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Revision 0

Hanford Reach Fall Chinook Redd Monitoring Report for Calendar Year 2014

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-09RL14728

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J. Nugent and J. Wilde
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, 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 Rev 1) 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; or that are rare and/or declining (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 0-5), providing a graded approach to monitoring biological resources 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 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. Fall Chinook salmon redds have been monitored annually on the Hanford Reach of the Columbia River since 1948.

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). Aerial counts of fall Chinook salmon redds have been conducted 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, MSA 2015). The counts are also used to

document the onset of spawning, to locate spawning areas, and to 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 between 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), the United States Department of Energy acting by and through the Bonneville Power Administration (BPA), National Oceanic and Atmospheric Administration Fisheries (NOAAF), the Washington Department of Fish and Wildlife (WDFW) and the Confederated Tribes of the Colville Indian Reservation (CCT) to protect Hanford Reach fall Chinook salmon during critical periods of their life-cycle through operational constraints imposed on the Priest Rapids Hydroelectric Project.

Chinook salmon, also commonly referred to as king salmon, 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 upon 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, which 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 an egg 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 that is covered by algae (periphyton). "Redd life" is a term describing the period of time when periphyton growth has not rendered the redd substrate indiscernible from the surroundings. Redd life is typically about six 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 better 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) (DOE/RL-2011-119 Rev. 1). These eight new sub-sections were divided so that redd counts and direct comparisons to historical records can still

