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HNF-68672
Revision 0

Hanford Site Roadside Bird Surveys Report for Calendar Year 2019

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000031

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Hanford Mission Integration Solutions

Date Published
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APPROVED
By Janis Aardal at 12:49 pm, Dec 14, 2022

Release Approval | Date

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1.0 Introduction

The U.S. Department of Energy, Richland Operations Office (DOE-RL) conducts ecological monitoring on the Hanford Site to collect and track data needed to ensure compliance with an array of environmental laws, regulations, and policies governing DOE-RL activities. Ecological monitoring data provide baseline information about the plants, animals, and habitats under DOE-RL stewardship at Hanford which is required for decision-making under the *National Environmental Policy Act* (NEPA) and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). The *Hanford Site Comprehensive Land Use Plan* (CLUP, DOE/EIS-0222-F), which is the Environmental Impact Statement for Hanford Site activities, helps ensure that DOE-RL, its contractors, and other entities conducting activities on the Hanford Site are in compliance with NEPA.

The *Hanford Site Biological Resources Management Plan* (BRMP, DOE/RL 96-32) is identified by the CLUP as the primary implementation control 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 provides a comprehensive direction that specifies DOE biological resource policies, goals, and objectives.*"

DOE-RL places priority on monitoring those plant and animal species or habitats with specific regulatory protections or requirements, that are rare and/or declining (federal or state listed endangered, threatened, or sensitive species), or are of significant interest to federal, state, tribal governments, or the public. The BRMP ranks wildlife species and habitats from Level 5 (highest priority) to Level 0 (lowest priority), providing a graded approach to monitoring biological resources based on the level of concern for each resource. Current monitoring of bird species and habitats on the Hanford Site spans a range of BRMP resource levels from maintaining protective buffers around Ferruginous Hawk (*Buteo regalis*) nest sites (Level 4), Bald Eagle (*Haliaeetus leucocephalus*) nest and night roost sites (Level 4), and burrowing owl nest sites (Level 3), to safeguarding migratory bird nest locations in Level 0 habitat. The roadside bird surveys support the obligations described in the Memorandum of Understanding between the U.S. Department of Energy's (DOE) and the United States Fish and Wildlife Service (USFWS) *Regarding the Implementation of Executive Order 13186,* "*Responsibilities of Federal Agencies to Protect Migratory Birds*" by conducting research and other activities for the preservation and enhancement of habitat for migratory birds, maintenance of bird populations, and minimization of human impacts onnative species (DOE/FWS 2013).

The Hanford Site lies within the semi-arid Pasco Basin of the Columbia Plateau in southeastern Washington State. The site occupies approximately 1,502 square kilometers (580 square miles) north of the city of Richland (DOE/EIS-0222-F). The DOE-RL Hanford Site is unique in that public access is restricted, there is little ongoing industrial development, and agricultural activities do not occur within its boundaries, making the area relatively undisturbed compared to surrounding lands. The Hanford Site contains a variety of bird habitats that include: basalt outcrops, riparian zones along streams and springs, shrub-steppe on slopes and plains, sand dunes and

blowouts, and abandoned fields or disturbed areas (PNL-8942). The Hanford Site provides large expanses of habitat for shrub-steppe birds and other landbirds that depend on either mature stands of sagebrush or areas with at least some component of native grasses in the understory (Soll et al. 1999). In some portions of the Hanford Site, human activities such as farming, urbanization, and industrial development associated with pre-Hanford development and Hanford Site operations have greatly decreased the amount of natural habitat that native landbirds require for survival. In contrast, bird habitat along the riparian areas of the Hanford Site may have been improved for some species by the planting of larger trees near homesteads and towns which, in turn, provide nesting locations, feeding areas, and roosting spots for many species.

The amount and quality of shrub-steppe habitat in the Columbia Plateau has been greatly reduced from historical levels due to urban development, agricultural conversion, wildfires, and fragmentation. These changes place additional stressors on shrub-steppe obligate species and some, such as the Greater Sage-Grouse (*Centrocercus urophasianus*), have been locally extirpated (Hays et al. 1998). The apparent decline of avifauna numbers is not localized to the southeastern Washington, but extends across North America, with an estimated net loss in abundance of nearly 3 billion individuals across the continent since 1970 (Rosenburg et al.). Rosenburg et al. (1970) examined long-term population monitoring data from multiple sources, including USGS Bird Breeding Surveys, and noted a large-scale decline in avifauna abundance across all breeding biomes except wetlands. Federal laws, including the Migratory Bird Treaty Act of 1918, provide protection for some of these species. Monitoring is essential not only to maintain current biological information on the abundance and distribution of these species on the Hanford Site, but also to ensure compliance with protection regulations and to inform future protection and management efforts.

Several sagebrush-steppe dependent species, such as the Sagebrush Sparrow (*Artemisiospiza nevadensis)*, Sage Thrasher (*Oreoscoptes montanus*), and Loggerhead Shrike (*Lanius ludovicianus*), are currently listed by the Washington State Department of Fish and Wildlife (WDFW) as "candidate species" and have the potential to be listed as threatened or endangered in the future (WDFW 2019). In addition, the Hanford Site and surrounding area provides refuge to approximately 17 state-listed species as well as numerous state-monitored species (WDFW 2019) that benefit from the large expanses of habitat. This list includes birds such as the Ferruginous Hawk, a state "threatened" species, the American White Pelican (*Pelecanus erythrorhynchos)*, a state "endangered" species, and the Bald Eagle, a state "sensitive" species (WDFW 2019).

