FISH OPERATIONS PLAN IMPLEMENTATION REPORT

August 2017

Submitted by the U.S. Army Corps of Engineers
Northwestern Division
Portland, OR.

Introduction

The U.S. Army Corps of Engineers (Corps) is submitting this report in accordance with the 2017 Fish Operations Plan (2017 FOP) posted to the Technical Management Team (TMT) website on March 6, 2017. The 2017 FOP describes the Corps' project operations for fish passage at its Federal Columbia River Power System (FCRPS) dams during the spring and summer fish migration season, generally April through August. To the extent Corps project operations are not specified in the 2017 FOP, the FCRPS operations will be consistent with the 2014 NOAA Fisheries Supplemental Biological Opinion (2014 Supplemental BiOp), the United States Fish and Wildlife Service's 2000 and 2006 Biological Opinions, and/or other operative documents, including the 2017 Water Management Plan (WMP), WMP seasonal updates, and the 2017 Fish Passage Plan (FPP).

The Corps' August 2017 lower Snake and Columbia River project and fish passage operations are contained in this report. In particular, information in this report includes the following:

- Hourly flow through the powerhouse at each dam;
- Hourly flow over the spillway compared to the spill target for that hour; and
- Daily average Total Dissolved Gas (TDG) levels (percent of saturation) in the tailwater at each project, and in the subsequent downstream project's forebay.[1]

This report also provides information on presented issues and unanticipated or emergency situations that arose during implementation of the 2017 FOP in August 2017.

Data Reporting

I. For each project providing fish passage operations, this report contains one graph per operational month (August) displaying the performance of the fish passage spill program, with hourly spill, FOP spill, generation, and total flows. The monthly graphs begin on August 1 and end on August 31 for the following lower Snake River and lower Columbia River projects: Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville.

[1] Averages reported are consistent with the current and applicable Oregon TDG standard modification (120% tailwater) and Washington TDG criteria adjustments (120% tailwater/115% forebay). The Oregon TDG standard modification and the Washington TDG criteria adjustments have different methodologies for calculating TDG. When the standards vary or conflict, the Corps applies the more stringent standard.

Operations represented on the monthly graphs start at 0100 hours on August 1 for the lower Snake River and the lower Columbia River projects as follows:

- The dark tan line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The dotted blue line represents the average hourly flow through the powerhouse each hour in kcfs.
- The dotted pink line represents the actual average hourly spill level through the spillway in kcfs.
- The thin green line represents the hourly FOP spill level as defined in the 2017 FOP.
- The thick green line represents the adjusted FOP spill.[2] This is the hourly maximum spill level that can be achieved taking into consideration that spill may vary as a function of total river flow, forebay elevation and generator capacity, and is subject to the following conditions:
    - spill percentage or flow rate specified in the 2017 FOP;
    - spill caps as set daily for TDG management;
    - test spill levels for fish passage research;
    - minimum generation for power system needs;
    - minimum spill at Bonneville Dam (50 kcfs); and
    - minimum spill at John Day Dam is 25 percent of project outflow.

II. The average daily %TDG for the 12 highest hours for all projects is shown in the August 2017 Average Percent TDG Values Table (Table 3). The numbers in red indicate the project exceeded the %TDG cap - i.e. 115% (forebay of the next downstream dam) or 120% (tailwater) for each project. For the lower Columbia projects, tailwater TDG values are presented by displaying the highest value %TDG (controlling limit), and the lower value is displayed with a strikethrough.

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the target spill due to various conditions as described below. When spill levels briefly deviate below or above the level specified in the 2017 FOP, the dotted pink line will be below or above the heavy green line in the figures.[3] Actual deviations from the target operation during voluntary spill hours are described below in the August 2017 Spill Variance Table (Table 1).[4] The Spill Variance Table includes average hourly data; therefore, while spill may vary from target FOP spill for only a portion of an hour, the Spill Variance Table characterizes the variance as a full hour. There are instances when the hourly FOP spill levels are not achievable due to mechanical limitations in setting spill gates

[2] As a result of minimum generation limitations in August, the adjusted FOP spill level is below FOP spill level at Lower Granite, Lower Monumental, Ice Harbor and Bonneville dams. The plots show actual spill at the adjusted FOP spill level.

[3] The actual thickness of the adjusted FOP spill level (heavy green line) does not represent the spill cap range; if the actual spill level is slightly outside the adjusted FOP spill level, it should not be construed to indicate a spill variance or involuntary spill.

[4] Involuntary spill conditions shown in the graphs are not considered variances and are not reported in the Spill Variance Table. Involuntary spill conditions may result from lack of load, high river inflows that exceed available powerhouse capacity, scheduled or unscheduled turbine unit outages or transmission outages of various durations, and passing debris.

to implement the regionally coordinated spill pattern. The project operator sets the spill gate stops to most closely approximate the 2017 FOP level of spill while also avoiding exceeding the %TDG spill cap to the extent practicable.

