2019 Highlight

The initial phase of the Conservation Habitat Assessment and Mitigation Prioritization (CHAMP) for the Hanford Site was completed in 2019. The CHAMP provides an ecosystem-level approach to identifying areas of highest priority for conservation and restoration on the U.S. Department of Energy, Richland Operations Office-managed lands of the Hanford Site.

The peak annual Hanford Reach fall Chinook salmon redd (nest) count for 2019 (7,899) was the ninth lowest count (range: 4,018 – 20,678) in the past 20 years (2000 – 2019) and was well below the previous 10-year average (11,247).

Four Ferruginous Hawk nests were occupied on the Hanford Site in 2019. At least two of these nests were successful, producing two young per nest for a total of four young.

The 183-D Clearwell and the 183-F Clearwell continue to be used by Yuma myotis (bats) as maternity roosts. Peak counts at 183-D Clearwell in 2019 was 2,395, while peaks counts at 183-F Clearwell were 1,959 in 2019.

Artificial burrows for Burrowing Owls were monitored for activity. Two new nests were located in the new Artificial Burrow designs. All hatch year young from these nests were banded and released back to the burrow.

Twenty bee nest boxes were installed on the Hanford Site in 2019. These bee nest boxes will be monitored for 5 years post-installation to determine their effectiveness in replacing lost bee nesting habitat. A total of 25% of the nest boxes were occupied in 2019 monitoring.

The riparian vegetation mapping effort along the Hanford Reach of the Columbia River continued in 2019. The map and the accompanying report can be found on the Hanford Site's ecological monitoring website: https://www.hanford.gov/page.cfm/EcologicalMonitoring.

Hanford Site archaeologists completed 71 *National Historic Preservation Act* Section 106 cultural resources reviews.

During 2019, 20 items were reviewed, cleared for public release, and /or transferred to the Hanford History Project repository for integration with the Hanford Collection. Nineteen artifacts and 1 linear ft (30.5 cm) of archival material were evaluated for inclusion in the Hanford Collection. These materials were delivered to the Hanford History Project repository at Washington State University, Tri-Cities leaving 20 (2.7%) of the 744 tagged artifacts onsite. They are scheduled for collection between 2020 and 2048.

11.0 Resource Protection

11.1 Ecological Protection

JW Wilde, KJ Cranna, ES Norris, JJ Nugent

Ecological monitoring is performed on the Hanford Site to collect and track data needed to ensure compliance with various environmental laws, regulations, and policies governing U.S. Department of Energy (DOE) activities. Ecological monitoring data provide baseline information about the plants, animals, and habitat under DOE stewardship at the Hanford Site required for decision making under the *National Environmental Policy Act of 1969* and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

The DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement,* (CLUP) evaluated future land-use planning at the Hanford Site to facilitate decision making about the Hanford Site's uses and facilities for a 50-year period. DOE adopted the CLUP to balance land use with the preservation of important ecological and cultural values of the Hanford Site.

The DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*, (BRMP) is identified by the CLUP as the primary plan for managing and protecting natural resources on the Hanford Site. According to the CLUP:

> *The BRMP provides a mechanism for ensuring compliance with laws protecting biological resources; provides a framework for ensuring that appropriate biological resource goals, objectives, and tools are in place to make DOE an effective steward of the Hanford biological resources; and implements an ecosystem management approach for biological resources on the Site. The [BRMP][1] provides a comprehensive direction that specifies DOE biological resource policies, goals, and objectives.*

DOE places priority on monitoring those plant and animal species or habitats with specific regulatory protections or requirements that are rare and/or declining (i.e., federal or state listed endangered, threatened, or sensitive species) or are of significant interest to federal, state, or Tribal governments or the public. The BRMP ranks wildlife species and habitats (Levels 0 through 5), providing a graded approach to monitoring biological resources based on the level of concern for each resource.

Ecological monitoring and ecological compliance support the Hanford Site's waste management and environmental restoration mission through the following activities:

- Ensuring the Hanford Site's operational compliance with laws and regulations including the *Endangered Species Act of 1973* (ESA); *Bald and Golden Eagle Protection Act*; *Migratory Bird Treaty Act of 1918*; as well as compliance with executive orders, DOE Orders, and DOE resource management guidance

[1]The DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement,* uses a different acronym (BRMaP, in place of BRMP used here) for abbreviating the *Hanford Site Biological Resource Management Plan* document.

- Providing data for environmental impact and ecological risk assessments
- Providing information and maps of the distribution and condition of biological resources at the Hanford Site
- Supporting Hanford Site land-use planning and stewardship.

Hanford Site ecological monitoring activities provide information useful to the Hanford Site natural resource stakeholders and the public on the status of some of the Hanford Site's most highly valued biological resources. Population level surveys are conducted to monitor fish, wildlife, and plants and are used to develop baseline information and monitor any changes resulting from Hanford Site operations. Population data collection and analysis are integrated with data from environmental surveillance monitoring of biotic and abiotic media, and analytical results are used to characterize any potential risk or impact to the biota.

11.1.1 Conservation Habitat Assessment and Mitigation Prioritization

JW Wilde, JJ Nugent

The initial phase of the Conservation Habitat Assessment and Mitigation Prioritization (CHAMP) for the Hanford Site was completed in 2019. This phase of the habitat assessment and prioritization identifies priority conservation areas based on current health, size, and status of native habitats and species and initiates the identification of priority mitigation areas. The products from this analysis form the foundation for continued assessments. The impetus for the CHAMP is to take a landscape approach to evaluating habitat quality on the U.S. Department of Energy, Richland Operations Office (DOE-RL)-managed portion of the Hanford Site (study area) and use the results to determine areas for conserving, restoring, mitigating, and connecting habitats.

The scope and scale of this habitat assessment and prioritization will help integrate key ecological data from the Hanford Site with data from other parties (e.g., U.S. Fish and Wildlife Service [USFWS], Washington Department of Fish and Wildlife [WDFW], Yakima Training Center) who's natural resource protection and restoration goals align within the broader landscape surrounding the Hanford Site, including the Columbia Plateau Ecoregion. This integration of data and coordination of actions is especially important between the DOE-RL-managed portion of the Hanford Site and the adjacent USFWS-managed Hanford Reach National Monument.

The CHAMP provides an ecosystem-level approach to identifying areas of highest priority for conservation and restoration on the DOE-RL-managed lands of the Hanford Site in south-central Washington State. The approach (Marxan analysis) is a spatially explicit habitat assessment and habitat prioritization that analyzes a diverse array of existing vegetation, species-specific data, and abiotic data traditionally collected on the Hanford Site.

This habitat assessment and prioritization is compatible and complementary to other efforts on the Hanford Site (e.g., DOE/EIS-0222-F and DOE/RL-96-32) and in the greater Columbia Plateau Ecoregion (e.g., the Arid Lands Initiative [ALI 2014] and the Washington Wildlife Habitat Connectivity Working Group [WHCWG]).

Marxan is the most widely used systematic conservation planning tool in the world based on the minimum set problem, stated as "What is the minimum number of sites, or minimum total area,

necessary to represent all species/habitats?" Within Marxan, targets for conservation features, weightings (penalties) of conservation features, and costs (constraints) can be varied, allowing for repetitious solutions. Marxan produces a range of results that meet conservation objectives that increase possibility of finding solutions that maximize targets while minimizing negative impacts and can lead to identification of unforeseen solutions (Ardon et al. 2010).

Three focal habitats (shrub-steppe, grasslands, and dunes) and one group of species (burrowing animals) were selected to guide the habitat assessment and prioritization. These focal habitats and species (including nested species and/or microhabitats) had the available data necessary to characterize the highest percentage of all species/habitats found on the study area. They met the following goals:

- Represent biodiversity at the Hanford Site and the functions occurring across this landscape
- Reflect ecoregional priorities for the Columbia Plateau Ecoregion
- Consider viable or restorable within this landscape
- Are threatened and, therefore, in need of conservation attention or strategy adjustment for achieving DOE-RL's objectives for the Hanford Site.

Once the focal habitats and species were identified, a viability assessment was developed for each of the focal groups. The intent of the viability assessment is to organize current understanding and knowledge of each habitat or species in a way that evaluates how to know whether that habitat has ecological integrity or the species is viable. Viability, or ecological integrity, quantifies whether the habitat or species is resistant to change in its structure or composition in the face of external stresses or resilient in light of those stresses — that is, able to recover from occasional severe stress (FOS 2009).

Key ecological attributes (KEAs) were recognized and developed for each focal habitat or species and indicators were identified to assess the quality of each KEA. One or more indicators are necessary to quantify each KEA. Indicators are measurable aspects of the KEA that provide information on its status. In order for the indicator values to be compatible with the Marxan analysis they were categorized using a rating system of Poor, Fair, Good, and Very Good. Marxan requires inputs of spatially explicit, digital layers that represent each KEA-indicator. Each of these input layers represent a Marxan target.

Eleven KEAs were identified for quality focal habitats and species and 21 indicators were used to represent the 11 KEAs. The focal habitats and species along with their KEA-indicator pairs are shown in Table 1. Several KEA-indicator pairs (e.g., fire regime, presence of critical or unique habitats and species, and density of noxious weeds) were shared between focal habitats and species.

Table 11-1. Summary of the Focal Habitats or Species Key Ecological Attributes and their Indicators. (2 Pages)

Focal Habitat or Species and KEA	Indicator
Shared Attributes	
Fire Regime	Low Freq. Fire Regime (Shrub and Dunes)
Fire Regime	High Freq. Fire Regime (Grasslands)

Table 11-1. Summary of the Focal Habitats or Species Key Ecological Attributes and their Indicators. (2 Pages)

Focal Habitat or Species and KEA	Indicator
Critical Habitat or Species	Presence of Critical, Unique Habitats or Species
Vegetative Composition	Density of Noxious Weeds
Shrub-steppe	
Absolute Patch Size	Absolute Shrub Patch Size (Area)
Connectivity	Connectivity/Proximity to Other Shrub Patches
Vegetative Composition	Type of Vegetation Cover in Shrub-steppe
Native Shrub Cover	Percent of Native Shrub Cover (High Freq.)
Wildlife Community	Sagebrush Obligate Wildlife Presence
Dunes	
Soil Type	Presence of Sandy Soil
Absolute Patch Size	Acreage of Open Sand (Area)
Connectivity	Connectivity/Proximity to Other Dune Patches
Vegetative Composition	Type of Vegetation Cover in Dunes
Ecosystem Intactness	Rare Dune Plant Species Presence
Grasslands	
Absolute Patch Size	Absolute Grassland Patch Size (Area)
Connectivity	Connectivity/Proximity to Other Grassland Patches
Vegetative Composition	Type of Vegetation Cover in Grasslands
Native Shrub Cover	Percent of Native Shrub Cover (Low Freq.)
Burrowing Animals	
Ground Squirrel Habitat	Ground Squirrel Habitat Model Areas
Burrowing Owl Habitat	Burrowing Owl Habitat Model Areas
Connectivity	Connectivity Among Ground Squirrel Colonies

After Marxan targets are defined, users must assign a relative level or goal for each target. The goal for each target is the desired percentage of the target's area that should be included in the Marxan conservation solution. When possible, target levels should be based on scientific data to maintain the integrity of ecosystems; however, economic concerns and political goals can be considered.

Another requirement of a Marxan analysis is the development of a single input layer that represents how all constraints vary across the landscape. Constraints (also called costs) can be factors that limit the ability of the habitat to function as normal (e.g., physical barriers like roads) or factors that limit the abilities to intervene or manage biological resources (e.g., contamination or zoned areas). Depending on the particular application that Marxan is being used for, the constraints that this input layer represents can be based on physical or biological limitations, management guidelines, or rules and policies governing the future use of the land. Eleven categories and 73 sub-categories of constraints on the study area were used in the analysis including areas under industrial use or highly disturbed areas zoned for development under the CLUP, National Historical Park sites, waste sites, utility towers and lines, roads, railroads, structures, fences, wells, and borrow pits.

Once the Marxan targets and target goals were selected, calibration was performed to ensure that Marxan-produced solutions were optimized or close to the lowest cost. Values within the function that typically require calibration are the Species Penalty Factor (SPF), Boundary Length Modifier (BLM), number of iterations, and the constraint layer range (effect). With goals invoked by this study, Marxan runs successfully met the targets in most cases over a variety of runs, iterations, and BLM manipulations. Therefore, performing a calibration for SPF to apply to unmet targets would have little bearing on the solutions.

The BLM is used to improve the spatial clustering and compactness of the solutions (Ardon 2010). If a BLM is set to 0, then solutions will be formed with no regard to their overall pattern and are typically dispersed and result in a fragmented solution. As BLM is increased, Marxan solutions show more connection and clumping as the algorithm begins to favor the selection of units adjacent to already selected units over isolated units that otherwise achieve target goals (ALI 2014). Managing compliance and conservation of small, dispersed, and fragmented habitats can be a difficult and undesirable task. Therefore, achieving a level of clustering that maximizes the trade-off of minimizing the boundary length of a solution while minimizing the overall solution cost is the desired goal when calibrating a BLM.

Initial calibrations of BLM were performed from BLM values of 0 to 5, refined and run from 0 to 2, and then further refined to BLM Values between 0.1 and 0.95 BLM. The values were plotted on a graph consisting of total cost on the x-axis and the total boundary length on the y-axis; the point on the curve at which there is a relatively large decrease in total boundary length (clumping) is associated with a relatively small increase cost that can be considered the desired BLM value. Using this technique, a BLM value of 0.46 was selected.

The simulated annealing solver in Marxan requires a large number of iterations to find quality solutions (Ardon et al. 2010). Marxan analysis for this study was performed with 100 runs. Each run produces its own unique solution, increasing the number of iterations per run allows Marxan to spend more time converging towards similar solutions across those runs. Solution time increases with the number of iterations, so there are practical limits on the number of iterations that can be considered reasonable. At some point it becomes far more useful to have an adequate number of restarts (new runs) than to try to ensure the efficiency of an entire solution set (Ardon et al. 2010). This study followed a similar approach to the ALI (2014), running the analysis 100 runs with different iteration versions. Using this analysis, the Environmental Management Team chose 25 million iterations per run, producing less than a 1% difference in solution scores over the 100 runs at the most efficient processing time.

One of the conditions for obtaining meaningful results from a Marxan run is to ensure that the terms (constraint [cost] layer, boundary length, and SPF) of the objective function are of the same magnitude to avoid one of the terms unduly influencing the outcome of the solution. In the case of the Hanford Site analysis, the boundary length was measured to be 88.25; and because all of the targets were met, the SPF was set at 1. In order to scale the constraint layer to the magnitude of the boundary length, the planning unit costs were multiplied by 100. Another 100 (unitless) was added to each of the planning units to make the base planning units, those units with no costs have a cost value of 100.

One caveat to note in this assessment is that although the researchers used the best available data, some indicators of KEAs identified in the viability assessment workshops had to be modified to accommodate poor, incomplete, or lacking data. Another caveat to consider is that the study area

boundary may have an influence on the solution outputs. While the Columbia River acts as an ecological boundary to the north and east of the study area, the south and west boundaries are primarily administrative in nature. The use of administrative boundaries can have an effect on the solution in relationship to clustering (Boundary Length) and limiting selection of planning units on boundary edges.

The Marxan analysis produced solutions that had a range over mean variance of less than 1%. The solution displayed on maps and discussed in this report is the Marxan "Best" solution. This solution represents the areas of highest priority for conservation that most efficiently meet the conservation target goals in the study area with the lowest score. The score can only be used in comparing runs within the same analysis. The best solution produced a score, boundary length (connectivity), and penalty factor for target shortfalls that were all lower than the average of the 100 runs. This solution achieved nearly 100% of target goals with only a fraction more cost and number of planning units required compared to the average.

The solution used 20,144 planning units of the 40,654 units available on the study area. Approximately 50% of the study area displays in the conservation solution (Figure 11-1). The solution is comprised of 13 patches ranging from 10 to 74,216 ac (4 to 30,034 ha) in area and covers approximately 100,720 ac (40,760 ha) of the study area. The largest solution patch, 74,216 ac (30,034 ha), is the bulk of the overall solution covering nearly 74% of the total solution.

Because Marxan produces a unique solution for every run within an analysis, the planning units selected can vary from each solution. Marxan produces a selection frequency output that displays the number of times each planning unit is selected over the 100 runs in an analysis. The best solution of this assessment contained 20,144 planning units, 61.53% (12,394 units) of the solution area was selected in each solution of the 100 runs. An additional 29.59% (5961 units) of the solution area was selected in 67 to 99 runs. Only 8.88% (1789 units) of the solution area was selected in 66 runs or fewer.

The appeal of the Marxan analysis is that Marxan can use a diverse array of input data types (already existing Hanford Site data) and can be compatible and complementary to other efforts on the study area (e.g., the CLUP [DOE/EIS-0222 1999] and the BRMP [DOE/RL-96-32 2017]) and in the greater Columbia Plateau Ecoregion (e.g., the ALI [2014] and the WHCWG [2012, 2013a, 2013b, 2014, 2015]). A key element to understanding the assessment is to evaluate the identified areas of high habitat value. The solution Marxan provided shows areas of good habitat with high value, but areas selected may not always include all high quality examples of that habitat. By nature of the Marxan tool, the solutions are a range of mathematical calculations that attempt to capture the desired quantity of a target while limiting a cost to the solution. Using BRMP and its practices, the areas of highest habitat quality and the best examples of resources will remain conserved through avoidance or minimal intrusion. The Marxan tool can be used to answer other habitat conservation questions (such as "what is a network and spatial configuration of areas that strategically meet conservation goals?") through visual display and statistical analysis. The CHAMP provides an additional decision-making tool that can support the practices of BRMP and highlight areas that may be underrepresented in particular resources but as whole provide value to the landscape.

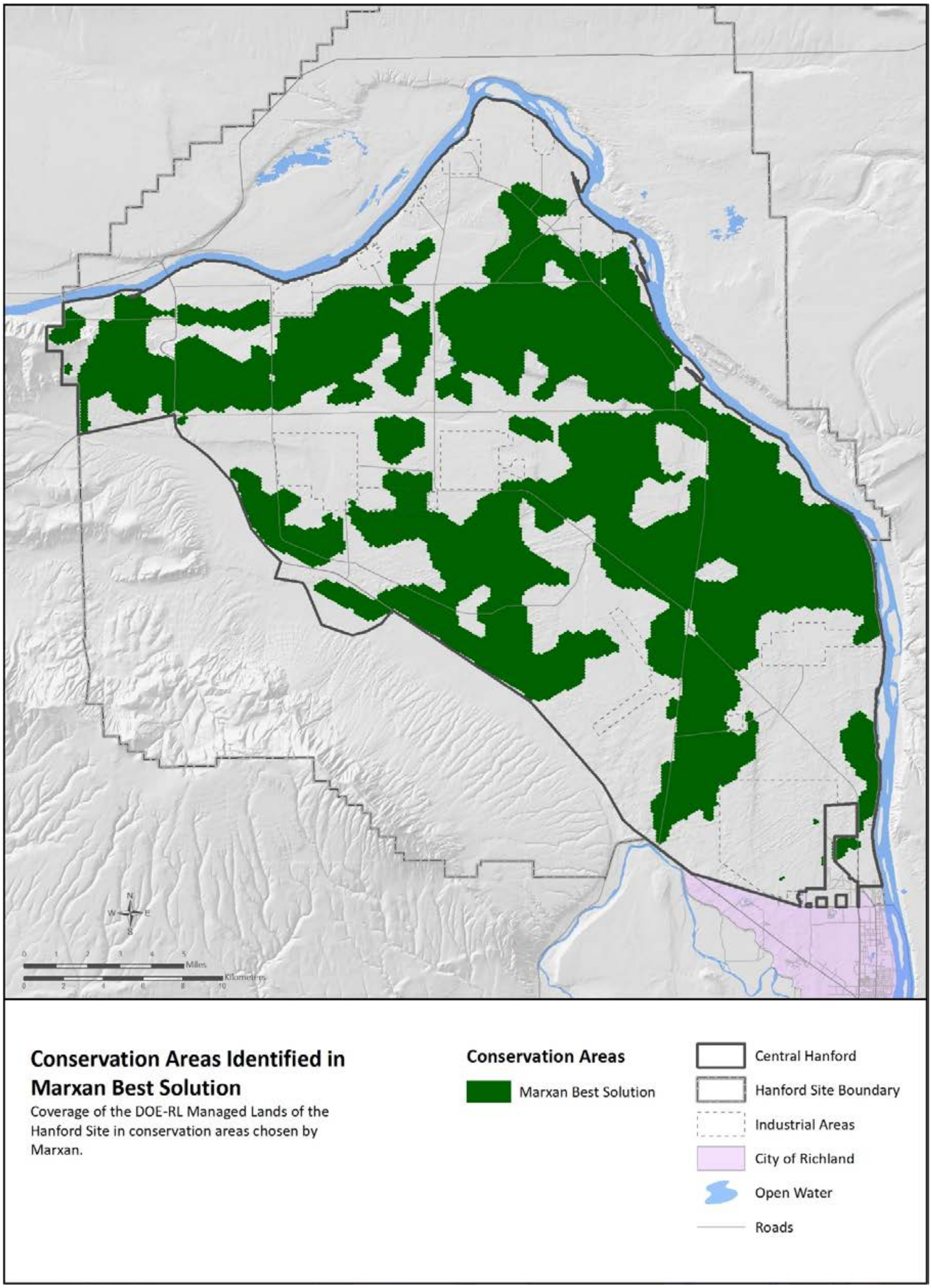

Figure 11-1. Best Solution Determined by Marxan Assessment for Conservation Areas on the DOE-RL-managed Portion of Hanford Site.

Evaluating the frequency of planning unit selection during the assessment can make inferences on the biological value of portions of the study area. Biological value of an area may be defined in terms of irreplaceability, or how important the specific area is for efficient achievement of conservation objectives. The higher the frequency of selection of a planning unit in Marxan, the closer a unit is to being considered irreplaceable within the solution. After establishing areas of irreplaceability from selection frequency of the solution, the next step would be to evaluate potential vulnerabilities to these areas. Vulnerability is the risk of an area being transformed through damage caused to the biodiversity features or threatening ecological processes (Kukkala and Moilanen 2012). For this discussion, vulnerabilities are further defined as the risk of impairment to an area from Hanford Site operations or other human activities. While it is not always possible to predict or limit Hanford Site operations to specific areas, the solution shows areas that are lower in their conservation status and not frequently selected as valuable in the outputs. These areas should be the preferred areas for future development to limit impact to sensitive biological resources. The vulnerability plotted against the irreplaceability can provide inference into potential actions (Figure 11-2). A spatial representation of this concept for the study area is provided in Figure 11-3.