As resource manager of the Hanford Site, DOE-RL is responsible for conservation of wildlife and wildlife habitats (DOE/RL 96-32). Avifauna have been documented and monitored on the Hanford site for over 60 years (WHC-EP-0402), including over 20 years of roadside survey monitoring (PNNL 2011). The monitoring performed in 2018 continues this historical data set for documenting species occurrence and distribution on the Hanford Site, and can be compared with the long-term data collected on the Hanford Site over multiple decades. The continuation of this bird monitoring data set provides a valuable tool for developing baseline information on the presence and distribution of biological resources across the Hanford Site, identifying trends in species or populations, and compiling biological information necessary to implement adaptive management (DOE/RL 96-32).

Excluding raptorial species, the 2019 season bird surveys consisted of point counts and roadside survey counts. Migratory bird and breeding bird roadside surveys were performed in 2019 utilizing four historical survey routes which were established by Pacific Northwest National Laboratory (PNNL) in 1988 (Figure 1). These routes were monitored in the spring months from 1988 through 1991, and winter counts were added in 1992 and 1993. Each transect was monitored monthly between 1994 and 2001 (Rickard Personal Communications), and has been monitored in some modified format at least during the breeding season in the following years.

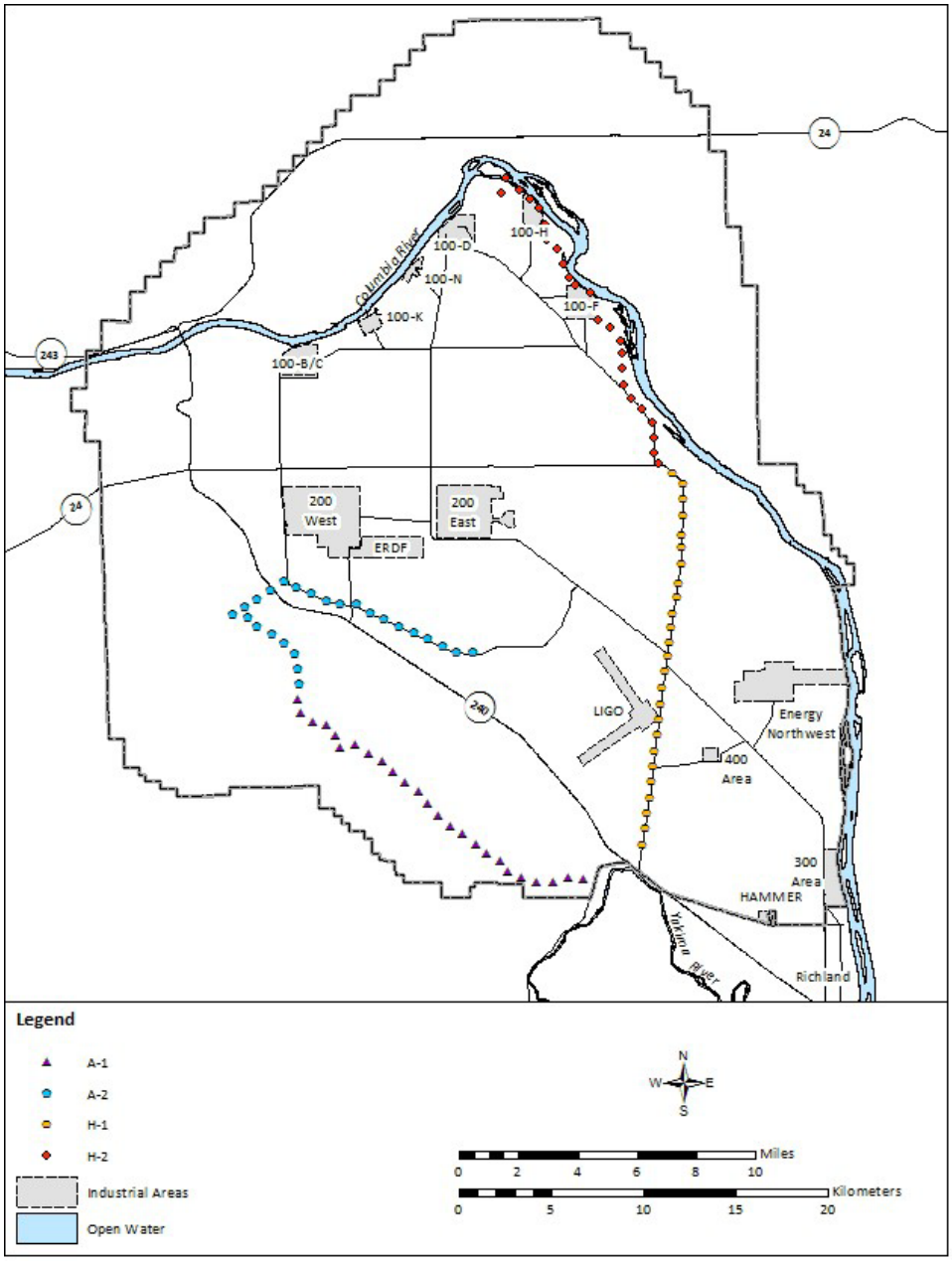

Figure 1. Roadside bird survey routes performed on the Hanford Site from 1988-2001

Bird Survey routes were modified in 2002 due to the transfer of management responsibility of the Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE) from the DOE-RL to the U.S. Fish and Wildlife Service (USFWS), and a large fire in 2000, which modified the habitat along the routes. In 2002, surveys along ALE were discontinued as part of the routine program, and a new route was established to monitor mature sagebrush communities on the north side of Gable Mountain and Gable Butte, previously burned areas, and successional grassland communities (Wilde et al. 2013). The four modified roadside bird survey routes that have been used from 2002 to present are shown in Figure 2.

