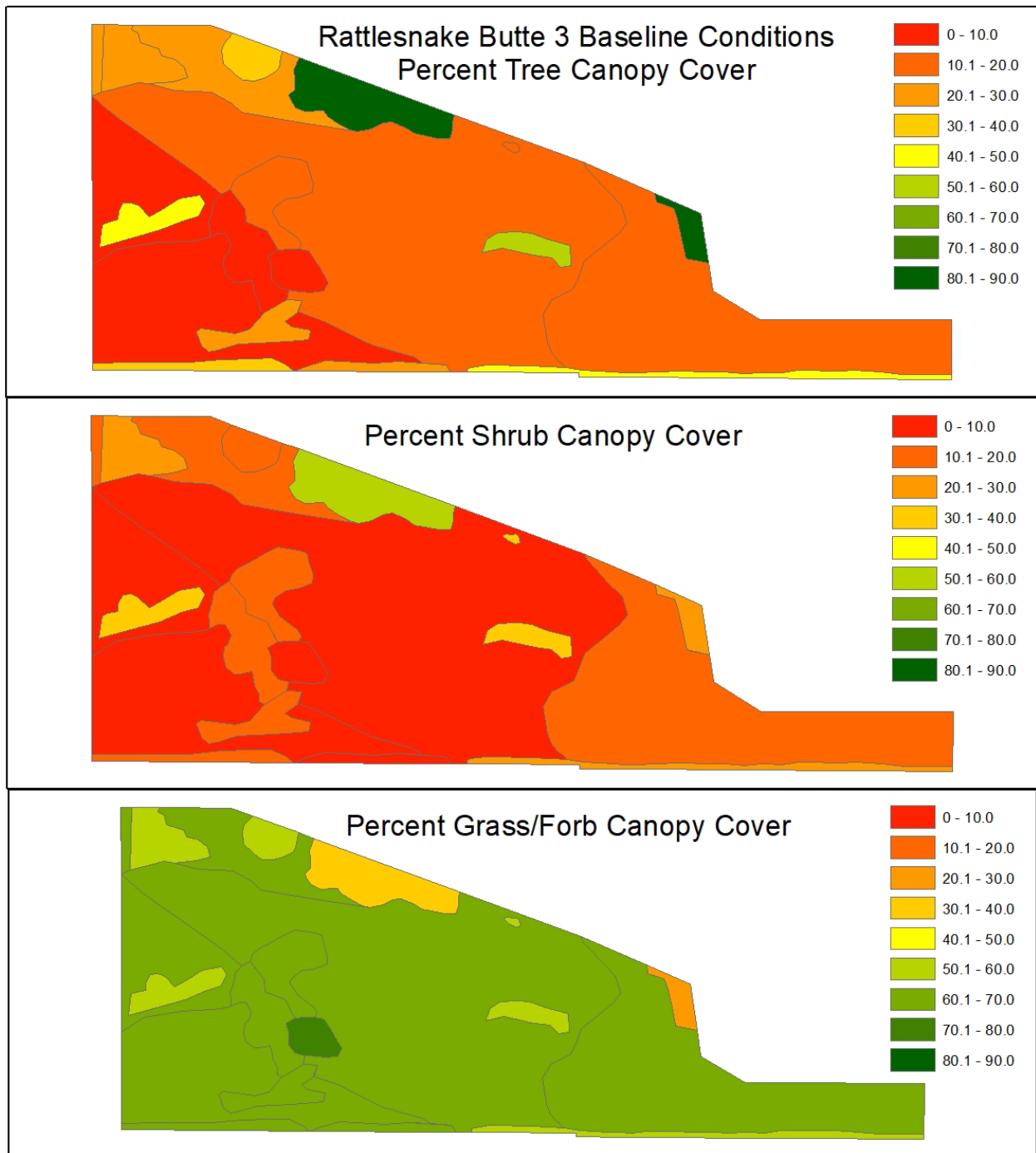
Figure 7. Baseline Percent Cover by Polygon
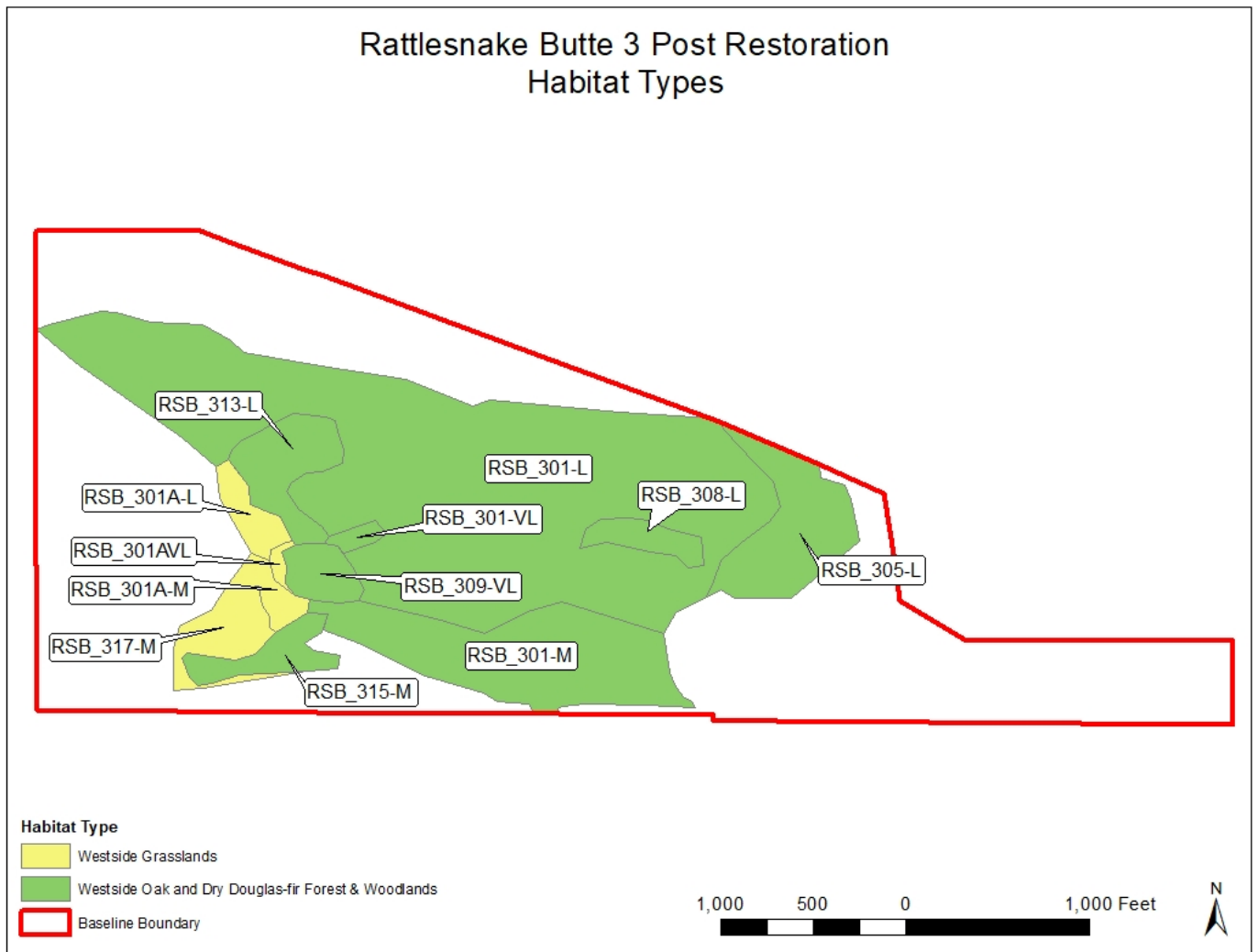
Figure 8. 2019 Post Restoration Habitat Types
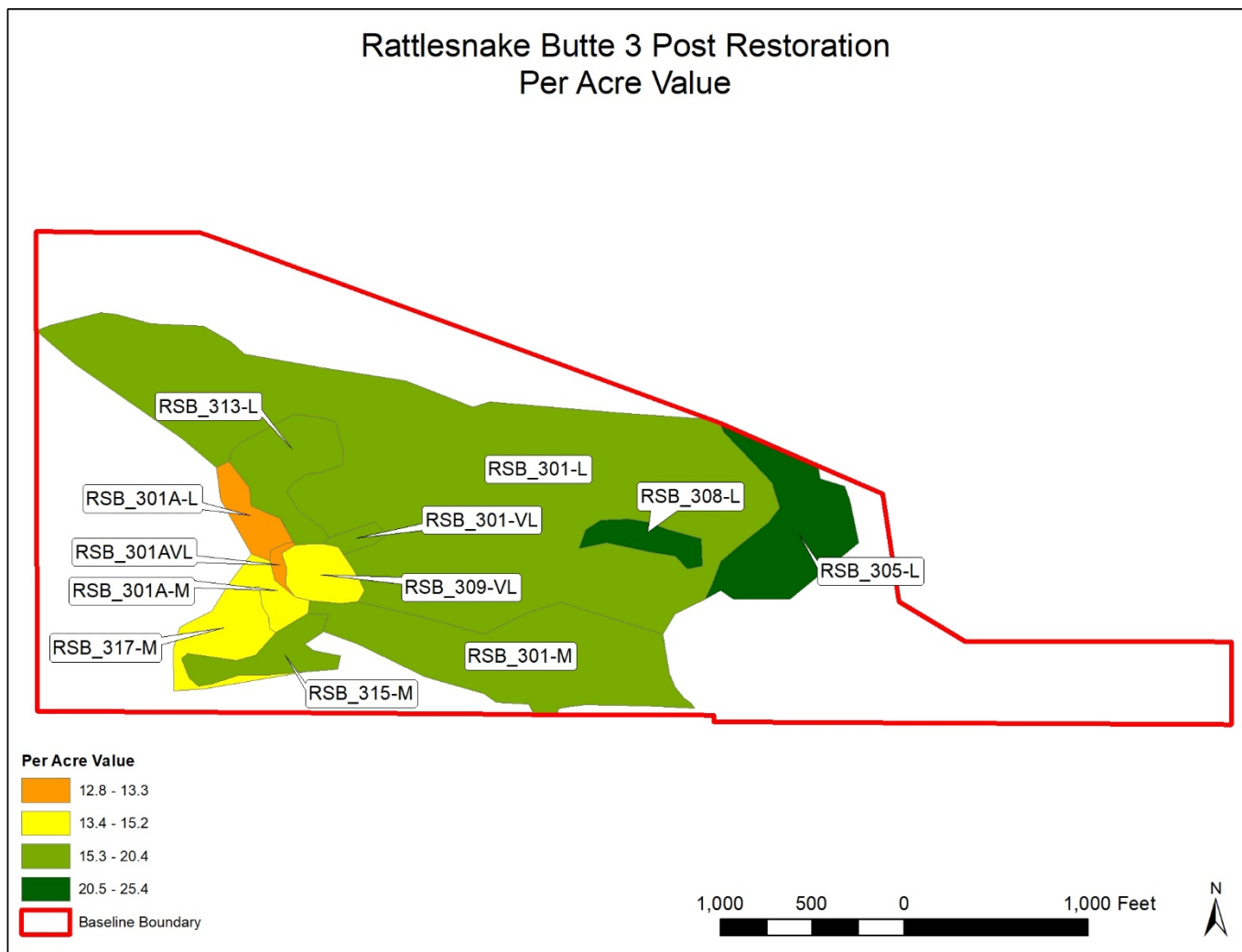