"Low flow" operations at the lower Columbia and Snake projects are triggered when inflow is insufficient to provide both minimum generation and the specified spill levels. In these situations, the projects operate at minimum generation and pass the remainder of project inflow as spill and through other routes, such as fish ladders, sluiceways, and navigation locks. As flows transition from higher flows to low flows, there may be situations when flows recede at a higher rate than forecasted. In addition, inflows provided by nonfederal projects upstream are variable and uncertain.

The combination of these factors may result in instances when unanticipated changes to inflow result in forebay elevations dropping to the low end of the Minimum Operating Pool (MOP). Since these projects have limited operating flexibility, maintaining minimum generation, MOP elevation, and the target spill may not be possible throughout every hour. During low flow periods at Little Goose Dam, the overall project spill percentage appears to be reduced because the calculations do not account for the volume of water released during navigational lockages; however, the actual spill volume remains constant. When this occurs, it is recorded in the monthly Pre-Coordinated Operations Table (Table 2)[5] denoted as "Navigation" type.

Actual spill levels at Corps projects with set flow targets may vary up to ±2 kcfs within the hour (except as otherwise noted in the 2017 FOP for Little Goose, Bonneville, and The Dalles dams[6], which may range up to ±3 kcfs) as compared to those specified in the 2017 FOP and the RCC spill priority list (defining the project %TDG spill caps). A number of factors influence actual spill, including hydraulic efficiency, exact gate opening calibration, spillway gate hoist cable stretch due to temperature changes, and forebay elevation (e.g. a higher forebay results in a greater level of spill since more water can pass under the spill gate).

The 2017 FOP describes project "Operations during Rapid Load Changes" (p. 6). For reporting purposes, when hourly spill levels were not met as a result of load swing hours and other related within-hour load variability issues, the notation "Transmission Stability" will be used in the Spill Variance Table. "Transmission Stability" occurs because projects must be available to respond to within-hour load variability to satisfy North American Electric Reliability Corporation (NERC) reserve requirements ("on response") or other NERC mandatory reliability regulatory requirements. In addition to within-hour load variability, projects on response must be responsive to within hour changes resulting from intermittent generation (such as wind generation). During periods of rapidly changing loads and intermittent generation, projects on response may have significant changes in turbine discharge within the hour while spill quantity remains the same within the hour. Under normal conditions, within-hour load changes primarily occur immediately preceding and following the peak load hours; however, within-hour changes

[5] Other routine activities that change spill levels and have been coordinated with regional partners will be identified in Table 2.

[6] As specified in the 2017 FOP, this applies at Little Goose during low flow conditions when spill levels change from 30% to a constant spill level of approximately 7-11 kcfs (p. 6), and at The Dalles when the spill level is below 40% of total flow at (p. 14).

in intermittent generation can occur at any hour of the day. Occasionally, several hours after peak load hours, the project may be decreasing total outflow and generation faster than the corresponding spill decreases causing the percent spill to be slightly higher. Due to the high variability of within-hour load, reporting actual spill percentages that vary by more than the ±1 percent within hour requirement (or other ranges specified in the 2017 FOP) may occur with greater frequency with "Transmission Stability" hours than other hours.

Occurrences requiring an adjustment in operations and/or regional coordination are described in greater detail in the "Operational Adjustments" section below.

August Operations

The month of August was characterized by near average flows for the lower Snake and lower Columbia rivers along with above average air temperatures and well below average precipitation across the Columbia Basin. The NOAA Northwest River Forecast Center[7] reported the August 2017 adjusted runoff for the Snake River at Lower Granite at 107% of the 30-year average (1981-2010) with a volume of 1.3 MAF (Million Acre Feet). The August 2017 adjusted runoff for the Columbia River at The Dalles was 81% of average with a volume of 6.2 MAF. Observed precipitation in August was 27% of average for the Snake River above Ice Harbor and 20% of average for the Columbia River above The Dalles. Observed air temperatures in August were 4.1°F above average for the Snake River above Ice Harbor and 4.7°F above average for the Columbia River above The Dalles.

During the August 2017 reporting period, the planned 2017 FOP spill operations were carried out as follows:

- Lower Granite Dam - The hourly target spill level was 18 kcfs, 24 hours/day.
- Little Goose Dam - The hourly target spill level was 30% of total project outflow, 24 hours/day. Spill transitioned to a fixed rate of 7-11 kcfs, depending on the previous day's average project outflow: outflow 28-32 kcfs = spill 11 kcfs; outflow 24-28 kcfs = spill 9 kcfs; outflow below 24 kcfs = spill 7 kcfs.
- Lower Monumental Dam - The hourly target spill level was 17 kcfs, 24 hours/day.
- Ice Harbor Dam - The hourly target spill level was 45 kcfs during the day and the %TDG cap during the night.
- McNary Dam - The hourly target spill level was 50% of total project outflow, 24 hours/day.
- John Day Dam - The hourly target spill level was 30% of total project outflow, 24 hours/day.
- The Dalles Dam - The hourly target spill level was 40% of total project outflow, 24 hours/day.
- Bonneville Dam - The hourly target spill level alternated in 2-day blocks between 95 kcfs, 24 hours/day vs. 85 kcfs during the day and 121 kcfs during the night.