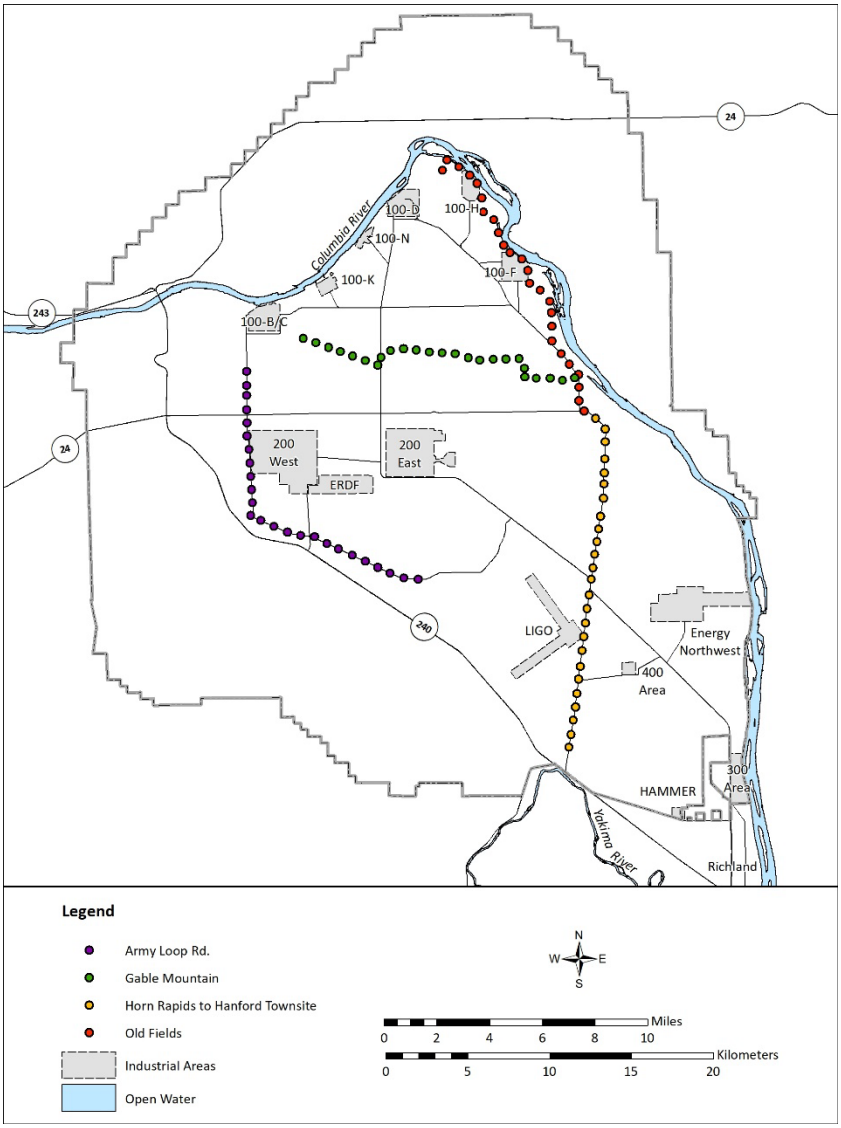

Figure 2. Roadside bird survey routes and point locations used on the Hanford Site since 2002

In 2005, Hanford became part of the North American Breeding Bird Surveys (BBS). The BBS is a unique collaborative counting effort designed to increase the understanding of North American bird populations and is now used as the primary data source for estimation of population change and modeling of the possible consequences of change in land use, climate, and many other possible stressors on bird populations (Sauer 2010). Jointly developed and coordinated by the United States Geological Survey (USGS), USFWS, and the Canadian Wildlife Service, the BBS incorporates counting efforts across the Unites States and Canada. Comprehensive summaries of population change have been calculated for >400 species of birds across North America (Sauer et al 2003). In 2005, two of the current routes, "Horn Rapids to Hanford Townsite" and "Old Fields", were surveyed in combination as the annual "Horn Rapids" BBS route. The "Richland" BBS route was created in 2006 from the previously discontinued ALE routes, including half of the current "Army Loop Rd" route, and surveys were performed by Hanford Site staff. This report includes the modified Hanford roadside bird survey routes that have been used since 2002. Hanford BBS route data are displayed on the USGS BBS

database for download and viewing. The two USGS BBS survey routes performed at Hanford are shown in Figure 3.

