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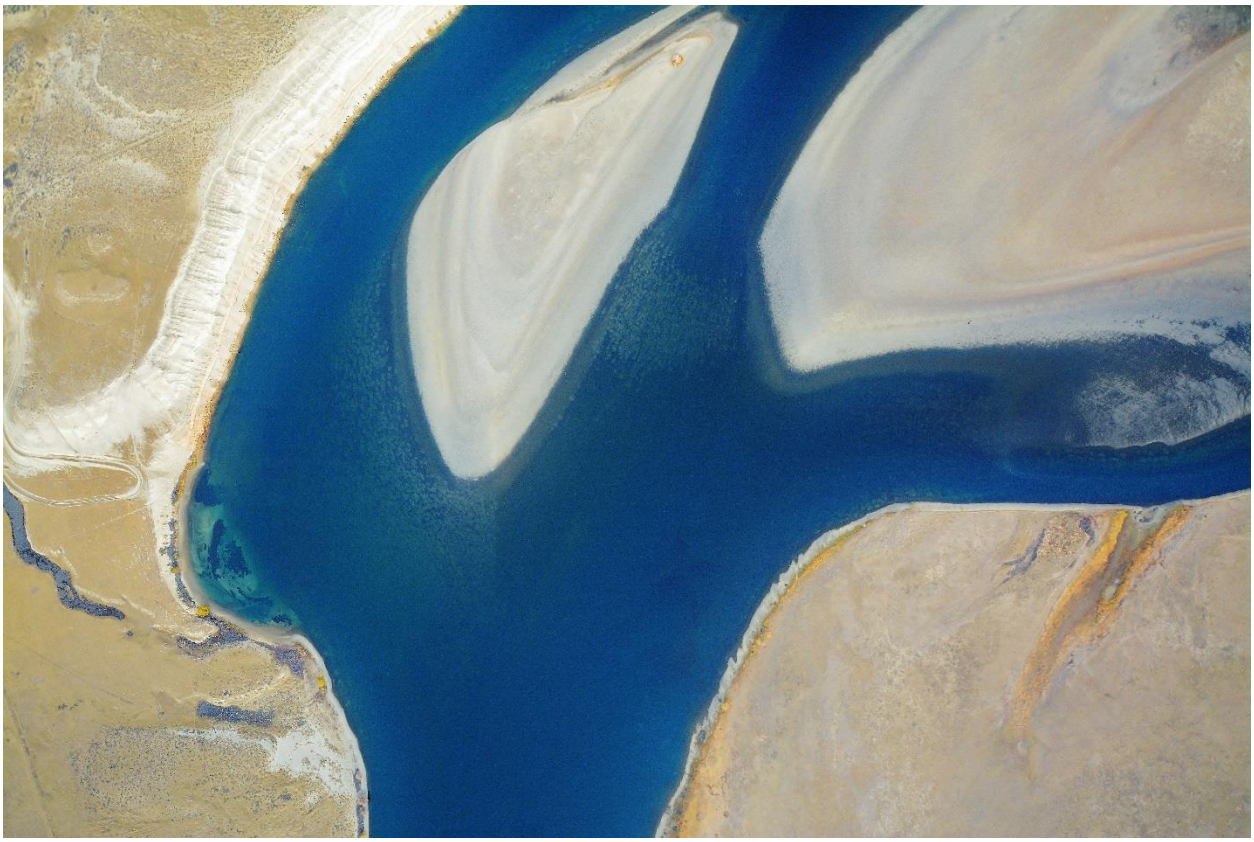
Revision 0

Hanford Reach Fall Chinook Redd Monitoring Report for Calendar Year 2015



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Assistant Secretary for Environmental Management

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Mission Support Alliance

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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 activities. Ecological monitoring data provide baseline information about the plants, animals, and habitats under DOE-RL stewardship at Hanford 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, USDOE 1999), which is the Environmental Impact Statement that evaluates the potential environmental impacts associated with implementing a comprehensive land-use plan for the Hanford Site for at least the next 50 years, ensures that DOE-RL, its contractors, and other entities conduct activities on the Hanford Site in compliance with NEPA.