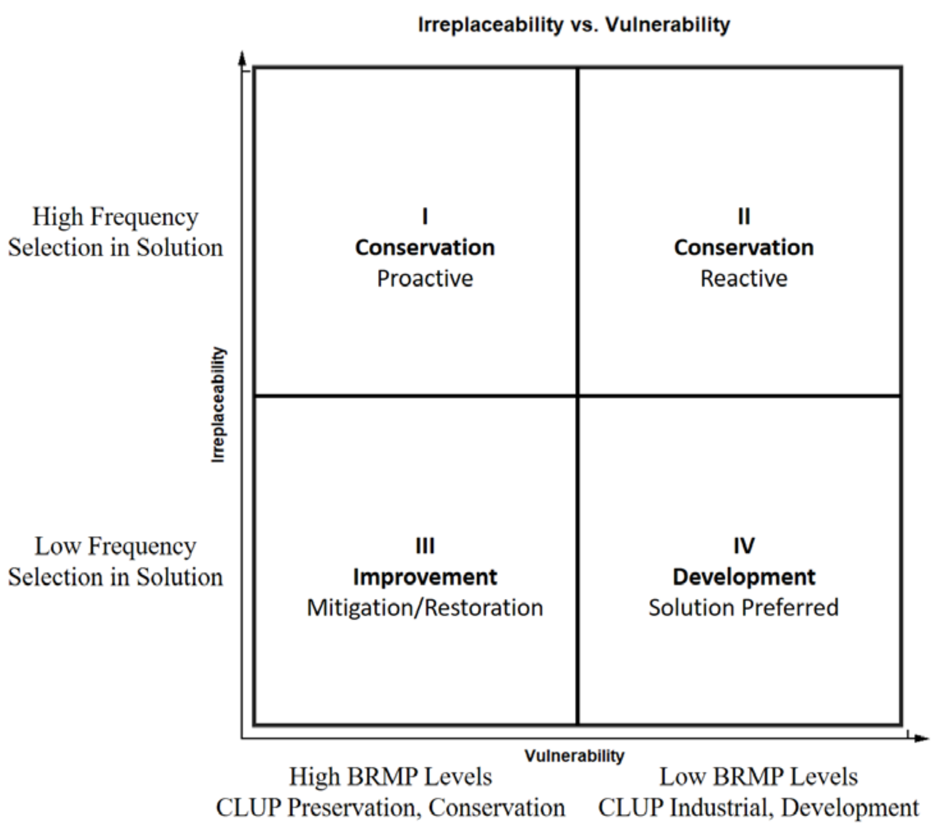

Figure 11-2. Irreplaceability vs Vulnerability Plot. Irreplaceability increases with the Increase in Selection Frequency of a Planning Unit. Vulnerability from Human Threats Increases as BRMP Levels are Reduced or CLUP Land Use Industrial and Development Designations.

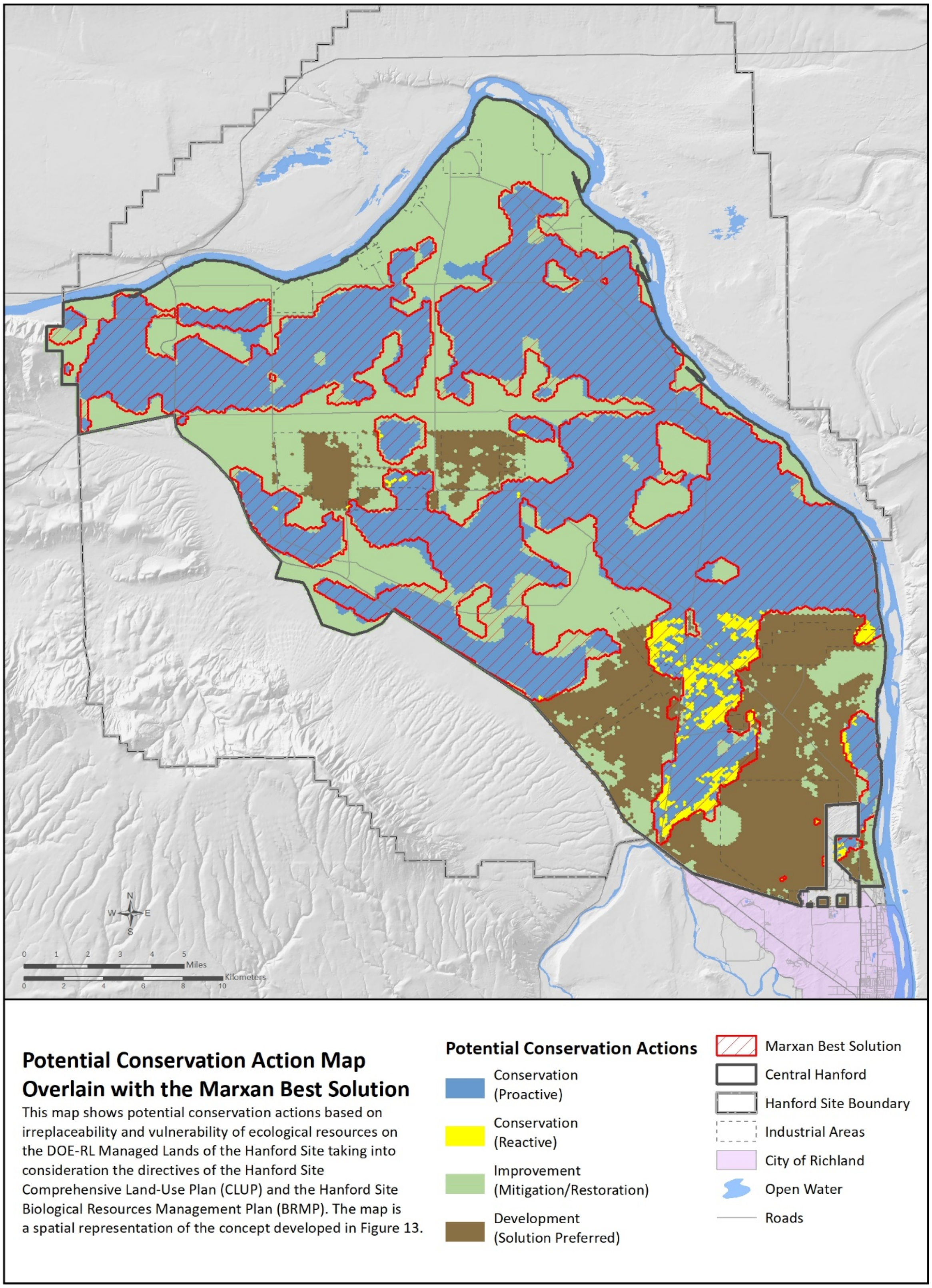

Figure 11-3. Potential Conservation Action Map for the DOE-RL-Managed Portion Hanford Site Overlain with the CHAMP Best Solution.

Integration of the CHAMP with existing site management plans (CLUP and BRMP) and existing regional habitat analysis (Arid Lands Initiative [ALI] and WHCWG) is an important function of the study results. The expectation of the study results is that they are compatible and complementary to the existing plans and analyses and provides reciprocating support. With the current CLUP map and designations, the CHAMP best solution identifying priority conservation areas is in agreement over 82% of its area (Figure 11-4 and Table 11-2) but also showed areas where CLUP designations could be improved. Even with added weight constraints, some areas of industrial (exclusive), industrial, and research and development were selected in the best solution.

The CHAMP best solution is also in reasonable agreement with the BRMP. Approximately 95% of the CHAMP best solution occurs in habitats identified for preservation (Level 4 and 5) or conservation (Level 2 and 3) in the BRMP (Figure 11-5 and Table 11-3). Approximately 90% of the CHAMP best solution appears in the top three highest BRMP resource priority Levels (Levels 3, 4, and 5).

The ALI Marxan analysis recognized the Hanford Site as an important priority core area at all goal levels. The Hanford Site overlays one of the larger priority core areas selected by the ALI analysis. At the planning unit size of 500 ac (202 ha), a large portion of the Hanford Site consistently met the conservation targets. However, at the local scale, it is apparent that some areas of high quality habitat were excluded from the ALI solution while other areas of low quality habitat were included. On the DOE-RL-managed portion of the Hanford Site, roughly 52% of the ALI best solution at the medium goal level intersects with the CHAMP best solution. This disparity reinforced the need for a local analysis with more detailed local data.

The CHAMP best solution aligns with the Washington WHCWG outputs and can provide local detail. A good example can be seen in the WHCWG black-tailed jackrabbit normalized least-cost corridor. This WHCWG output combines habitat concentration areas and linkages into a single map class. The CHAMP best solution generally matches the black-tailed jackrabbit network map, including the corridors.

An intended purpose of the CHAMP was to identify potential areas on the study area that would benefit from mitigation work and restoration efforts. Providing a one-size fits all prescription for mitigation on the Hanford Site is not a feasible expectation of any analysis. Once decisions are made on potential locations of mitigations based on ecological factors of the solution, staff can evaluate the potential success of restoration activities in those areas. The CHAMP can be effective in avoiding unnecessary costs or effort in restoration. In addition to evaluating the ecological and external factors that will impact the success of future mitigation actions, it is important to evaluate the planning units to determine why they were not selected as part of the solution. This information can help guide specific mitigation actions after the planning units are chosen. Once a mitigation area is chosen, Marxan can be used to potentially model the desired outcome of the mitigation actions. To perform these actions, the values of the individual planning units can be altered in the selected target layer to reflect the desired future conditions of the mitigated area, and the Marxan run will be performed under the same conditions. These results can show the potential future effects of the proposed actions at a landscape scale, including changes in connectivity, patch buffering, and habitat quality increase. After this evaluation, the mitigation plan can then be altered, if necessary, to create the desired changes.

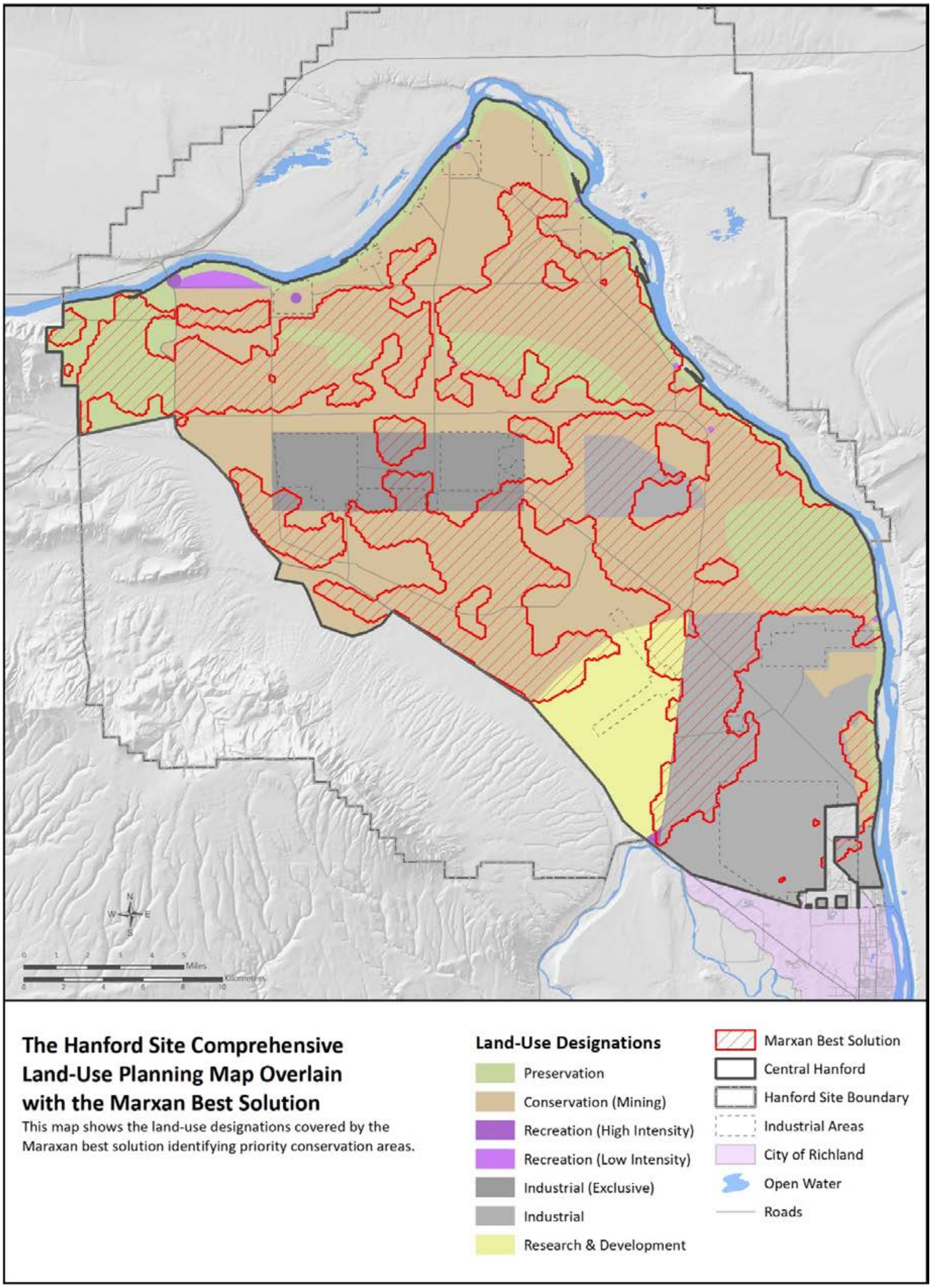

Figure 11-4. The Hanford Site Comprehensive Land-Use Planning Map Overlain with the CHAMP Best Solution.

Table 11-2. Area of the DOE-RL-Managed Portion of Hanford Site and the Marxan Best Solution Covered by Each Hanford Site Comprehensive Land-Use Planning Designations.

Designation	Area of Study Area (Hectares)	Percent of Study Area	Area of Best Solution (Hectares)	Percent of Best Solution
Conservation (Mining)	44,156.2	54.63	25,502.5	62.78
Preservation	11,800.9	14.60	7,877.3	19.39
Recreation (High Intensity)	107.1	0.13	16.9	0.04
Recreation (Low Intensity)	327.2	0.40	22.7	0.06
Industrial (Exclusive)	5,063.9	6.26	1,110.6	2.73
Industrial	14,253.7	17.63	5,060.8	12.46
Research & Development	4,908.6	6.07	1,009.7	2.49
River	212.7	0.26	19.1	0.05
Total	**80,830.2**	**100.00**	**40,619.7**	**100.00**

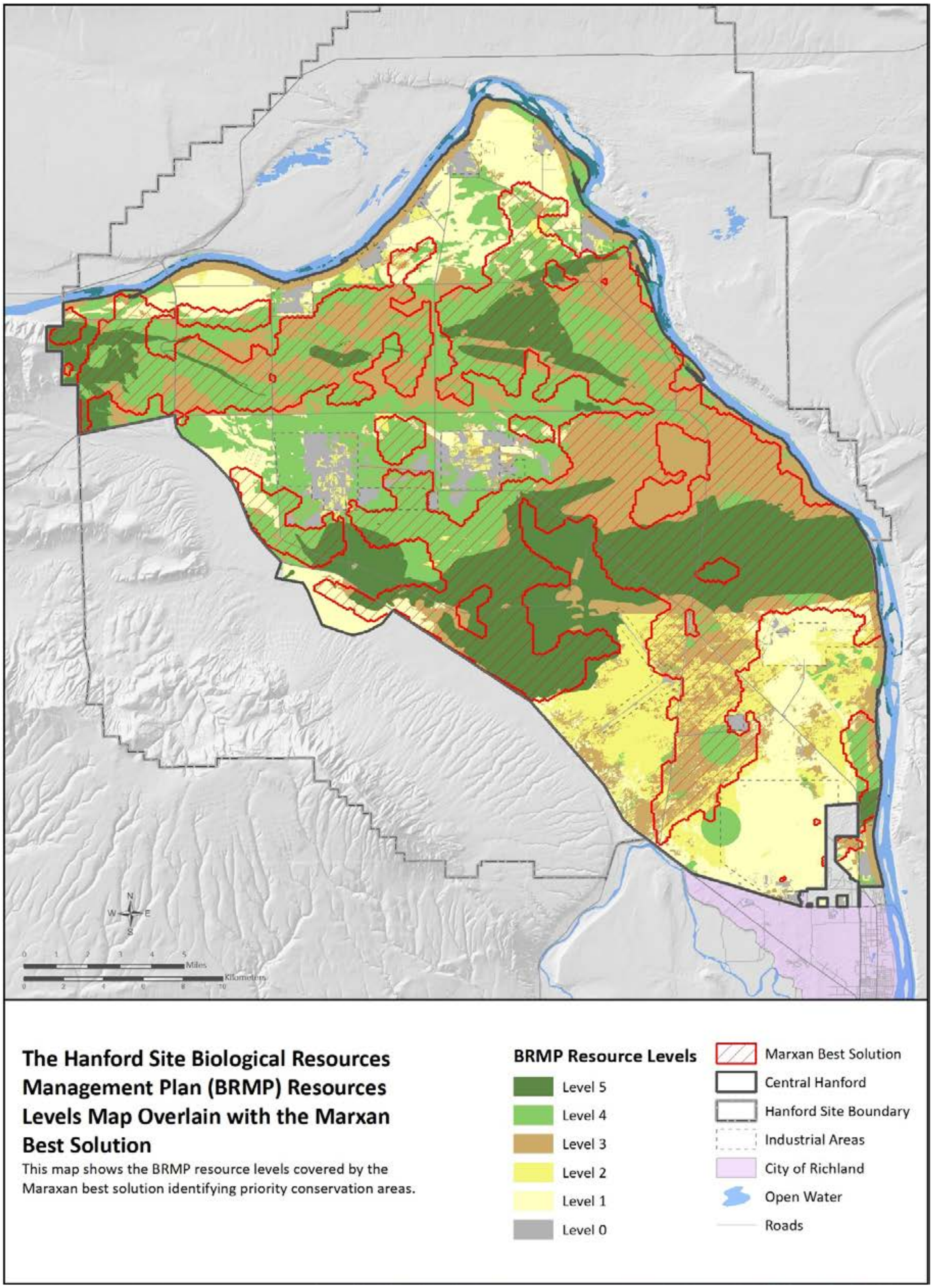

Figure 11-5. The Hanford Site Biological Resources Management Plan Resources Levels Map Overlain with the CHAMP Best Solution.

Table 11-3. Area of the DOE-RL-Managed Portion of Hanford Site and the Marxan Best Solution Covered by Each Biological Resources Management Plan Resource Level of Concern.

BRMP Resource Level of Concern	Area of Study Area (Hectares)	Percent of Study Area	Area of Best Solution (Hectares)	Percent of Best Solution
Level 5	17,611.2	21.80	13,269.5	32.66
Level 4	20,015.8	24.78	11,190.7	27.54
Level 3	19,808.8	24.52	12,276.9	30.21
Level 2	7,255.1	8.98	1,765.5	4.34
Level 1	12,914.7	15.99	2,012.9	4.95
Level 0	3,167.8	3.92	118.7	0.29
Total	**80,773.4**	**100.00**	**40,634.3**	**100.00**

Performing this conservation assessment met the purpose of identifying areas of high habitat value and areas for restoration of habitat that meet the conservation goals and objectives of the Hanford Site. The solution provided, coupled with existing conservation documents and processes, will support ecological impact and mitigation decision making on the Hanford Site. The CHAMP is an adaptive tool that can be employed in various ways to target generic or specific solutions.

Future analysis will shift focus to identify potential areas on the Hanford Site that would benefit from mitigation work. To perform this investigation, input layers will be set to highlight areas that meet mitigation potential goals. Items to consider for focusing solution to mitigation areas may include the following:

- Identify planning units with Fair target ratings that can be moved into the Good category with mitigation actions like revegetation, animal reintroduction, or other habitat restoration activities
- Alter targets to better represent a mitigation habitat so Good ratings are no longer resources or habitats that are quality representations but rather have quality in its mitigation potential
- Make changes to current constraints and add new constraints specific to their impacts on mitigation and long-term success
- Manipulate target goal levels to highlight planning with weaker features that would benefit from mitigation or restoration.

11.1.2 Fish and Wildlife Monitoring

JW Wilde

This section provides inventory, monitoring, and survey information for fish and wildlife evaluated at the Hanford Site during 2019. This information is provided in context with historical data and trend information. Historically, three fish and wildlife species (fall Chinook salmon [*Oncorhynchus tshawytscha*], steelhead [*Oncorhynchus mykiss*], and bald eagles [*Haliaeetus leucocephalus*]) have been monitored annually on the Hanford Site. These species are either protected by federal or state laws and regulations or are of special interest to the public and stakeholders. Monitoring consisted of estimating

numbers of fall Chinook salmon redds, surveying for steelhead redds, and assessing bald eagle nesting and night roosting activity. Yearly monitoring provides occurrence and distribution data to ensure their protection from Hanford Site operations. Additional annual monitoring efforts include nesting ferruginous hawks and migratory birds. Each calendar year, additional species-specific monitoring are performed based on stakeholder interest, legal requirements, resource status, BRMP resource level, and data needs. In addition to the aforementioned annual projects, calendar year 2019 monitoring also included burrowing owls, pollinator habitat, deer, and bats. The following sections provide summaries of the monitoring results; additional reports on these species can be found at http://www.hanford.gov/page.cfm/EcologicalMonitoring.

11.1.2.1 Fall Chinook Salmon

JJ Nugent

Commonly referred to as king salmon, Chinook (*Oncorhynchus tshawytscha*) are the largest of the Pacific salmon (Myers et al. 1998, Netboy 1958). Adult fall Chinook salmon destined for the Hanford Reach enter the Columbia River in late summer and spawn in the fall. Females fan out nests or redds in suitable gravel substrate and deposit eggs in a pocket while males simultaneously extrude milt to fertilize the eggs. Redds are readily identifiable during this time and appear as clean swept gravel patches amidst darker undisturbed substrate covered by algae (periphyton).

