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Hanford Reach Fall Chinook Redd Monitoring Report for Calendar Year 2012

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

P.O. Box 650
Richland, Washington 99352

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Hanford Reach Fall Chinook Redd Monitoring Report for Calendar Year 2012

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Mission Support Alliance

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1. Introduction

Chinook salmon (*Oncorhynchus tshawytscha*), 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 (URB), 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).

Aerial counts of Chinook salmon redds have been conducted since 1948 at Hanford to provide an index of relative abundance among spawning areas and years. The counts are also used to document the onset of spawning, to locate spawning areas, and to determine intervals of peak spawning activity. The survey area has historically been divided into sections with the number of redds being totaled by section (Figure 1).

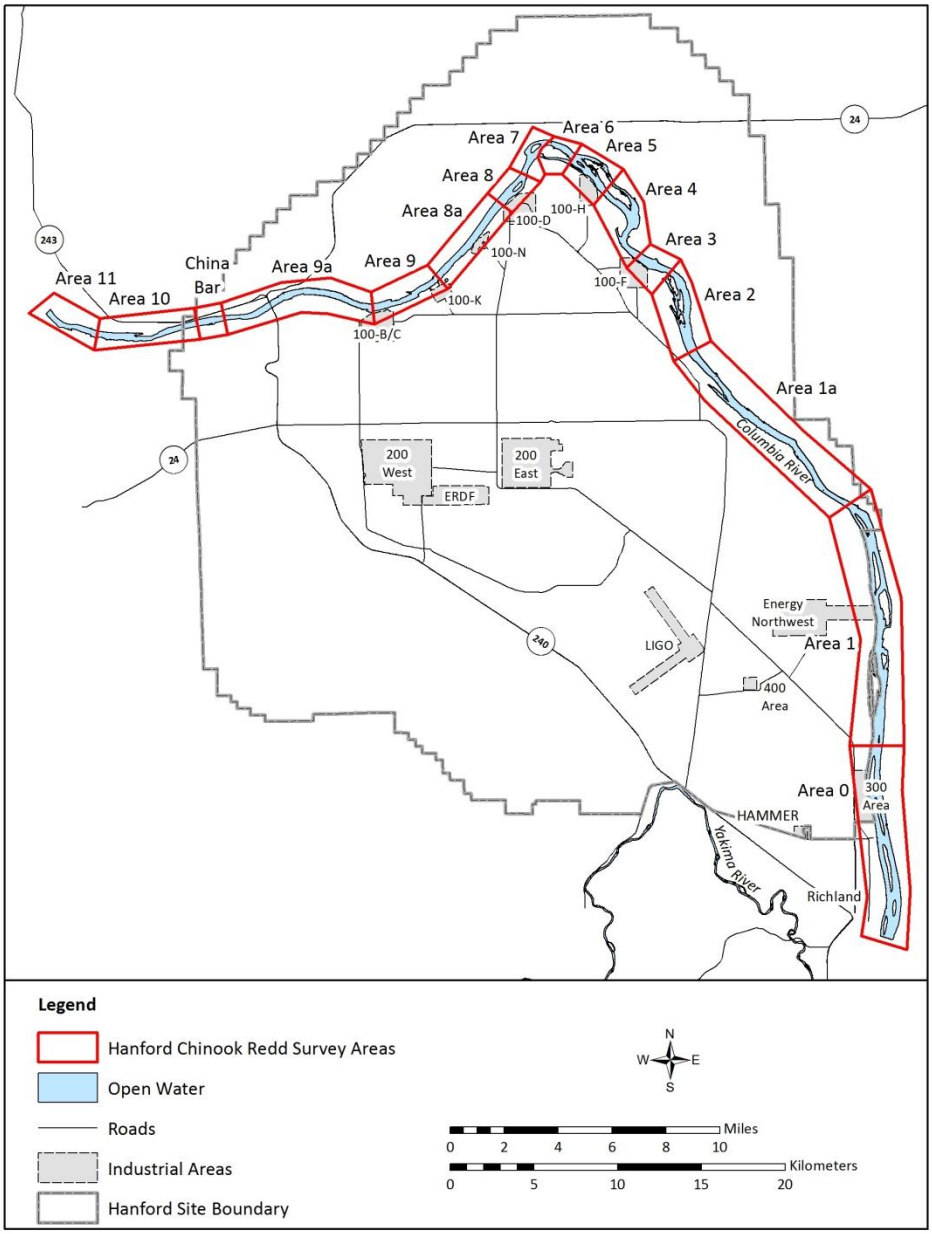

Figure 1. Aerial Survey Areas for Fall Chinook Redds Used Historically and in 2012