The vision for the DOE-RL managed portion of the Hanford Site focuses not only on the clean-up of nuclear facilities and waste sites, but on the protection of groundwater and the Columbia River and the restoration of Hanford lands for access and use. To reach these goals Hanford is working closely with partners, such as the U.S. Fish and Wildlife Service (USFWS) and National Park Service (NPS), to enable use of the Hanford land consistent with the CLUP. As the Hanford Site moves toward accomplishing this vision, understanding of the ecological resources present and the need for conservation and/or protection of those resources will be critical for making informed decisions for responsible site stewardship.

The *Hanford Site Biological Resources Management Plan* (BRMP, USDOE 2013) is identified by the CLUP as the primary implementation document for managing and protecting natural resources on the Hanford Site. 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; or that are rare and/or declining (federally 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 0–5) based on the level of concern for each resource. Fall Chinook salmon spawning areas are ranked as Level 5 resources, the highest ranking level in BRMP. According to the BRMP, "resources classified as Level 5 are the rarest and most sensitive habitats and species and are considered irreplaceable or at risk of extirpation or extinction." The management goal of Level 5 resources is preservation and requires a high level of status monitoring.

The population of fall Chinook salmon (*Oncorhynchus tshawytscha*) 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, and 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). Fall Chinook salmon redds have been monitored annually, including aerial counts, since 1948 at Hanford to provide an index of relative abundance among spawning areas and years (Wagner et al. 2012a, Wagner et al. 2013, Lindsey and Nugent 2014, Nugent and Wilde 2015, Mission Support Alliance [MSA] 2016). 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, which are the focus of this report, is vitally important for the implementation of the Hanford Reach Fall Chinook Protection Program (HRFCPP; USACE 2006). The HRFCPP is an agreement among Public Utility District No. 2 of Grant County, Washington (Grant), Public Utility District No. I of Chelan County, Washington (Chelan), Public Utility District No. 1 of Douglas County, Washington (Douglas), DOE acting by and through the Bonneville Power Administration (BPA), National Oceanic and Atmospheric Administration Fisheries (NOAAF), Washington Department of Fish and Wildlife (WDFW), and the Confederated Tribes of the Colville Indian Reservation (CCT). The goal of this program is to protect Hanford Reach fall Chinook salmon during critical periods of their life-cycle through operational constraints imposed on the Priest Rapids Hydroelectric Project.

Commonly referred to as king salmon, Chinook are the largest of the Pacific salmon (Myers et al. 1998, Netboy 1958). The Columbia River supports three major runs (spring, summer, and fall) of Chinook salmon, generally based on the season during which the adults re-enter the estuary to begin their upstream migration to spawn. Chinook salmon that spawn in the Hanford Reach of the Columbia River are fall-run fish. Fall Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Myers et al. 1998, Fulton 1968, Healey 1991). Adult fall Chinook salmon destined for the Hanford Reach are upriver brights that enter the Columbia River in late summer and spawn in the fall. Spawning in the Hanford Reach typically begins in mid-October and lasts through November. From 1948 through 1988, the first-observation of spawning ranged from September 28 to October 26 with a median date of October 16 (Dauble and Watson 1990). 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 at this time and appear as clean swept gravel patches amidst darker undisturbed substrate covered by algae (periphyton). "Redd life" is a term describing the period during which periphyton growth has not rendered the redd substrate indiscernible from the surroundings. Redd life is typically about 6 weeks on the Hanford Reach (Dauble and Watson 1990), but redds have been recorded to remain visible for over 16 weeks (Wagner et al. 2012b, Wagner et al. 2014).

2.0 Methods

Aerial surveys of fall Chinook salmon redds were conducted in areas of the Hanford Reach consistent with past survey efforts and the historical data set (Figure 1). Eight additional sub-sections (100-B/C, 100-K, 100-N, 100-D, 100-H, 100-F, Dunes, and 300 Area) were added beginning in 2011 to monitor the abundance and distribution of fall Chinook salmon redds in areas of the Columbia River adjacent to contaminated groundwater plumes of the Hanford Site (Figure 2; USDOE 2014). These eight new sub-sections were divided so that redd counts and direct comparisons to historical records can still be made in the original areas. The new sub-sections were added to the DOE-RL Public Safety and Resource Protection Program's (PSRP) data set.