Figure 9. 2019 Post Restoration Per-Acre Value
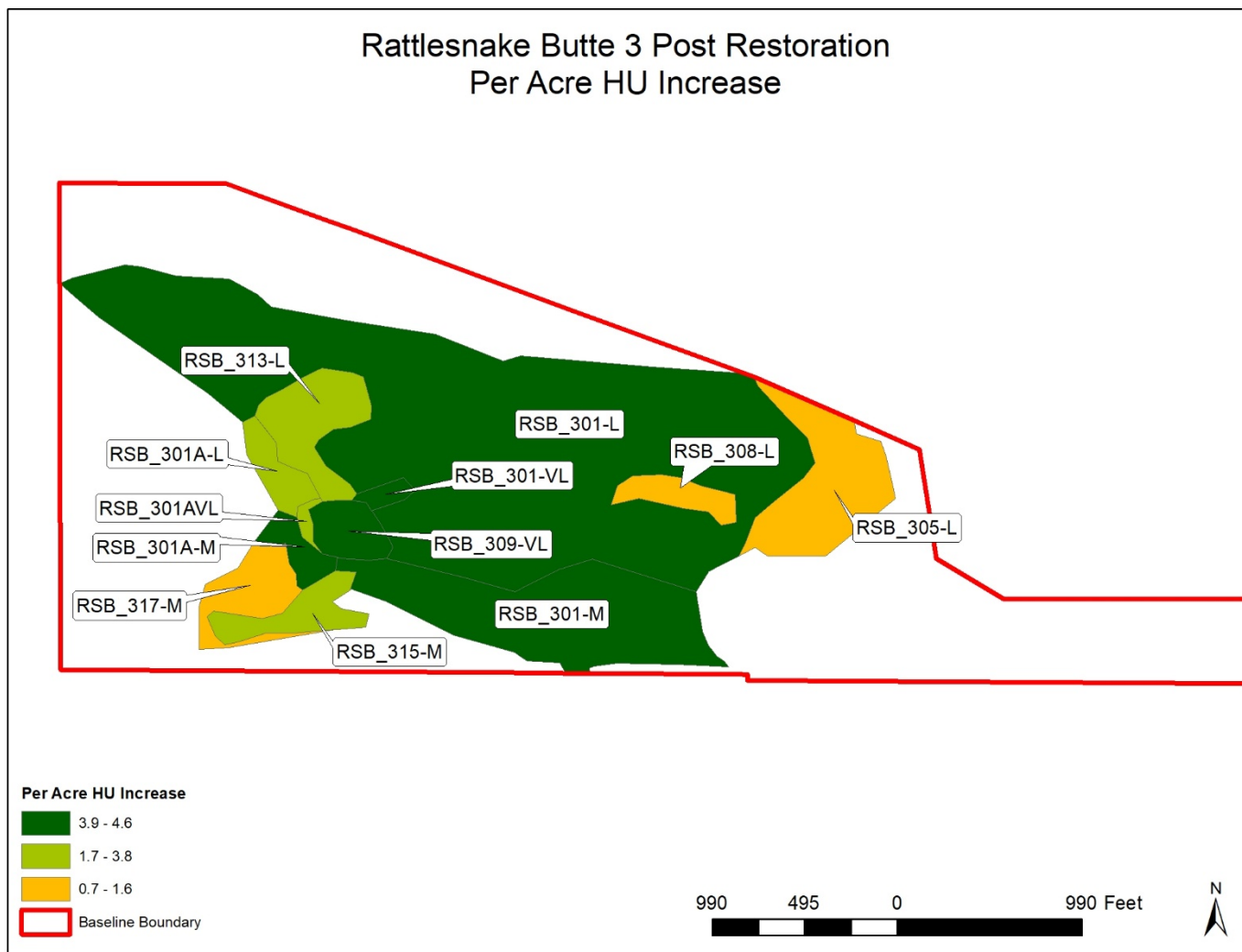
Figure 10. 2019 Post Restoration Habitat Unit Change
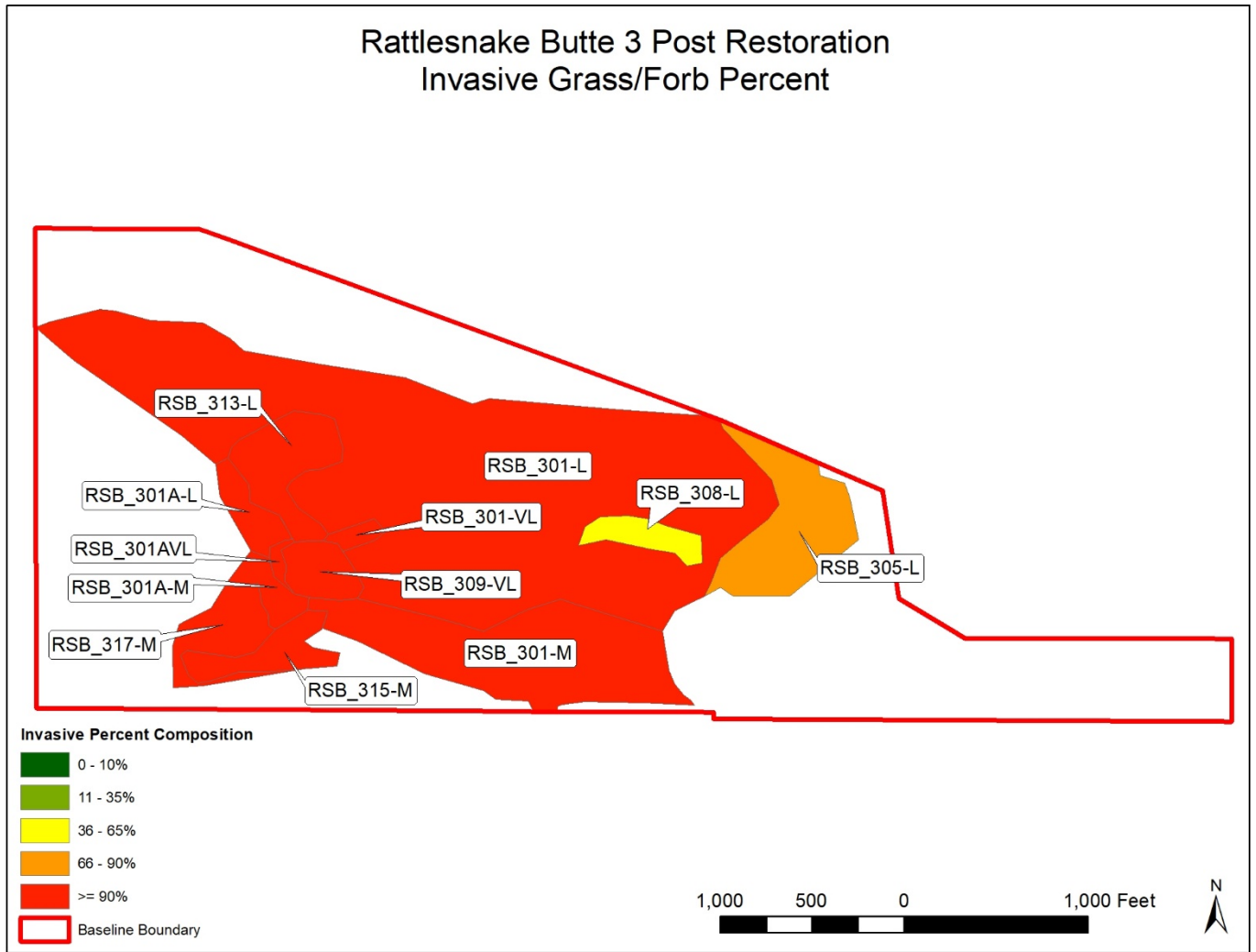
Figure 11. 2019 Post Restoration Invasive Grass/Forb