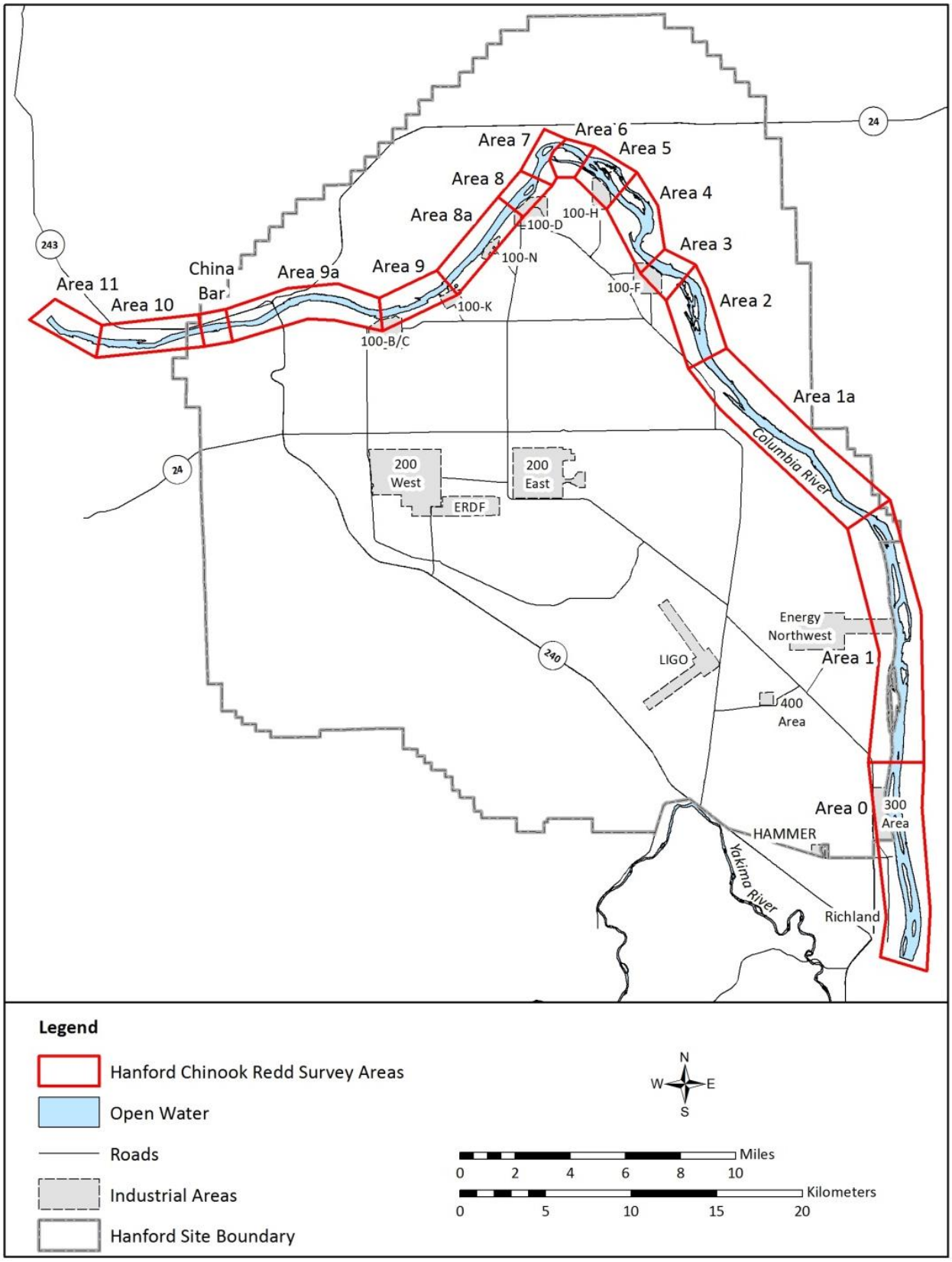

Figure 1. Aerial Survey Areas for Fall Chinook Redds Used Historically and in 2014