The primary physical factors influencing the accuracy of aerial counts include depth of water over redds and water clarity. Wind action, available light, orientation of the river, and direction of the current can also affect redd counts. The accuracy of aerial counts also decreases with increasing numbers and density of redds within a large aggregate of redds (Visser et al. 2002). Flights are cancelled if weather conditions are not favorable (i.e., wind, fog, or low clouds). Field measurements suggest that the upper depth limit for detecting redds during aerial surveys conducted on the Hanford Reach in 1988 was 3–4 meters (m, 10–13 feet [ft]; Dauble and Watson 1990), while other studies indicate that fall Chinook salmon spawn in water up to 9 m (30 ft) deep (Swan 1989); therefore, a proportion of redds located in deeper water may not be detected during aerial surveys (Dauble and Watson 1990). Because it is seldom possible to view all redds from the air, these counts provide only an annual index of relative abundance and distribution of fall Chinook salmon spawning in the Hanford Reach of the Columbia River.

Beginning in mid-October under the terms of the HRFCPP, river flows are reduced in the morning every Sunday (the day of the week with the lowest power demand) to the Priest Rapids Dam minimum operating discharge of 1,000 cubic meters per second (m^3/s, 36,000 cubic feet per second [ft^3/s]). This allows the Agency (NOAAF, WDFW, and CCT) and Utility (Grant, Chelan, Douglas, and BPA) Party Monitoring Team to perform a ground survey of redd distribution at Vernita Bar just downstream of Priest Rapids Dam. These drawdowns occur every Sunday morning until the initiation of fall Chinook spawning has been set both above and below the 1,416 m^3/s (50,000 ft^3/s) flow elevations. A final drawdown is conducted on the Sunday prior to Thanksgiving to establish the minimum critical flow needed to protect pre-emergent fall Chinook. Given the previously described limitations, this weekly reduction in river flow affords the best viewing conditions for aerial flights, which are then scheduled concurrent with the Sunday morning drawdowns, when possible.