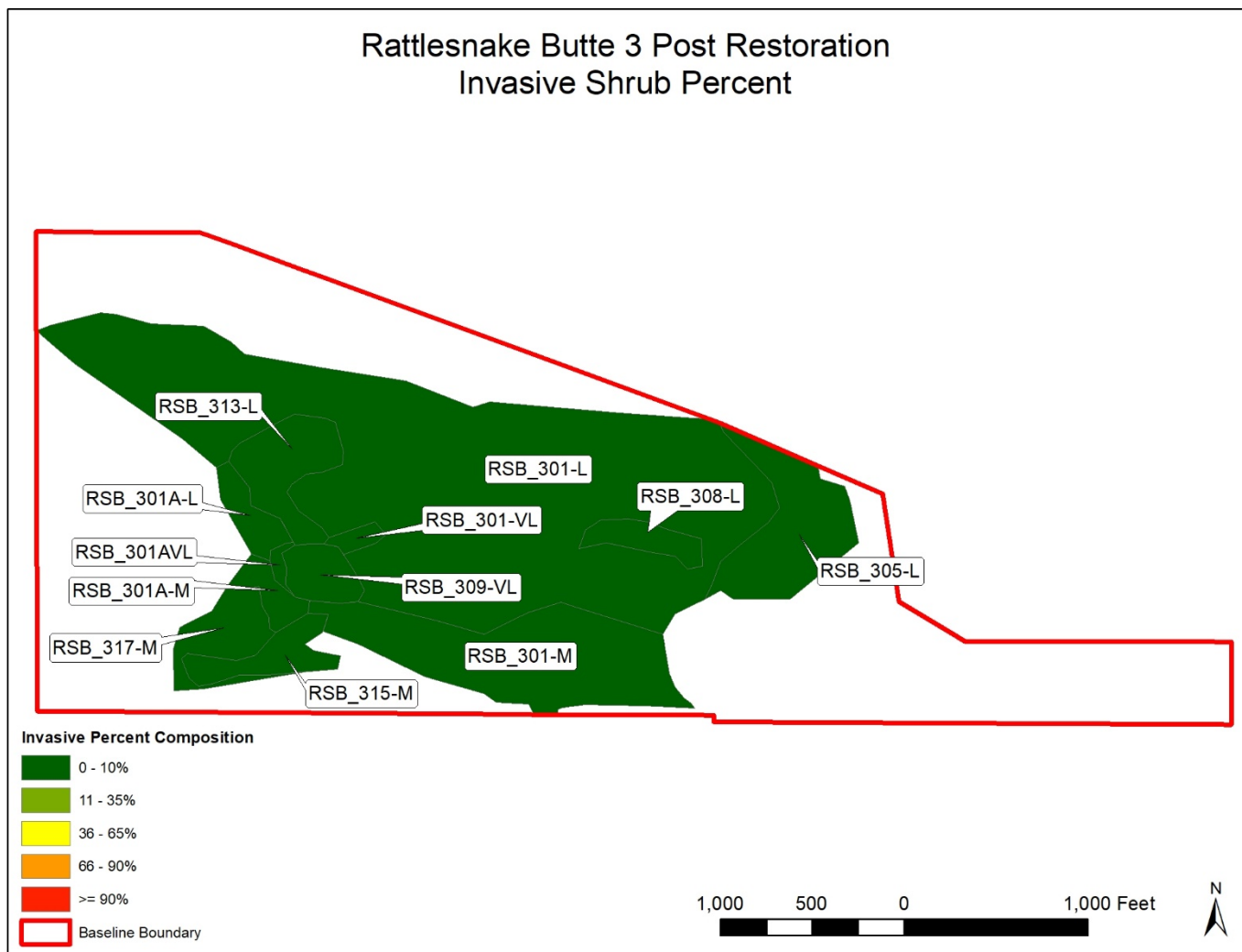
Figure 12. 2019 Post Restoration Invasive Shrub
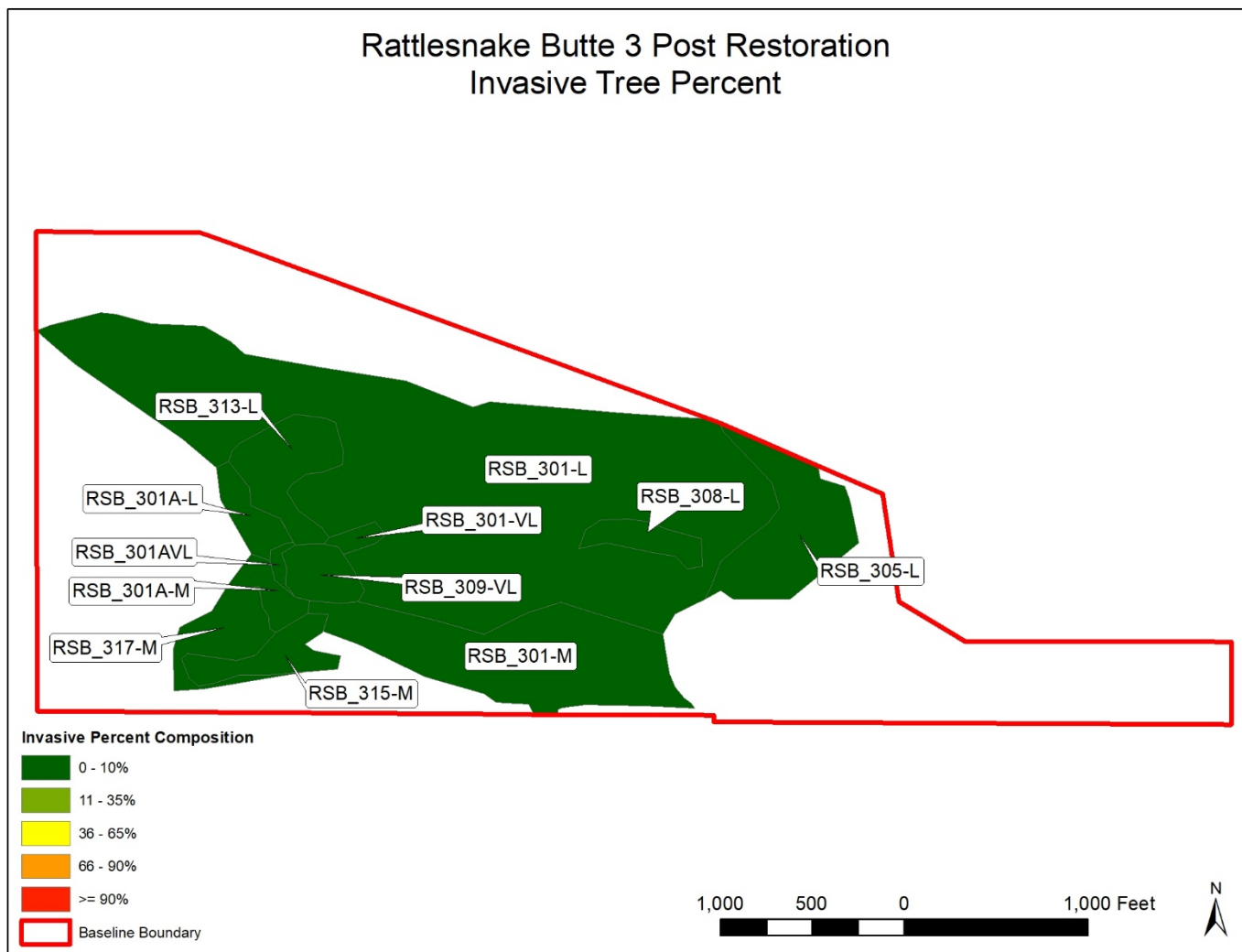
Figure 13. 2019 Post Restoration Invasive Tree
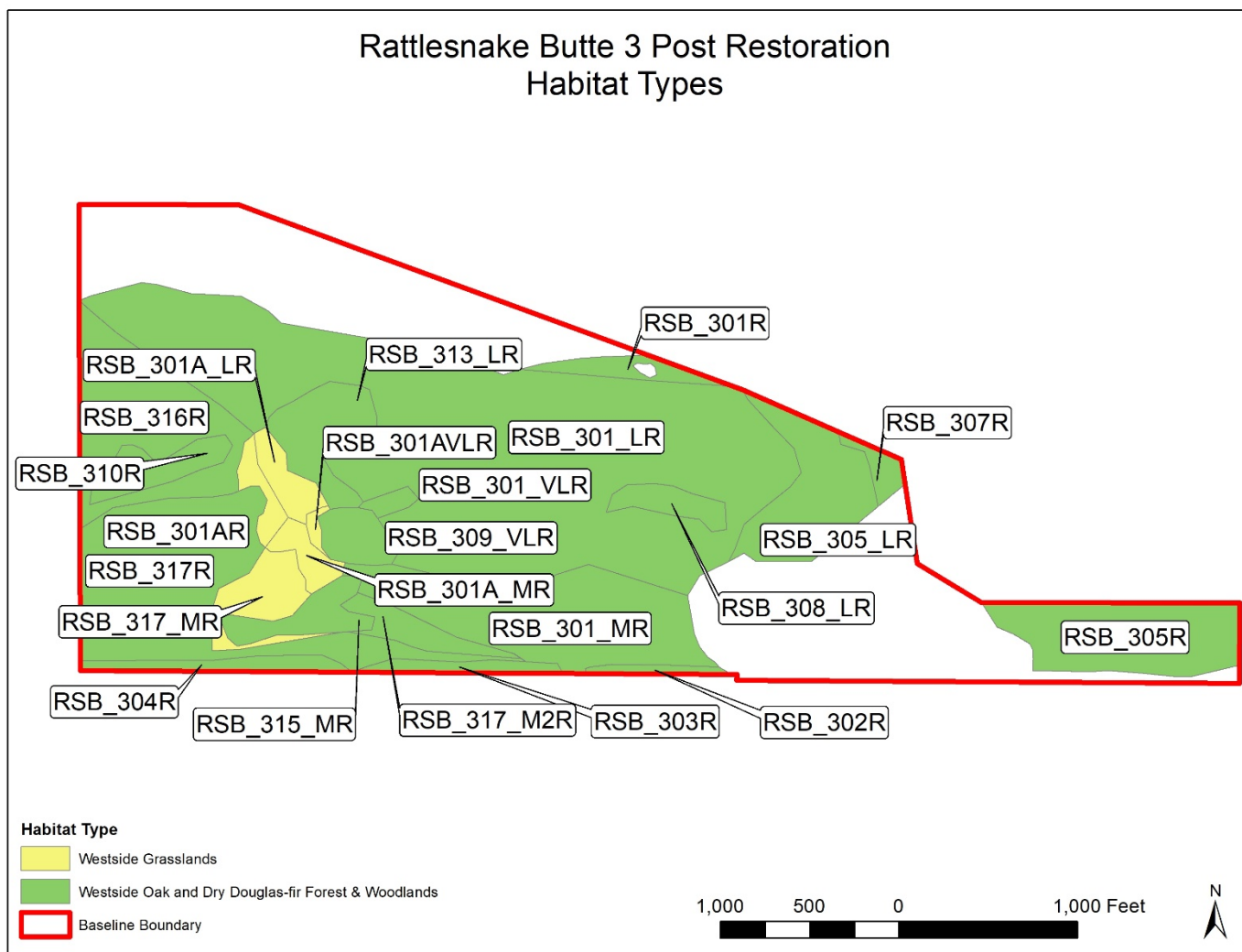
Figure 14. 2021 Post Restoration Habitat Types