2. Methods

Aerial surveys of fall Chinook redds were conducted in areas of the Hanford Reach consistent with past survey efforts and the historical database (Figure 1). Eight additional sub-sections (100B/C, 100K, 100N, 100D, 100H, 100F, Dunes, 300 Area) were added, beginning in 2011, to better monitor the abundance and distribution of fall Chinook redds in areas directly adjacent to Hanford Site operations (Figure 2). These eight new sub-sections were added to the DOE-RL Public Safety and Resource Protection Program's (PSRP) Aquatic Community database. This change to the historical monitoring technique provides additional spatial resolution to the survey information, but the sum of redd counts in the original areas and the sub-areas they contain allows collected data to be directly comparable to historical records.

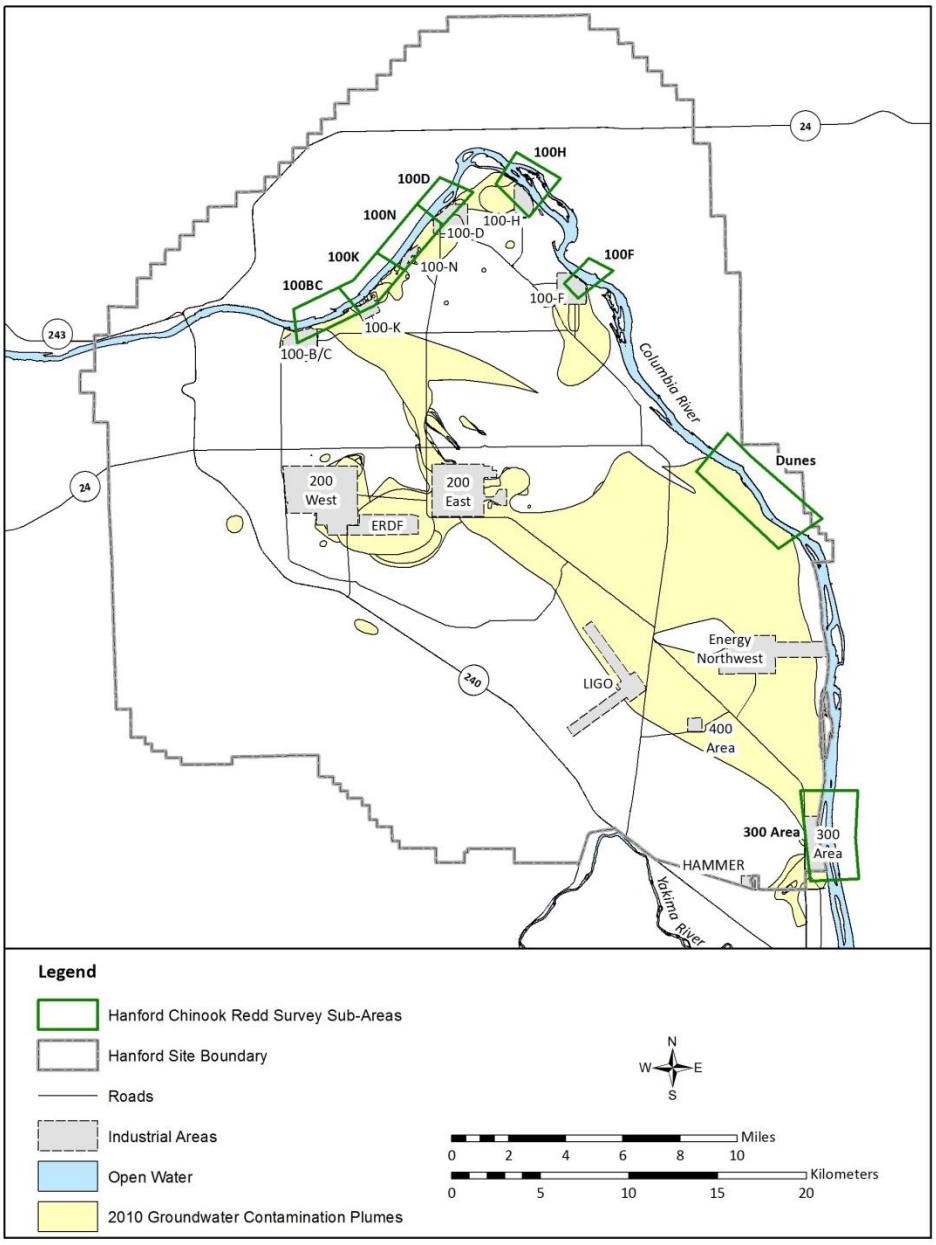

Figure 2. Fall Chinook Survey Sub-areas Adjacent to Hanford Site Operations.

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. Flights are cancelled if weather conditions are adverse (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 m (Dauble and Watson 1990). Other studies indicate that fall Chinook salmon spawn in water up to 9 meters 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 spawning in the Hanford Reach of the Columbia River.

Beginning in mid-October, under the terms of the Hanford Reach Fall Chinook Protection Program Agreement, 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 (ft^3) per second (1,000 cubic meters (m^3) per second). This allows the Agency and Utility 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 ft^3 per second (1,400 m^3 per second) 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.

Flights are scheduled from mid-October (initiation of spawning) through the third week of November (end of spawning) to encompass the entire fall Chinook spawning period. As indicated above, flights are scheduled on Sundays to maximize low flow viewing conditions. Four to six 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 Reach. Multiple flights are necessary to minimize the effect of poor visibility or other sources of count variability, which 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 flight redd count information is shared with the Hanford Reach Fall Chinook Protection Program 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.

3. Results