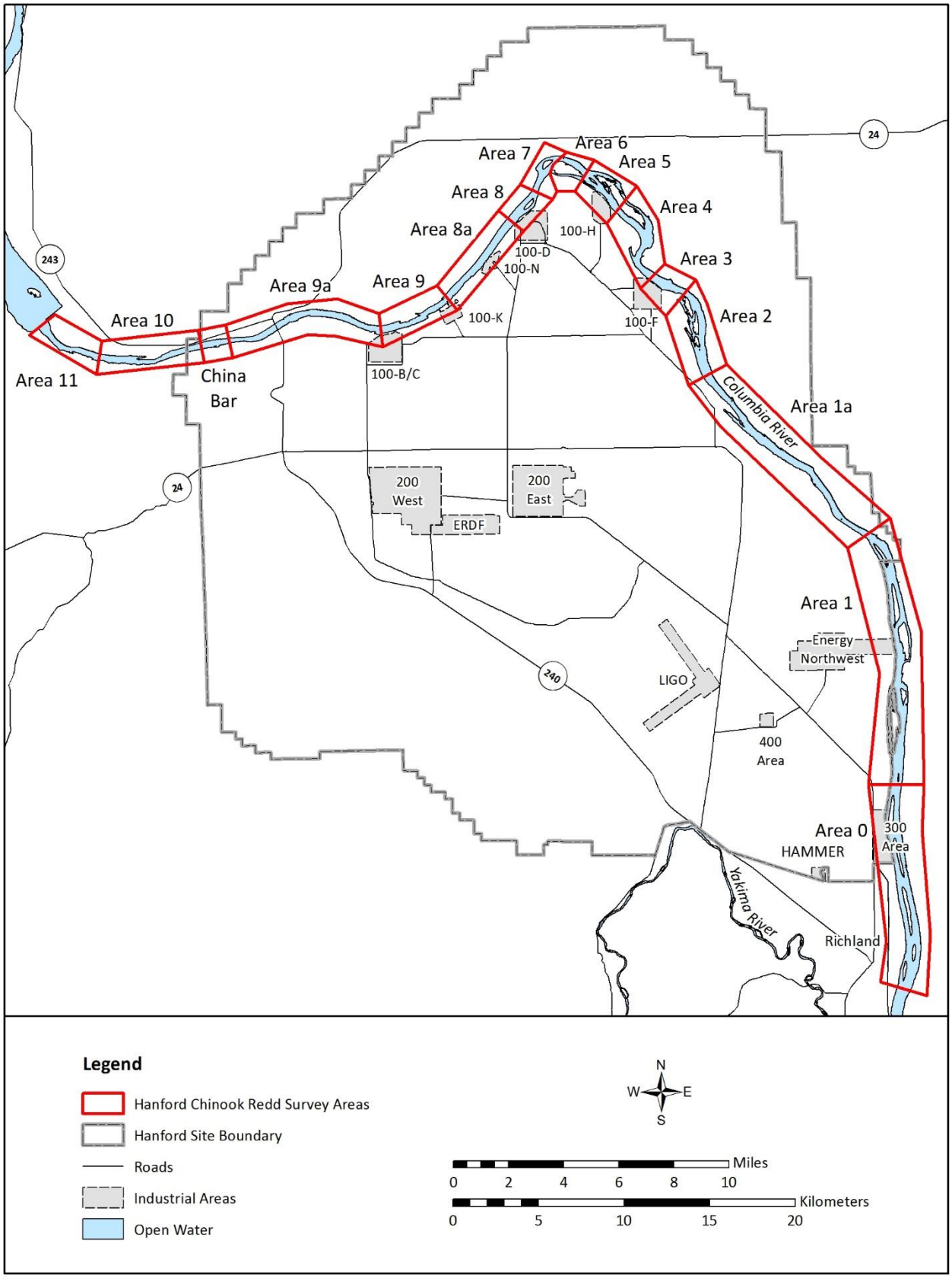

Figure 1. Aerial Survey Areas for Fall Chinook Redds Used Historically and in 2015