The population of fall Chinook salmon that spawns in the Hanford Reach of the Columbia River is the largest run remaining in the Pacific Northwest and has regional ecological and cultural significance, as well as economic importance that reaches areas downstream on the Columbia River and along the Pacific Ocean as far as southeast Alaska (Dauble and Watson 1997). These fall Chinook salmon have been vital in efforts to preserve and restore other depleted Chinook salmon stocks in the Columbia Basin (Anglin et al. 2006). Aerial counts of fall Chinook salmon redds have been conducted since 1948 at the Hanford Site to provide an index of relative abundance among spawning areas and years (HNF-52190; HNF-54808; HNF-56707; HNF-58823; HNF-59813; MSA 2018; HNF-64540; HNF-64542). The counts are also used to document the onset of spawning, locate spawning areas, and determine intervals of peak spawning activity. These data also allow for planning to avoid impacts such as disturbance or siltation to redds from Hanford Site activities. Understanding the location and abundance of spawning is a critical part of the management of this important population. The information collected during the aerial surveys is vitally important for the implementation of the Hanford Reach Fall Chinook Protection Program (ACE 2006). Prior to 2011, the Hanford Reach was divided into 16 areas that were maintained in the current monitoring campaign. In 2011, eight additional sub-areas (100-B/C, 100-K, 100-N, 100-D, 100-H, 100-F, Dunes, and 300 Area) were defined to better monitor the abundance and distribution of fall Chinook salmon redds in areas of potential upwelling of contaminated groundwater. The original 16 areas and the newer 8 areas are not mutually exclusive areas, they simply represent different divisions of the Hanford Reach.

In 2019, three surveys were completed along the Hanford Reach (October 21, November 4, and November 24). Table 11-4 summarizes the results of visual aerial surveys for fall Chinook salmon redds in the originally defined 16 areas. The results for the same surveys, organized into the eight operational areas, are shown in Table 11-5. The peak annual redd count for 2019 (7,899) was the ninth lowest count (range: 4,018 through 20,678) in the past 20 years (2000 through 2019) and was well below the previous 10-year average (11,247). During the final survey (November 24), a silt plume originating along the eastern shoreline near Locke Island and the 100-F Islands obscured any redds observed on

November 4, 2019, downstream of the Hanford Townsite. The historical trend in redd counts since 1948 is shown in Figure 11-6.

Table 11-4. Summary of Fall Chinook Salmon Redd Counts by Areas for the 2019 Aerial Surveys in the Hanford of the Columbia River.

Area	Description	10/21/2019	11/4/2019	11/24/2019	Maximum Count
0	Islands 17-21 (Richland)	0	0	0[a]	0[a]
1	Islands 11-16	11	166	0[a]	166
1a	Savage Island/Hanford Slough	0	0	0	0
2	Islands 8-10	31	665	723	723
3	Near Island 7	7	308	408	408
4	Island 6 (lower half)	25	671	810	810
5	Island 4, 5, and upper 6	35	829	939	939
6	Near Island 3	2	175	300	300
7	Near Island 2	25	440	720	720
8	Near Island 1	0	140	150	150
8a	Upstream of Island 1 to Coyote Rapids	0	0	0	0
9	Near Coyote Rapids	24	112	112	112
9a	Upstream of Coyote Rapids to China Bar	0	0	0	0
China Bar	China Bar/Midway	1	20	30	30
10	Near Vernita Bar	49	2,800	3,530	3,530
11	Upstream of Vernita Bar to Priest Rapids Dam	0	6	11	11
[a] Area obscured by silt plume					

Table 11-5. Summary of Fall Chinook Salmon Redd Counts by Sub-areas Adjacent to Hanford Site Operations for the 2019 Aerial Surveys in the Hanford Reach of the Columbia River.

Sub-area	10/21/2019	11/4/2019	11/24/2019	Maximum Count
300 Area	0	0	0	0
Dunes	0	0	0	0
100-F	7	308	408	408
100-H	35	829	939	939
100-D	0	140	150	150
100-N	0	0	0	0
100-K	0	0	0	0
100-BC	24	112	112	112

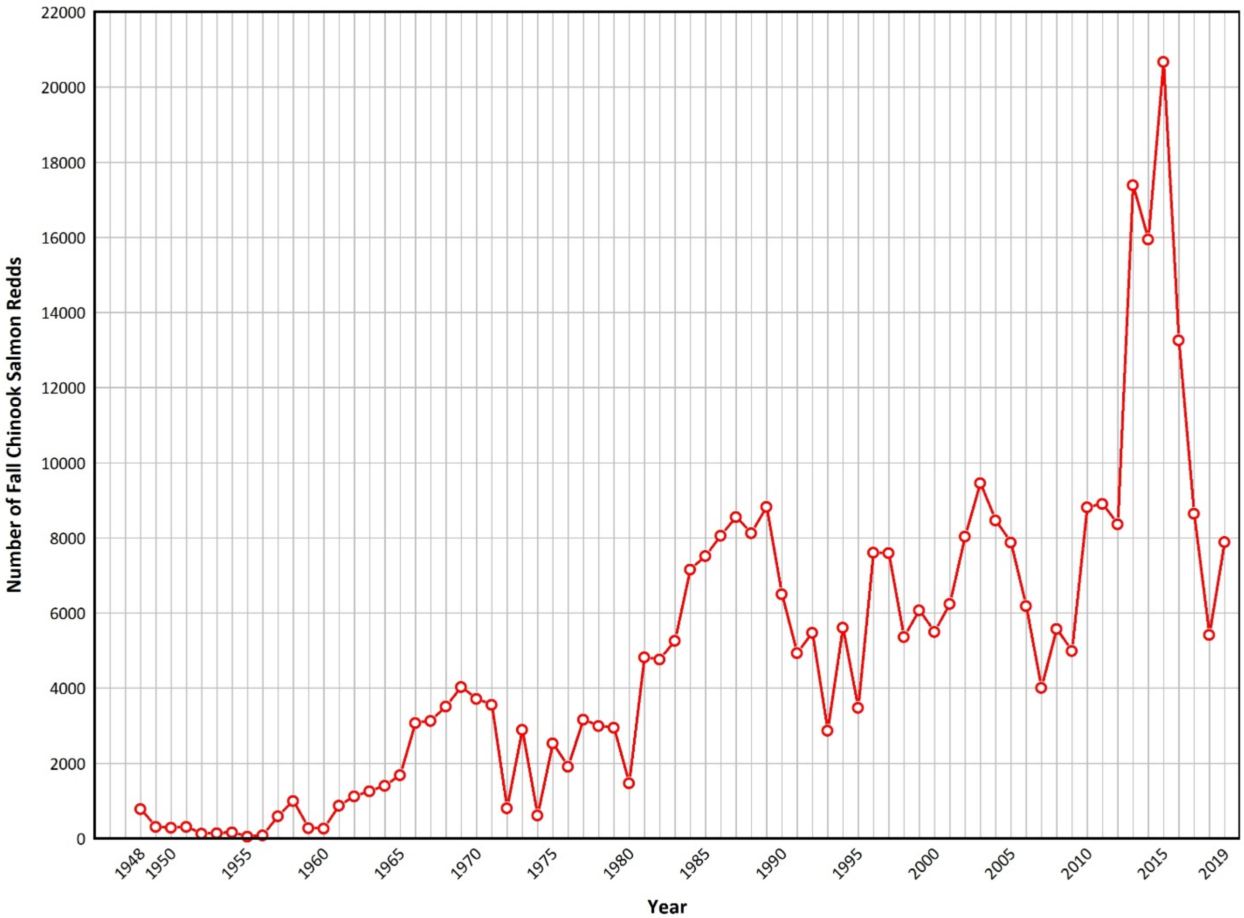

Figure 11-6. Visual Hanford Reach Fall Chinook Salmon Redd Counts 1948 to 2019.

11.1.2.2 Steelhead

JJ Nugent

Steelhead use the Hanford Reach for rearing as juveniles, as a migratory corridor for juveniles and adults, and for spawning as adults. Upper Columbia Summer-run Steelhead are currently listed as federally threatened under the ESA in 16 USC 1531 and as a state candidate in Washington State (WDFW 2019). Because of their listing status and importance to recreational and Tribal fisheries, steelhead are monitored on the Hanford Reach.

Steelhead build nests (termed “redds”) in gravel or cobble substrate and spawn in the spring; the steelhead fry emerge from the gravel later that same spring. Adult steelhead generally use smaller tributary habitat and substrate; however, adult steelhead will spawn in larger mainstream rivers with suitable habitat, such as the Columbia River. Suitable spawning conditions within the Hanford Reach occur between February and early June with peak spawning in mid-May (Watson 1973).

Aerial surveys for steelhead redds are conducted on the Hanford Reach in the spring of each year to identify potential spawning areas and timing, as well as to provide an annual index of relative abundance among spawning areas. The surveys document any change in the status of steelhead spawning in the Hanford Reach and could help plan project activities to avoid redds, if any are identified. Similar to the methods used to document fall Chinook salmon spawning, the survey area is divided into

11 areas, with the number of redds being totaled by area. Eight additional sub-areas (100-B/C, 100-K, 100-N, 100-D, 100-H, 100-F, Dunes, and 300 Area) were added to monitor the abundance and distribution of steelhead redds in areas of potential upwelling of contaminated groundwater. The original 11 areas and the newer 8 areas are not mutually exclusive areas, they simply represent different divisions of the Hanford Reach.

Information on the quantity and location of steelhead spawning is difficult to assess because aerial surveys of steelhead spawning are often hampered by high spring runoff that obscures visibility. Excessively high flows resulting from spring run-off flood areas typically characterized by terrestrial vegetation and lacking steelhead spawning habitat, and leave previously usable habitat with flows too swift for spawning and too deep to be observed from the air. Sustained flows in excess of 160 kcfs (4,531 m^3/sec) are considered too high to survey.

In 2019, two steelhead redd surveys were completed on the Hanford Reach (April 17 and May 13). No steelhead redds were observed during the flights. Columbia River flows rose above 160 kcfs (4,531 m^3/sec) in mid-May, reducing the likelihood of observing redds for the remainder of the spawning season (Figure 11-7). No other surveys were conducted in 2019.

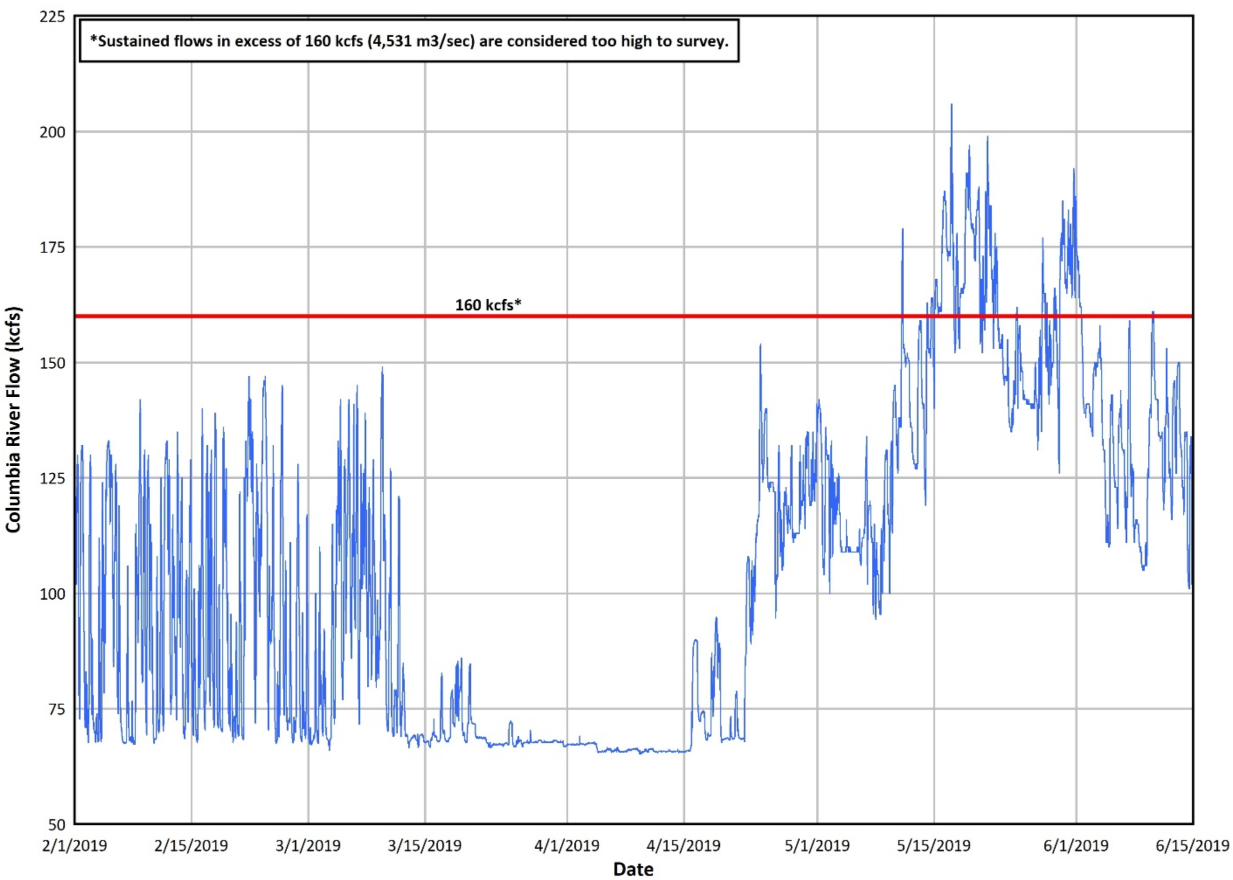

Figure 11-7. Columbia River Flows on the Hanford Reach during Late Winter and Spring 2019.

11.1.2.3 Bald Eagles

JW Wilde, M Paulsen

Bald Eagles are a success story for species protection under the ESA. In 2007, 40 years after the Bald Eagle was listed as endangered and given protection under the ESA, the USFWS determined that the population of Bald Eagles in the lower 48 States had recovered sufficiently to be removed from the ESA list. The state of Washington also down-listed Bald Eagles from threatened to sensitive. Despite the significant recovery of Bald Eagle populations, federal laws including the *Bald and Golden Eagle Protection Act of 1940* and the *Migratory Bird Treaty Act of 1918* still provide protection for eagles, their nest trees, and communal night roosts. In addition, following delisting, the USFWS developed the *National Bald Eagle Management Guidelines*, which provides monitoring and management guidance for Bald Eagles (USFWS 2007).

The DOE/RL-94-150, *Bald Eagle Management Plan for the Hanford Site*, was developed by DOE to provide an overview of Bald Eagle distribution, behavior, and ecology important to understanding the issues related to management and protection of this species on the Hanford Site.

The information provided in this document defines the actions that constitute DOE policy regarding Bald Eagle protection and management on the Hanford Site. Key among these actions are protective measures for roost sites and nests, which are based on federal and state guidelines. Bald Eagles are attracted to the abundant fish and waterfowl found along the river and use the Hanford Reach of the Columbia River as a wintering area, and more recently as nesting area for producing young. Most Bald Eagles arrive on the Hanford Site in mid-November to forage and are usually present until mid-March. Wintering eagles use different habitats for various activities such as perching, foraging, and roosting.

Nest building has occurred most years, but historically the adults abandoned most nests on the Hanford Site by mid-March prior to producing young. The timing of this abandonment coincides with the eagles migrating toward summer feeding areas or other nesting territories. Bald Eagles were first observed successfully producing fledged young from nests on the Hanford Site in 2013. In Washington State, nesting may begin as early as December and young may fledge as late as August (DOE/RL-94-150). Bald Eagle nests are monitored for occupancy (adults present) and productivity (production of young). A successful nest is described as a nest from which at least one young fledged, or one in which at least one young was raised to an advanced stage of development (Postupalsky 1974). Potential nest sites are monitored to determine if new nest protection areas are necessary. When a new nest is identified, nesting exclusion buffers of 660 ft (200 m) are enforced until the nest is abandoned or the young eagles have fledged.

Night roost surveys are conducted at the eight protected night roost sites from November through March (Figure 11-8). The eight areas are divided into three monitoring routes consisting of 2 to 4 night roost monitoring locations each. Surveys are initiated 15 minutes prior to sunset and continue until survey is complete or there is insufficient light to see individual birds. Surveyors approached each location in a vehicle and remained outside of the designated 660-ft (200-m) buffer zones. After staff adequately observe the roost to count all eagles present, generally 3 to 7 minutes, surveyors proceed to the next night roost location until all locations have been surveyed. Nest surveys are performed at all known potential nest locations. An observation location is chosen at an appropriate distance, generally at least 660 ft (200 m) from the nest. Staff view the nest area with binoculars or spotting scope, and nesting behaviors are documented during the observation period.

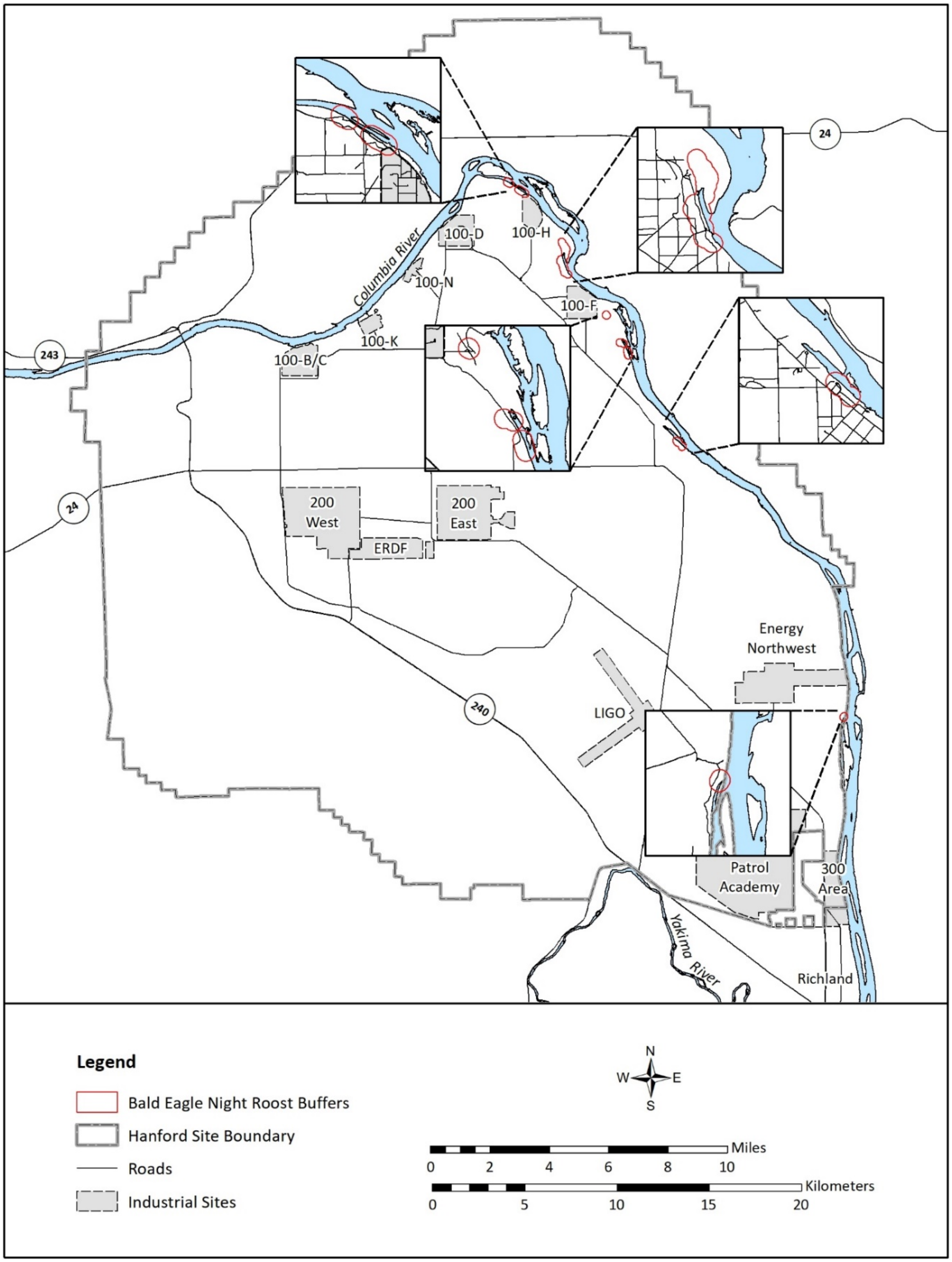

Figure 11-8. Hanford Bald Eagle Night Roost Buffers.

Nest surveys typically consisted of 1-hour observations in the area of interest, documenting any signs of nesting activity (e.g., territory defense, nest tending, pair bonding behaviors).

In addition to the roost and nest surveys, boat surveys are performed at least once a year (target once in November/December and once in March) to determine the age class, distribution, and number of eagles on the Hanford Reach. Both shorelines of the Columbia River along the Hanford Site are surveyed, beginning immediately upstream of Vernita Bridge and ending at the 300 Area. All boat surveys are performed on the same date as a night roost survey. By performing the two surveys in succession, correlations of day and night counts and distributions can be used to determine additional potential night roost areas and nest sites for future Bald Eagle monitoring efforts.

Six night roost surveys at the eight currently protected night roost monitoring locations were completed during the fiscal year (FY) 2019 season with the final night roost survey being conducted in concurrence with a boat survey. Bald Eagle use was documented at all the night roost locations monitored during FY 2019. Roughly 70% of the eagles present during the first three night roost surveys were juveniles, who grouped in large numbers in areas where spawned out fall Chinook salmon carcasses are known to accumulate. As the season progressed, the number of juveniles on the Hanford Reach dropped off dramatically while the number of adults declined less rapidly. This was likely due to juvenile eagles taking advantage of the fall Chinook salmon (*Oncorhynchus tshawytscha*) food resource then leaving after the carcasses were no longer available, while adult eagles continued to use the Hanford Reach likely feeding on waterfowl and carrion. The night roost survey dates and results are summarized in Table 11-6 with summaries of observations described in the paragraphs following. Figure 11-9 displays the total number of individuals by age class observed during each survey.

Table 11-6. Bald Eagle Night Roost Monitoring Data for FY 2019.