Three aerial surveys were completed along the length of the Hanford Reach during the 2012 survey. The first survey was performed on October 21, the second on October 30, and the third on November 18. One additional survey was attempted on November 11 but was suspended due to poor weather conditions. 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 redd count total is calculated by summing the maximum redd count from each survey area and this equaled 8,368 in 2012. The number of redds occurring within the newly defined sub-areas, coinciding with Hanford Site operational areas, is shown in Table 2.

Table 1. Summary of Fall Chinook Aerial Redd Counts for the CY2012 Aerial Surveys in the Hanford Reach, Columbia River

Area	Description	10/21/2012	10/30/2012	11/18/2012	Maximum Count
0	Islands 17-21 (Richland)	0	0	0	0
1	Islands 11-16	3	147	533	533
2	Islands 8-10	4	353	807	807
3	Near Island 7	12	425	700	700
4	Island 6 (lower half)	14	553	1,375	1,375
5	Island 4, 5 and upper 6	9	947	1,195	1,195
6	Near Island 3	1	225	475	475
7	Near Island 2	6	301	528	528
8	Near Island 1	4	160	340	340
9	Near Coyote Rapids	1	19	29	29
	Midway (China Bar)	0	25	68	68
10	Near Vernita Bar	28	1,180	2,315	2,315
11	Near Priest Rapids Dam	0	0	3	3
	TOTAL	**82**	**4,335**	**8,368**	**8,368**

Table 2. Summary of Fall Chinook Aerial Redd Counts for the CY2012 Aerial Surveys by Operational Area Sub-sections

Hanford Site Sub-Area	10/21/2012	10/30/2012	11/18/2012	Maximum Count
300 Area	0	0	0	0
Dunes	0	0	0	0
100F	12	425	700	700
100H	9	947	1,195	1,195
100D	4	160	340	340
100N	0	0	0	0
100K	0	0	0	0
100BC	1	19	29	29
TOTAL	**26**	**1,551**	**2,264**	**2,264**

4. Discussion

Aerial counts of fall Chinook redds have been conducted in the Hanford Reach since 1948 to generate annual indices of abundance and distribution. This was the second year that these counts have been conducted under the Mission Support Alliance (MSA) contract. Because long term trends in both redd abundance and distribution are important monitoring components, several steps were taken during 2011 and 2012 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 and with the Grant County Public Utility District 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 as well as field data recording forms.
5) Using the same air service, airplane, and pilots in 2012 that were used in previous years.
6) Using the same primary surveyor during 2011 and 2012.