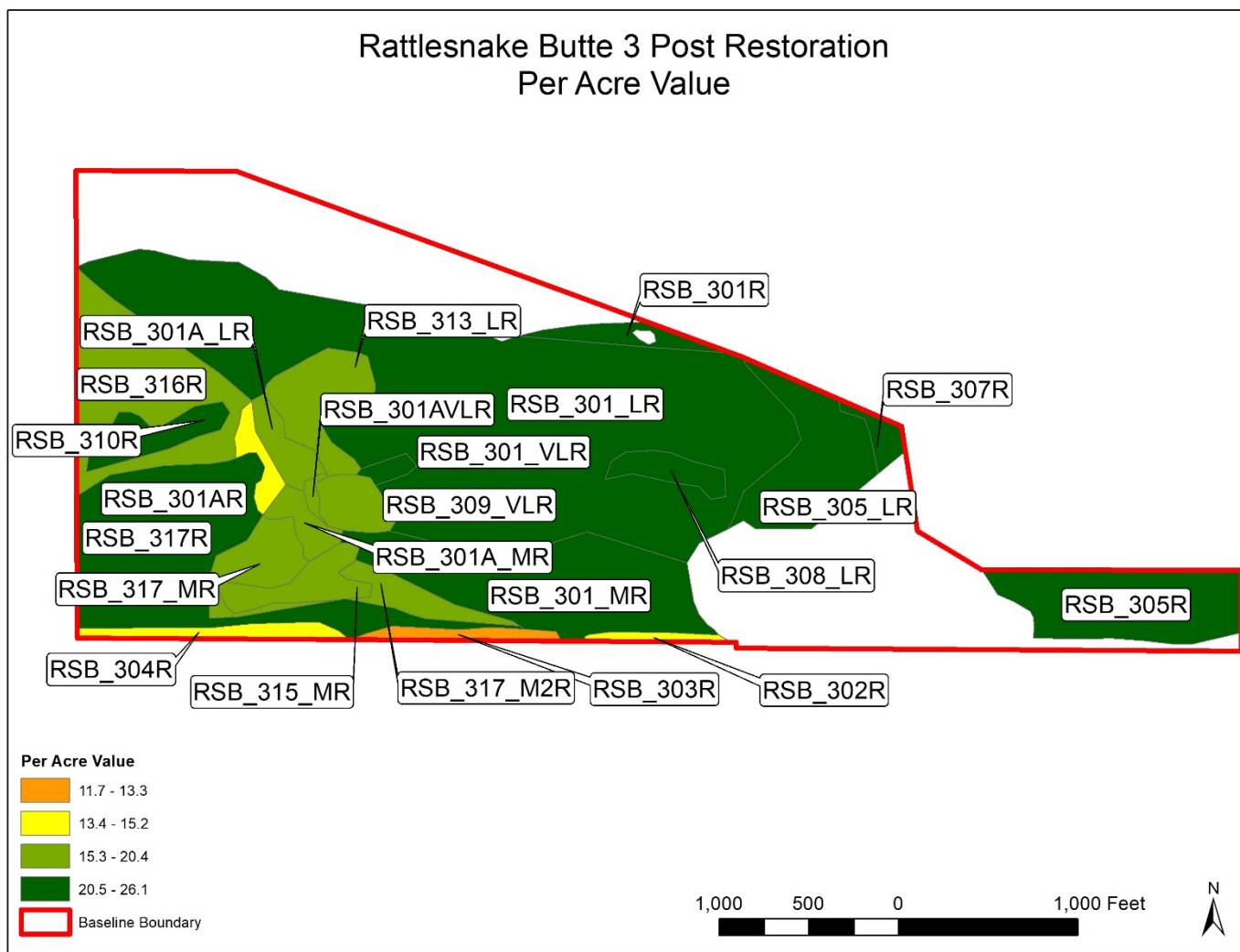
Figure 15. 2021 Post Restoration Per-Acre Value
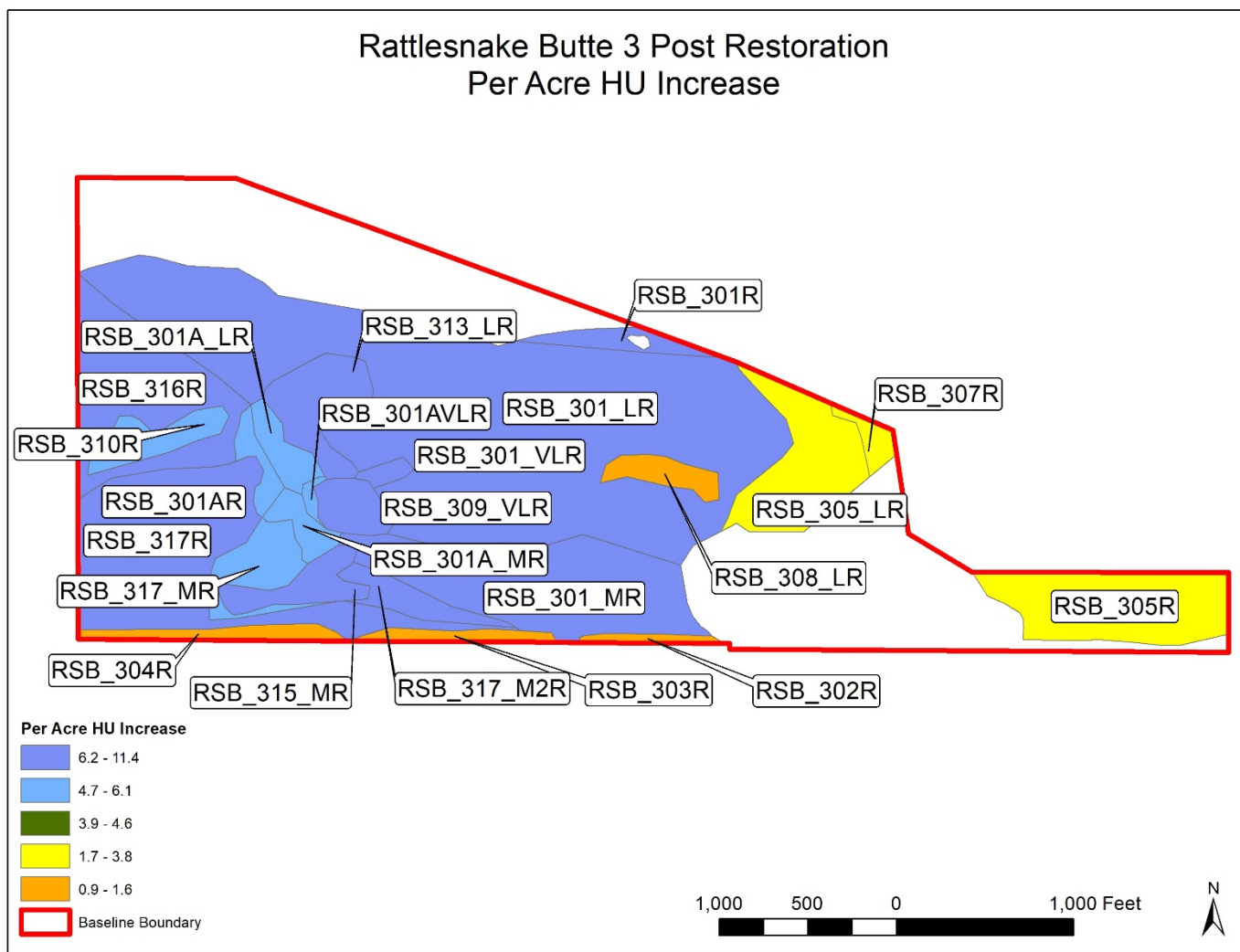
Figure 16. 2021 Post Restoration Habitat Unit Change
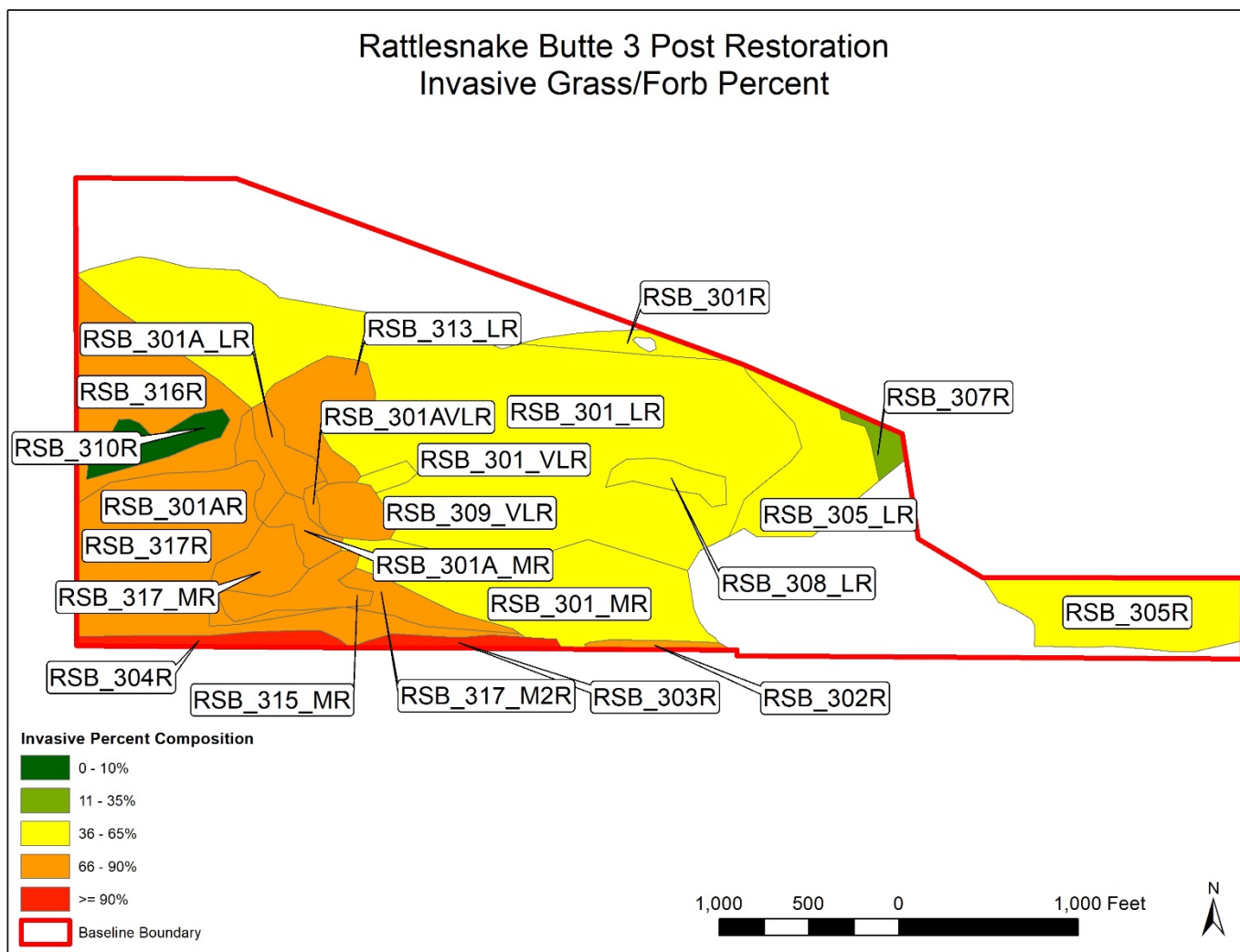