Night Roost Location	Number of Eagles Present					
	11/28/18	**12/10/18**	**12/17/18**	**1/7/19**	**1/21/19**	**3/18/19**
100-H Upstream	26	11	9	4	4	1
100-H Downstream	0	1	4	0	4	0
White Bluffs Upstream	36	13	16	5	5	2
White Bluffs Downstream	0	0	0	0	4	0
100-F Island Upstream	18	2	0	0	1	0
100-F Slough	0	0	0	0	1	0
Townsite Substation	3	2	0	2	2	1
Upstream of Wooded/Nest Site Area	2	3	4	2	2	3
Totals	**85**	**32**	**33**	**13**	**23**	**7**

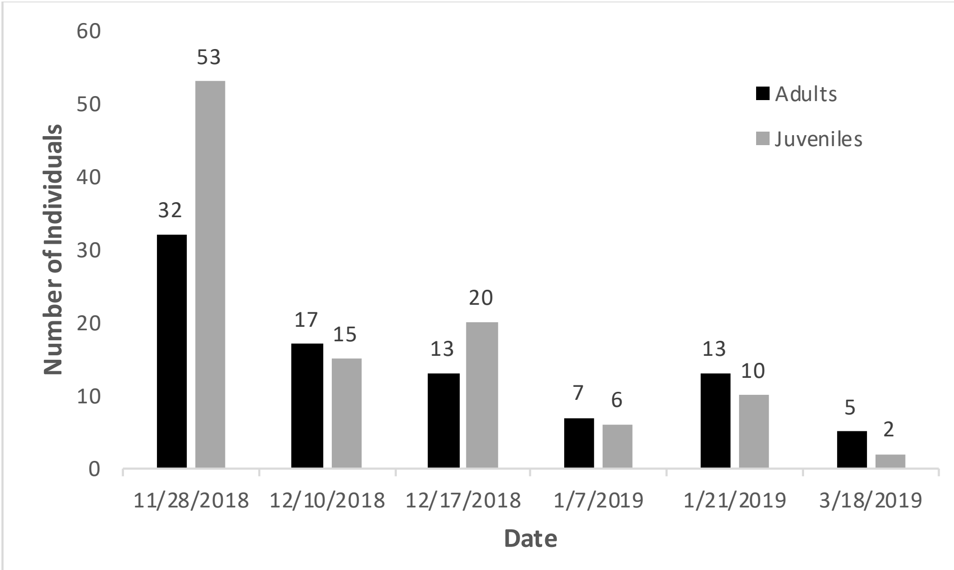

Figure 11-9. Age Class of Bald Eagles Counted During Roost Surveys.

In addition to the night roost surveys, one boat survey was performed on March 18, 2019, to search for potential nesting locations. A peak count during the winter was not conducted due to unforeseen circumstances. A total of 18 eagles, 9 adults and 9 juveniles, were observed during the March 18 boat survey. These numbers are slightly higher than numbers recorded during the March boat survey in FY 2018, which reported a total of 10 eagles (8 adults and 2 juveniles).

Successful nesting was documented in FY 2019 at the Hanford Townsite Substation, White Bluffs Slough, Benton Substation, and 100-N. At least one juvenile Bald Eagle was observed at all nest survey locations in FY 2019 aside from the nest located downstream from the Hanford Townsite.

Beginning in FY 2013 and again in FY 2014, monitoring staff documented a successful nest upstream of Wooded Island that produced a pair of fledglings each year. In FY 2015, the nest was occupied for a third consecutive year with three fledglings observed near the nest in late spring. During FY 2016, monitoring staff were performing other monitoring work in the area and noted that a large stick nest was being constructed on a tower near the Bonneville Power Administration's Benton substation; approximately 0.68 mi (1,100 m) northwest of the Upstream Wooded Island nest site. Monitoring staff later confirmed that the nest was active and the Wooded Island nest was nearly gone, presumably from the Bald Eagles using the old nest materials to build the new nest. On April 27, 2016, monitoring staff confirmed that the nest was occupied with two Bald Eagle chicks in the nest. A pair of adult Bald Eagles were observed utilizing the nest during each night roost survey conducted in FY 2017; once again the nest was found to be occupied with two chicks seen in the nest the following spring (HNF-63012). This nest was observed to be active again in FY 2018, with a pair of adults in and around the nest observed on multiple night roost surveys. After a nest survey on May 10, 2018, it was confirmed that this nest again produced young with one chick observed. This nest was again confirmed as being active in FY 2019, with a juvenile documented on the May 15, 2019, survey.

The nest located on the White Bluffs Peninsula was occupied throughout the FY 2015 nesting season; however, because its location was obscured by foliage later in the nesting season, monitoring staff could

not confirm presence of young in the nest. On June 5, 2015, surveyors performing a roadside breeding bird survey documented a juvenile Bald Eagle perched in the tree containing the nest, which could indicate a successful nest attempt. However, actual success could not be determined. During a nest survey on May 15, 2017, one chick was observed in the nest along with one adult (HNF-63012). In FY 2018, staff performing a nest survey on May 10, 2018, observed one young chick (down feather covered) in the nest. One adult and two juvenile Bald Eagles were observed in this nest during the May 16, 2019, survey, meaning it can be defined as an active and successful nest for FY 2019.

During FY 2019 a nest was monitored in the 100-N Area. One adult was observed at this nest during the April 3, 2019, survey and an adult along with two chicks were observed during the May 2, 2019, survey. This nest was considered active and successful despite being surveyed prior to May 10.

A pair of Bald Eagles appeared to be attempting to nest in a previously constructed rookery nest at the Hanford Townsite Substation night roost in FY 2017. The location was named the Hanford Townsite Substation nest. During night roost surveys, the pair was observed both in and around the nest. As the nesting season continued, nest monitoring proved the nest to be abandoned and the pair absent from the area (HNF-63012). A pair was again observed to be utilizing the nest in FY 2018 during the night roost surveys. While conducting a nest survey on May 10, 2018, two chicks with mature feathers were observed in the nest, while one adult perched nearby. During the final nest survey on June 14, 2018, the two chicks were observed exercising their wings and conducting short hover flights in the nest. No adults were observed in the area. In FY 2019, a pair of eagles were observed in this nest during the March 28 survey. Later in the season, during the May 14, 2019, survey, one adult was observed along with two young chicks.

A possible new nest was observed inland and downstream from the Hanford Townsite High School during the March 19, 2018, boat survey. The location was surveyed and determined to be active on April 9, 2018, with two adults in and around the nest. The location was named the Hanford Townsite Downstream Nest. Subsequent surveys determined the nest to be abandoned. The Hanford Townsite Downstream Nest appeared to be utilized by at least one adult during the March 28, 2019, survey; however, when this nest was surveyed on May 14, 2019, no birds were observed in the nest itself, with only one adult being seen flushing from a nearby tree.

11.1.2.4 Ferruginous Hawk Nesting Territory Occupancy and Productivity Monitoring

JJ Nugent

The Ferruginous Hawk, a Washington State threatened species (WDFW 2019) and the largest of the North American Buteo species, inhabits grassland, shrub-steppe, and desert habitats of western North America from southern Canada to central Mexico. Generally, Ferruginous Hawks begin arriving in Washington State to nest in mid-February and begin laying eggs in mid-March. Most eggs hatch in May and most young fledge from late May through late July (WDFW 1996). Ferruginous Hawks build large stick nests. On the Hanford Site, Ferruginous Hawks have been found nesting on cliffs, rock outcrops, trees, and transmission towers.

Ferruginous Hawks are especially sensitive to human disturbance and incursion into their nesting areas. On the Hanford Site, nesting Ferruginous Hawks are protected using WDFW guidelines (WDFW 2004). Buffer zones of 3,281 ft (1,000 m) are established around active nests. Road closure signs are placed in the roads where they intersect with the 3,281-ft (1,000-m) buffers. Nest areas are protected from all human disturbance within 820 ft (250 m) between March 1 and May 31, and within 3,281 ft (1,000 m)

for prolonged (greater than 0.5 hour) activities during the entire nesting and fledging season (March 1 to August 15). The identification of active nest sites during annual surveys allows for the protection of nesting Ferruginous Hawks.

Nesting Ferruginous Hawks were uncommon on the Hanford Site prior to 1987, with only one or two pairs nesting each year on basalt outcroppings on the side hills of Rattlesnake Mountain (Fitzner and Newell 1989). In 1987, four pairs of Ferruginous Hawks were observed nesting on the relatively new 230-kV transmission towers associated with the Washington Public Power Supply System reactors (now known as Energy Northwest). Construction of the transmission towers began in 1976 and lines were energized between December 1976 and July 1981. In 1988, seven Ferruginous Hawk nests were observed on 230-kV transmission towers and one in a tree. In 1991, 1992, and 1993, 11 active Ferruginous Hawk nests were reported each year on the entire Hanford Site (8 to 10 active nests on the central Hanford Site) (WHC-EP-0513; Nugent 1995). The majority of these nests were located on the newly built transmission towers. A decrease in the number of nesting Ferruginous Hawks on the Hanford Site has occurred since the 1990s. PNNL-SA-46396, *Breeding Population Status and Nest Site Characterization of Hawks (Buteo spp.) and Common Ravens (Corvus corax) on the Hanford Site, Southcentral Washington*, reported four nesting pairs on transmission towers in 2005 and WDFW (Livingston 2012) documented two nesting pairs on transmission towers in 2010. The number of occupied Ferruginous Hawk nests have remained stable on the Hanford Site since 2010 with two to four nests occurring each year (all on transmission towers) from 2012 to 2018 (HNF-53073; HNF-56769; HNF-58717; HNF-59755; HNF-60469; MSA 2018; DOE/RL-2019-33). In 2016, a productivity survey found a total of six young were produced on the Hanford Site at three nest sites (two young at each nest site) (HNF-60469). In 2017, nest surveys located three occupied nesting territories but only two territories were successful. One young each was produced at two of the nests (MSA 2018). In 2018, four occupied nests were identified on 230-kV transmission towers. During a subsequent productivity survey, one nest was reported down with no young (this nest had two small chicks during the occupancy survey) and the other three nests were found to each have two young for a total of six young (DOE/RL-2019-33).

Two surveys were conducted in 2019, one occupancy survey and one productivity survey. The occupancy survey took place May 30. Four occupied nests were found, all of them were on 230-kV transmission towers (Figure 11-10). The productivity survey was performed on June 20. Productivity surveys are performed when most young are 2 to 5 weeks old but, ideally, when young are almost old enough to fly to consider the nest successful. One nest was being tended by an adult Ferruginous Hawk during the occupancy survey but no young were observed at that time. No birds were seen at this nest during the productivity survey and was considered unsuccessful. Another nest contained three young during the occupancy survey but during the productivity survey, the nest was dilapidated and the young could not be located and their fate was unknown. The other two nests were found to each have two young for a total of four young.

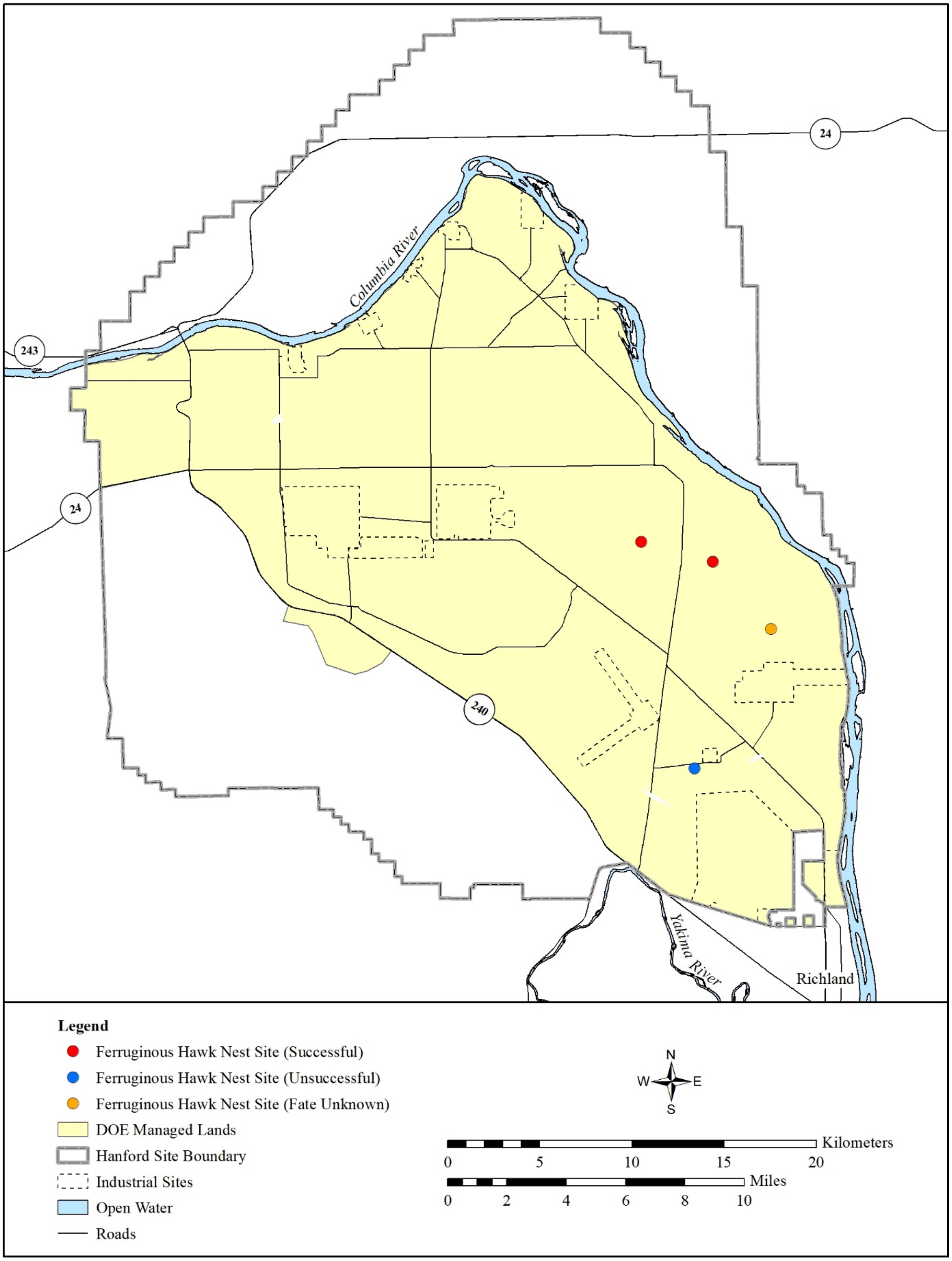

Figure 11-10. Active Ferruginous Hawk Nests Observed on DOE-RL-Managed Lands of the Hanford Site in 2019.

11.1.2.5 Burrowing Owl Artificial Burrow Installation

JW Wilde

The Western Burrowing Owl (Athene cunicularia) is declining over much of its range. Range contractions have occurred in southern Canada, the northeast Great Plains, and parts of California and the Pacific Northwest. It is theorized Burrowing Owl declines in Washington State are due to loss of native grasslands and shrub steppe along with the decline of ground squirrels (Urocitellus spp.), yellow-bellied marmots (Marmota flaviventris), and American badgers (Taxidea taxus), which create natural soil burrows that the owls use for nests. The Hanford Site is situated at the center of the predicted distribution of Burrowing Owls in Washington State (Washington Gap Analysis 1997) and is an important area for the conservation of Burrowing Owls. Natural soil burrows may have a limited lifespan of a few years and declining small mammal populations have led to a decrease in mammal digs. Effective restoration of Burrowing Owl nesting habitat can help prevent this decline.

Historically, Burrowing Owls occupying the Hanford Site would nest in natural soil burrows. Today, the majority of Burrowing Owl nests on the Hanford Site are found in anthropogenic (i.e., old irrigation pipes) or artificial burrows installed by previous mitigation efforts. Previous artificial burrow installation efforts at the Hanford Site used an older design and had varying success. In 2018, Mission Support Alliance's (MSA) Ecological Monitoring Program initiated an effort to replace many of the existing artificial burrows that were unusable or had been inactive for multiple years. The objective of this effort was to replace unused artificial burrows with new artificial burrows that had an improved design with the goal of creating more suitable Burrowing Owl nesting habitats and increasing Burrowing Owl population levels at the Hanford Site. The new artificial burrows provide more nesting space than the historic burrows and are made up of one half of a 55-gal (208-L) plastic drum with a 10 ft (3.05 m) length of 6-in. (15.24-cm) corrugated plastic tunnel access. These artificial burrow systems have an access port that sits just a few inches below grade so that staff can monitor and maintain the chambers in the future (Figure 11-11). Use of this improved design in other areas of the Columbia Basin have proven successful in creating nesting habitat for Burrowing Owls (Johnson 2017). This improved design will extend the life of the burrows and allow for a level of monitoring not possible on past Hanford Site installations.

A total of 51 artificial burrows with the new design were installed at various locations throughout the Hanford Site. In addition to replacing 25 unused older artificial burrows with the new design, 26 new artificial burrows were installed in areas on the Hanford Site that had been identified as a historic or potential Burrowing Owl habitat (Figure 11-12). Annual maintenance and monitoring of the new burrow systems began in 2019. Each of the 51 newly installed burrows was maintained by vegetation removal, plunging the tunnel, uncovering and removing the chamber access bucket, and cleaning out any debris in the chamber. If the burrow was deemed occupied upon arrival, the tunnel was blocked with a plunger until chamber could be evaluated.

Overall, burrows were in good condition. A few burrows showed signs of tampering or damage from elk (Cervus elaphus). The damage presented itself as pipes being pulled from under rock armoring, deeming them unusable for owls. Most all chambers were in good condition with no debris, a small number of chambers contained small mammal nests. Two clusters with the newly installed burrows were active and contained nests. Burrow clusters installed along Highway 240 showed signs of use. Burrow 47 and 49 were being used as a cache, containing dead mice and insects. Burrow 48, in the same cluster as 49, contained nine eggs and three newly hatched birds (Figure 11-13). Burrow 39 located west of the

Volpentest Hazardous Materials Management and Emergency Response (HAMMER) Emergency Vehicle Operations Course (EVOC) contained five young owls estimated at approximately 9 days old (Figure 11-14).

These two nest locations were visited on June 18, 2019, to attempt to count and band all hatch year burrowing owls. A total of 11 hatch year birds were counted; 7 from burrow 49, 2 from burrow 48, and 2 from burrow 39 (Figure 11-15). Burrow 39 was the only new design burrow located in the cluster, there may have been additional hatch birds present but located in burrows inaccessible to researchers.

Figure 11-11. Burrowing Owl Artificial Burrow System Chamber Installed on the Hanford Site.

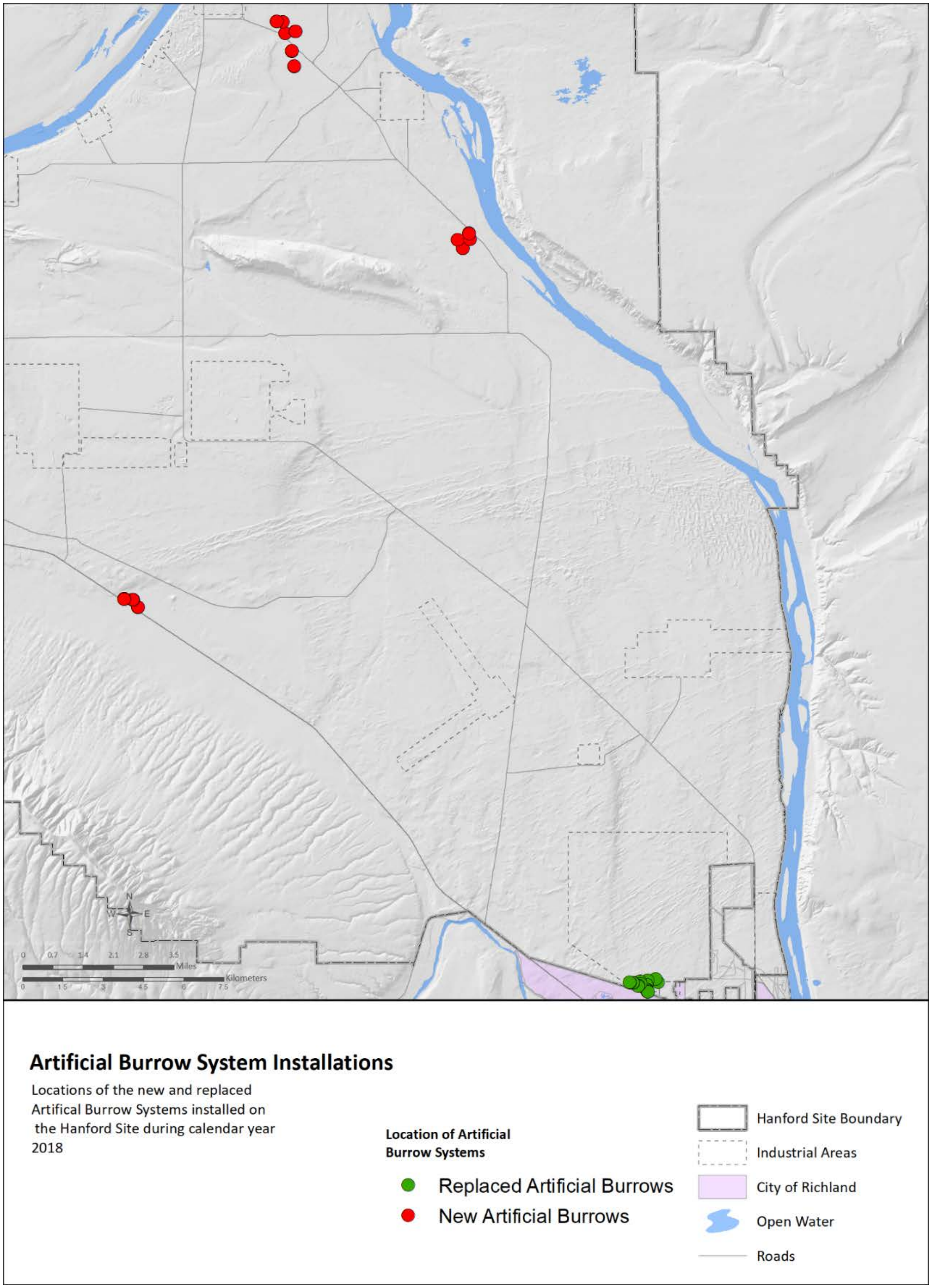

Figure 11-12. Locations of the New and Replaced Artificial Burrow Systems Installed on the Hanford Site During Calendar Year 2018.