[7] Obtained September 1, 2017 from: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

Operational Adjustments

There are no operational adjustments to report for August 2017.

Table 1: Spill Variance Table – August 2017 (8/1 to 8/31)

Project	Parameter	Date	Time[8]	Hours	Type	Reason
Little Goose	Additional Spill	8/1/17	1500	1	Maintenance	Hourly spill increased to 32% (above 30% ± 1% range), while generation decreased to respond to a ground fault alarm. Daily average spill was 30%.
Little Goose	Additional Spill	8/15/17	0200-0800	7	Human Error	Hourly spill remained at 11 kcfs (above 9 kcfs FOP spill) due to a miscalculation of spill.
Little Goose	Reduced Spill	8/23/17	0100-0500	6	Human Error	Hourly spill remained at 9 kcfs (below 11 kcfs FOP spill). Delay in changing to 11 kcfs.
Ice Harbor	Reduced Spill	8/15/17	1100	1	Maintenance	Hourly spill of 18 kcfs was 1 kcfs below FOP minimum generation spill, while generation was above the minimum range for Unit 1 (8.2-10.0 kcfs) to 10.4 kcfs due to testing unit 3 for an oil leak.
The Dalles	Reduced Spill	8/9/17	1300	1	Transmission Stability	Hourly spill decreased to 37% (below 40% ± 1% range). Project on response during rapidly changing load and/or intermittent generation (see p. 3-4). 24-hr avg spill 40%.

Table 2: Pre-Coordinated Operations – August 2017 (8/1 to 8/31)

Project	Date	Type	Description of Event	Regional Coordination
Little Goose	August 7 and August 10	Maintenance	Spill increased due to units taken offline in order to perform doble testing.	2017 FPP, LGS section 4.3.5 and Appendix A sections 1.5 and 8.1.3.
Lower Monumental	Every other day from August 1 through August 15	Navigation	Spill was reduced for safe passage of fish barges crossing project tailwater.	2017 FOP, pages 2, 4, 7 and 12
Lower Monumental	August 17	Maintenance	Spill was decreased and then increased during testing of a new digital governor	2017 FPP, Appendix A sections 7.1.6
Ice Harbor	August 16	Maintenance	Spill was increased during inspections of the Submersible Traveling Screens (STS).	2017 FPP, Ice Harbor Dam section 2.3.1.2.
Ice Harbor	August 31	Maintenance	Spill remained the same while generation increased in order to perform post-shutdown testing for annual maintenance of unit 5.	2017 FPP, Ice Harbor Dam section 4.3.1.2

[8] Note: Data collected for reporting spill variances is reported using hourly-averaged data. Therefore, while spill may be increased or decreased for only a portion of an hour, it is represented in the Spill Variance Table as an hour.

Table 3: August 2017 Average Percent TDG Values Table (8/1 to 8/31)[9]