Figure 17. 2021 Post Restoration Invasive Grass/Forb
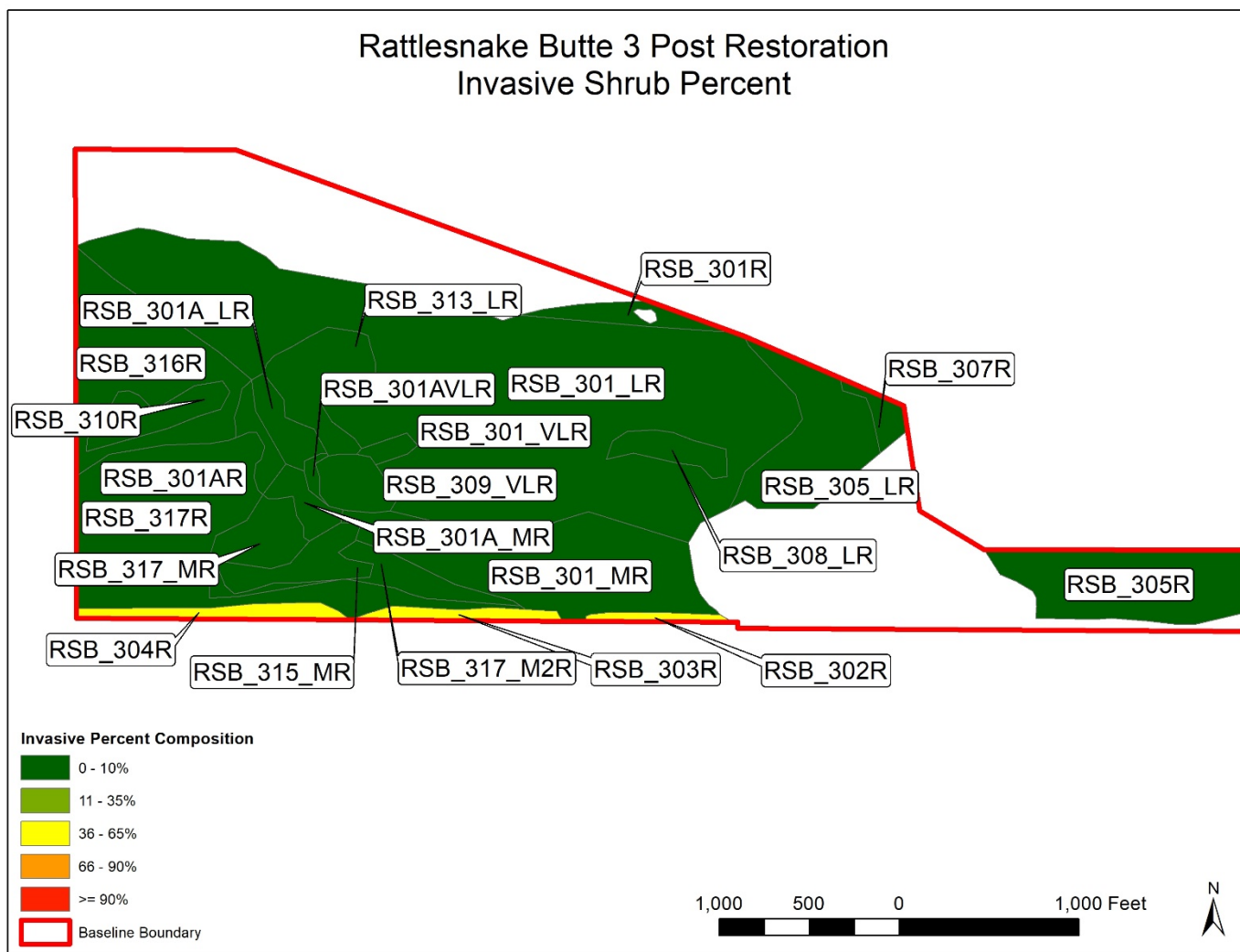
Figure 18. 2021 Post Restoration Invasive Shrub
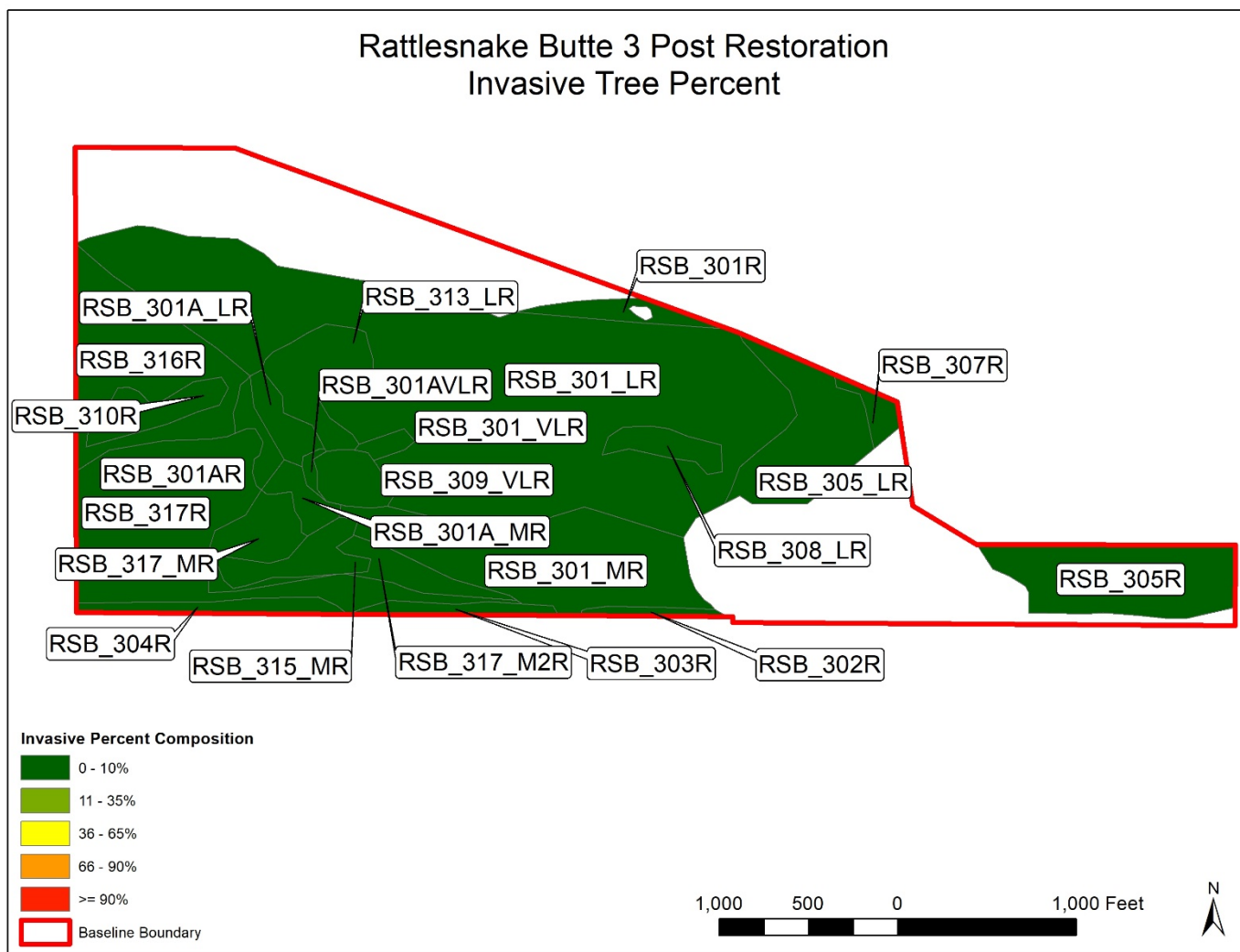
Figure 19. 2021 Post Restoration Invasive Tree