Figure 11-13. Burrow 49, Located Along Highway 240, Contained Nine Eggs and Three Newly Hatched Young.

Figure 11-14. Burrow 39, Located Near the HAMMER EVOC Facility Contained Five Hatch Year Owls.

Figure 11-15. Newly Banded Hatch Year Owl Being Returned to Burrow.

11.1.2.6 Roadside Bird Surveys

JW Wilde

Ecological monitoring staff conduct roadside bird counts to monitor changes in species richness and relative abundance of shrub-steppe birds over time and in response to various types of land-use changes. In 2019, roadside surveys were performed during breeding season (May and June). Three Hanford routes (Figure 11-16) were surveyed one time each in 2019. For the 2018 breeding season surveys, 1,382 individual birds were counted during surveys. The total number of individual birds counted was similar to the average number of individuals since 2013. A total of 46 unique bird species were documented in the 2019 breeding season survey (Table 11-7), which was similar to the average of approximately 47 species since 2013.

The Old Fields survey route had the highest species diversity with 37 identified. The Army Loop Road survey route had the lowest species diversity at 11 species (Table 11-7). The Cliff Swallow (*Petrochelidon pyrrhonota*) was the most abundant species documented in 2019. Surveys counted 356 individuals on two survey routes, 25.8% of the total number of individuals seen. This was due to a very high number of breeding swallows present around the reactor areas during the morning of the survey. The typically abundant steppe species were present in high numbers. The Horned Lark (*Eremophila alpestris*) had 327 individuals and the Western Meadowlark (*Sturnella neglecta*) had 253 individuals. These three species (Cliff Swallow, Horned Lark, and Western Meadowlark) accounted for 67.73% of the individuals documented.

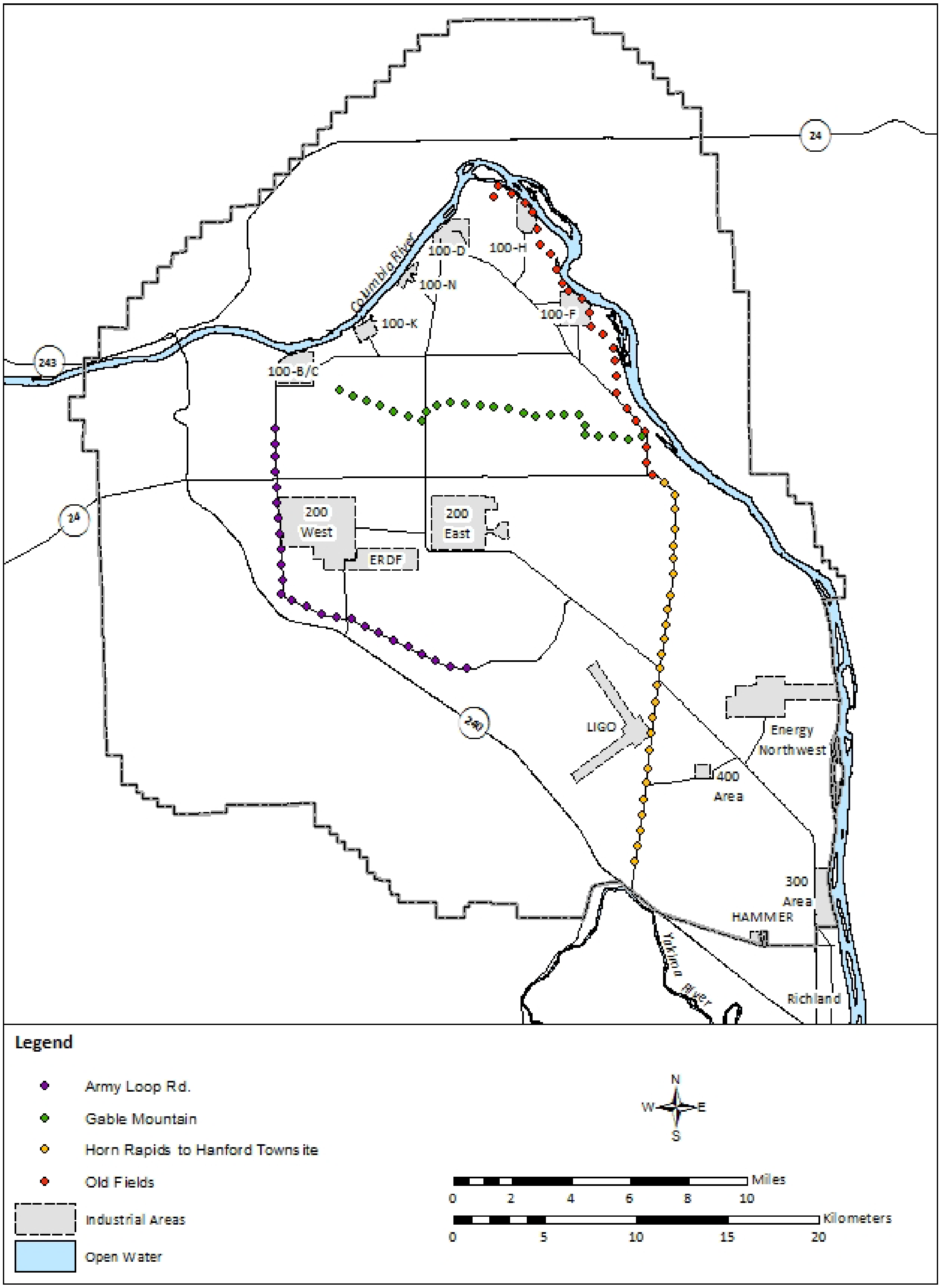

Figure 11-16. Roadside Bird Survey Routes Surveyed for Calendar Year 2019.

Table 11-7. Species Richness and Abundance Counted During the 2018 Breeding Season Roadside Bird Survey Routes on the Hanford Site Sorted by Route.

Route Name	Surveys Performed	Species Richness	Abundance
Army Loop Road	1	11	265
Gable Mountain	1	15	244
Horn Rapids to Hanford Townsite	1	13	167
Old Fields	1	37	706
Total	**4**	**46[a]**	**1,382**

[a] Unique species identified

The Hanford Site bird monitoring program documents the presence, abundance, and distribution of species of concern on the Hanford Site. Both the USFWS and the WDFW maintain lists of species that are of management concern because populations or habitat availability are limited. In Washington State, those listings include (in order of least to greatest concern) state candidate, state sensitive, state threatened, and state endangered. The WDFW also maintains a list of state-monitor species, a group of birds not considered species of concern but for which status and distribution data are documented. There are currently no avian species listed as federally threatened or endangered on the Hanford Site, although several are considered federal species of concern in eastern Washington. Additional information detailing migratory bird monitoring efforts is available at http://www.hanford.gov/page.cfm/ecologicalmonitoring.

11.1.2.7 Bat Monitoring

JW Wilde

Under BRMP, bat roosts are classified as a Level 3 resource, which includes species recognized by Washington State as having conservation concern. The management goal for Level 3 resources is conservation with a compensatory mitigation action of habitat replacement. During Hanford Site remediation demolition efforts, a pallid bat maternity colonies was discovered to be utilizing the associated headhouses of the 183-D and 183-F water treatment plants.

While male Yuma myotis typically roost individually or in small numbers throughout the feeding season, mature females congregate in groups, sometimes consisting of many thousand individuals forming maternity colonies. In these maternity roosts, female bats will give birth to and raise their young until they can fend for themselves, a process that typically takes 2 to 3 months. The Hanford Site monitors these critical habitats for trends and any needed conservation actions.

The 2019 bat surveys at the 18-3F and 183-D Clearwells were conducted simultaneously by teams of two staff members at each location using the same survey method. The counting methodology followed a bat colony emergence count protocol developed by the WDFW Bat Colony Emergence Count Protocol. The initial two surveys were scheduled within 3 to 7 days of each other to minimize the possibility of short-term weather events or other environmental conditions influencing emergence counts. Surveys began a half hour before sunset and ended when either it became too dark to observe bats (emergence slowed to a period of no bats observed exiting for 5 minutes) or when more bats were entering than exiting over a 5-minute period. Staff positioned themselves roughly 10 to 25 ft (3 to 8 m) from the ceiling hatch and counted bats exiting and entering the clearwell through the opening. In order to tally the two sets of counts, a manual hand counter was operated in each hand (one hand for exiting, the

other hand for entering). During the survey, the two observers did not share their observations with each other in order to keep the survey unbiased. Emergence totals were calculated by using the formula:

$$\frac{(\textbf{Surveyor 1}\ \text{Exiting Total} - \text{Entering Total}) + (\textbf{Surveyor 2}\ \text{Exiting Total} - \text{Entering Total})}{2} = \textbf{Estimated Colony Emergence Total}$$

In addition to staff surveyors, two additional monitoring techniques were deployed during the surveys. A thermal camera (ATN OTS HD Thermal Monocular) was placed on a tripod and faced the opening of the clearwell to record the emergence throughout the survey. Recordings were timestamped with date and time. If data from surveyors provided discrepancies or was put in question, these videos are reviewed to resolves issues. Staff began testing new infrared bat counters produced by Apoemus. These detectors operate by the use of 30 plus modulated infrared barrier beams, providing counts and directions. Three detectors were placed together and fitted over the top of the clearwell openings during the counts (Figure 11-17). All bats exiting the clearwells are required to pass through one of the three detectors to exit. All data is stored on memory cards within the unit, to be downloaded to a computer following the survey.

Figure 11-17. Apodemus Infrared Camera Bat Counters Placed on the 183-F Clearwell Opening.

Both clearwell sites show a continued use as a maternity roost for Yuma myotis. Colony emergence maximum counts of Yuma myotis (*Myotis yumanensis*) in 2019 was estimated with staff surveys at 1,959 bats and 2,395 bats for 183-F and 183-D, respectively, during the June surveys (Figure 11-18). These data show that the 183-D Clearwell population was at a higher count than 183-F population for the first time since the monitoring initiated in 2008. The growth of the 183-D population may be due to a portion of the 183-F population immigrating to the 183-D Clearwell or other environmental factors affecting the clearwells. There are known maternity colonies of Yuma myotis in the vicinity, located in

the 190-D/DR water process tunnels (WCH-634), which may also be influencing the growth of the 183-D Clearwell population through immigration. Testing the infrared bat counter provided another view of the emergence counts. It was noted that in both survey nights the use of the bat counter may have impacted the count numbers. These impacts were seen as lower counts to the surveyor only counts. Referencing the WDFW protocol, emergence counts end when exit activity matches entrance activity. The bat counter data was charted and the survey end can be inferred (Figure 11-19). Using these survey end times, the difference between exits and entrances prior to this time is calculated as the roost size. From infrared bat counter data the 183-F colony was calculated at 1,947 bats compared to 1,438 bats counted by surveyors on same date. Surveyors end counts earlier than the infrared counter survey end time due to lack of visibility. Colony for the 183-D was calculated at 1,633 bats to the surveyors 1,053 bats on the same date. Additional work is needed, and proposed for 2020 work, on comparing the three emergence techniques of human survey, thermal camera, and infrared counter.

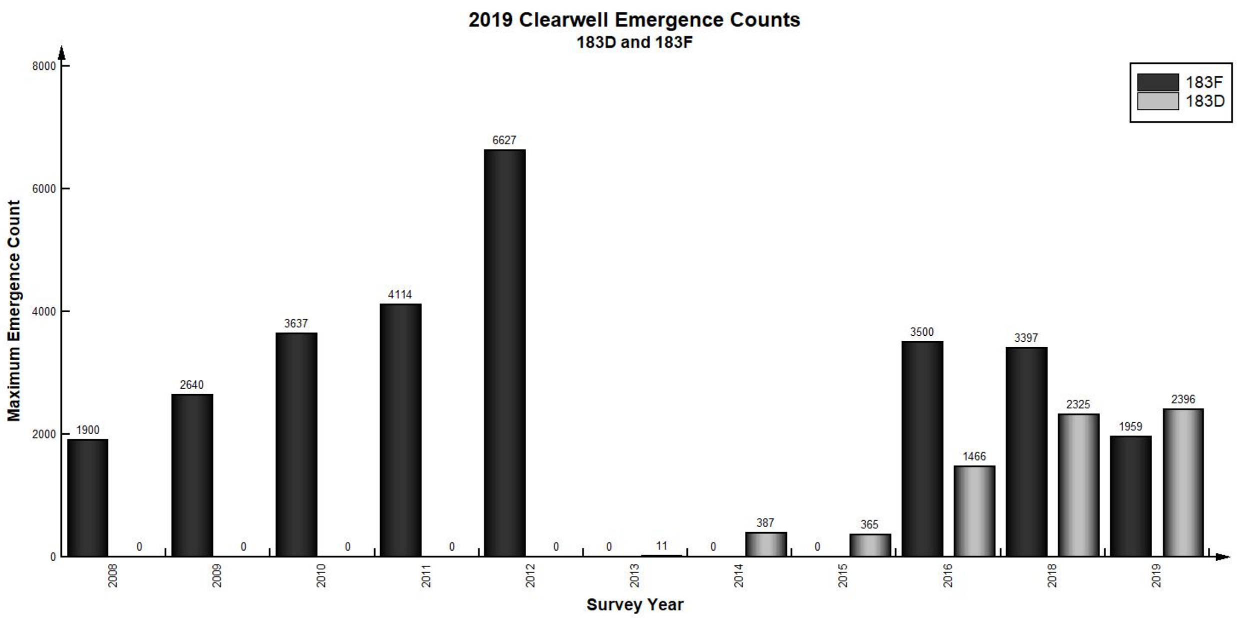

Figure 11-18. Maximum Emergence Counts from the 183-F and 183-D Clearwells Since 2008.

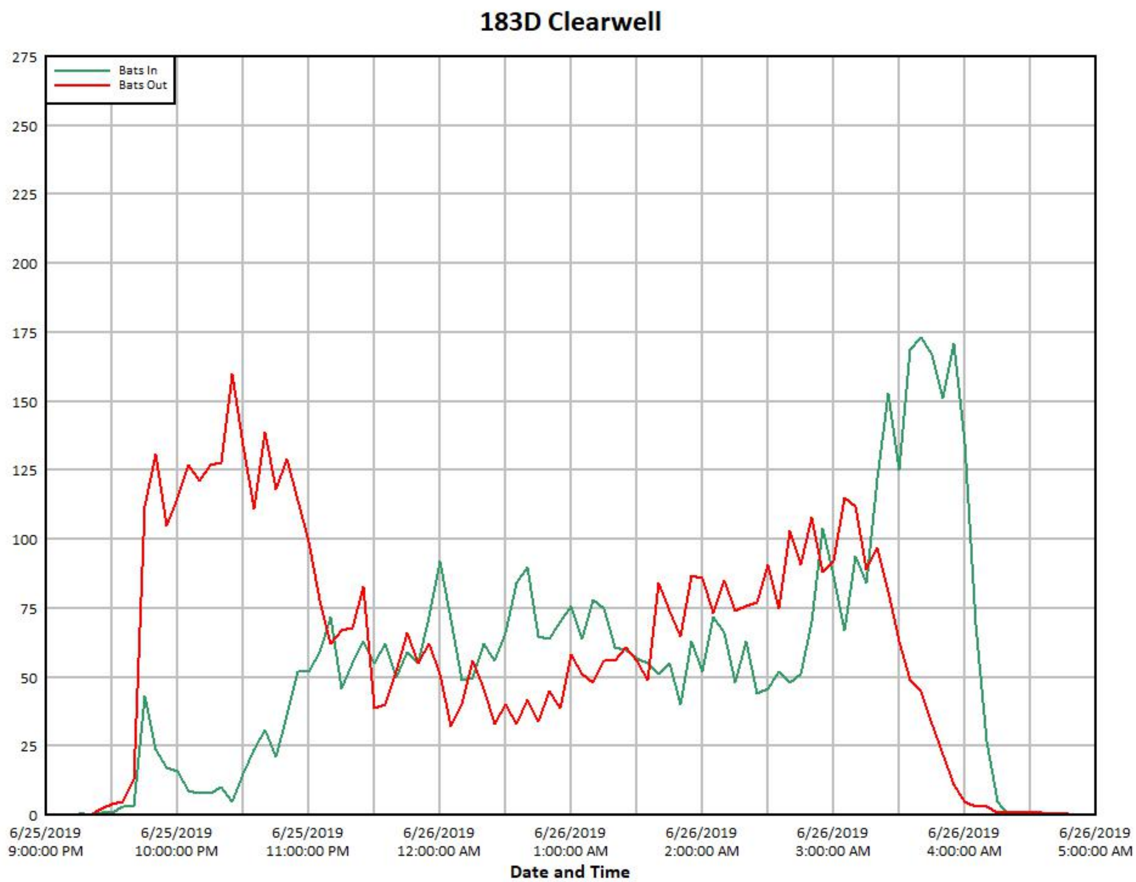

Figure 11-19. Infrared Bat Counter Ins and Outs from June Roost Survey Displayed in Chart View.

Monitoring and protection of roosting locations is becoming increasingly important with the outbreak of the fungal infection referred to as White Nose Syndrome (WNS). WNS is affecting bats in the eastern United States and Canada and is rapidly expanding westward. Bats save energy during the winter by reducing their body temperature and entering a state of hibernation called torpor. They break these torpor bouts by warming their body temperature back up at regular intervals through the winter, these events are termed "arousals." Bats are thought to use these arousals for depuration, defecation, grooming, breeding, and possibly drinking. Although these arousals represent a relatively small portion of the time the bats spend winter roosting, a large amount (up to 80%) of their energy stored for the season is burned during arousals (Thomas et al. 1990). Bats are thought to increase the number of arousals due to WNS, likely for additional grooming. Although other factors may be contributing, the excessive arousals cause bats to exhaust their energy stores prior to the end of the winter, resulting in starvation. This disease spreads quickly through roosting colonies and causes fatality rates up to 100% at infected winter roosts (more information available at whitenosesyndrome.org). The expansion of this disease occurred westward in 2016 when a little brown myotis (*Myotis lucifigus*) was found in Western Washington. With the disease now present in the state, it is extremely important to monitor and characterize roosts to provide a baseline in case the disease reaches this area. Bat researchers must follow strict WNS protocols established by the USFWS and other agencies when working with bats (WNS 2016).

Mist netting activities took place on April 25, 2019, with the support of Hanford Site biologists and radiological control technicians with WDFW biologists. Two single high mist nests (30 ft [9 m] and 40 ft [12 m]) were located immediately south of the 183-F Clearwell entrance with a triple high 40-ft (12-m) net located to the east end of the clearwell. Following sundown, a total of 33 bats were captured in the mist nets as they emerged from the structure.

All bats were bagged for additional measurements. All bats were surveyed both for radiological contamination and ultraviolet for detection of *Pseudogymnoascus destructans* (*Pd*), the fungus that causes WNS. All bats returned negative for both contamination and ultraviolet detection of any fungus. All bats appeared healthy and of normal expected weight, no signs of wing damage. All samples were submitted to the United States Geological Survey National Wildlife Health Center. The center provided final report on June 21, 2019, with results testing negative for the *Pd* fungus.

11.1.2.8 Deer Monitoring

JJ Nugent

Population characteristics of mule deer (*Odocoileus hemionus*) on the Hanford Site have been monitored since 1994. Roadside surveys have been conducted during the post-hunting period from mid-December to January to assess age and sex ratios and the frequency of testicular atrophy in males. Although hunting is not permitted on the Hanford Site, wildlife can enter and leave freely. Due to this movement, surveys are conducted after deer hunting season has ended, which runs from September through early December. Additionally, during the winter months following the fall rut, deer tend to herd into tighter groups, greatly easing monitoring efforts.

Prior to FY 2003, variable numbers of surveys were performed each year. Between FY 2003 and FY 2009, five surveys were conducted during each post-hunt period. In FY 2010 and 2011 this was reduced to three surveys. No surveys were conducted in FY 2012. Since FY 2013, three surveys have been performed every 3 years. During each survey, individual animals were identified according to sex and age class (fawn or adult). For male deer, the presence of misshapen, velvet-covered antlers was used as an indicator of testicular atrophy.

Trends in the ratios of fawns to does over time can be used to monitor changes in mule deer population size and health. Mule deer populations provide a rough indication of overall habitat quality. Additionally, mule deer are a trustee resource of interest and importance to wildlife resource agencies and local tribes.

Rocky Mountain Elk (*Cervus elaphus*) data was also collected during deer surveys, recording locations, gender, and herd counts. It was not until 1972 when elk were first documented on the Hanford Site, and in recent years the population has grown drastically. These surveys provide a valuable opportunity to document areas regularly occupied by elk and the status of population. While roadside surveys may not represent a dependable long-term survey methodology, these observations may be sufficient to maintain an ongoing record of the relative abundance of elk on the central Hanford Site.

Surveys were conducted from a vehicle along a route approximately 37 mi (60 km) long; the northern end of the route is near 100-B/C, the southern end is just north of the 300 Area (Figure 11-20). The survey route is divided into a northern region and a southern region, with the break occurring at the north end of the Hanford Townsite. Surveys begin at dawn or mid-afternoon (to end near dusk) and are driven alternatively from north to south and south to north.