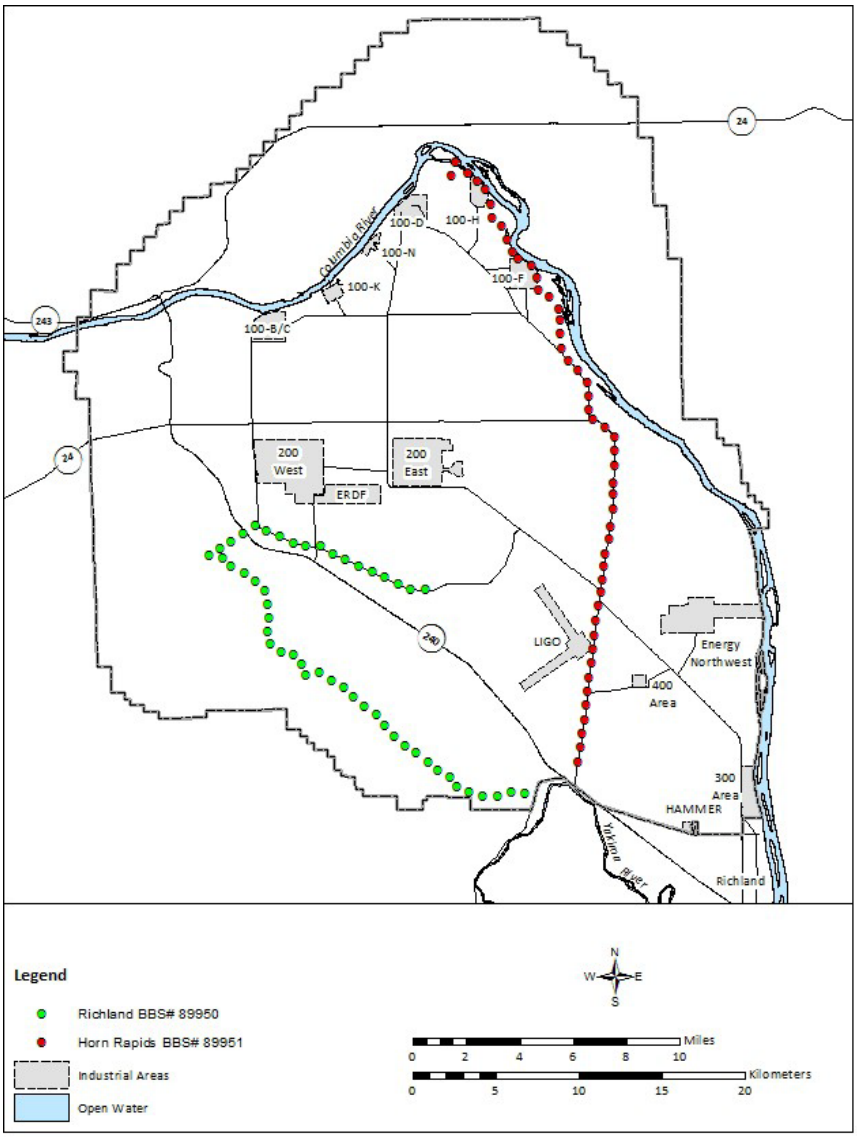

Figure 3. The U.S. Geological Survey Breeding Bird Survey routes performed annually on the Hanford Site

Surveys of the two Hanford BBS routes include two of the established Hanford routine roadside bird survey routes and surveys of half of a third route. MSA followed the methods of the BBS described in Section 2.0 when performing counts along survey routes to maintain consistency and allow the official BBS data to fit within the annual program results,

This report does not provide an inventory of all birds that inhabited any portion of the Hanford Site in 2019, but rather documents the status of birds identified through a transect survey method, providing an index that is comparable among years. For 2019, this report lists those species counted during the surveys of the four Hanford routes, which may be used for trending and evaluation in coming years. Road surveys are a practical way to monitor changes in species' richness (number of species represented in the community) and relative

abundance (how common or rare a species is relative to other species in the community) of shrub-steppe birds over time and in response to land-use changes, or changes to the landscape itself.

2.0 Methods

In 2019, the survey protocols for bird species, excluding raptorial species, were comprised of roadside survey counts that were conducted across four survey routes over the course of three days. Surveys were conducted in this manner to provide large geographic coverage of the survey area. The methodology is described in further detail in the following section.

Roadside survey counts follow the protocols used for the BBS coordinated by the USGS annually throughout North America (Bystrack 1981; Sauer 2010). Four survey routes (Figure 2) or portions of routes were surveyed one time during the 2019 breeding season in coordination with BBS (June).

Hanford routine roadside routes are 20 kilometers (km) (12.43 mi) compared to the 40-km (24.85 mi) routes used in the BBS (Figure 2, Figure 3). The 40-km (24.85 mi) "Horn Rapids 89951" BBS route surveys both the "Horn Rapids-to-Hanford Townsite" [20-km (12.43 mi)] and "Old Fields" [20-km (12.43 mi)] Hanford survey routes. All roadside routes contain point counts at 0.8-km (0.5 mi) intervals marked with steel fence posts, rebar posts, pin flags, or by GPS coordinates only. There are 25 survey points per Hanford route and 50 survey points per BBS route. Birds within 400 meters (m) (0.25 mi) of each survey point were identified by sight or sound during a three-minute period at each marker post. Surveyors drove to each survey location and observed the area for three minutes, recording their observations. The number of vehicles passing by during the survey time was recorded on the field sheet for each point. Observers remained at a survey point for more than the three minutes only if additional time was needed to confirm identification or to count birds that were noted during the three-minute observation period. Observations of any nesting activities within 400-m of the survey point were also noted. When complete staff will travel to the next point.