Appendix F: Transect Results

Transect RSB 301 data summary – No Snags

Table 1 RSB 301 shrub cover by species and height (includes fern spp.)

SHRUB TRANSECT RESULTS

Area: Rattlesnake Butte	**Covertype:** Riparian Forest		
Date of study: 12/04/18	**Transect Type** Point Intercept		
Transect Number: 301	**Unit of measure:** Feet		
Investigators: Eric & Tom	**Interval:** 5'		
	Sample unit size: 100'		
	Height unit of measure: 0.10 ft.		

	GPS COORDINATES		Mag AZ	Length
Start	473040	4900796	63	300
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
End	473111	4900847	Total Length	300

Shrub Intercept Data: __60__ **POINTS NEEDED**   __60__ **POINTS ENTERED**   __26__ **POINTS are BARE**

| Species	N	% CC	Mean height	s	%cc s	y	%cc y	m	%cc m	d	%cc d	vd	%cc vd	dd	%cc dd
Blackberry	25	41.7%	4.2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Thistle	2	3.3%	3.8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Madrone	1	1.7%	4.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Fern	1	1.7%	1.5	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Rose	1	1.7%	3.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Snowberry	4	6.7%	4.9	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

AGE DISTRIBUTION	N	%
Seedling	0	
Young	0	
Mature	0	
Decadent	0	
Very Decadent	0	
Dead	0	

Overall Height	
MEAN	4.1
MODE	8.0
MAX	8.0
MIN	0.5
ST.DEV	2.5
TOTAL CC	56.7%

AGE KEY

Symbol	Meaning
s	seedling
y	young
m	mature
d	decadent
vd	very decadent
dd	dead

Table 2 Transect RSB 301 percent herbaceous cover summary[2]

MICROPLOT RESULTS

Area: Rattlesnake Bu   **Covertype:** Riparian Forest

Date of study: 12/04/18   **Transect Type**

Transect Number: 301   **Unit of measure:** Ft

Investigators: Eric & Tom   **Interval:** Independent

Number of plots 15

GPS COORDINATES		Mag AZ	Length
Start	473040	4900796	63	300
Turning Point	0	0	0	0
Turning Point	0	0	0	0
Turning Point	0	0	0	0
End	473111	4900847	Total Length	300

Microplot Data: ___15___ **PLOTS NEEDED** ___15___ **PLOTS ENTERED** ___0___ **PLOTS BARE**

Microplot frame size: 1/4 Meter   **Mean Veg height** ___0.9___ **Ft**

Plot interval: ___20-Ft___   **% CC TOTAL** ___82.3%___

			GRASS % CC		FORB % CC		EXOTIC % CC
%CC	- - - - - -	_____	Grass	74.3%	Shiny Geranium	7.0%	Black Berry	2.7%
%CC	- - - - - -	_____		_____		_____		_____
%CC	- - - - - -	_____		_____		_____		_____
%CC	- - - - - -	_____		_____		_____		_____
			TOTAL %cc Grass 74.3%		**TOTAL %cc Forbs** 7.0%		**TOTAL %cc Exotic** 2.7%

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[2] Ignore "mean veg height" data. Height data not taken….figure shown is place holder data needed for spreadsheet to function.