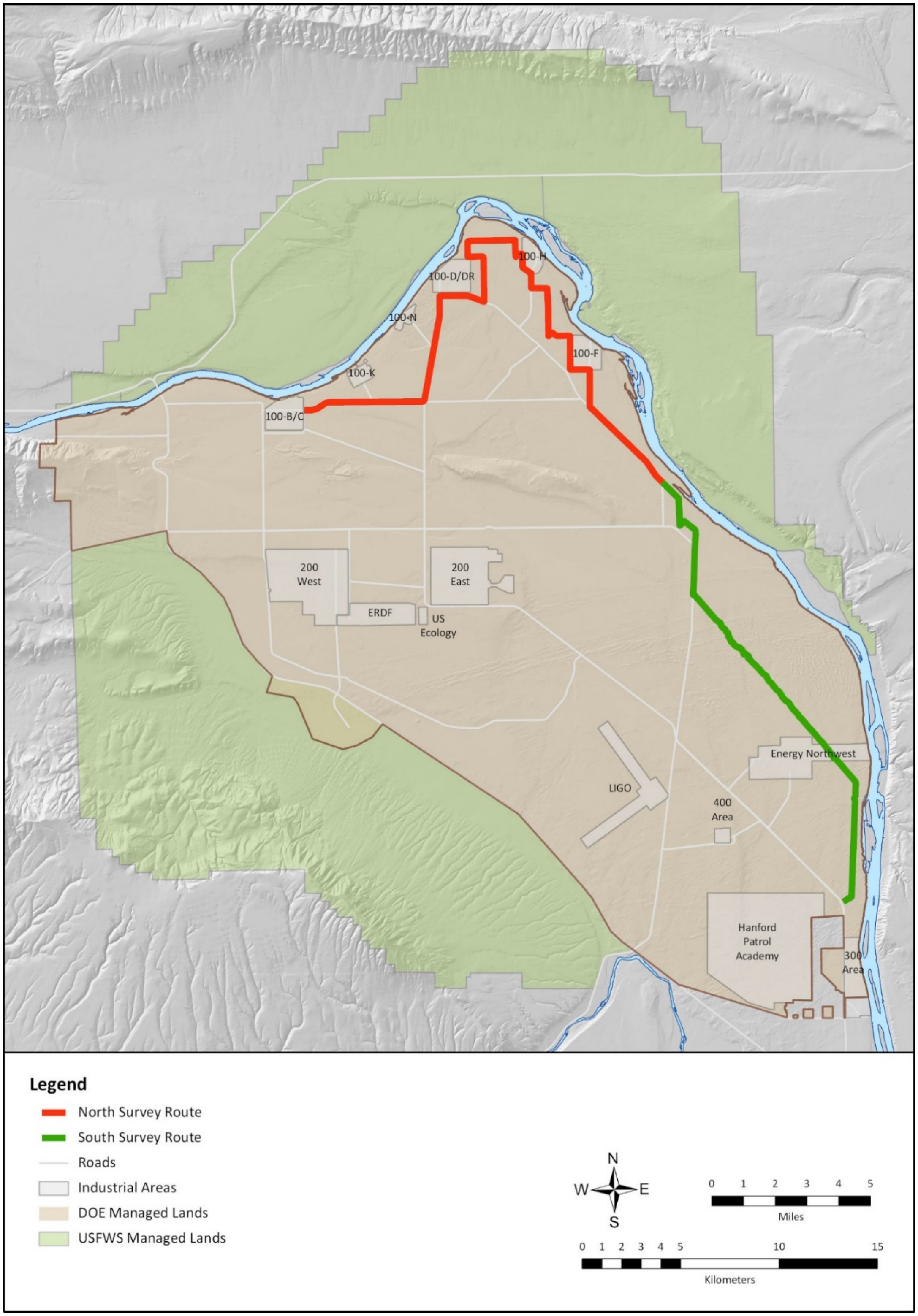

Figure 11-20. Northern and Southern Region Driving Routes used for FY 2019 Hanford Site Mule Deer Surveys.

Deer and elk are most active during early morning and late evening periods. Therefore, to attain maximum sample sizes and help attain representative estimates for these population characteristics, surveys were performed within four hours of twilight and dusk, when deer and elk were most likely to be active.

The FY 2019 northern and southern driving routes were each surveyed four times during the post-hunting period from December 2018 to January 2019. Both regions were surveyed on December 13, 2018, and January 17 and 29, 2019. Additionally, the northern region was surveyed on December 26, 2018, and the southern region was surveyed on December 27, 2018, due to staffing limitations that prevented the surveys from occurring on the same day.

A total of 206 mule deer were observed over the five survey dates (Table 11-8). Total observations were relatively equal between regions, with 43.2% in the southern region and 56.8% in the northern region, however, there were three times more bucks observed in the southern region than the northern. Combined, bucks accounted for 7.8% of observations, which is down from 19.1% in FY 2016 and 14.8% in FY 2013. There were almost twice as many fawns observed in the northern region than the southern region. Combined, fawns accounted for 38.8% of observations, up from 20.6% in FY 2016 and 21.2% in FY 2013.

Table 11-8. Mule Deer Survey Results for FY 2019.

Region / Date	Bucks	Does	Fawns	Antlerless [a]	Total
Northern Region					
December 13, 2018	0	6	6	0	12
December 27, 2018	2	21	9	0	32
January 17, 2019	2	7	8	0	17
January 29, 2019	0	26	30	0	56
Total - North	**4**	**60**	**53**	**0**	**117**
Southern Region					
December 13, 2018	5	13	6	3	27
December 26, 2018	3	17	12	0	32
January 17, 2019	2	2	0	0	4
January 29, 2019	2	11	9	4	26
Total – South	**12**	**43**	**27**	**7**	**89**
Combined					
December 13, 2018	5	19	12	3	39
December 26-27, 2018	5	38	21	0	64
January 17, 2019 [b]	4	9	8	0	21
January 29, 2019	2	37	39	4	82
Total Combined	**16**	**103**	**80**	**7**	**206**

[a] Antlerless are either fawns or does, but age could not be accurately determined.
[b] Inclement weather may have impacted survey numbers on this day.

The number of mule deer observed in the northern region averaged 29.3 ± 19.8 deer in FY 2019. In the southern region, there was an average of 22.3 ± 12.4 deer surveyed. When combining daily counts from both regions in FY 2019, the average number of mule deer was 51.5 ± 26.9 (Figure 11-21), with a range

of 21 to 82 deer observed. This average is similar to averages calculated since data collection started in 1995 and the 95% confidence interval falls within the range of the confidence intervals for all other recorded survey years, indicating that the average from FY 2019 is not statistically different than previous years. The wide confidence interval associated with the averages is likely due to a variety of factors (e.g., imperfect detection and immigration or emigration of deer in the survey areas). Increasing the number of surveys could tighten the confidence interval and provide a better assessment of changes in deer numbers over time.

The largest concentrations of mule deer were observed in the northern region between 100-D/DR and 100-H, with additional clusters between 100-N and 100-D/DR and between 100-H and 100-F (Figure 11-22). The southern region had smaller clusters of deer and were mostly observed in the immediate vicinity of the Hanford Townsite. There were no deer observed in the northern region between 100-B/C and 100-N and very few between the southern end of the Hanford Townsite and Energy Northwest in the southern region.

The number of fawns per 100 does in FY 2019 was estimated to be 94.4 (±22.5) in the northern region and 65.2 (±12.8) in the southern region. Although the yearly ratio of fawns per 100 does has varied, the running 10-year average has remained consistent with a sharp increase in FY 2019 (Figure 11-23).

There were no deer observed with abnormal antler growth in FY 2019. Historical percentage values of observed bucks with abnormal antler growth are documented below in Figure 11-24, which shows that observations have held at no more than around 3 to 4% on any given year since FY 2011. The 10-year rolling average has also remained at around 3 to 4% since FY 2009.

Elk were observed during all four surveys in the northern region and the December 27, 2018, and January 17, 2019, surveys in the southern region. The size of elk herds observed on the Hanford Site during deer surveys has grown in recent years. The largest herd of 118 individuals observed in FY 2019 was up from 77 observed in FY 2016 and 39 in FY 2013.

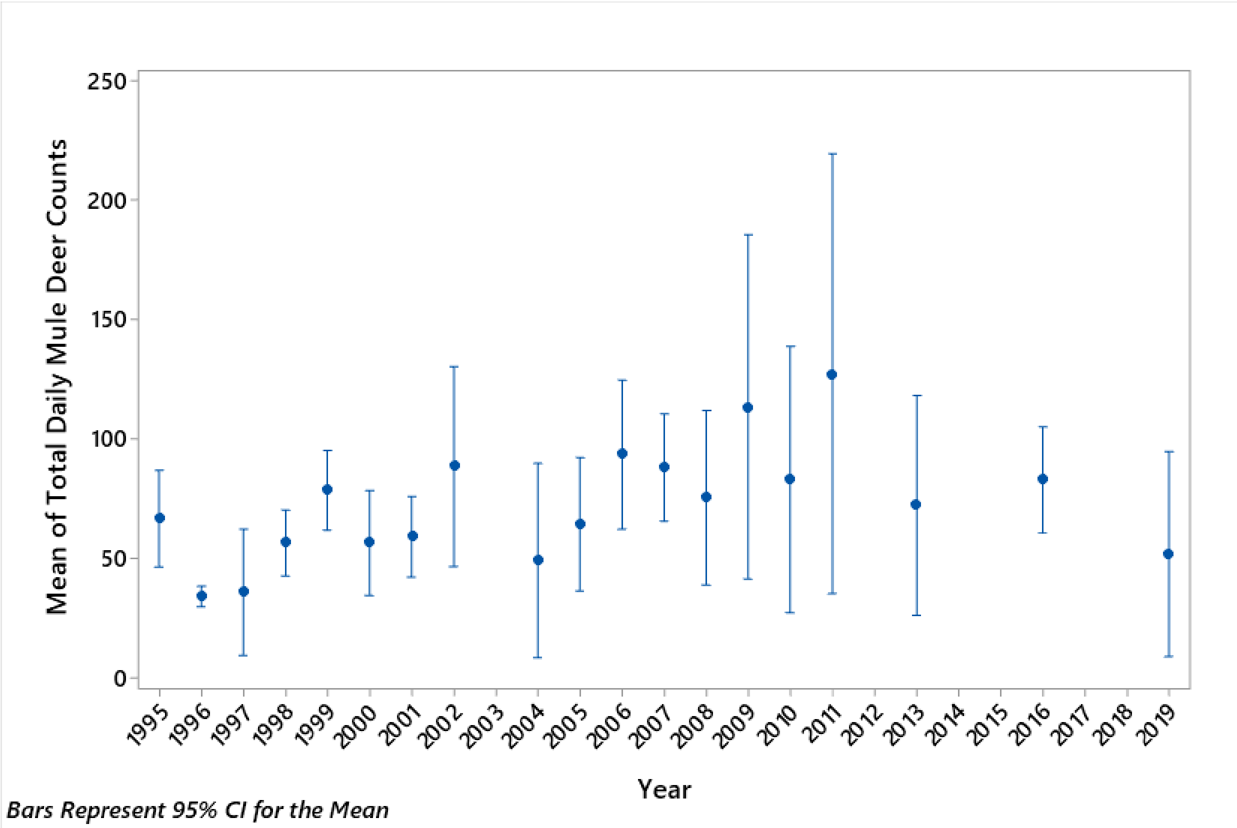

Figure 11-21. Average Number of Deer Observed in Both Regions FY 1995 to FY 2019.

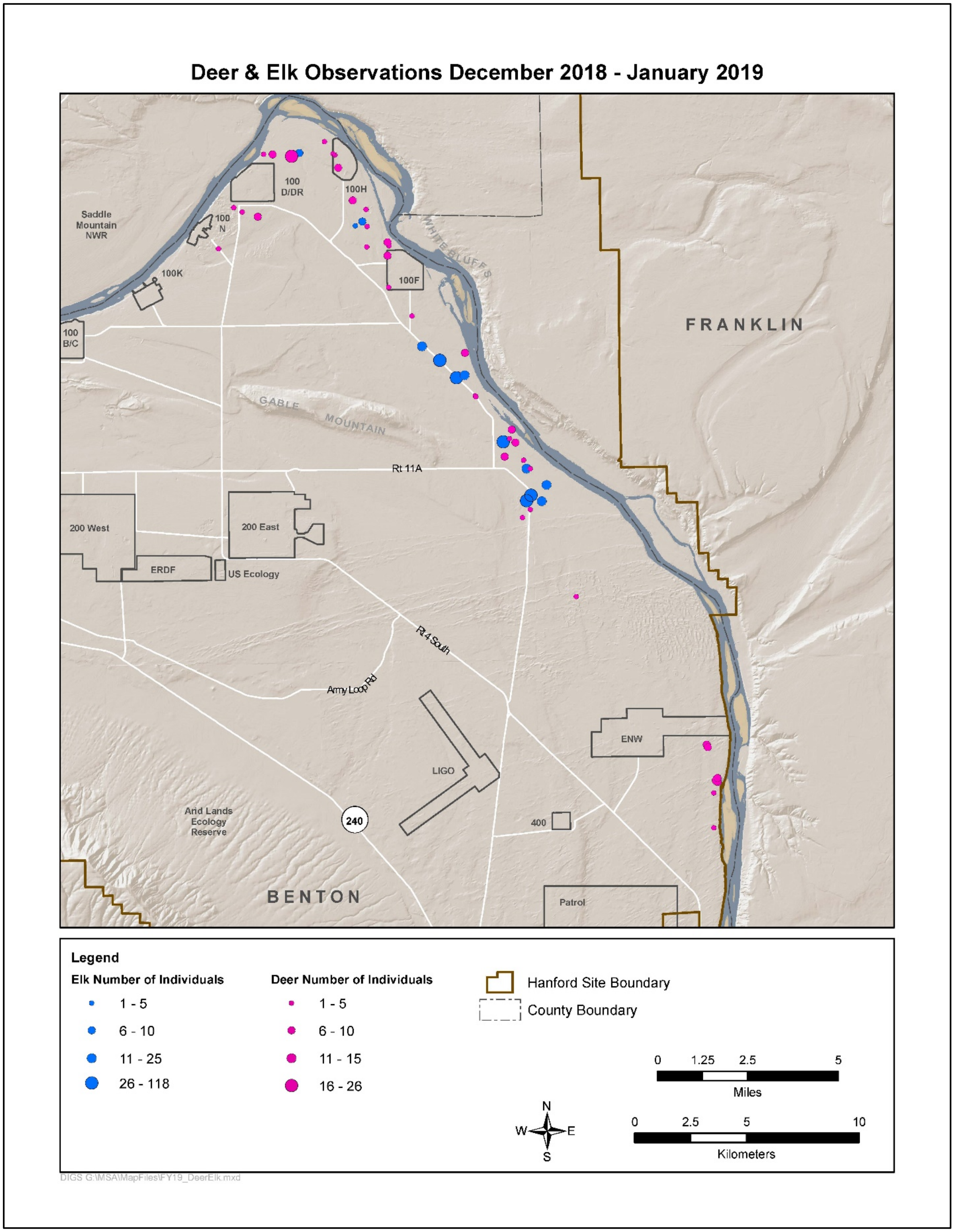

Figure 11-22. Distribution of Observed Mule Deer and Incidental Elk Herds During FY 2019.

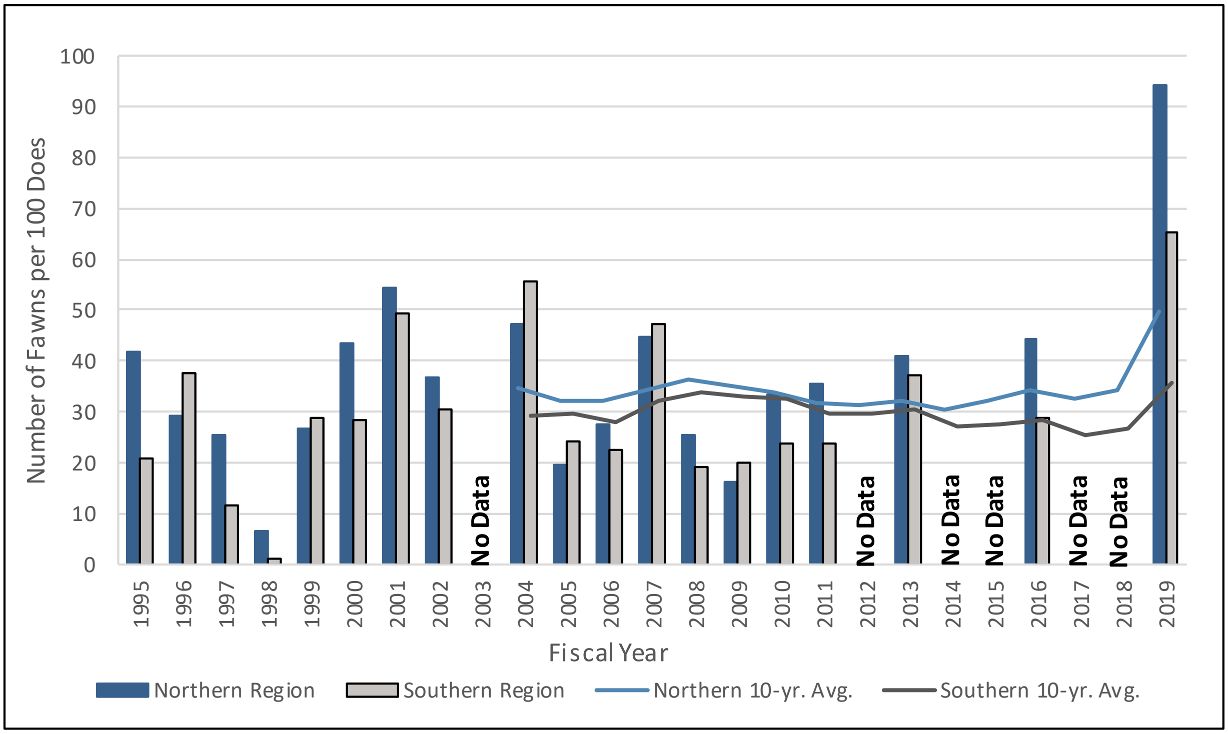

Figure 11-23. Ratio of Fawns to Does in each Region from FY 1995 to FY 2019.

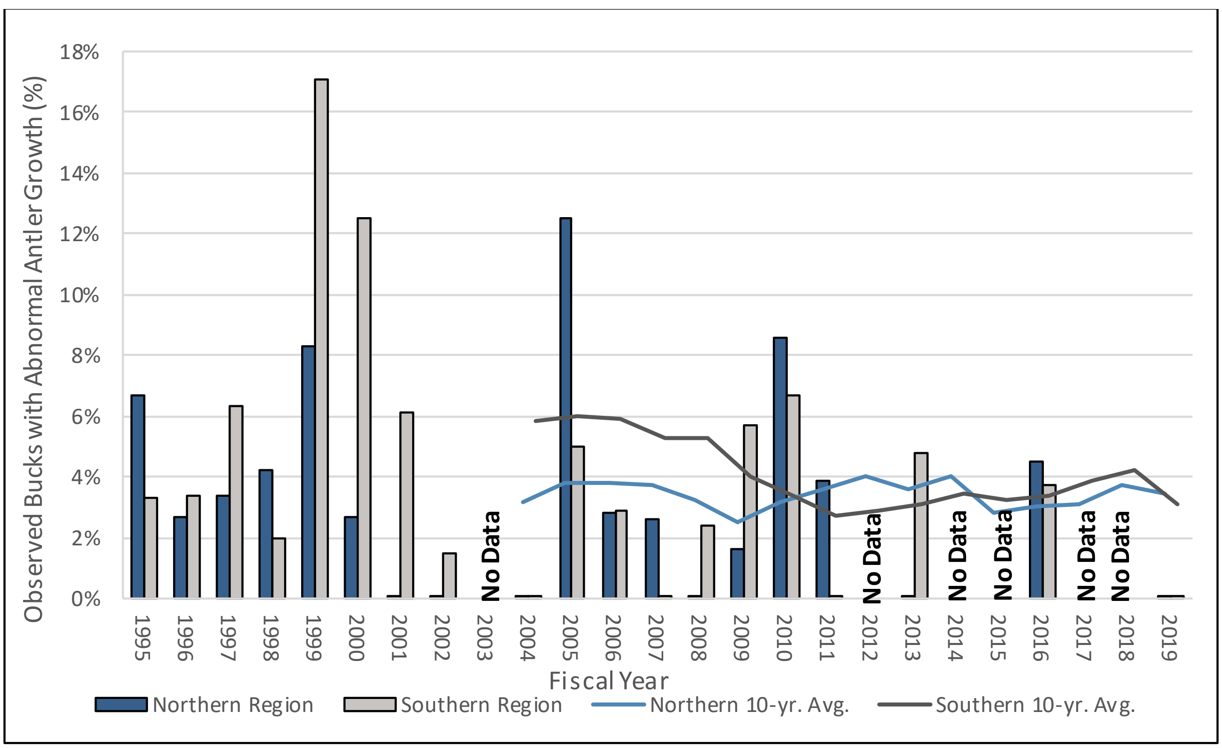

Figure 11-24. Percentage of Bucks with Abnormal Antler Growth, FY 1995 through FY 2019.

11.1.2.9 Pollinators

ES Norris

Pollinators are vital to the health of native environments (Potts et al. 2010). By enabling successful plant reproduction, pollinators support the health of nearly all other organisms in the environment that rely on healthy plant populations. Bees are the most important group of pollinators worldwide (Kearns et al. 1998, Michener 2007) and are the primary pollinating species of the Columbia River Basin (Tepedino and Griswold 1995). Within the last century, rapid declines in both wild and managed bee populations have been recorded throughout the world (Kearns et al. 1998, Goulson et al. 2005, Biesmeijer et al. 2006).

The Hanford Site Pollinator Study identified a number of best management practices to help support pollinator populations on the Hanford Site (HNF-62689). In areas where vegetation is disturbed to support project activities, the study recommends replacing pollinator food resources by restoring with native flowering plants. This study also recommended additional restoration actions to replace bee nesting habitat, as nesting area availability can be the driving factor in solitary bee population sizes (Steffan-Dewenter and Schiele 2008).

Bee nest boxes are designed to replace lost nesting resources by providing areas for solitary bees to nest. Twenty bee nest boxes were installed in July 2019 as a component of compensatory mitigation for the installation of the L-894 water line between the 200-East and 200-West Areas of the Hanford Site. The goal of this compensatory mitigation is to replace lost nesting habitat for above-ground nesting bees in a mature sagebrush ecosystem. Annual monitoring will track the condition and occupation of the bee nest boxes to determine if the compensatory mitigation was successful and to identify best practices when replacing nesting habitat for native bees. The first annual monitoring effort occurred in December 2019.

Two differing designs of bee nest boxes were installed as part of 2019 efforts in order to study the effectiveness of different box designs (Figure 11-25). The different designs, called Design A and Design B, each had varying amounts of nesting space in the form of nest tubes and drilled holes. Occupation monitoring involves visiting each box and counting the total number of nest tubes/holes and the number of occupied nest tubes/holes. Occupied nest holes are identified with the cut pieces of leaf or mud plugging the nest tubes/holes.

Occupation monitoring found that 25% (5 of the 20) bee nest boxes installed in 2019 contained bee nests. Within the 5 boxes that were occupied 15 nests were recorded. For the purposes of this monitoring effort, one nest refers to one occupied nest tube or drilled hole. Thirteen of these nests were within drilled holes and two were within the nest tubes. Seven of the 15 nests were created with mud (47%), 6 were created with leaves (40%), and 2 were created with a cellophane-like substance (13%). Of the 15 recorded nests, 6 nests were in Design A boxes (40%) and 9 nests were in Design B boxes (60%). All of the nests in the Design A boxes were located in drilled holes, while the Design B boxes had seven nests in drilled holes and two nests in nest tubes. When considering total use, 20% of Design A and 30% of Design B nest boxes were occupied by bees in 2019 monitoring.