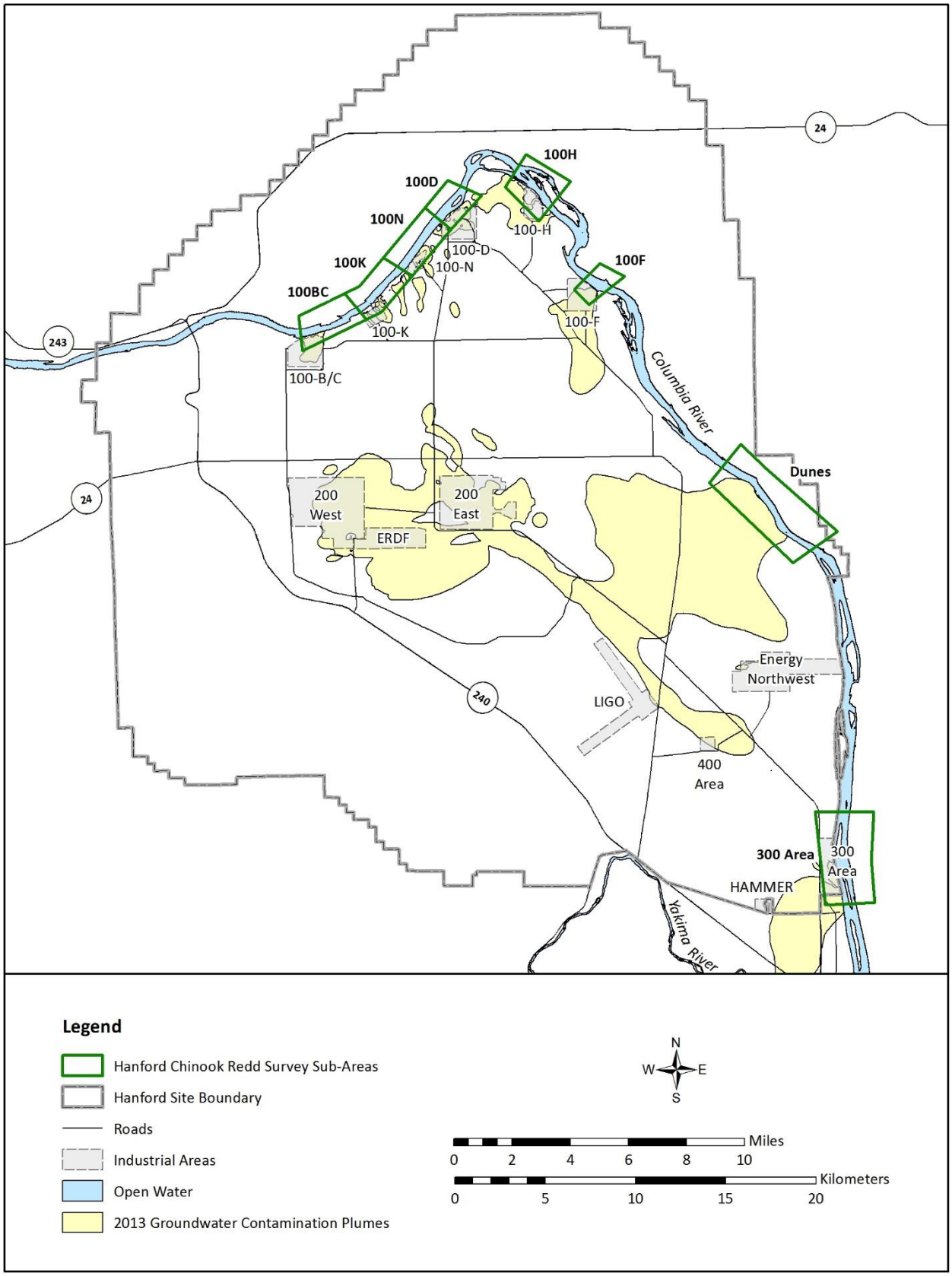

Figure 2. Fall Chinook Survey Sub-areas Adjacent to Groundwater Contamination Plumes

Flights are scheduled to encompass the entire fall Chinook spawning period, usually mid-October (initiation of spawning) through the end of November (end of spawning). Three to four flights are typically conducted during this period. Early flights (October) are conducted to establish the initiation of spawning, and later flights (November) occur during and just after the peak spawning period to establish the maximum redd count for the season by area and for the entire Hanford Reach. Multiple flights are necessary to minimize the effect of poor visibility or other sources of count variability that may occur during a single flight. Multiple flights also ensure comparability within the long-term database through consistency with past efforts. As a courtesy and consistent with past practices, aerial redd count information is shared with the HRFCPP parties to assist in the implementation of protective measures.

Survey flight altitudes range from 244 to 366 m (800 to 1200 ft) with air speeds of 120 to 161 kilometers per hour (kph, 75 to 100 miles per hour [mph]). Widely spaced fall Chinook redds are individually counted, while tightly grouped clusters of redds are estimated in groups of 10 or 50. Heavy spawning areas require multiple aerial passes to collect complete counts. Observations begin in Richland at the Interstate 182 Bridge and end at Priest Rapids Dam. Flights are conducted near noon to bracket the highest angle of the sun for optimum viewing conditions. Observers wear polarized glasses as necessary to reduce glare. All redds observed are documented by survey area on large format printed maps.

Because long-term trends in both redd abundance and distribution are important monitoring components, MSA has taken several steps to ensure compatibility and consistency with past efforts, which include the following:

1) Thoroughly reviewing and adopting past monitoring protocols.
2) Coordination/training with former redd count personnel.
3) Coordination and exchange of information with the WDFW and with the Grant County Public Utility District (GCPUD) to support the ongoing HRFCPP.
4) Using maps detailing the entire survey reach as well as all historical sub-areas and spawning sites both as in-flight guidance documents and as field data recording forms.
5) Using the same air service, airplane, and pilots in 2015 that were used in previous years.