Date	FIXED MONITORING STATIONS																	
	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW		JDY	JHAW		TDA	TDDO		BON	CCIW	
	Lower Granite FB	Lower Granite TW	Little Goose FB	Little Goose TW	Lower Monumental FB	Lower Monumental TW	Ice Harbor FB	Ice Harbor TW	McNary FB	McNary TW		John Day FB	John Day TW		The Dalles FB	The Dalles TW		Bonneville FB	Bonneville TW	
Gas Cap %:	115	120	115	120	115	120	115	120	115	120		115	120		115	120		115	120	
Method:	WA	WA	WA	WA	WA	WA	WA	WA	WA	OR	WA	WA	OR	WA	WA	OR	WA	WA	OR	WA
8/1/2017	104	112	108	110	107	116	113	113	111	~~114~~	116	106	113	~~113~~	110	114	~~114~~	110	~~115~~	116
8/2/2017	104	112	108	110	107	116	113	113	112	116	~~116~~	106	114	~~114~~	109	115	~~115~~	112	116	~~116~~
8/3/2017	105	113	108	110	107	116	114	113	112	~~116~~	116	108	114	~~114~~	110	~~114~~	115	114	117	~~117~~
8/4/2017	105	113	110	110	108	116	115	113	113	~~115~~	116	109	~~114~~	114	109	~~114~~	114	114	117	~~117~~
8/5/2017	105	113	110	110	108	116	115	112	113	~~115~~	115	109	~~114~~	114	108	~~113~~	114	113	~~116~~	117
8/6/2017	104	113	109	110	108	116	114	112	112	115	~~115~~	108	114	~~114~~	109	113	~~113~~	110	116	~~116~~
8/7/2017	104	113	109	111	108	116	113	112	112	115	~~115~~	109	114	~~114~~	111	114	~~114~~	109	117	~~116~~
8/8/2017	104	113	109	110	108	116	112	112	111	114	~~114~~	109	114	~~114~~	111	114	~~114~~	109	116	~~116~~
8/9/2017	103	113	108	111	108	116	112	112	111	114	~~114~~	109	~~114~~	114	111	115	~~115~~	110	~~116~~	116
8/10/2017	103	112	109	113	108	116	112	112	112	115	~~115~~	109	~~115~~	115	110	115	~~115~~	111	116	~~116~~
8/11/2017	103	113	109	111	108	116	113	112	112	115	~~115~~	110	115	~~115~~	110	~~114~~	115	111	~~117~~	117
8/12/2017	104	113	109	110	108	115	113	111	111	~~114~~	115	110	~~115~~	115	110	~~111~~	113	109	~~117~~	117
8/13/2017	104	112	109	110	108	116	112	112	111	~~113~~	114	109	~~114~~	115	106	~~110~~	111	106	~~116~~	117
8/14/2017	103	113	108	109	107	115	112	111	109	114	~~114~~	107	~~114~~	114	106	111	~~111~~	104	116	~~116~~
8/15/2017	103	113	106	109	107	115	110	112	107	114	~~114~~	106	~~114~~	114	108	112	~~112~~	105	117	~~117~~
8/16/2017	103	112	106	109	106	116	110	112	107	~~114~~	114	105	~~112~~	113	108	~~111~~	112	106	~~117~~	117
8/17/2017	102	112	106	109	105	115	108	112	108	114	~~114~~	104	~~112~~	112	107	~~110~~	111	106	~~115~~	117
8/18/2017	102	110	106	109	105	113	109	106	108	~~114~~	114	103	~~112~~	112	106	~~109~~	110	105	~~113~~	113
8/19/2017	102	111	107	109	105	113	109	95	108	114	~~114~~	103	112	~~112~~	106	~~110~~	110	105	113	~~113~~
8/20/2017	101	111	107	109	105	113	110	82	109	~~114~~	114	102	~~111~~	112	107	111	~~110~~	105	115	~~115~~
8/21/2017	101	110	106	109	105	113	110	•	109	114	~~114~~	102	112	~~112~~	107	111	~~111~~	106	114	~~114~~
8/22/2017	102	113	107	109	105	113	110	113	108	114	~~114~~	104	~~112~~	112	109	112	~~112~~	109	~~116~~	116
8/23/2017	102	112	107	109	106	112	110	114	108	~~114~~	114	105	112	~~112~~	109	~~111~~	112	109	~~114~~	115
8/24/2017	102	112	107	109	107	112	109	113	108	~~114~~	114	105	~~112~~	112	107	~~110~~	111	108	~~114~~	114
8/25/2017	102	112	106	111	108	112	109	114	107	114	~~114~~	104	112	~~112~~	106	~~109~~	109	106	~~113~~	113
8/26/2017	102	111	106	109	108	110	109	110	107	114	~~114~~	104	~~111~~	111	108	109	~~109~~	106	~~113~~	113
8/27/2017	102	112	105	109	106	112	108	112	106	113	~~113~~	105	111	~~111~~	109	110	~~110~~	107	~~112~~	112
8/28/2017	102	113	106	109	106	112	108	112	107	114	~~114~~	106	~~114~~	114	111	111	~~111~~	110	114	~~114~~
8/29/2017	102	113	106	109	107	113	109	113	107	115	~~115~~	107	115	~~115~~	111	113	~~113~~	111	~~116~~	117
8/30/2017	102	113	106	109	107	112	109	112	108	~~114~~	115	107	~~113~~	114	110	~~111~~	113	111	~~116~~	117
8/31/2017	102	112	106	108	106	114	109	113	107	115	~~115~~	105	115	~~115~~	106	111	~~111~~	107	116	~~116~~

➢ Red shaded cells indicate no data due to malfunctioning gage.

[9] Two TDG values are reported for fixed monitoring stations where both Oregon's standard and Washington's criteria applies. The two states' standards/criteria and calculation methodologies differ as represented in the two columns. The smaller of the two values is denoted with a strikethrough because the Corps operates to the more stringent standard/criteria.