Figure 11-25. Bee Next Boxes: Design A (Left) and Design B (Right), Not to Scale.

One of the goals of analyzing bee nest box occupation was to determine if the nest boxes were effective at replacing bee nesting habitat. A complicating factor in first-year monitoring of the nest boxes was the timing of installation. The nest boxes were installed in July 2019, approximately 3 months after the active season for bees had begun. The majority of bee activity at the Hanford Site occurs in June (HNF-62689) and the late installation of these boxes may have resulted in lower occupation and skewed the results of year one monitoring. Though 25% of the bee nest boxes were occupied, less than 1% of the available nesting spaces were used. This number is expected to increase as the boxes are available during the entire active season for bees.

The occupied bee nest boxes were numbers 1, 2, 9, 18, and 20, shown in Figure 11-26 below. Boxes 1, 2, and 20 were the closest to areas of high human activity and environmental disturbance. The lack of alternative bee nesting habitat in the areas surrounding boxes 1, 2, and 20 may have contributed to the higher occupation of those boxes.

Continued monitoring is necessary to evaluate the effectiveness of the bee nest boxes in replacing lost bee nesting habitat. Monitoring and maintenance will continue for 5 years following installation of the boxes. Additional information detailing the results of first-year monitoring for bee nest boxes is available at http://www.hanford.gov/page.cfm/ecologicalmonitoring.

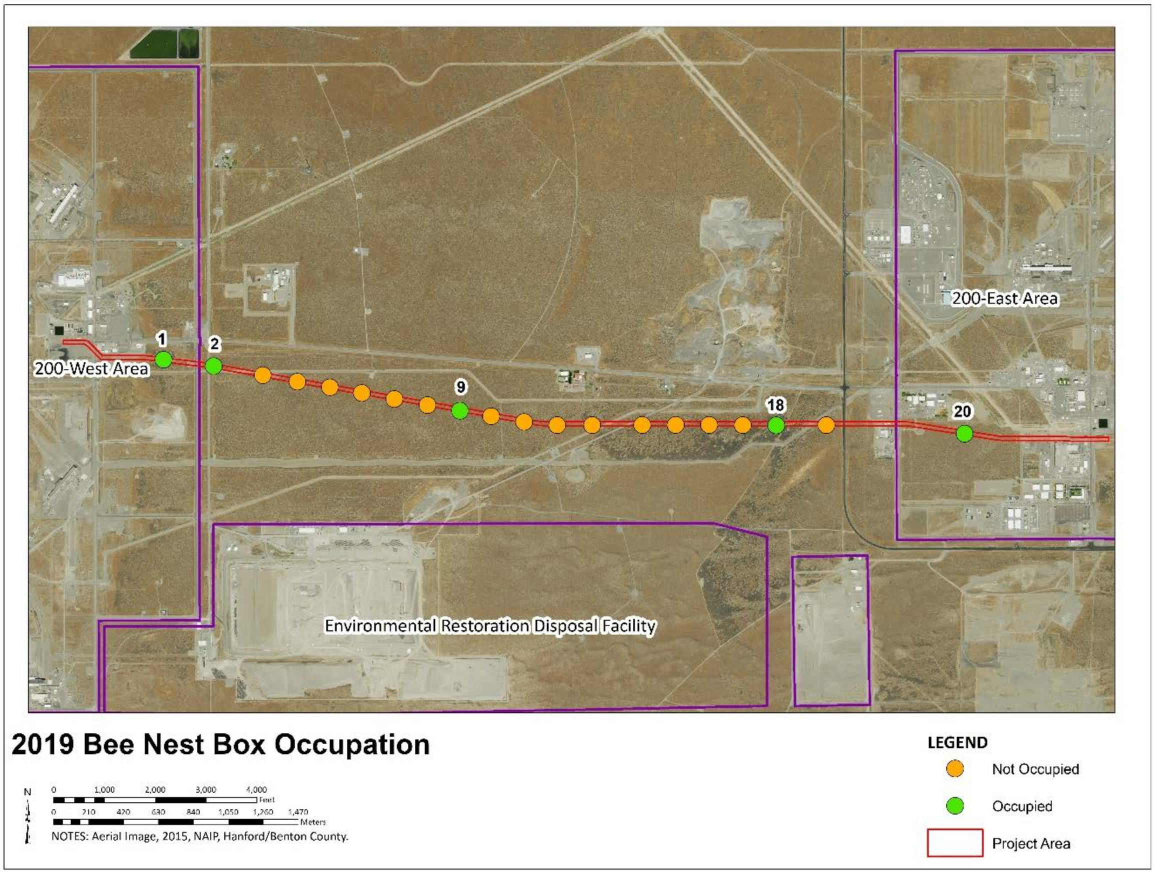

Figure 11-26. The Occupied Bee Nest Boxes in December 2019.

11.1.3 Vegetation and Habitat Monitoring

ES Norris

This section provides inventory, monitoring and survey information for vegetation and habitats evaluated at the Hanford Site during 2019. This information is provided in context with historical data and trend information, if applicable. Vegetation occurring on the Hanford Site has been surveyed periodically for decades. This survey information has been used to create vegetation maps, track rare plant species occurrence and distribution, and classify areas of the Hanford Site as rare element occurrences, as defined by the Washington Natural Heritage Program (WNHP 2019). In addition, monitoring data are used to protect rare and sensitive vegetation and habitats from Hanford Site operations. In 2019, vegetation and habitat monitoring included riparian vegetation classification, riparian rare plant monitoring, and vernal pool monitoring. The following sections provide summaries of the monitoring results; additional reports can be found at: http://www.hanford.gov/page.cfm/EcologicalMonitoring

11.1.3.1 Riparian Vegetation.

In the late summer and fall 2018, riparian vegetation along the Hanford Reach of the Columbia River was mapped. Riparian mapping work continued in 2019 and built upon the work done in 2018 in order to update the riparian vegetation map along high priority areas of the Hanford Reach. The portion of the shoreline mapped in 2019 is depicted in Figure 11-27. The vegetation mapping included applying a

template of vegetation types to observed vegetation assemblages, revisiting known rare plant sites in the study area, and documenting other rare plant occurrences as they were encountered.

Riparian vegetation monitoring in 2019 included establishing 371 geo-referenced photo points to depict changes in the dominant vegetation over time. Additionally, approximately 175 plots were established to further characterize vegetative zones in riparian areas. Vegetative cover types were assigned according to the vegetation cover types as defined by Pacific Northwest National Laboratory, as defined in Table 11-9 (PNNL-14687).

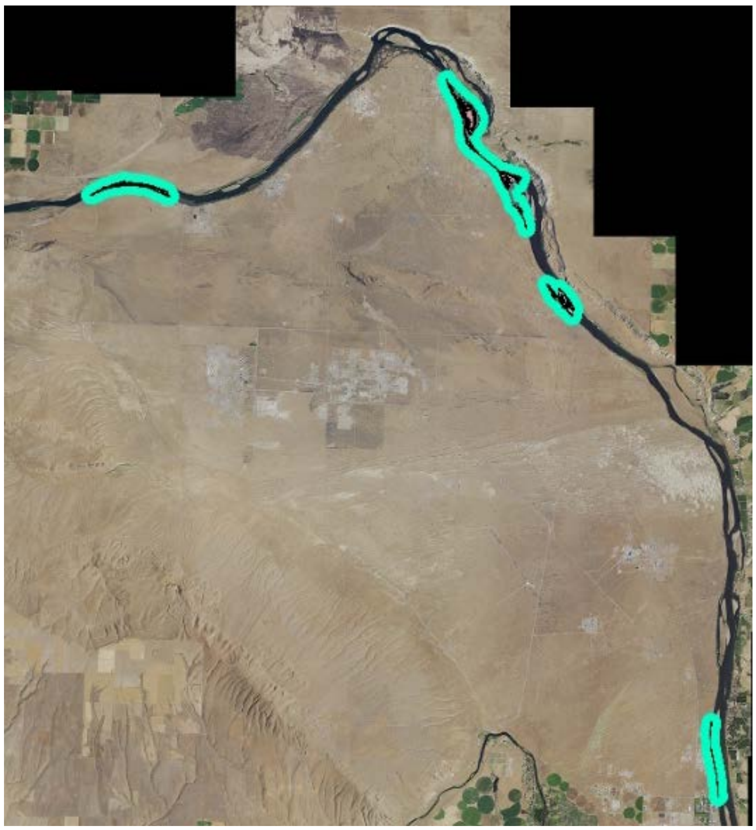

Figure 11-27. Area Monitored in 2019 Riparian Vegetation Mapping Surveys.

Table 11-9. Vegetation Cover Types (PNNL-14687). (2 Pages)

Vegetation Cover Type	Cover Type Description
Bare bankslope	No vegetation.
Bare silt	No vegetation.
Cobble	Little to no vegetation.
Low shrub-forb-cobble association	Vegetation band on unconsolidated cobble adjacent to the "low water mark" with low rhizomatous subshrubs, common dogbane (*Apocynum cannabinum*) and western goldenrod (*Euthamea occidentalis)* and scattered herbs.
Exotic weeds	Introduced weedy species such as knapweeds (*Centaurea diffusa* and *Rhaponticum repens*), Russian thistle (*Salsola tragus*), and cheatgrass (*Bromus tectorum*).

Table 11-9. Vegetation Cover Types (PNNL-14687). (2 Pages)

Vegetation Cover Type	Cover Type Description
Horsetail association	Horsetails (*Equisetum* species) as the dominant cover occurring in topographic lows along the shoreline with silt embedded cobble or some siltation present.
Juniper	Characterized by widely spaced junipers (*Juniperus scopulorum*) at the transition between riparian and upland cover types.
Non-persistent emergent and emergent wetlands	Wetland areas of backwater and sloughs characterized by cattails (*Typha latifololia*), rushes (*Juncus* species and *Bolboschoenus maritimus*), and sedges (*Cyperus* species, *Eleocharis* species, and *Carex* species).
Reed canary grass	Stands of reed canary grass (*Phalaris arundinaceae*).
Willow	Coyote willow (*Salix exigua*) patches and small groves scattered along the shore with occasional peach leaf willow (*Salix amygdaloides*).
Riparian mosaic	Patchy mosaic of riparian wheatgrass association, forb-cobble, willow, non-persistent emergent wetland, reed canary grass, wormwood/riparian wheatgrass, and exotic weed.
Rock/Road/Outflow	No vegetation.
Tree association	Clumps or small stands of both native and non-native trees.
Upland shrub-steppe	Upland areas including snow buckwheat (*Eriogonum niveum*)/bunchgrass, sagebrush (*Artemisia tridentata*)/bunchgrass, rabbitbrush (*Chrysothamnus viscidiflorus* or *Ericameria nauseosa*)/bunchgrass, rabbitbrush/cheatgrass, and Antelope bitterbrush (*Purshia tridentata*)/bunchgrass.
Riparian wheatgrass association	Riparian wheatgrass (*Elymus lanceolatus*) is the dominant species intermixed with other grasses and forbs.
Wormwood/forb	Low-lying areas, at or below the daily high water mark, with cobble/silty soil. The plant community is comprised of perennial *Artemisia* subshrubs with an understory hairy goldaster (*Heterotheca villosa*), western willow aster (*Symphotrichum lanceolatum*), Columbia tickseed (*Coreopsis tinctoria*), sneezeweed (*Helenium autumnale*), leafy beggar ticks (*Bidens frondosa*), and other riparian forbs.
Wormwood/perennial grass	Perennial *Artemisia* subshrub species including Pacific sage or field sagewort (*Artemisia campestris*), Columbia River wormwood or mugwort (*Artemisia lindleyana* ssp. *lindleyana*), and prairie or white sagebrush (*Artemisia lindleyana* ssp. *ludoviciana*).
Sand dropseed grass association	A subset of the wormwood/perennial grass category where the wormwood component is sparse or missing (sand dropseed [*Sporobolus cryptandrus*]).
Wormwood/riparian wheatgrass	Perennial *Artemisia* subshrub species with riparian wheatgrass as the dominant understory grass.
Wild rye association	Great Basin wild rye (*Leymus cinereus*), a large perennial bunchgrass.
Open sand	Open sand beaches occur in small stretches.
Riparian shrub	Small patches of dense choke cherry (*Prunus virginiana*), currant (*Ribes* species) and/or Wood's rose (*Rosa woodsii*), clematis (*Clematis ligusticifolia*), and various forbs or grasses may be present.

11.1.3.2 Rare Plants.

Rare plant data were collected for a number of species during riparian monitoring in 2019 (Table 11-10). These occurrences were located in both known rare plant areas and occurred in previously undocumented areas. During the course of the surveys, an annual spike-rush was located in muddy backwaters at two locations. It has been tentatively identified as *Eleocharis atropurpurea*, or purple spike-rush, but further investigation is required to determine the species. If identified as *Eleocharis*

atropurpurea, it will be the first individual found in the region as it has only been documented once before in Washington State in Lake Chelan in 1892 (WDNR 2019). Occurrence forms of rare plant species will be submitted to the Washington State Natural Heritage Program.

Table 11-10. Rare Plant Data During Riparian Monitoring 2019.

Species	Common Name	Status [a]	Number of Point Locations (2019)
Eleocharis cf. atropurpurea	Purple spike-rush	Possibly Extirpated	12
Epilobium campestre	Smooth willowherb	WA Review List 1	15
Hypericum majus	Canadian St. John's-wort	State Sensitive	40
Lipocarpha aristulata	Awned halfchaff sedge	State Threatened; Federal Sensitive	45
Oenothera cespitosa	Tufted evening-primrose	State Sensitive; Federal Sensitive	1
Rorippa columbiae	Columbia yellowcress	State Threatened; Federal Sensitive	13
Rotala ramosior	Lowland toothcup	State Sensitive; Federal Sensitive	93
Sporobolus compositus	Composite dropseed	State Sensitive; Federal Sensitive	32

[a] Status from Washington Natural Heritage Program 2019 Washington Vascular Plant Species of Special Concern, published July 15, 2019

11.1.3.3 Vernal Pools

Shallow ephemeral wetlands (also known as vernal pools) in very small to rarely large depressions occur throughout the exposed, volcanic scablands on the Columbia Plateau. These pools are characterized by fresh water inundation for much of the winter and spring, followed by dramatic lowering of the water table at the approach of summer. On the Columbia Plateau, vernal pools are geographically limited but can be locally common (Rocchio and Crawford 2015b). In the state of Washington the Columbia Plateau Vernal Pool ecosystem is considered to be "Imperiled," that is with a high to moderate risk of extirpation (Rocchio and Crawford 2015a).

In 1997, during surveys done on the Hanford Site for the DOE, The Nature Conservancy located three previously undocumented clusters of approximately 20 vernal pools. The Hanford Site pools were located on the east end of Umtanum Ridge, in the central part of Gable Butte, and at the eastern end of Gable Mountain (TNC 1998). The majority of these pools were located again in the spring of 2017 after an unusually wet period resulted in 6.86 in. (17.4 cm) of precipitation and 28 in. (71 cm) of snowfall between October 2016 and the end of February 2017. Roughly 25 vernal pools were containing water during monitoring in 2017. The vernal pools were monitored again the following winter, which received less precipitation in the same time period with 4.12 in. (10.46 cm) of precipitation and 6.8 in. (17.27 cm) of snowfall. Pools were monitored for presence/absence and for vegetative composition. No pools were found containing water during monitoring in 2018.

The fall and winter of 2018/2019 was fairly mild until February 2019 when the Hanford Site saw large amounts of snowfall comparable to the snowfall experienced before the 2017 vernal pool monitoring season. Precipitation between October and the end of February totaled 5.15 in. (13.1 cm), more than

the winter of 2017/2018 and less than the winter of 2016/2017. In addition to the 32.1 in. (81.5 cm) of snowfall received from October 2018 to February 2019, 4.4 in. (11.2 cm) of snow fell in March 2019. This unusually large amount of snowfall presented an opportunity to monitor vernal pools for presence/absence. Additionally, monitoring during a year with higher snowfall and lower precipitation than the 2016/2017 season may indicate if precipitation or snowfall have a greater effect on vernal pool water levels.

Vernal pools were monitored in April 2019. Though snowfall in 2019 was significantly higher than in the 2016/2017 season, vernal pools were not as numerous or robust in 2019 as they were in 2017 (Figure 11-28). Gable Butte and Gable Mountain pools were the only pools monitored that contained water, suggesting these pools are more likely to contain water in lower precipitation and snowfall years. Because they held water in a year when not all pools were inundated, pools GB-4, GB-7, GM-1, and GM-2 may host different cohorts of plants than the drier pools. Interestingly, vegetative composition surveys in 2018 found facultative wetland plants at GM-2, GM-3, and GB-4. Gable Butte pool BC-1 was the only pool where facultative wetland plants were found in 2018 and that did not contain water in 2019.

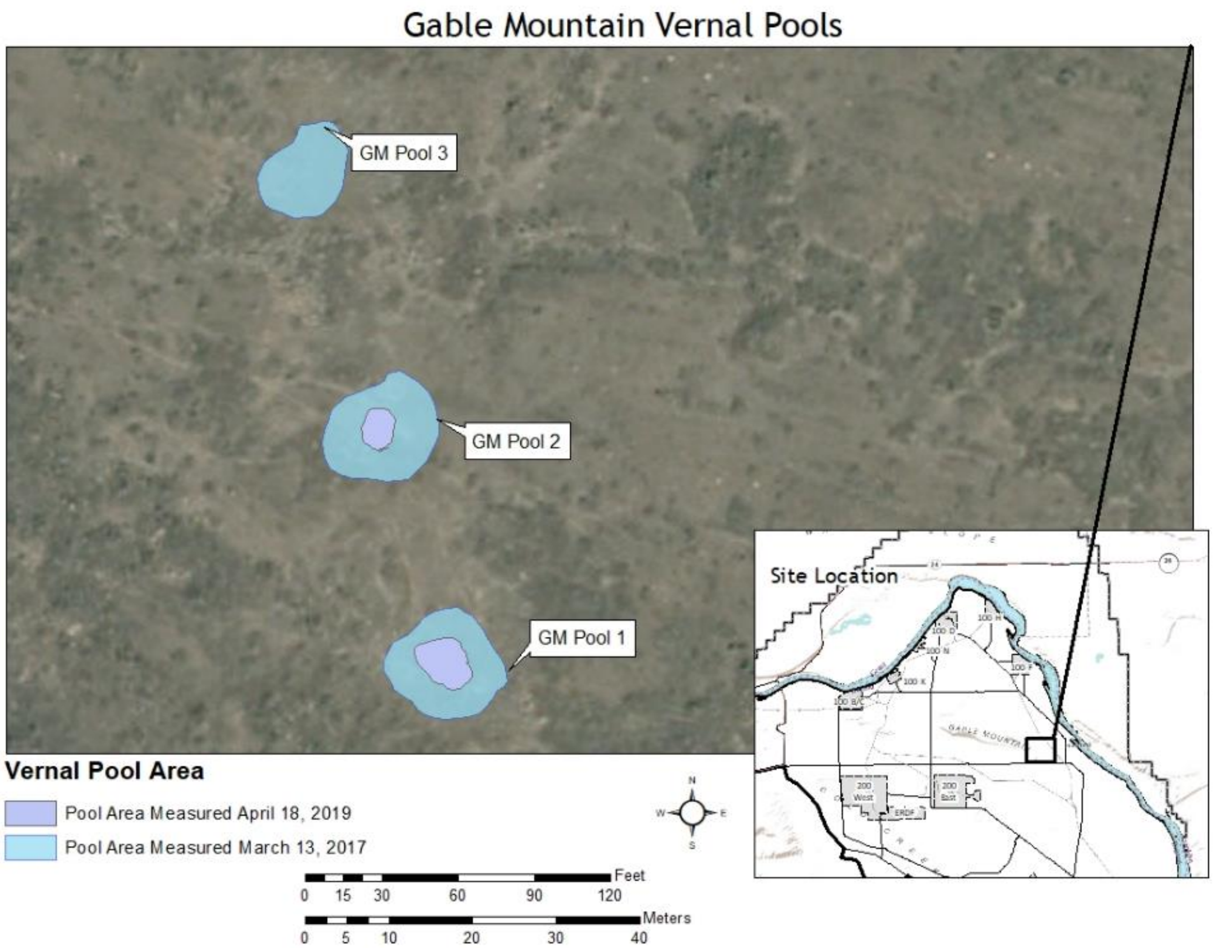

Figure 11-28. Boundaries of the Gable Mountain Pools in 2019 Compared to 2017 Boundaries.

The small size and limited occurrence of the vernal pools after heavy snowfall suggests a few possible scenarios. It is possible that winter precipitation plays a greater role in determining vernal pool water levels than snowfall, and 2018/2019 precipitation was not enough to fill pools to 2017 levels. Vernal pool progression may also be associated with daily temperatures and the speed of snowmelt. It is also possible that monitoring in mid-April was too late in the season to detect all of the vernal pools that had filled that year. For example, 2017 monitoring found the Gable Mountain pools were all present on March 30 but only GM-1 was present on May 8. Future monitoring with the goal of determining presence/absence of vernal pools should aim to visit the pools as soon as snowmelt occurs, ideally early March. Monitoring the vernal pools in early March 2019 was not possible, as it snowed the first week of March 2019 and there was significant snow on the ground through the first half of the month.

Additional information detailing the results of 2019 vernal pool monitoring are available at http://www.hanford.gov/page.cfm/ecologicalmonitoring.

11.2 Endangered and Threatened Species

ES Norris, JW Wilde

This section describes federal and state endangered and threatened species, candidate or sensitive plant and animal species, and other species of concern potentially found at the Hanford Site. Endangered species are those in danger of extinction within all or a significant portion of their range. Threatened species are those likely to become endangered in the near future. Sensitive species are species that are vulnerable or declining and could become endangered or threatened without active management or removal of threats. The federal list of endangered and threatened species is maintained by the USFWS in 50 CFR 17.11, "Endangered and Threatened Wildlife," and 50 CFR 17.12, "Endangered and Threatened Plants." The Washington Natural Heritage Program (WNHP 2019) maintains state lists for both plant and animal species.