3.0 Results

Three aerial surveys were completed along the length of the Hanford Reach during 2015. No surveys were conducted on Sundays due to unfavorable weather or plane unavailability. The first survey was performed on October 19, the second on November 2, and the third on November 16. A final flight was scheduled for the fourth week in November, but heavy fog on November 22, 23, and 24 prevented the flight from occurring. The counts performed by survey area for each flight are shown in Table 1. The maximum count describes the highest number of redds documented in a survey area within any single flight. The visual redd count total is calculated by summing the maximum redd count from each survey area, which equaled 20,678 in 2015. The number of redds counted within the newer defined sub-areas coinciding with Hanford Site operational areas is shown in Table 2. Viewing conditions were very good to excellent for the three

flights performed with one exception. During the November 16 flight, a muddy plume was observed along the eastern shoreline near the 100-F Island, a possible slump from the bluffs that spread across the river downstream.

Table 1. Summary of Fall Chinook Visual Aerial Redd Counts for the CY2015 Aerial Surveys in the Hanford Reach, Columbia River

Area	Description	10/19/15	11/02/15	11/16/15	Maximum Count
0	Islands 17–21 (Richland)	0	0	0	0
1	Islands 11–16	4	581	1,193	1,193
1a	Savage Island/Hanford Slough	0	0	0	0
2	Islands 8–10	18	1,320	3,145	3,145
3	Near Island 7	1	535	800	800
4	Island 6 (lower half)	5	1,630	2,315	2,315
5	Island 4, 5, and upper 6	13	1,550	2,540	2,540
6	Near Island 3	5	320	1,100	1,100
7	Near Island 2	12	1,400	1,900	1,900
8	Near Island 1	0	400	1,000	1,000
8a	Upstream of Island 1 to Coyote Rapids	0	0	15	15
9	Near Coyote Rapids	15	215	750	750
9a	Upstream of Coyote Rapids to China Bar	0	71	230	230
China Bar	China Bar/Midway	3	400	1,500	1,500
10	Near Vernita Bar	10	3,250	4,175	4,175
11	Upstream of Vernita Bar to Priest Rapids Dam	0	10	15	15
	Total	**86**	**11,682**	**20,678**	**20,678**

Table 2. Summary of Fall Chinook Visual Aerial Redd Counts for the CY2015 Aerial Surveys by Operational Area Sub-sections

Sub-area	10/19/15	11/02/15	11/16/15	Maximum Count
300 Area	0	0	0	0
Dunes	0	0	0	0
100F	1	535	800	800
100H	13	1,550	2,540	2,540
100D	0	400	1,000	1,000
100N	0	0	15	15
100K	0	0	0	0
100BC	15	215	750	750
Total	**29**	**2,700**	**5,105**	**5,105**

4.0 Discussion

The peak annual redd count for 2015 (20,678) was the highest count since 1948, and well exceeds the previous 10-year average (8,813). The historical trend in redd counts since 1948 is shown in Figure 3. Fall Chinook salmon redd counts continue to increase dramatically on the Hanford Reach. Harnish et al. (2014) attribute the increase in productivity of fall Chinook salmon in the Hanford Reach to operational changes at Priest Rapids Dam over the past 30-year period, changes that are now part of the HRFCPP. They showed a 217% increase in productivity that corresponded with constraints enacted to prevent redd dewatering and an additional 130% increase that coincided with enactment of constraints to limit stranding and entrapment of juveniles.