Figure 1

Lower Granite Dam - Hourly Spill and Flow

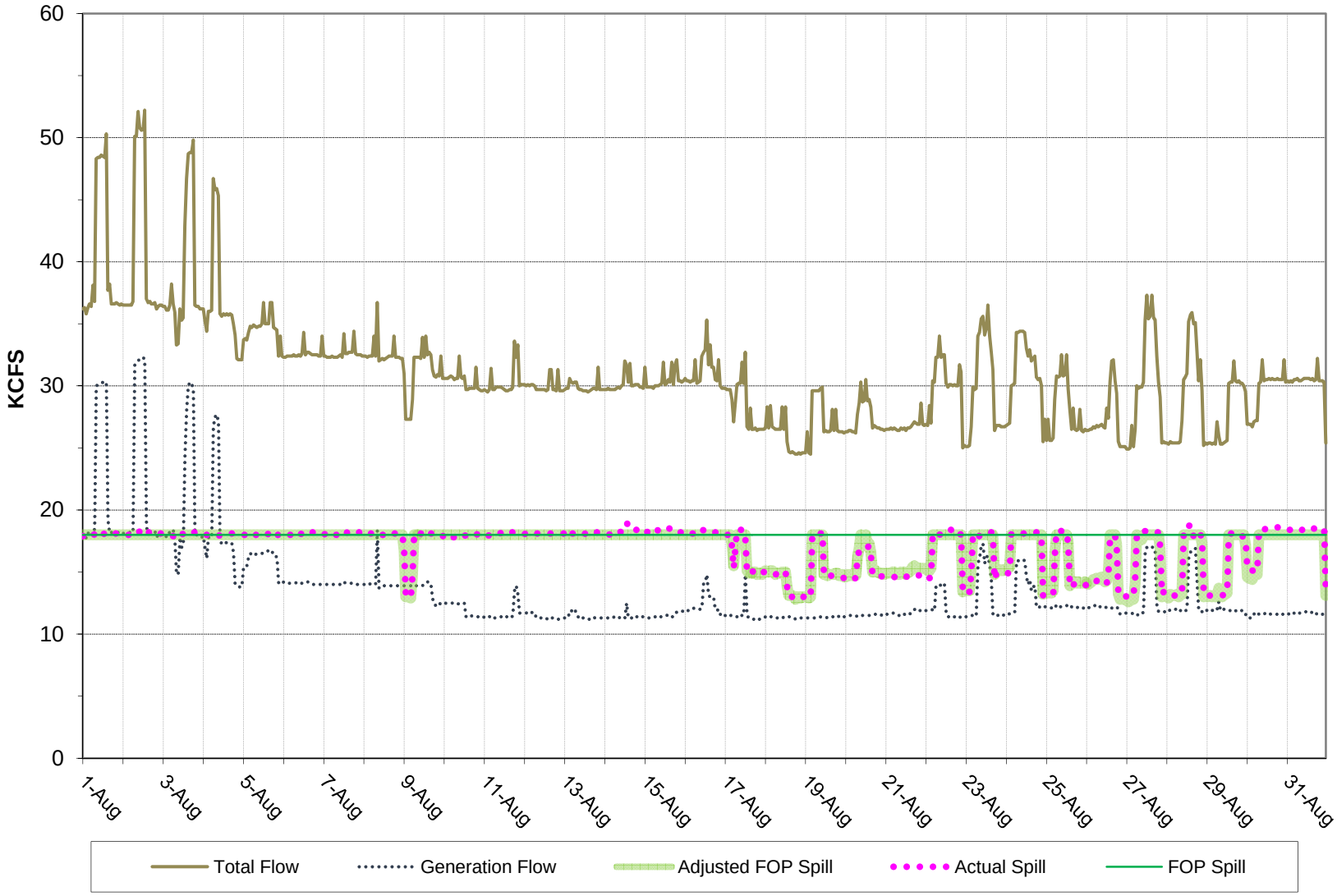


Figure 2

Little Goose Dam - Hourly Spill and Flow

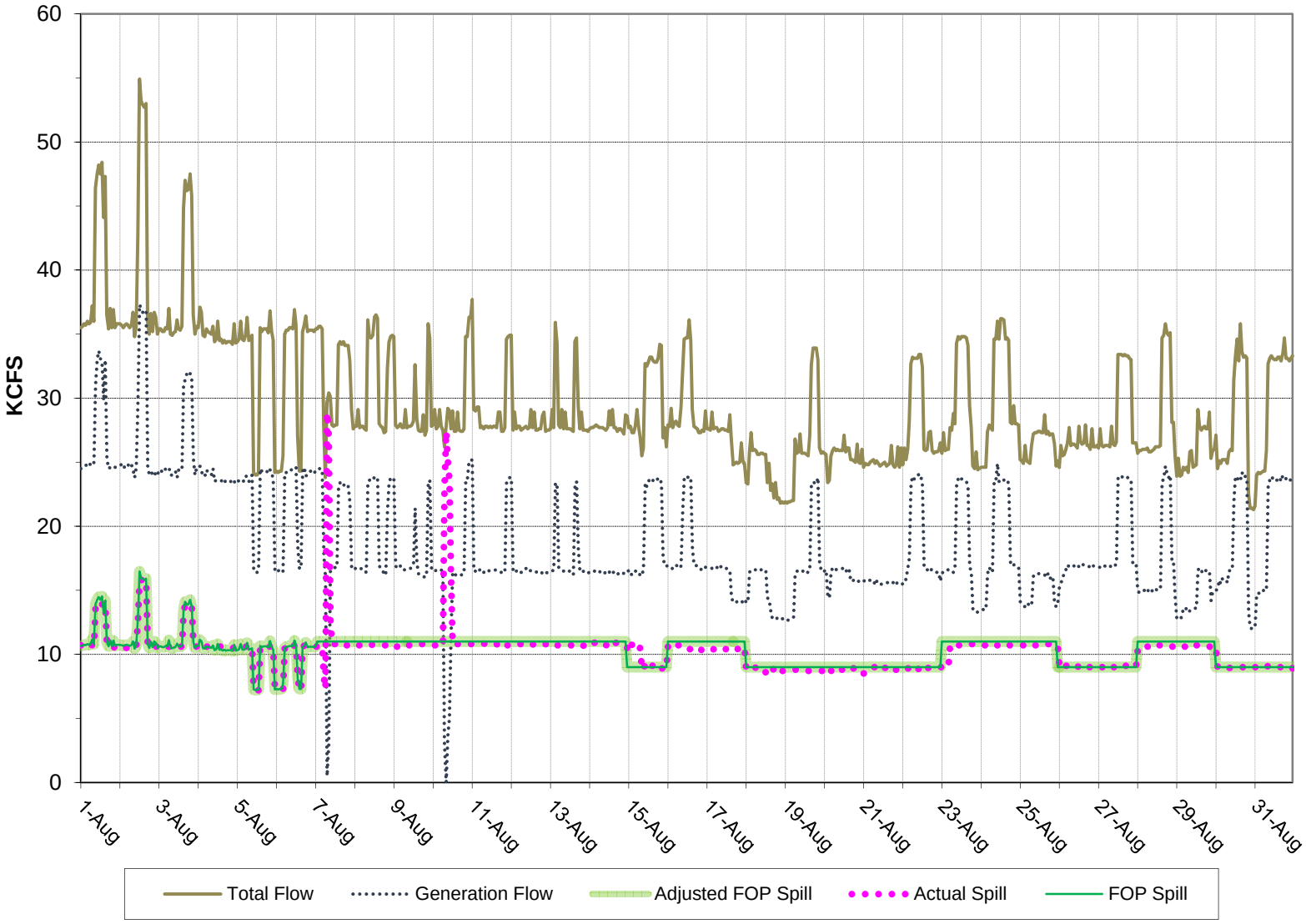