Roadside monitoring protocols are not without bias; however, the benefits are considered to outweigh most disadvantages. Time spent traveling between survey points can be vastly reduced when utilizing a roadside survey protocol, resulting in more data collected per survey day than compared to off-road survey methods. One concern that needs to be considered when conducting roadside point surveys is that in some cases, the road will not pass through all habitat types represented in the survey area. Another concern is that a road can modify the surrounding habitats and introduce bias into the survey. It is accepted, however, that the use of tertiary road systems (narrow dirt roads) can allow for birds to be counted in a similar capacity to off-road point surveys (USDA 1993).

Hanford surveys start in the early morning hours, starting no earlier than 30 minutes before sunrise and no later than 30 minutes following sunrise. The BBS survey routes are started as near as possible to 0438 hours, as required in the USGS protocols. Surveys are halted if adverse weather conditions such as high winds, heavy rain, or snowfall develop during the route survey. Each route is surveyed once during the breeding period.

3.0 Results

Roadside surveys were performed during the breeding period of the year. Four surveys were completed

successfully, which resulted in data collection for four Hanford survey routes (Table 1). The "Horn Rapids" BBS route includes both the "Horn Rapids to Townsite" and "Old Fields" routes in a single run. The second half of the "Army Loop Rd" route (points 12-25) were surveyed again in 2019 as part of the "Richland" BBS route completion. The breeding season is the most consistently surveyed period throughout the years, and the best data sets used for trending. For the 2019 breeding season surveys, a total of 1,380 individual birds were documented (Table 2), higher than the 1,105 individuals counted during breeding period surveys in 2018 and 1,223 individuals from same period in 2017. Forty-five bird species were documented in the 2019 breeding season survey (Table 2), which was more than the 41 species seen in breeding period surveys during 2018 and the 43 species observed in the surveys during 2017. The same observer has conducted most surveys over the past five years, providing consistency to the data collected.

Table 1. 2019 Survey dates and location.

Route Name	Survey Date
Army Loop Rd	6/20/2019
Gable Mountain	5/28/2019
Horn Rapids to Townsite	6/8/2019[b]
Old Fields	6/8/2019[b]

[b] Surveyed in conjunction with Horn Rapids BBS

The Cliff Swallow (*Petrochelidon pyrrhonota*) was the most abundant species documented with 356 individuals observed across the surveys. These 356 individuals made up 25.8% of the total number of observed individuals; of these, 175 were counted at a single point. The Horned Lark (*Eremophila alpestris*) was the second most abundant species, with 327 individuals observed, 23.7% of all individuals counted. The Western Meadowlark (*Sturnella neglecta*) was counted 253 times, 18.3% of all individuals observed. The Cliff Swallow was observed at only 14 survey points (14% of points surveyed), while the Western Meadowlark was more frequently detected; observed at 79 survey points (79% of points surveyed). Other notable species include American White Pelicans (WDFW Endangered Species, 1 individual) Sagebrush Sparrows (*Artemisiospiza nevadensis*, WDFW Candidate Species, 13 individuals), and Loggerhead Shrike (*Lanius ludovicianus*, WDFW Candidate Species, 10 individuals). The full list of species observed is displayed in Table 2 below.

During the breeding season, the "Old Fields" route had the highest species diversity and the highest abundance of individuals (Table 3). The "Old Fields" route has historically been the route with the highest species richness and abundance. The route runs along the northeastern edge of the central Hanford Site, often directly adjacent to the Columbia River, providing the largest variety of habitats of the selected routes.

Table 2. Species, Sorted by Abundance, Over Roadside Surveys Performed on the Central Hanford Site in 2019.

Common Name	Scientific Name	Routes[a]	Individuals	% Counts	Stops[b]	% Stops
Cliff Swallow	Petrochelidon pyrrhonota	2	356	25.8	14	14
Horned Lark	Eremophila alpestris	4	327	23.7	77	77
Western Meadowlark	Sturnella neglecta	4	253	18.3	79	79
European Starling	Sturnus vulgaris	2	71	5.14	9	9
Lark Sparrow	Chondestes grammacus	3	48	3.48	28	28
Common Raven	Corvus corax	4	39	2.83	25	25
California Quail	Callipepla californica	3	32	2.32	7	7
Bank Swallow	Riparia riparia	1	19	1.38	4	4
Bullock's Oriole	Icterus bullockii	3	17	1.23	7	7
Red-winged Blackbird	Agelaius phoeniceus	1	17	1.23	6	6
Western Kingbird	Tyrannus verticalis	4	15	1.09	6	6
Common Nighthawk	Chordeiles minor	2	13	0.94	2	2
Ring-billed Gull	Larus delawarensis	1	13	0.94	4	4
Sagebrush Sparrow	Artemisiospiza nevadensis	2	13	0.94	7	7
Brewer's Blackbird	Euphagus cyanocephalus	1	11	0.8	5	5
Canada Goose	Branta canadensis	1	11	0.8	2	2
Great Egret	Ardea alba	1	10	0.72	2	2
Loggerhead Shrike	Lanius ludovicianus	2	10	0.72	6	6
Tree Swallow	Tachycineta bicolor	1	10	0.72	1	1
Mourning Dove	Zenaida macroura	3	9	0.65	5	5
Rock Wren	Salpinctes obsoletus	1	9	0.65	5	5
American Goldfinch	Spinus tristis	1	7	0.5	2	2
American Robin	Turdus migratorius	1	7	0.5	2	2
Black-billed Magpie	Pica hudsonia	2	7	0.5	5	5
House Finch	Haemorhous mexicanus	2	7	0.5	5	5
White-crowned Sparrow	Zonotrichia leucophrys	1	7	0.5	1	1
Eastern Kingbird	Tyrannus tyrannus	1	6	0.43	4	4
Double-crested Cormorant	Phalacrocorax auritus	1	5	0.36	2	2
Grasshopper Sparrow	Ammodramus savannarum	2	4	0.29	4	4
Mallard	Anas platyrhynchos	1	4	0.29	2	2
Osprey	Pandion haliaetus	1	3	0.22	3	3
Red-Tailed Hawk	Buteo jamaicensis	3	3	0.22	1	1
Brewer's Sparrow	Spizella breweri	1	2	0.14	1	1
Caspian Tern	Hydroprogne caspia	1	2	0.14	1	1
Common Merganser	Mergus merganser	1	2	0.14	1	1
Say's Phoebe	Sayornis saya	1	2	0.14	1	1
American Kestrel	Falco sparverius	1	1	0.07	1	1
American White Pelican	Pelecanus erythrorhynchos	1	1	0.07	1	1
Bald Eagle	Haliaeetus leucocephalus	1	1	0.07	1	1
Great Horned Owl	Bubo virginianus	1	1	0.07	1	1
Northern Harrier	Circus cyaneus	1	1	0.07	1	1