Table 3 RSB 301 percent tree cover summary

TREE TRANSECT RESULTS

Area: Rattlesnake Butte
Date of study: 12/04/18
Transect Number: 301
Investigators: Eric & Tom
Covertype: Riparian Forest
Transect Type Point Intercept
Unit of measure: Feet
Interval: 5'

Sample unit size: 100'

Height unit of measure: Feet

	GPS COORDINATES		Mag AZ	Length
Start	473040	4900796	63	300
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
End	473111	4900847	Total Length	300

60 POINTS NEEDED   **60** POINTS ENTERED   **51** POINTS are BARE

Species	N	% CC	Mode DBH	<4"	%CC	4" to 6"	%CC	6" to 10"	%CC	10" to 20"	%CC	> 20"	%CC	NT	%CC
Oak	9	15.0%	10 to 20	0	0.0%	0	0.0%	0	0.0%	9	15.0%	0	0.0%	0	0.0%

DBH DISTRIBUTION	N	%
Small (<4")	0	0.0%
Medium (4" - 6")	0	0.0%
Medium large (6" - 10")	0	0.0%
Large (10" - 20")	9	100.0%
Very Large (>20")	0	0.0%
DBH not taken	0	0.0%

Overall tree height	
MEAN	57.3
MODE	68
MAX	68
MIN	44
ST.DEV	12.65
TOTAL CC	15.00%

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Transect RSB 302 data summary – No Snags

Table 4 RSB 302 shrub cover by species and height (includes fern spp.)

SHRUB TRANSECT RESULTS

Area:	Rattlesnake Butte	**Covertype:**	Oak / Fir Forest
Date of study:	12/04/18	**Transect Type**	Point Intercept
Transect Number:	302	**Unit of measure:**	Feet
Investigators:	Eric & Tom	**Interval:**	5'
		Sample unit size:	100'
		Height unit of measure:	0.10 ft.

	GPS COORDINATES		Mag AZ	Length
Start	472942	4901141	340	300
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
End	0	0	Total Length	300

Shrub Intercept Data: **60** POINTS NEEDED   **60** POINTS ENTERED   **43** POINTS are BARE

Species	N	% CC	Mean height	s	%cc s	y	%cc y	m	%cc m	d	%cc d	vd	%cc vd	dd	%cc dd
Oak	7	11.7%	6.1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Douglas Fir	3	5.0%	5.3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Snowberry	6	10.0%	4.8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Black Berry	1	1.7%	4.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

AGE DISTRIBUTION	N	%
Seedling	0	
Young	0	
Mature	0	
Decadent	0	
Very Decadent	0	
Dead	0	

Overall Height	
MEAN	**5.4**
MODE	**6.0**
MAX	**10.0**
MIN	**2.5**
ST.DEV	**2.2**
TOTAL CC	**28.3%**

AGE KEY	
Symbol	Meaning
s	seedling
y	young
m	mature
d	decadent
vd	very decadent
dd	dead

Table 5 Transect RSB 302 percent herbaceous cover summary[3]

MICROPLOT RESULTS

Area: Rattlesnake Bu   **Covertype:** Oak / Fir Forest

Date of study: 12/04/18   **Transect Type**

Transect Number: 302   **Unit of measure:** Ft

Investigators: Eric & Tom   **Interval:** Independent

DATA INCOMPLETE   **Number of plots** 15

	GPS COORDINATES		Mag AZ	Length
Start	472942	4901141	340	300
Turning Point	0	0	0	0
Turning Point	0	0	0	0
Turning Point	0	0	0	0
End	0	0	Total Length	300

Microplot Data: __15__ **PLOTS NEEDED** __14__ **PLOTS ENTERED** __0__ **PLOTS BARE**

Microplot frame size: 1/4 Meter   **Mean Veg height** __1.1__ **Ft**

Plot interval: __20-Ft__   **% CC TOTAL** __58.2%__

	GRASS % CC		FORB % CC		EXOTIC % CC	
%CC	- - - - - -		Grass	40.0%	Shiny Geranium	17.1%	Black Berry	0.0%
%CC	- - - - - -				Twin Flower	0.4%	Poison Oak	0.4%
%CC	- - - - - -							
%CC	- - - - - -							
		TOTAL %cc Grass	40.0%	TOTAL %cc Forbs	17.5%	TOTAL %cc Exotic	0.4%

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[3] Ignore "mean veg height" data. Height data not taken…. figure shown is place holder data needed for spreadsheet to function.

Table 6 RSB 302 percent tree cover summary

TREE TRANSECT RESULTS

Area:	Rattlesnake Butte
Date of study:	12/04/18
Transect Number:	302
Investigators:	Eric & Tom
Covertype:	Oak / Fir Forest
Transect Type	Point Intercept
Unit of measure:	Feet
Interval:	5'
Sample unit size:	100'
Height unit of measure:	Feet

	GPS COORDINATES		Mag AZ	Length
Start	472942	4901141	340	300
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
End	0	0	Total Length	300

60 POINTS NEEDED   **60** POINTS ENTERED   **40** POINTS are BARE

Species	N	% CC	Mode DBH	<4"	%CC	4" to 6"	%CC	6" to 10"	%CC	10" to 20"	%CC	> 20"	%CC	NT	%CC
Oak	20	33.3%	<4	20	33.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Madrone	0	0.0%		0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

DBH DISTRIBUTION	N	%
Small (<4")	20	100.0%
Medium (4" - 6")	0	0.0%
Medium large (6" - 10")	0	0.0%
Large (10" - 20")	0	0.0%
Very Large (>20")	0	0.0%
DBH not taken	0	0.0%

Overall tree height	
MEAN	28.5
MODE	25
MAX	35
MIN	18
ST.DEV	5.19
TOTAL CC	33.33%

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Transect RSB 303 data summary

Table 7 RSB 303 snag summary

SNAG TRANSECT RESULTS

			GPS COORDINATES		Mag AZ	Length
Area:	Rattlesnake Butte					
Date of study:	12/04/18	Start	473551	4901011	270	300
Transect Number:	303	Turning Pt.	0	0	0	0
Investigators:	Eric & Tom	Turning Pt.	0	0	0	0
Covertype:	Oak / Fir Forest	Turning Pt.	0	0	0	0
Belt width 44	Ft	End	0	0	Total Length	300
Belt legnth 100	Ft					
Circular plot size:						
Height unit of measure: Ft		**Plots needed** 3			**Plots entered** 3	

DBH DISTRIBUTION	PLOT 1	PLOT 2	PLOT 3	PLOT 4	PLOT 5	PLOT 6	PLOT 7	PLOT 8	PLOT 9	PLOT 10	TOTAL SNAGS	AVERAGE per BELT
No snags	No snags	Sampled	No snags	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled		
<4"	0	2	0								2	0.7
> 4" =< 6"	0	0	0								0	N/A
> 6" to 10"	0	0	0								0	N/A
>10" to 20"	0	0	0								0	N/A
> 20"	0	0	0								0	N/A
Not recorded	0	0	0								0	N/A
TOTAL snags	0	2	0								2	0.7

AVERAGE HEIGHT	PLOT 1	PLOT 2	PLOT 3	PLOT 4	PLOT 5	PLOT 6	PLOT 7	PLOT 8	PLOT 9	PLOT 10	Weighted average height	
No snags	No snags	Sampled	No snags	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled		
<4"	0.00	15.00	0.00								15.00	Ft
> 4" =< 6"	0.00	0.00	0.00								N/A	
> 6" to 10"	0.00	0.00	0.00								N/A	
>10" to 20"	0.00	0.00	0.00								N/A	
> 20"	0.00	0.00	0.00									
Not recorded	0.00	0.00	0.00								N/A	
Mean height	N/A	15.00	N/A								15.00	Ft

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Table 8 RSB 303 shrub cover by species and height (includes fern spp.)

SHRUB TRANSECT RESULTS

Area:	Rattlesnake Butte
Date of study:	12/04/18
Transect Number:	303
Investigators:	Eric & Tom

Covertype:	Oak / Fir Forest
Transect Type	Point Intercept
Unit of measure:	Feet
Interval:	5'
Sample unit size:	100'
Height unit of measure:	0.10 ft.