The peak annual redd count for this season (8,368) was slightly less than in 2011 (8,915), was less than the all-time highest count of 9,465 (year 2003), and was well in excess of the average for the previous ten years (7,239). Viewing conditions were fair to excellent during all three surveys which undoubtedly contributed to the relatively high number of redds counted in 2012. The historical trend in redd counts since 1948 is shown in Figure 3.

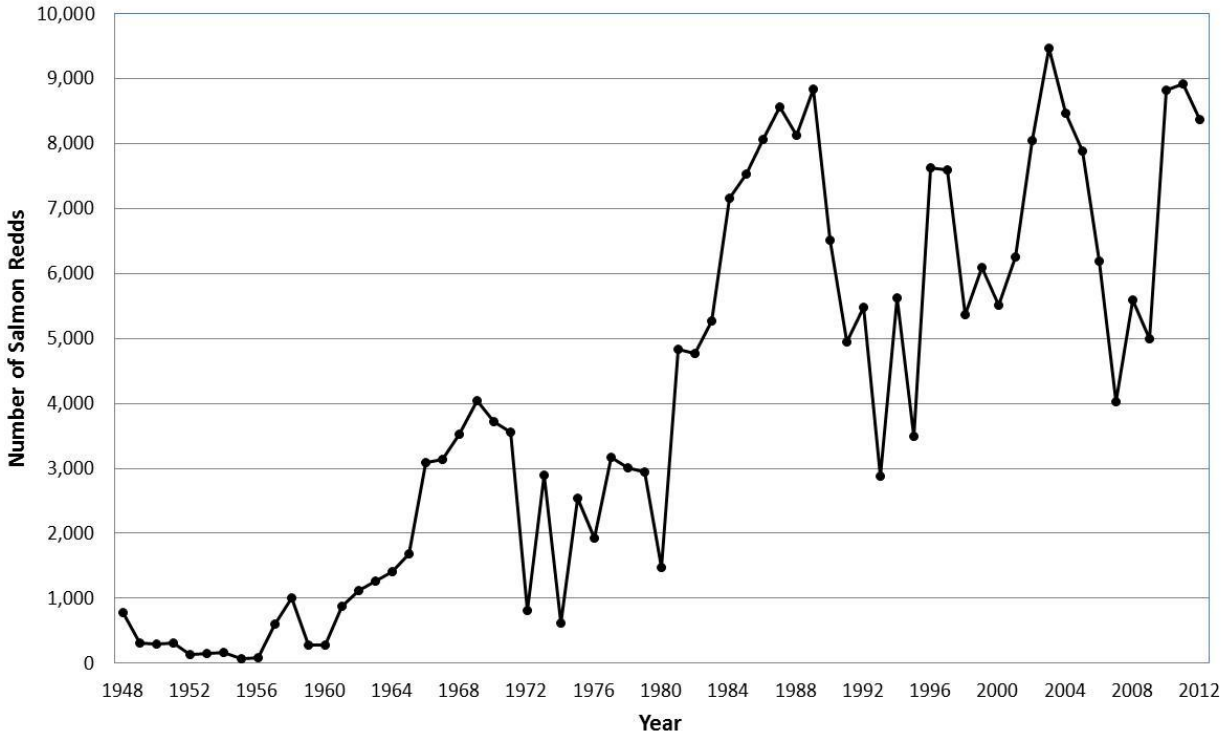

Figure 3. Hanford Reach Fall Chinook Salmon Redd Counts 1948 to 2012

The relationship between annual fall Chinook redd counts collected by the DOE and the adult fall Chinook escapement estimates generated annually for the Hanford Reach by the Washington Department of Wildlife fitted with a line to approximate the overall long-term trend in the data is depicted in Figure 4. It is interesting to note that these data appear curvilinear with an asymptote at