Northern Mockingbird	Mimus polyglottos	1	1	0.07	1	1
Swainson's Hawk	Buteo swainsoni	1	1	0.07	1	1
Western Wood-pewee	Contopus sordidulus	1	1	0.07	1	1
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	1	1	0.07	1	1

[a] Count of how many of the 4 unique Hanford Roadside routes was species identified (4 Max)
[b] Number of survey points the species was identified

Table 3. Species Richness and Abundance Counted During the 2019 breeding season Roadside Bird Survey Routes on the Hanford Site Sorted by Route

Route Name	Species	Abundance
Army Loop Rd	10	263
Gable Mountain	15	244
Horn Rapids to Townsite	13	167
Old fields	38	706
Total	**45[a]**	**1380**

[a] Number of unique species identified

4 . 0 Discussion

For 27 years, the roadside bird survey monitoring program has provided the Hanford Site with valuable avian community data needed for population and habitat evaluation. As designed, the surveys are intended to be an indicator of abundance, species distribution, and potential habitat quality. Performing surveys using BBS methods is an efficient way of collecting species data over large portions of the Hanford Site and provides data that are comparable with the historical data set. All Hanford BBS route data are also displayed on the USGS BBS database for download and viewing.

The species and number of individuals documented was similar to past years with Cliff Swallow, Horned Lark, and Western Meadowlark being the most abundant species observed. It is worth noting that the Cliff Swallow were all observed at just 14 stops throughout the survey routes while the Horned Lark and Western Meadowlark were observed at 77 and 79 stops, respectively. These three species made up 67.8% of all observed individuals which would contribute to lower diversity index values. Species richness on the Old Fields route (n=38) was the highest of all routes which is consistent with previous years surveys and this result is to be expected as the largest diversity of species-rich habitats occurs along the route near the Columbia River. Over the past five years, the Gable Mountain route had a higher diversity index and higher evenness than Army Loop Road and Horn Rapids-to-Townsite even though it has a lower species richness. Much of this route passes through high quality shrub habitat on the north side of Gable Mountain. While the number of species is lower, there are fewer areas for Western Meadowlark and Horned Lark to dominate the survey numbers, and species like Loggerhead Shrike and Sagebrush Sparrows are more prevalent leading to more evenness in individuals across species. The data reveals the value of the remaining high-quality habitats on the Hanford Site to the avian community and provide justification for the conservation of these areas.

Sagebrush Sparrow and Loggerhead Shrike are both candidate species for listing in the state of Washington, trends of these species are especially important. Sagebrush Sparrow, Loggerhead Shrike, and Long-billed Curlew are common breeders on the Hanford site, so trends are examined below. This data is plotted on a log-number observed scale to determine the population trend over the past five years during the breeding season (Figure 4, 5 and 6). A log-based y-axis was used to reduce the variation and provide a better fit for the trend line and R^2 value to the data over such a short temporal scale. By solely using R^2 from trend lines in these plots, a statement may be made that ~74% variation in Loggerhead Shrike is accounted for by a decrease in numbers with increasing year (figure 5). Moderate R^2 in the Long-billed Curlew (~53%) (Figure 6) and very low (~.5%) for Sagebrush Sparrow (Figure 4) suggest that the variation in numbers is not related to an increase in year but rather some additional unmeasured variable. The Sagebrush Sparrow's rather stable population numbers on the Hanford Site are a positive sign due to the protection of habitat on Hanford, or possibly due to an increased stress on shrub habitat outside of Hanford due to wildfires and agriculture. The apparent decrease in Long-billed Curlew numbers may be of concern because it was removed from consideration of federal listing in 2008.

Bird surveys will continue on Hanford to document species diversity, population trending, and other environmental changes in the area. Hanford should continue to protect remaining shrub habitats and continue with quality restoration and revegetation projects across the site to increase the amount of shrub

habitat. The data suggests that quality shrub habitats produce a more diverse and even population in the avian communities that inhabit these areas. Measuring effectiveness of habitat conservation, restoration or mitigation through bird surveys can be an efficient method. The data collected during these surveys help to show that quality habitat will continue to provide the most diverse and abundant numbers of many bird species.