	GPS COORDINATES		Mag AZ	Length
Start	473551	4901011	270	300
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
End	0	0	Total Length	300

Shrub Intercept Data: **60** POINTS NEEDED   **61** POINTS ENTERED   **28** POINTS are BARE

Species	N	%CC	Mean height	s	%cc s	y	%cc y	m	%cc m	d	%cc d	vd	%cc vd	dd	%cc dd
Oak	16	26.2%	6.8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Douglas Fir	2	3.3%	7.5	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Snowberry	4	6.6%	5.8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Black Berry	6	9.8%	1.8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Madrone	4	6.6%	4.2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Rose	1	1.6%	5.5	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

AGE DISTRIBUTION	N	%
Seedling	0	
Young	0	
Mature	0	
Decadent	0	
Very Decadent	0	
Dead	0	

Overall Height	
MEAN	5.4
MODE	1.0
MAX	15.0
MIN	1.0
ST.DEV	3.8
TOTAL CC	54.1%

AGE KEY

Symbol	Meaning
s	seedling
y	young
m	mature
d	decadent
vd	very decadent
dd	dead

Table 9 Transect RSB 303 percent herbaceous cover summary[4]

MICROPLOT RESULTS

Area: Rattlesnake Bu	**Covertype:** Oak / Fir Forest				
Date of study: 12/04/18	**Transect Type**				
Transect Number: 303	**Unit of measure:** Ft				
Investigators: Eric & Tom	**Interval:** Independent				
	Number of plots 15				

	GPS COORDINATES		Mag AZ	Length
Start	473551	4901011	270	300
Turning Point	0	0	0	0
Turning Point	0	0	0	0
Turning Point	0	0	0	0
End	0	0	Total Length	300

Microplot Data: **15**   PLOTS NEEDED   **15**   PLOTS ENTERED   **0**   PLOTS BARE

Microplot frame size: 1/4 Meter   **Mean Veg height**   1.4   Ft

Plot interval: 20-Ft   **% CC TOTAL**   62.7%

			GRASS % CC	**FORB % CC**		**EXOTIC % CC**	
%CC	- - - - - -		Grass **61.0%**	Shiny Geranium **0.3%**		Black Berry **0.3%**
%CC	- - - - - -			Twin Flower **0.7%**		Poison Oak **0.0%**
%CC	- - - - - -			Strawberry **0.3%**		
%CC	- - - - - -					
			TOTAL %cc Grass 61.0%	**TOTAL %cc Forbs 1.3%**		**TOTAL %cc Exotic 0.3%**

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[4] Ignore "mean veg height" data. Height data not taken….figure shown is place holder data needed for spreadsheet to function.

Table 10 RSB 303 percent tree cover summary

TREE TRANSECT RESULTS

Area:	Rattlesnake Butte	
Date of study:	12/04/18	
Transect Number:	303	
Investigators:	Eric & Tom	
Covertype:	Oak / Fir Forest	
Transect Type	Point Intercept	
Unit of measure:	Feet	
Interval:	5'	
Sample unit size:	100'	
Height unit of measure:	Feet	

	GPS COORDINATES		Mag AZ	Length
Start	473551	4901011	270	300
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
End	0	0	Total Length	300

60 POINTS NEEDED   **60** POINTS ENTERED   **57** POINTS are BARE

Species	N	% CC	Mode DBH	<4"	%CC	4" to 6"	%CC	6" to 10"	%CC	10" to 20"	%CC	> 20"	%CC	NT	%CC
Oak	1	1.7%	<4	1	1.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Madrone	0	0.0%		0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Douglas Fir	2	3.3%	<4	2	3.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

DBH DISTRIBUTION	N	%
Small (<4")	3	100.0%
Medium (4" - 6")	0	0.0%
Medium large (6" - 10")	0	0.0%
Large (10" - 20")	0	0.0%
Very Large (>20")	0	0.0%
DBH not taken	0	0.0%

Overall tree height

MEAN	18.3
MODE	18
MAX	19
MIN	18
ST.DEV	0.58
TOTAL CC	5.00%

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Transect RSB 304 data summary – No Snags

Table 11 RSB 304 shrub cover by species and height (includes fern spp.)

SHRUB TRANSECT RESULTS

				GPS COORDINATES		Mag AZ	Length
Area: Rattlesnake Butte		**Covertype:** Oak / Fir Forest	Start	473963	4900895	240	300
Date of study: 12/04/18		**Transect Type** Point Intercept	Turning Pt.	0	0	0	0
Transect Number: 304		**Unit of measure:** Feet	Turning Pt.	0	0	0	0
Investigators: Eric & Tom		**Interval:** 5'	Turning Pt.	0	0	0	0
		Sample unit size: 100'	End	0	0	Total Length	300
		Height unit of measure: 0.10 ft.					

Shrub Intercept Data: **60** POINTS NEEDED   **61** POINTS ENTERED   **33** POINTS are BARE

Species	N	% CC	Mean height	s	%cc s	y	%cc y	m	%cc m	d	%cc d	vd	%cc vd	dd	%cc dd
Oak	8	13.1%	9.1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Douglas Fir	1	1.6%	12.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Black Berry	12	19.7%	4.2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Fern	3	4.9%	2.3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Big Leaf Maple	1	1.6%	6.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Snowberry	3	4.9%	6.8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

AGE DISTRIBUTION	N	%		Overall Height			AGE KEY	
							Symbol	Meaning
Seedling	0			MEAN	**6.0**		s	seedling
Young	0			MODE	**2.0**		y	young
Mature	0			MAX	**14.0**		m	mature
Decadent	0			MIN	**1.0**		d	decadent
Very Decadent	0			ST.DEV	**3.8**		vd	very decadent
Dead	0			TOTAL CC	**45.9%**		dd	dead

Table 12 Transect RSB 304 percent herbaceous cover summary[5]

MICROPLOT RESULTS

			GPS COORDINATES		Mag AZ	Length
Area: Rattlesnake Bu	**Covertype:** Oak / Fir Forest	Start	473963	4900895	240	300
Date of study: 12/04/18	**Transect Type**	Turning Point	0	0	0	0
Transect Number: 304	**Unit of measure:** Ft	Turning Point	0	0	0	0
Investigators: Eric & Tom	**Interval:** Independent	Turning Point	0	0	0	0
	Number of plots 15	End	0	0	Total Length	300

DATA INCOMPLETE

Microplot Data: **15**   **PLOTS NEEDED**   **14**   **PLOTS ENTERED**   **0**   **PLOTS BARE**

Microplot frame size: 1/4 Meter   **Mean Veg height**   1.4   **Ft**

Plot interval: 20-Ft   **% CC TOTAL**   66.8%

		GRASS % CC		**FORB % CC**		**EXOTIC % CC**	
%CC	- - - - - -	Grass	**57.5%**	Shiny Geranium	**5.4%**	Black Berry	**0.4%**
%CC	- - - - - -			Twin Flower	**1.1%**	Poison Oak	**0.0%**
%CC	- - - - - -			Fern	**2.1%**		
%CC	- - - - - -			Thistle	**0.4%**		
Habitats & Wildlife		**TOTAL %cc Grass**	**57.5%**	**TOTAL %cc Forbs**	**8.9%**	**TOTAL %cc Exotic**	**0.4%**

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[5] Ignore "mean veg height" data. Height data not taken….figure shown is place holder data needed for spreadsheet to function.

Table 13 RSB 304 percent tree cover summary

TREE TRANSECT RESULTS

Area:	Rattlesnake Butte
Date of study:	12/04/18
Transect Number:	304
Investigators:	Eric & Tom
Covertype:	Oak / Fir Forest
Transect Type	Point Intercept
Unit of measure:	Feet
Interval:	5'
Sample unit size:	100'
Height unit of measure:	Feet

	GPS COORDINATES		Mag AZ	Length
Start	473963	4900895	240	300
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
Turning Pt.	0	0	0	0
End	0	0	Total Length	300

60 POINTS NEEDED   **60** POINTS ENTERED   **57** POINTS are BARE

Species	N	% CC	Mode DBH	<4"	%CC	4" to 6"	%CC	6" to 10"	%CC	10" to 20"	%CC	> 20"	%CC	NT	%CC
Oak	2	3.3%	<4	2	3.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Douglas Fir	1	1.7%	<4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.7%

DBH DISTRIBUTION	N	%
Small (<4")	2	66.7%
Medium (4" - 6")	0	0.0%
Medium large (6" - 10")	0	0.0%
Large (10" - 20")	0	0.0%
Very Large (>20")	0	0.0%
DBH not taken	1	33.3%

Overall tree height	
MEAN	21.0
MODE	#N/A
MAX	25
MIN	18
ST.DEV	3.61
TOTAL CC	5.00%

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