Salmon are important to the transport of energy and nutrients between the ocean, estuaries, and freshwater environments in the Pacific Northwest (Cederholm et al. 2000). Salmon at all stages of their life cycle provide direct and indirect feeding opportunities to many aquatic and terrestrial species and can have an indirect effect on the entire food web (Cederholm et al. 2000). The increased number of fall Chinook salmon spawning in the Hanford Reach has benefited many species of wildlife. One clear example is wintering Bald Eagles (*Haliaeetus leucocephalus*) that feed on post-spawned fall Chinook salmon carcasses that wash up along the shores of the Hanford Reach. Bald eagle numbers have significantly increased correspondingly to the dramatic raise in fall Chinook salmon numbers. A comparison of the peak annual fall Chinook salmon redds count and the peak annual wintering Bald Eagles count in the Hanford Reach from 1961 and 2015 is shown in Figure 4.

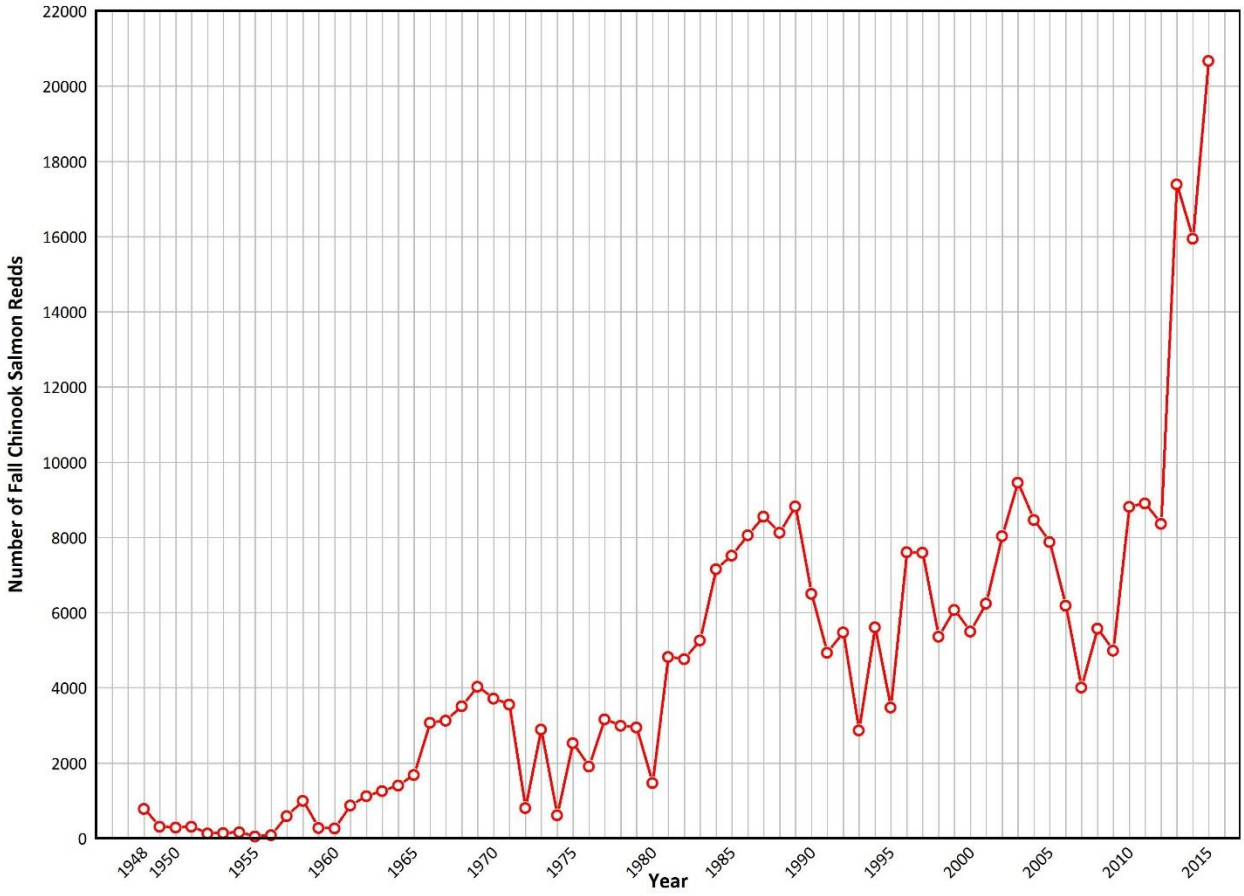

Figure 3. Visual Hanford Reach Fall Chinook Salmon Redd Counts 1948 to 2015

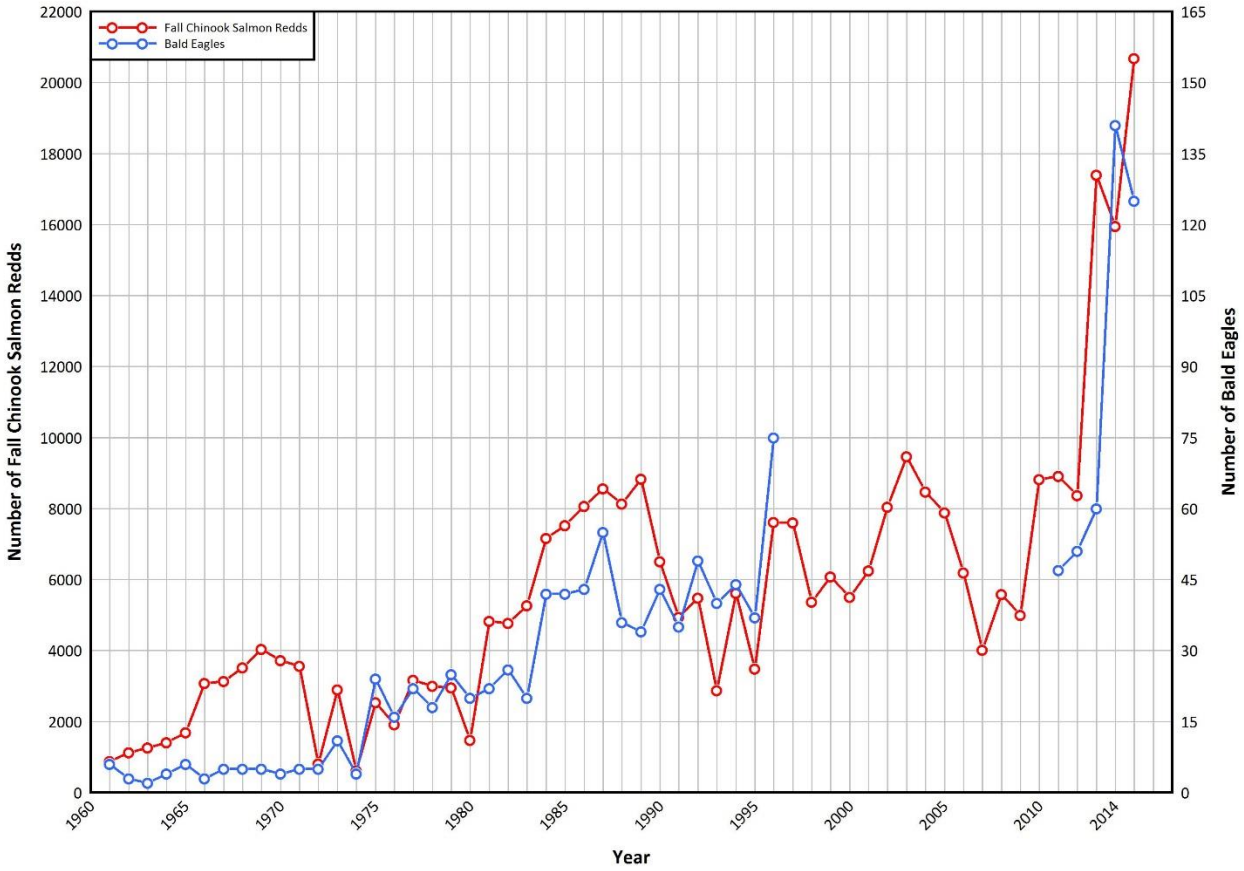

Figure 4. Peak Annual Count of Fall Chinook Salmon Redds and Wintering Bald Eagles in the Hanford Reach from 1961 and 2015

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