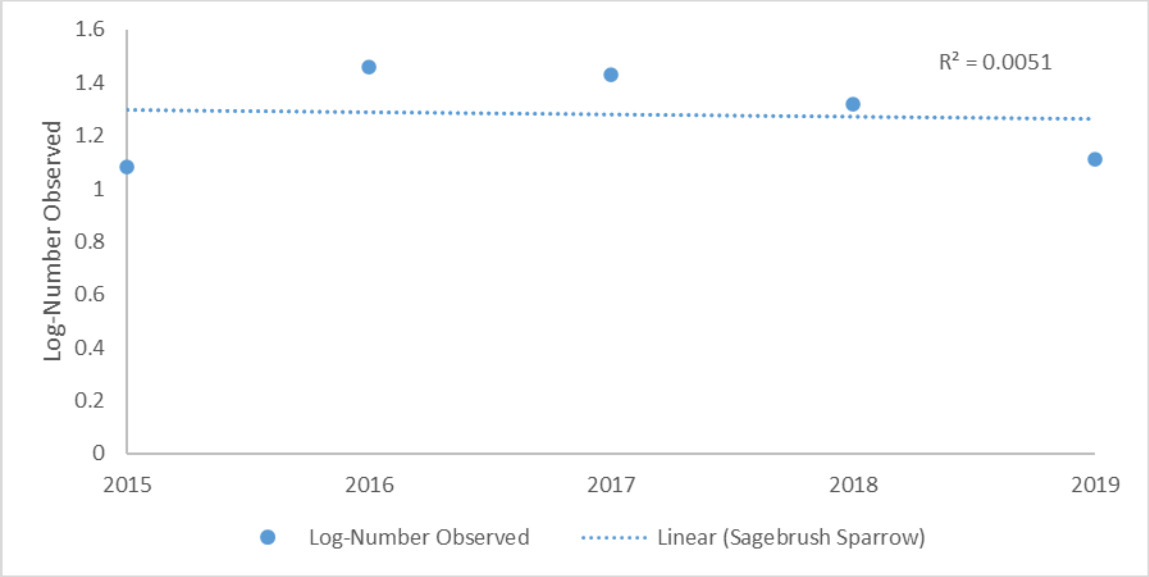

Figure 4. Trend, Log-Linear for Sagebrush Sparrow on the Hanford Site, 2015-2019

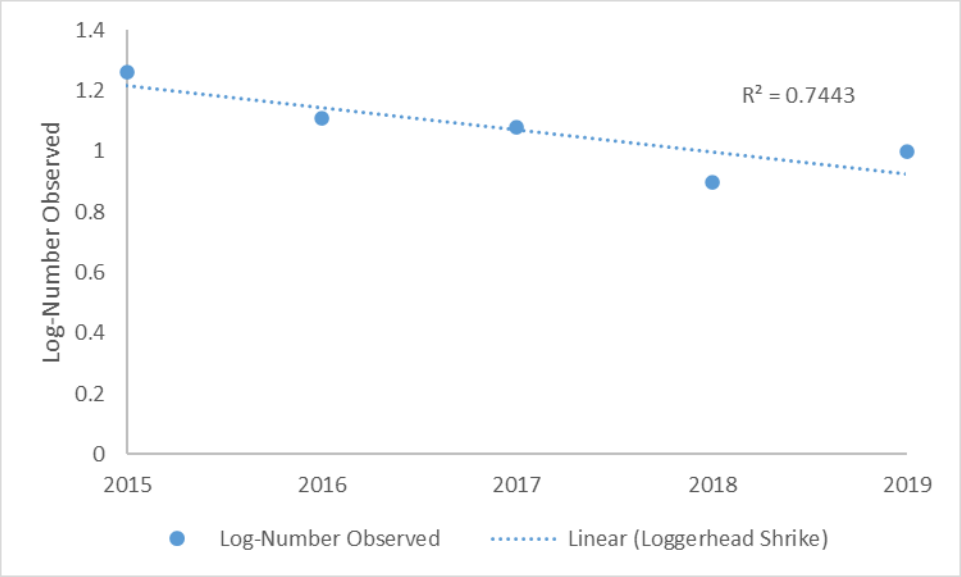

Figure 5. Trend, Log-Linear for Loggerhead Shrike on the Hanford Site, 2015-2019

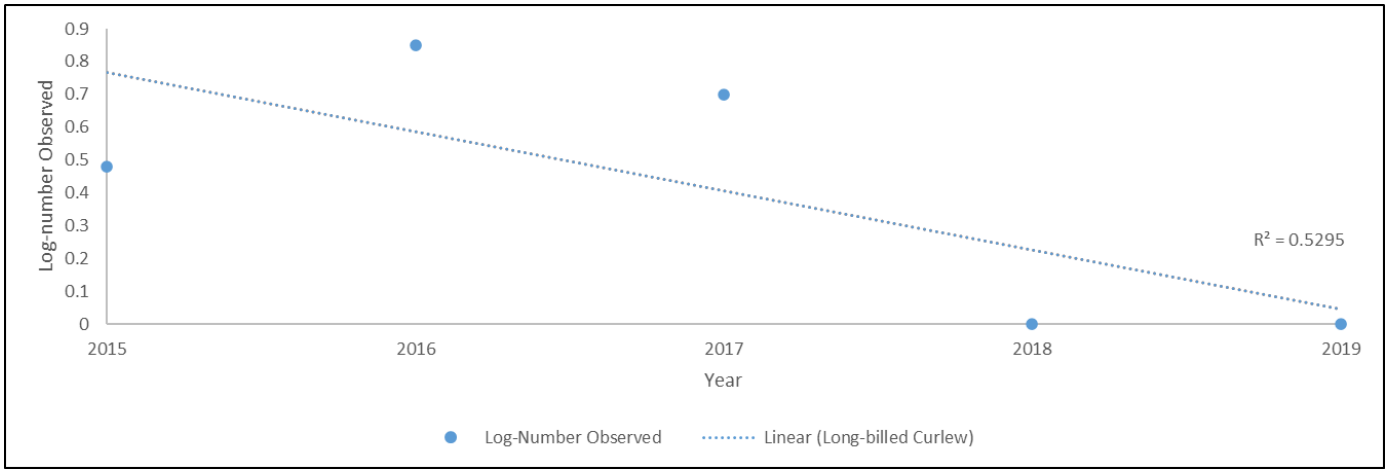

Figure 6. Trend, Log-Linear for Long-billed Curlew on the Hanford Site, 2015-2019

5 . 0 References

Bystrak, D. "The North American Breeding Bird Survey." Trans. Array *Estimating Numbers of Terrestrial Birds: Studies in Avian Biology*. Lawrence, Kansas: Cooper Ornithological Society, Allen Press, 1981. 34-41. Online at: http://pubs.er.usgs.gov/publication/5210285.

DOE/RL 96-32, 2013. Hanford Site Biological Resources Management Plan., Rev. 1. United States Department of Energy, Richland, Washington. Online at: https://www.hanford.gov/files.cfm/DOE-RL-96-32-01.pdf

DOE/EIS-0222-F, 1999. Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement, U.S. Department of Energy, Washington, D.C. Online at: https://energy.gov/nepa/downloads/eis-0222-final-environmental-impact-statement-0

DOE/FWS, 2013. Memorandum of Understanding between The United States Department of Energy and The United States Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds". https://www.energy.gov/sites/prod/files/2013/10/f3/Final%20DOE-FWS%20Migratory%20Bird%20MOU.pdf

Hays, D. W., M. J. Tirhi, M. J., and D. W. Stinson. 1998. Washington State status report for the sage grouse. Wash. Dept. Fish and Wildl., Olympia. 62 pp.

Pacific Northwest National Laboratory (PNNL). (2011). *Shrub-steppe Birds*. Accessed February 1, 2012.

PNL-8942, 1993. *Habitat Types on the Hanford Site: Wildlife and Plant Species of Concern*. Downs, J. L., W. H. Rickard, C. A. Brandt, L. L. Cadwell, C. E. Cushing, D.R. Geist, R. M. Mazaika, D. A. Neitzel, L. E. Rogers, M. R. Sackschewsky, and J. J. Nugent. Pacific Northwest Laboratory, Richland, Washington. Online at: https://www.osti.gov/servlets/purl/10110777

Rickard, W. Monitoring Landbird Use of Sagebrush – Grass and Abandoned Farmland Habitats Located On Central Hanford, Handwritten accounts by Rickard passed on to PSRP staff in 2011.