Figure 3

Lower Monumental Dam - Hourly Spill and Flow

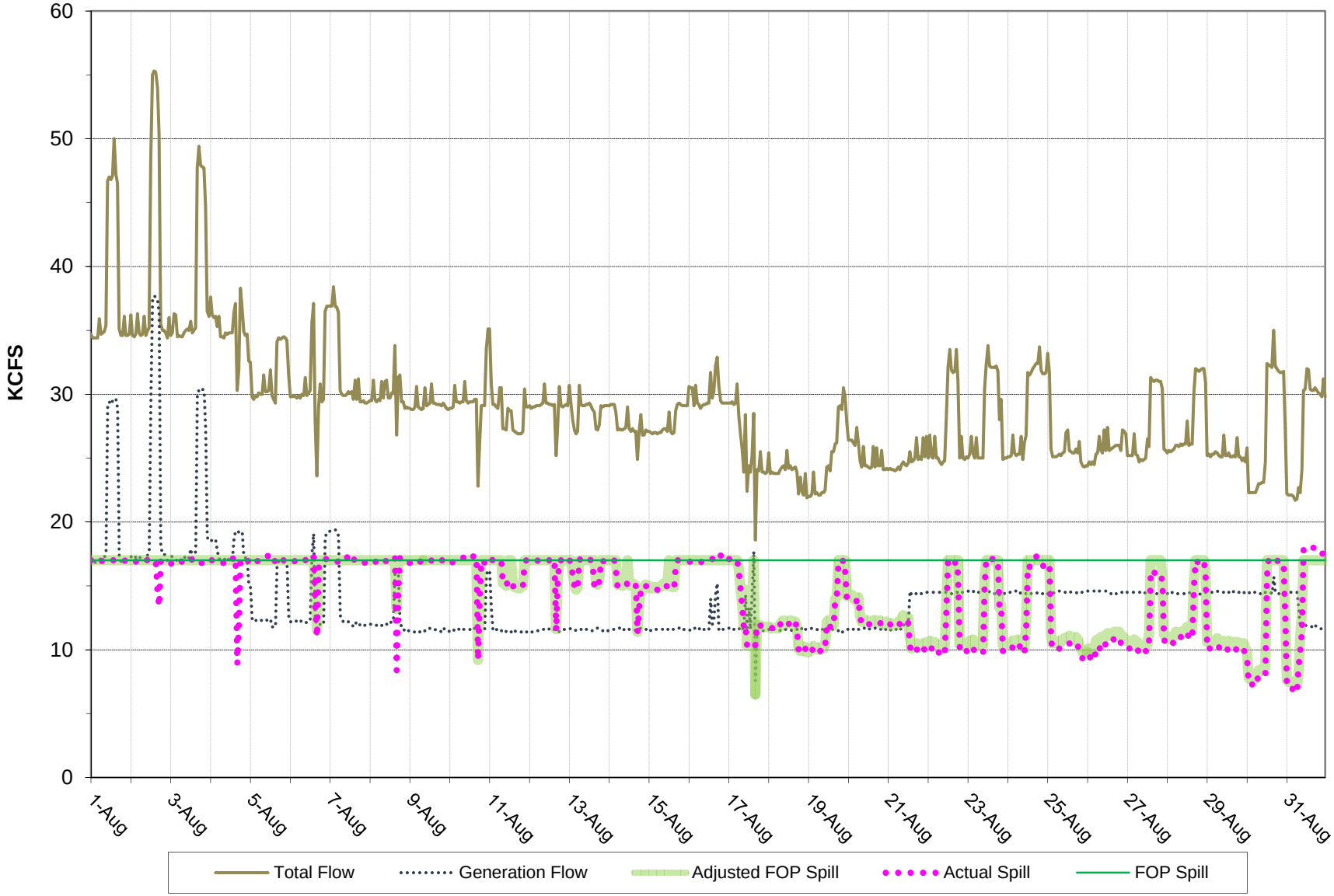


Figure 4

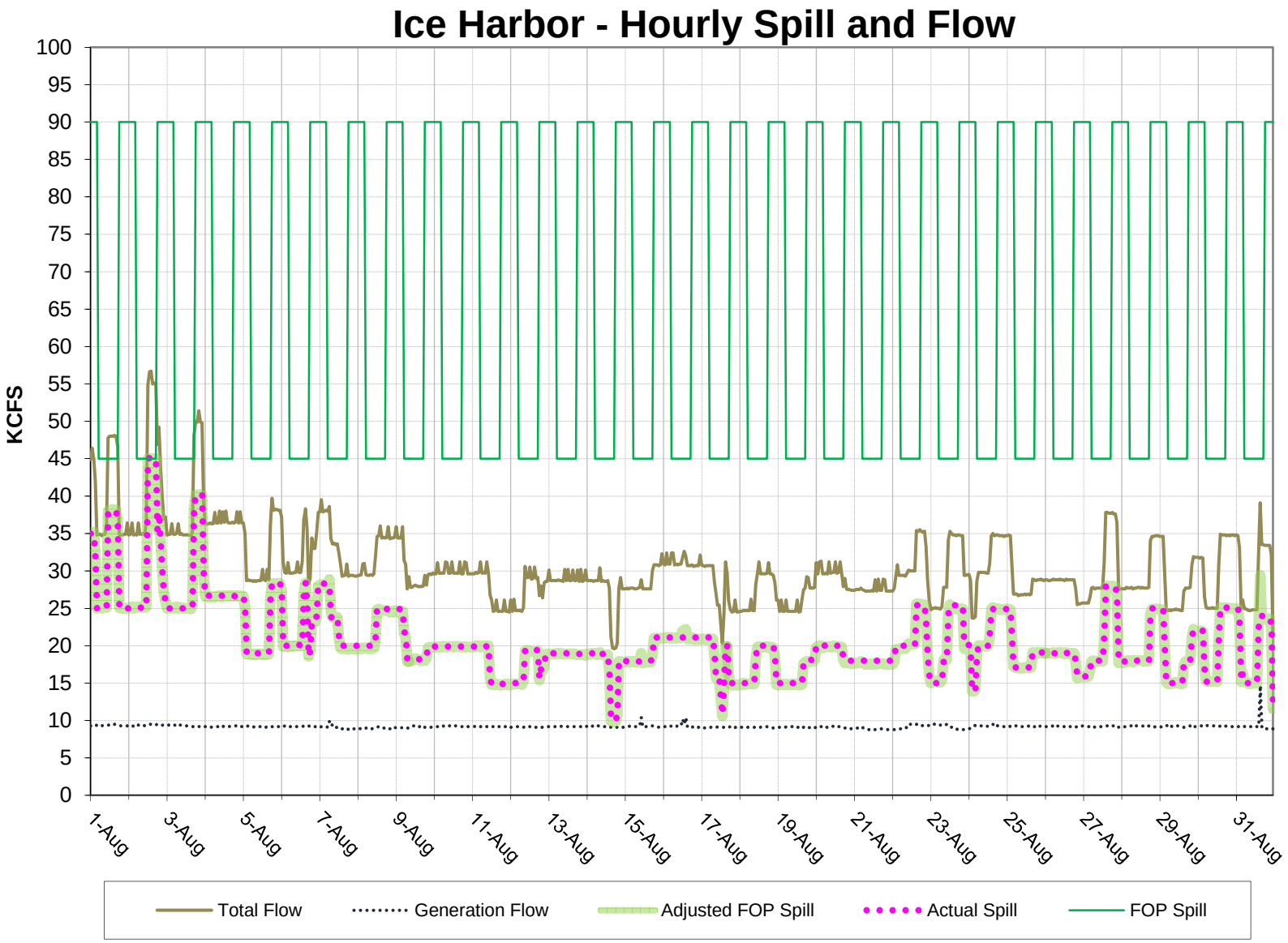

Ice Harbor - Hourly Spill and Flow