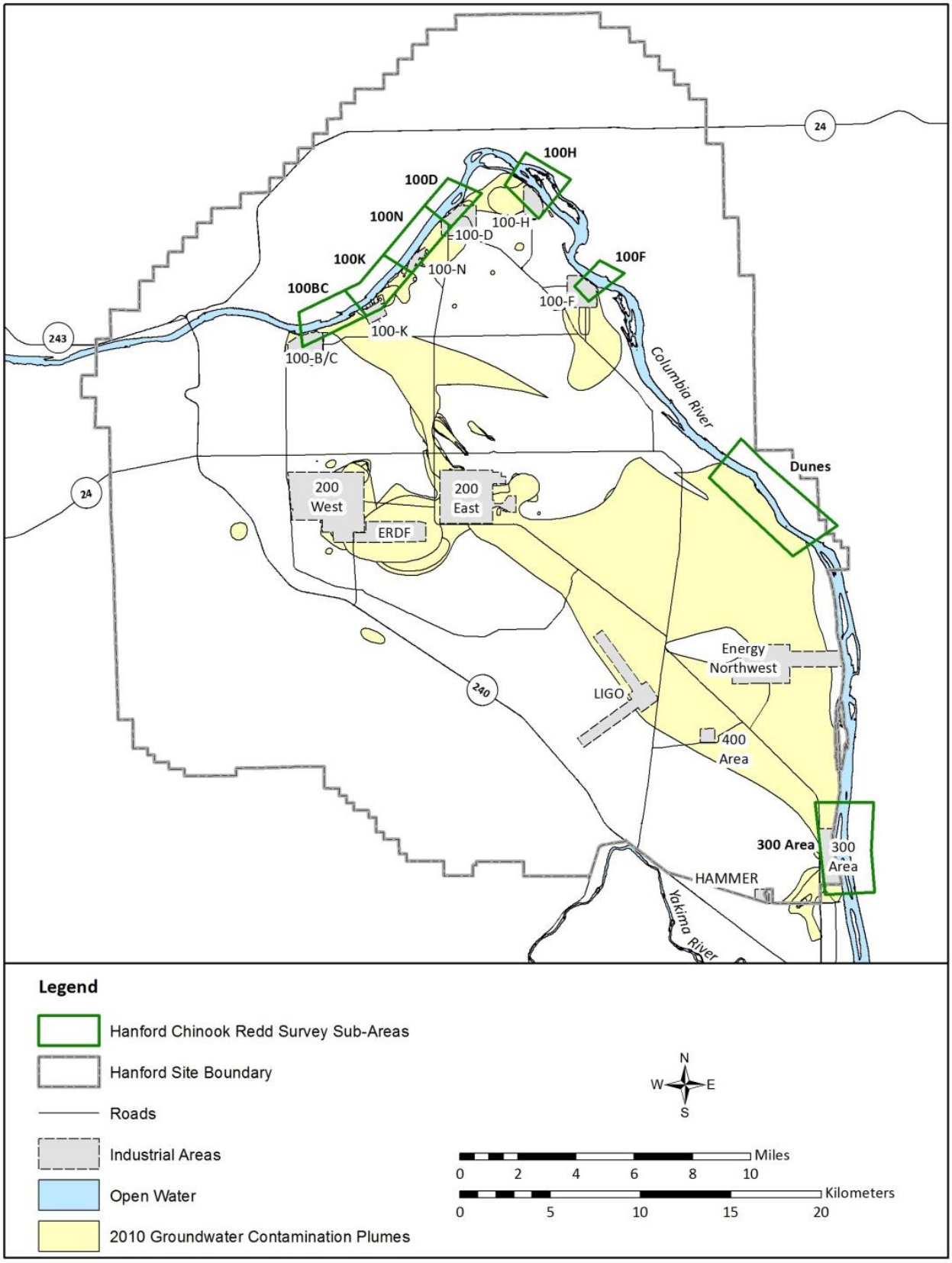

Figure 2. Fall Chinook Survey Sub-areas Adjacent to Groundwater Contamination Plumes

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. Accuracy of aerial redd 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). 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 a consistent 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 every Sunday morning (day of lowest power demand) to the Priest Rapids Dam minimum operating discharge of 36,000 cubic feet per second (ft3/s) [1,000 cubic meters per second (m3/s)]. This allows the Agency (NOAAF, WDFW, and CCT) and Utility (Grant, Chelan, Douglas, and BPA) Party Monitoring Team to manually survey for 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 50,000 ft3/s (1,416 m3/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. Aerial flights are therefore scheduled to be conducted concurrent with the Sunday morning drawdowns, when possible.

Flights are scheduled to encompass the entire fall Chinook spawning period, usually from 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. Later flights (November) are conducted 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, 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 in order to collect complete counts. Observations begin in Richland at the I-182 Bridge and end at Priest Rapids Dam. Flights are conducted near noon with the intent 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, Mission Support Alliance (MSA) has taken several steps to ensure compatibility and consistency with past efforts.

These included:

1) Thoroughly reviewing and adopting past monitoring protocols.
2) Coordination/training with former redd count personnel to ensure consistency with past efforts.
3) Coordination and exchange of information with the Washington Department of Fish and Wildlife (WDFW) and with the Grant County Public Utility District (GCPUD) to ensure consistency with the ongoing Hanford Reach Fall Chinook Protection Program.
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 2014 that were used in previous years.

3.0 Results

Four aerial surveys were completed along the length of the Hanford Reach during 2014. None of the surveys were conducted on Sundays due to unfavorable weather or other unexpected circumstances. The first survey was performed on October 20, the second on November 10, the third on November 24, and the fourth on December 1. 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 and this equaled 15,951 in 2014. The number of redds counted within the newly defined sub-areas, coinciding with Hanford Site operational areas, is shown in Table 2.

4.0 Discussion

The peak annual redd count for 2014 (15,951) was the second highest count since 1948. It was less than last year's (2013) all time highest count of 17,398 but was well in excess of the previous 10 year average (8,065). Viewing conditions were fair to excellent during the surveys in 2014. The historical trend in redd counts since 1948 is shown in Figure 3.

Table 1. Summary of Fall Chinook Visual Aerial Redd Counts for the CY2014 Aerial Surveys in the Hanford Reach, Columbia River

Area	Description	10/20/2014	11/10/2014	11/24/2014	12/1/2014	Maximum Count
0	Islands 17-21 (Richland)	0	0	0	0	0
1	Islands 11-16	0	76	767	906	906
1a	Savage Island/Hanford Slough	0	0	0	0	0
2	Islands 8-10	0	427	1,470	1,565	1,565
3	Near Island 7	0	400	1,100	1,100	1,100
4	Island 6 (lower half)	10	1,020	2,230	2,530	2,530
5	Island 4, 5 and upper 6	25	730	2,030	2,080	2,080
6	Near Island 3	0	100	900	1,000	1,000
7	Near Island 2	23	1,010	2,030	2,050	2,050
8	Near Island 1	0	200	400	500	500
8a	Upstream of Island 1 to Coyote Rapids	0	0	0	0	0
9	Near Coyote Rapids	25	255	400	500	500
9a	Upstream of Coyote Rapids to China Bar	0	0	0	0	0
China Bar	China Bar/Midway	0	20	50	60	60
10	Near Vernita Bar	55	1,830	3,600	3,650	3,650
11	Upstream of Vernita Bar to Priest Rapids Dam	0	5	10	10	10
	Total	138	6,073	14,987	15,951	15,951