The purpose of the ESA is to: 1) provide a means to conserve critical ecosystems, 2) provide a program for the conservation of endangered and threatened species, and 3) ensure appropriate steps are taken to achieve the purposes of the treaties and conventions established under the ESA. Washington State regulations also list species as endangered and threatened; however, such a listing does not carry the protection of the federal ESA. The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA 2015) has the responsibility for federal listing of anadromous fish (i.e., fish that require both saltwater and freshwater to complete a lifecycle). The USFWS is responsible for all other federally listed species at the Hanford Site. Table 11-11 lists the federal species of plants and animals that occur or potentially occur on the Hanford Site and are listed as endangered, threatened, sensitive, or candidate by either the federal or state government.

Table 11-11. Federal and State Endangered, Threatened, Sensitive, and Candidate Species. (3 Pages)

Species	Status[a]	
	Federal	State
Plants		
Annual sandwort (*Minuartia pusilla*)		Threatened
Awned halfchaff sedge (*Lipocarpha aristulata*)	Sensitive	Threatened
Beaked spike-rush (*Eleocharis rostellata*)		Sensitive

Table 11-11. Federal and State Endangered, Threatened, Sensitive, and Candidate Species. (3 Pages)

Species	Status[a]	
	Federal	State
Canadian St. John's wort (*Hypericum majus*)		Sensitive
Columbia milkvetch (*Astragalus columbianus*)	Sensitive	Sensitive
Columbia yellowcress (*Rorippa columbiae*)	Sensitive	Threatened
Composite dropseed (*Sporobolus compositus*)	Sensitive	Sensitive
Coyote tobacco (*Nicotiana attenuata*)	Sensitive	Sensitive
Desert cryptantha (*Cryptantha scoparia*)		Sensitive
Desert dodder (*Cuscuta denticulata*)		Threatened
Dwarf evening primrose (*Eremothera pygmaea*)	Sensitive	Sensitive
Foxtail mousetail (*Myosurus alopecuroides*)	Sensitive	Threatened
Geyer's milkvetch (*Astragalus geyeri* var. *geyeri*)	Sensitive	Threatened
Grand redstem (*Ammannia robusta*)	Sensitive	Threatened
Gray cryptantha (*Cryptantha leucophaea*)	Sensitive	Threatened
Great Basin gilia (*Aliciella leptomeria*)		Threatened
Hairy bugseed (*Corispermum villosum*)		Sensitive
Hoover's desert parsley (*Lomatium tuberosum*)	Sensitive	Sensitive
Loeflingia (*Loeflingia squarrosa*)		Threatened
Lowland toothcup (*Rotala ramosior*)	Sensitive	Sensitive
Red poverty-weed (*Micromonolepis pusilla*)	Sensitive	Threatened
Rosy pussypaws (*Calyptridium rosea*)	Sensitive	Threatened
Small-flower evening-primrose (*Eremothera minor*)		Sensitive
Snake River cryptantha (*Cryptantha spiculifera*)	Sensitive	Sensitive
Snowball cactus (*Pediocactus nigrispinus*)	Sensitive	Sensitive
Suksdorf's monkey flower (*Erythranthe suksdorfii*)	Sensitive	Sensitive
Thompson's sandwort (*Eremogone franklinii* var. *thompsonii*)		Sensitive
Tufted evening-primrose (*Oenothera cespitosa* ssp. *cespitosa*)	Sensitive	Sensitive
Umtanum desert buckwheat (*Eriogonum codium*)	Threatened	Endangered
White Bluffs bladderpod (*Physaria douglasii* ssp. *tuplashensis*)	Threatened	Endangered
White eatonella (*Eatonella nivea*)		Threatened
Whited's fuzzytongue penstemon (*Penstemon wilcoxii*)	Sensitive	Threatened
Yellow wildrye (*Leymus flavescens*)	Sensitive	Sensitive
Mollusks		
California floater (*Anodonta californiensis*)		Candidate
Ashy pebblesnail (*Fluminicola fuscus*)		Candidate
Shortface lanx (*Fisherola nuttalli*)		Candidate
Insects		
Columbia clubtail (dragonfly; *Gomphus lynnae*)		Candidate
Columbia River tiger beetle (*Cicindela columbica*) [b]		Candidate
Silver-bordered fritillary (*Boloria selene*)		Candidate
Fish		
Bull trout (mid-Columbia River; *Salvelinus confluentus*)[c]	Threatened	Candidate
Chinook salmon (upper Columbia spring-run; *Oncorhynchus tshawytscha*)	Endangered	Candidate
Leopard dace (*Rhinichthys falcatus*) [c]		Candidate
Mountain sucker (*Catostomus platyrhynchus*)[c]		Candidate
River lamprey (*Lampetra ayresii*)[c]	Species of Concern	Candidate
Steelhead (upper Columbia River; *Oncorhynchus mykiss*)	Threatened	Candidate
Birds		
American white pelican (*Pelecanus erythrorhynchos*)		Threatened
Bald eagle (*Haliaeetus leucocephalus*)	Species of Concern	None
Burrowing owl (*Athene cunicularia*)		Candidate
Clark's grebe (*Aechmophorus clarkii*)		Candidate
Common loon (*Gavia immer*)		Sensitive

Table 11-11. Federal and State Endangered, Threatened, Sensitive, and Candidate Species. (3 Pages)

Species	Status[a]	
	Federal	State
Ferruginous hawk (*Buteo regalis*)		Threatened
Flammulated owl (*Otus flammeolus*)[c]		Candidate
Golden eagle (*Aquila chrysaetos*)		Candidate
Greater sage grouse (*Centrocercus urophasianus*)	Species of Concern	Threatened
Lewis' woodpecker (*Melanerpes lewis*)[c]		Candidate
Loggerhead shrike (*Lanius ludovicianus*)		Candidate
Northern goshawk (*Accipiter gentilis*)[c]		Candidate
Sagebrush sparrow (*Artemisiospiza nevadensis*)		Candidate
Sage thrasher (*Oreoscoptes montanus*)		Candidate
Sandhill crane (*Grus canadensis*)		Endangered
Western grebe (*Aechmophorus occidentalis*)		Candidate
Amphibians and Reptiles		
Sagebrush lizard (*Sceloporus graciosus*)		Candidate
Striped whipsnake (*Masticophis taeniatus*)		Candidate
Western toad (*Anaxyrus boreas*)		Candidate
Mammals		
Black-tailed jackrabbit (*Lepus californicus*)		Candidate
Merriam's shrew (*Sorex merriami*)		Candidate
Townsend's ground squirrel (*Spermophilus townsendii*)		Candidate
Washington ground squirrel (*Urocitellus washingtoni*)[c]	Candidate	Candidate
White-tailed jackrabbit (*Lepus townsendii*)		Candidate

[a] Endangered=Species in danger of extinction within all or a significant portion of its range; Threatened=Species likely to become endangered in the near future; Candidate=Species believed to qualify for threatened or endangered species status but for which listing proposals have not been prepared; Sensitive=Taxa vulnerable or declining that could become endangered or threatened without active management or removal of threats
[b] Probable but not observed on the Hanford Site.
[c] Reported but seldom observed on the Hanford Site.

Two federally listed fish species are known to occur regularly in the Hanford Reach of the Columbia River, spring-run Chinook salmon (*Oncorhynchus tshawytscha*), which is listed as endangered, and steelhead (*O. mykiss*), which is listed as threatened. One additional federally listed threatened fish species, bull trout (*Salvelinus confluentus*), was recorded at the Hanford Site but scientists believe this species is transient. Two plant species, Umtanum desert buckwheat (*Eriogonum codium*) and White Bluffs bladderpod (*Physaria douglasii* ssp. *tuplashensis*), were listed as threatened under the federal ESA in April 2013; the rule was reaffirmed and made effective later that year (78 FR 23984). No other plants or animals known to occur on the Hanford Site are currently on the federal list of endangered and threatened species (50 CFR 17); however, one mammal species (Washington ground squirrel) is currently a candidate for federal listing. In addition, 16 plant species and 4 bird species have been listed as either endangered or threatened by Washington State. Numerous additional species of animals and plants are listed as candidate or sensitive species by Washington State. There are 31 state-level sensitive and candidate species of animals and 12 sensitive plant species occurring or potentially occurring on the Hanford Site.

11.3 Cultural and Historic Resource Protection

CD Currie, AP Fergusson, and KM Mendez

Cultural and historic resources protection on the Hanford Site is conducted under the direction of the DOE-RL Cultural and Historic Resources Program, implemented by MSA, to ensure site compliance with federal cultural resources laws and regulations (Section 2.5). Program activities in 2019 included the following:

- Performed cultural resources reviews for federal undertakings conducted at the Hanford Site in accordance with *National Historic Preservation Act of 1966* (NHPA) Section 106 and CERCLA with NHPA as an applicable or relevant and appropriate requirement
- Monitored site conditions to ensure important cultural resources were protected
- Maintained a database of cultural resources site records, project records, and regional ethno-history
- Maintained archaeological and historical collections
- Identified and evaluated new cultural resources to ensure they were appropriately managed
- Consulted with Native American Tribes and other stakeholders to gather input on the identification, documentation, and management of cultural resources important to them.

Cultural and Historic Resources Program personnel oversee all cultural resource activities at the Hanford Site. Project-specific NHPA Section 106 compliance work scope in 2019 was performed by staff archaeologists from MSA.

The Cultural and Historic Resources Program also schedules weekly meetings with archaeological staff from MSA to discuss and resolve issues relating to cultural resources management (e.g., survey procedures, site testing, site evaluation, consultations with external parties) with the objective of establishing and maintaining consistency among contractors.

11.3.1 Cultural Resources Reviews

Pursuant to the NHPA Section 106, DOE-RL conducts cultural resources reviews of federal undertakings at the Hanford Site. NHPA Section 106 cultural resources reviews ensure that important cultural resources are identified and effects to those resources are evaluated prior to project initiation so that mitigation measures can be conducted, if necessary. The NHPA is also addressed as applicable or relevant and appropriate requirements under the CERCLA Section 121(d), requiring remedial actions to identify and take into account the effects of activities on Historic Properties included in or eligible for inclusion in the National Register of Historic Places.

In 2019, Hanford Site archaeologists completed 71 NHPA Section 106 cultural resources reviews that included the following:

- Twenty-six undertakings had the potential to affect cultural resources, which included efforts to identify cultural resources that might be affected by project activity, an assessment of potential impacts, and the development of mitigation measures, if necessary[2].
  - Twenty were identified as No Historic Properties Affected.
  - Five were determined to have No Adverse Effects to Historic Properties.
  - One was identified as having Adverse Effects requiring mitigation measures as documented in a resulting project-specific Memorandum of Agreement. Adverse effects were avoided by taking specific actions to minimize impacts including avoidance, following treatment plan guidelines, and archaeological monitoring.
- Twenty projects affected historic buildings and were determined exempt by Hanford Site archaeologists after meeting the DOE-approved historic buildings Programmatic Agreement (DOE/RL-96-77) exemption criteria following an initial review.
- Eighteen projects had been reviewed for effects to cultural resources under previous NHPA Section 106 reviews (Previously Reviewed Project Analyses).
- Six projects were reviewed and completed by Hanford Site archaeologists under an emergency declaration (Post Reviews) in accordance with Section 5.1.1 of DOE/RL-98-10, *Hanford Cultural Resources Management Plan.*

The following were completed as part of the reviews described above:

- A total of 915.1 ac (370.3 ha) of new ground was surveyed for cultural resources from NHPA Section 106 project-specific surveys
- Some undertakings required National Register of Historic Places (36 CFR 60) eligibility evaluations
- Most projects cleared under expedited reviews (Programmatic Agreement Exemptions and Previously Reviewed Project Analyses) occurred in the 200 Areas of the Hanford Site (Figure 11-29).

[2]This number does not reflect all full cultural resources reviews initiated in 2019. Additional reviews were initiated in 2019 but completed in 2020 and are not included in this report.

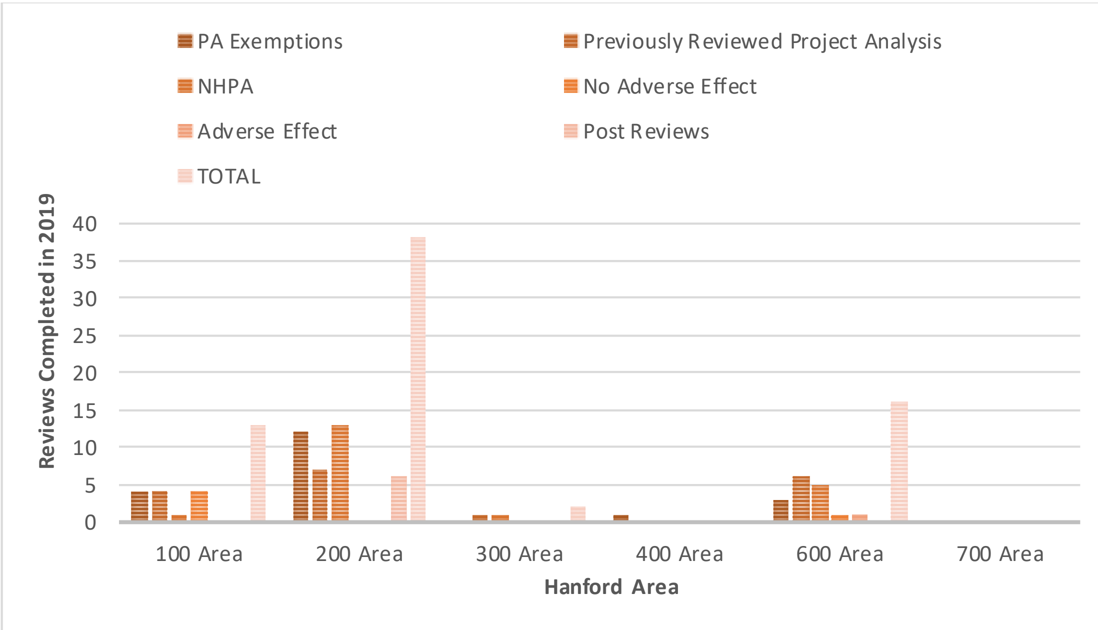

Figure 11-29. Hanford Site National Historic Preservation Act Section 106 Reviews by Area.

DOE-RL conducted formal consultations with the Washington State Historic Preservation Officer within the Department of Archaeology and Historic Preservation, Native American Tribes, and other interested parties for cultural resources reviews to comply with NHPA Section 106 and *National Environmental Policy Act* (Section 2.1.4). DOE-RL consulted with the Washington State Historic Preservation Officer and Native American Tribes on all 26 projects that required a full review because of their potential to affect cultural resources within the project area.

DOE-RL Cultural Resources Program staff members held 11 meetings in 2019 with Tribal Cultural Resources staff members from the Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes and Bands of the Yakama Nation, and Wanapum. Discussions focused on the cultural resources reviews completed and initiated in 2019, proposed undertakings within traditional cultural property boundaries and view sheds, and approaches to protecting threatened archaeological sites and places containing Native American human remains.

11.3.2 Cultural Resources Protections and Section 110 Activities

To ensure protection of cultural and historic resources located on the Hanford Site, Hanford Site archaeologists conducted monitoring activities to comply with NHPA Section 110 and the *Archaeological Resources Protection Act*:

> *to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals (Sec. 2(4)(b)).*

A monitoring program has been in place since 1989 to assess weathering and erosion effects and/or unauthorized excavation and collection of significant cultural resources on the Hanford Site. Activities

include onsite inspections to monitor site conditions, assess impacts, and identify protective measures, if necessary.

In 2019, 18 pre-contact and 5 historic archaeological sites were monitored under the Section 110 site conditions monitoring program. As part of Section 110 block survey Hanford Site archaeologists surveyed 230.11 ac (93.12 ha) and recorded three historic sites and nine historic isolates. Tribal cultural resources personnel participated in site monitoring activities.

11.3.2.1 Identification and Evaluation Activities.

Identification and evaluation activities are performed to comply with Sections 106 and 110 of the NHPA. In 2019, 16 new archaeological sites were recorded and 20 new isolated finds were located (Table 11-12). National Register evaluations were completed for 13 newly recorded archaeological sites. No new archaeological site forms for previously recorded archaeological sites were updated. No Historic Property Inventory Forms were completed during the reporting period for components of the Hanford Site's built environment.

Table 11-12. Sites and Isolates Recorded or Updated.

2019	Eligible	Not Eligible	Unevaluated	Total
Site updates	0	0	0	0
New sites	0	13	3	16
New isolates	0	0	20	20
Historic Property Inventory Form	0	0	0	0
Total	**0**	**13**	**23**	**36**

11.3.2.2 Data and Artifact Collections Management.

In 2014, the Cultural Resources Program transitioned to a paperless record keeping system, a process that continued in 2019. The Hanford Site Section 106 database tracks all cultural resources reviews conducted on the Hanford Site. The Section 106 database is used to track dates, actions, letters, and results of the cultural resources reviews. Once a project is complete it is closed out in the database and accessioned into the MSA digital archives for use by all Hanford Site cultural resource contractors and other interested researchers. Maintenance of these files is essential to the completion of all cultural resource compliance activities conducted on the Hanford Site.

In 2019, 150 new projects were opened, with pertinent information entered as acquired into the Section 106 database. A total of 141 projects were closed out after data entry was complete, with a digital copy of the project documentation added to the digital archive.

The cultural resources Geographic Information System (GIS) database contains cultural resource data collected from Hanford Site contractors including new archaeological surveys completed as part of Section 106 work, newly recorded and updated archaeological site locations, and contextual information describing the survey or site. All Hanford Site contractors use the GIS database for literature reviews, cultural resource compliance reporting and documentation, and research by DOE-approved users. As part of ongoing database management in 2019, a total of 23 polygons delineating completed archaeological surveys were added to the Hanford Site Survey Master shapefiles (map file) and 36 new archaeological sites/isolates, together with associated spatial and contextual information, were added

to the GIS Archaeological Site and Isolate database. Spatial and contextual information for four archaeological sites/isolates were updated in this database based on information gathered during recent re-visits to these locations.

Largely due to excavations conducted as mitigation for adverse effects on archaeological sites, the Cultural and Historic Resources Program manages a collection of artifacts related to the Native American settlement of the area within the mid-Columbia Basin that would become the Hanford Site. Similarly, a small collection of artifacts that mark the pre-1943 Euro-American settlement of the Priest Rapids Valley, later designated as the Hanford Site, is also maintained. The Cultural and Historic Resources Program manages a collection of archaeological artifacts. These artifacts are curated at the Wanapum Heritage Center. The Wanapum Heritage Center repository meets federal standards for archaeological collections storage and meets regulatory requirements outlined in 36 CFR 79, "Curation of Federally Owned and Administered Archaeological Collections." Staff at the Wanapum Heritage Center are documenting, accessioning, and preparing artifacts for long-term storage in a manner consistent with current curation standards.

11.4 Collection Management and Curation

M Petrich-Guy and J Gardner-Andrews

DOE's National Park Program is responsible for management of the artifacts from the Hanford Site's Manhattan Project and Cold War eras collected in compliance with DOE/RL-96-77. This programmatic agreement directs DOE-RL to identify and preserve any artifacts that may have value as interpretive or educational exhibits within national, state, or local museums. To further public access and education goals, DOE and MSA have formed a partnership with Washington State University's Hanford History Project (HHP) for management and curation of this collection.

The HHP provides professional curatorial and archival services for the management, conservation, and public access of the Hanford Collection. The Hanford Collection consists of artifacts and multimedia relating to the Manhattan Project and Cold War Era (Figure 11-30). In addition to care, security, and public access to the collection, the partnership provides research opportunities and use in academic programs for undergraduates. Washington State University, Tri Cities (WSU-TC) also provides a repository for the collection that allows DOE to meet the requirements of 36 CFR 79 including protecting these resources from theft, fire, breakage, or deterioration.

Prior to being moved offsite, Collection items were screened for residual radioactivity above allowable limits (DOE O 458.1) and controlled or classified materials to determine whether items could be released to the public. Transition of the bulk of the Hanford Collection to WSU-TC curation facility was previously completed in 2016, with the exception of those materials requiring scarce historic media players for review.

Collection tasks for 2019 consisted of reviewing historic media items for public release and transfer to the HHP repository, artifact conservation, and archival processing. Of the materials scheduled for screening in 2019, 20 items were reviewed, cleared for public release, and/or transferred to the HHP repository for integration with the Hanford Collection (Figure 11-31). Nineteen artifacts and one linear foot of archival material were evaluated for inclusion in the Hanford Collection. These materials were

delivered to the HHP repository at WSU-TC, leaving 20 (2.7%) of the 744 tagged artifacts scheduled for collection between 2020 and 2048.

Figure 11-30. Storage of Artifacts and Multimedia from the Manhattan Project and Cold War Era.

Figure 11-31. Ground Penetrating Radar Equipment Used on the Hanford Site, Transferred to the Hanford History Project Repository in 2019.

During 2019, the HHP processed and housed artifacts, multimedia were moved , and public access was facilitated to the Hanford Collection and Hanford Outreach Collection. Artifacts continue to be indexed and added to the collections management database (Re:Discovery Proficio) for tracking and management. An additional 351 historic items were catalogued during 2019; to date, approximately 788 (44%) of Hanford Collection and Hanford Outreach Collection items collected since 2011 and now housed by HHP have been fully catalogued.

In coordination with DOE's National Park Program, the HHP worked with the public as well as regional and national institutions to implement access to the collection for education and research. As part of public education and outreach efforts, the HHP received and worked with 16 student interns, volunteers, and research/usage requestors; as well as participated in outreach events that reached hundreds of members of the public in the Tri-Cities. Artifacts, multimedia, and information were supplied to several museums and institutions (e.g., Wanapum Heritage Center, Washington State Historical Society, Spokane Public Library, City of Richland, and Columbia Basin Consulting Group) as well as used for interpretation at the Manhattan Project National Historical Park's B Reactor. In December 2019, 123 Hanford Collection and Hanford Outreach Collection items were moved from the B Reactor National Historic Landmark to the HHP repository (Figure 11-32). This move took place to make room for new interpretive displays at the B Reactor National Historic Landmark. Additionally, MSA presented information on the Hanford Collection at the annual Northwest Anthropological Conference held in Kennewick, Washington, March 20 through 23, 2019.

Figure 11-32. Communication Panels from 105-B Reactor, Transferred to the Hanford History Project Repository in 2019.

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