approximately 9,000 redds. The apparent reduction in redds counted per escaping adult, as illustrated in the upper portion of the curve, is likely related to saturation of preferred spawning areas during periods of high escapement. This relationship may become more apparent with escapement counts exceeding 100,000 individuals. Although not observed to be extensive in year 2012, redd superimposition during higher periods of escapement has been documented as recently as year 2011 (Wagner et al. 2012). Redd superimposition is a factor that is virtually impossible to quantify but can certainly result in an under estimate of the actual number of redds present. Spawning in deeper, more difficult areas to view is another factor that has been well documented (Dauble and Watson 1990). This could result from displacement of spawners during periods of high escapement, further contributing to an under estimate of the actual number of redds present. In addition, redds are counted individually, and in groups of 10 and 50. During periods of extensive spawning, counting redds in groups of 50 is often necessary but this procedure requires a higher level of count estimation on the part of the surveyor which could further result in an under estimate of the actual number of redds.

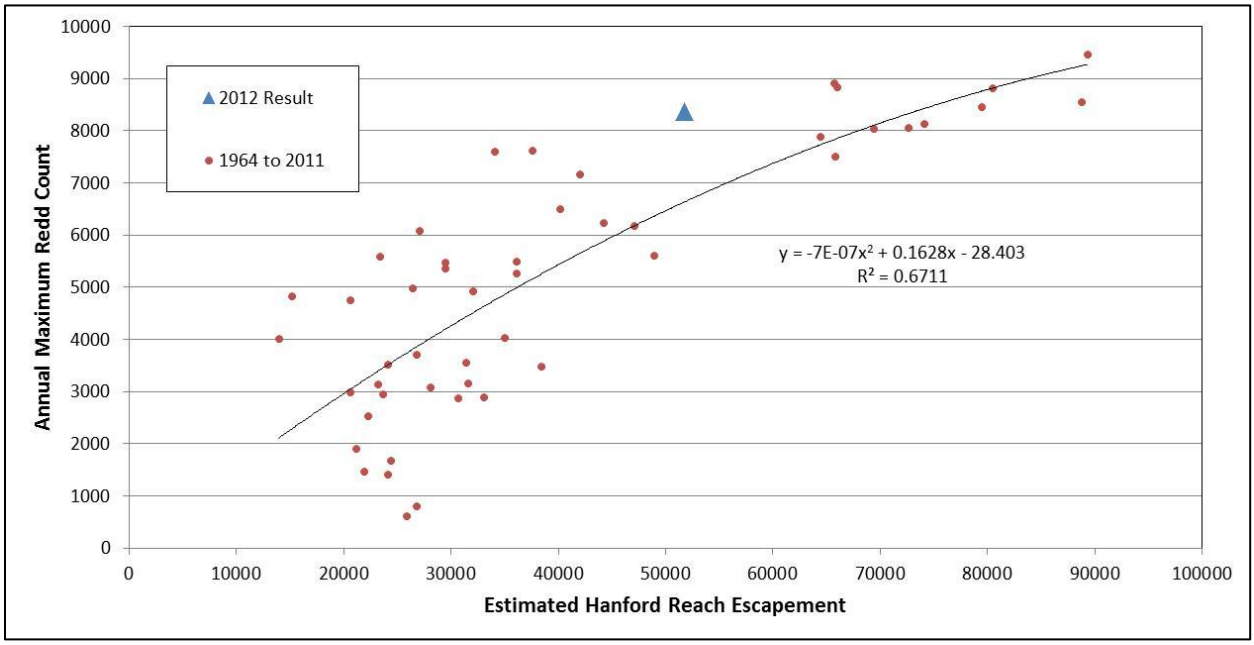

Figure 4. Relationship Between Annual Fall Chinook Maximum Redd Count and Estimated Hanford Reach Escapement 1964 to 2012

The presence of contaminated groundwater at the Hanford Site is well documented (DOE/RL-2011-119). The historical areas where fall Chinook redds were observed in 2011 and 2012 included locations where contaminated groundwater may be upwelling into the Columbia River. However, more work would be necessary to confirm the actual presence of contaminated groundwater upwelling within spawning areas.

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