Table 2. Summary of Fall Chinook Visual Aerial Redd Counts for the CY2014 Aerial Surveys by Operational Area Sub-sections

Sub-area	10/20/2014	11/10/2014	11/24/2014	12/1/2014	Maximum Count
300 Area	0	0	0	0	0
Dunes	0	0	0	0	0
100F	0	400	1,100	1,100	1,100
100H	25	730	2,030	2,080	2,080
100D	0	200	400	500	500
100N	0	0	0	0	0
100K	0	0	0	0	0
100BC	25	255	400	500	500
Total	50	1,585	3,930	4,180	4,180

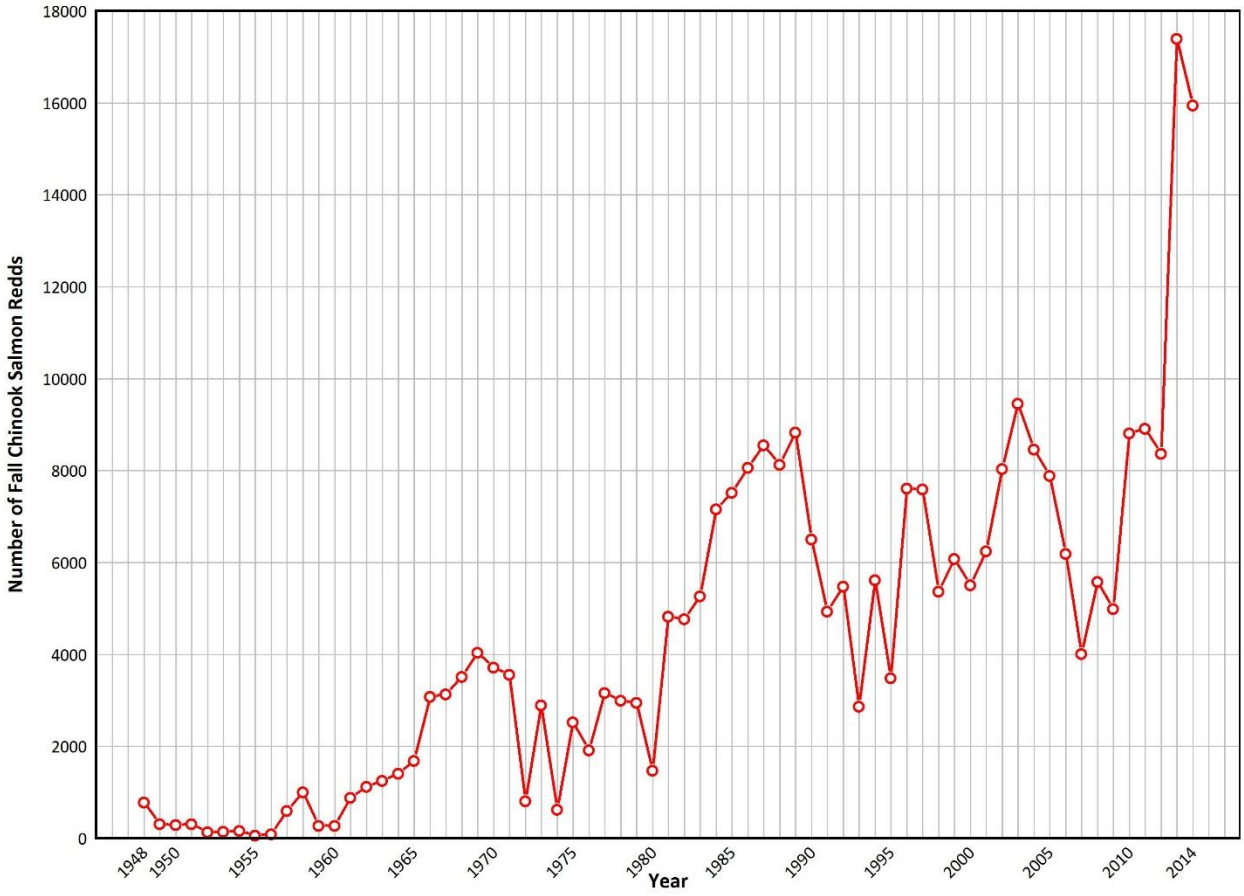

Figure 3. Visual Hanford Reach Fall Chinook Salmon Redd Counts 1948 to 2014

Although the reasons for the dramatic increase in redd counts in recent years is uncertain, 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.

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