Rosenberg, K. V., A. M. Dokter, P. J. Blancher, J.R. Sauer, A. C. Smith, P. A. Smith, J. C. Stanton, A. Panjabi, L. Helft, M. Parr, P. P. Marra. *Decline of the North American avifauna.* Science 04 Oct 2019 : 120-124. Online at: https://science.sciencemag.org/content/366/6461/120

Sauer, J. R., J. E. Fallon, and R. Johnson. 2003. *Use of North American Breeding Bird Survey Data to estimate population change for bird conservation regions*. J. Wildlife Management 67:372-389.

Sauer, J.R. 2010. *The North American Breeding Bird Survey 1966-2009 Summary Analysis and Species Accounts*. Online at: https://meridian.allenpress.com/naf/article/doi/10.3996/nafa.79.0001/438467/The-North-American-Breeding-Bird-Survey-1966-2011

Soll, J., J.A. Hall., R. Pabst, and C. Soper. 1999. Biodiversity inventory and analysis of the Hanford Site. Final Report: 1994-1999. The Nature Conservancy of Washington, Seattle, WA. 179 pp.

USDA, United States Department of Agriculture, 1993. *Handbook of Field Methods for Monitoring Landbirds.* Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, D. F. DeSante. General Technical Report PSW-GTR-144-www, Pacific Southwest Research Station, Albany, California. Online at: http://www.fs.fed.us/psw/publications/documents/psw_gtr144/psw_gtr144.pdf.

WHC-EP-0402, 1992. *Status of Birds at the Hanford Site in Southeastern Washington*., Rev. 1. Landeen, D.S., A.R. Johnson, and R.M. Mitchell. Westinghouse Hanford Company, Richland,Washington. Online at: https://inis.iaea.org/search/search.aspx?orig_q=RN:24026504.

WDFW (Washington Department of Fish and Wildlife). 2019. *State Listed Species*, Online at: https://wdfw.wa.gov/species-habitats/at-risk/listed?species=&state_status=All&federal_status=All&category=25379

Wilde, J.W., M.S. Filan and S.J. Johnson. 2013. *Hanford Roadside Bird Surveys Report for Calendar Year 2012*, Rev. 0. HNF-55491. Prepared by Mission Support Alliance for the U.S. Department of Energy, Richland, Washington. Online at: http://www.hanford.gov/files.cfm/hnf-55491_rev_0_release.pdf.