KCFS
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1-Aug
3-Aug
5-Aug
7-Aug
9-Aug
11-Aug
13-Aug
15-Aug
17-Aug
19-Aug
21-Aug
23-Aug
25-Aug
27-Aug
29-Aug
31-Aug
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 5

McNary Dam - Hourly Spill and Flow

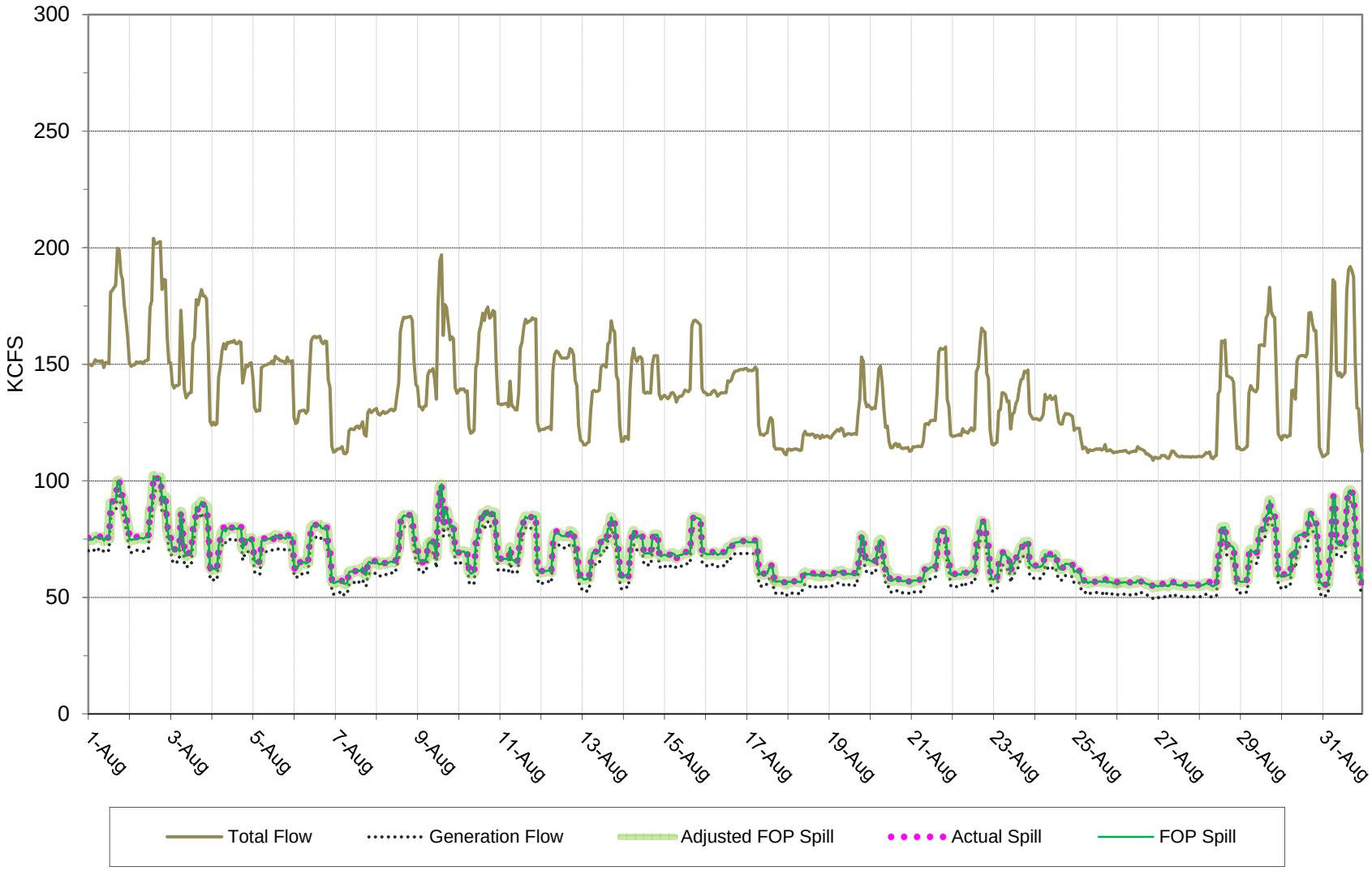


Figure 6

John Day Dam - Hourly Spill and Flow

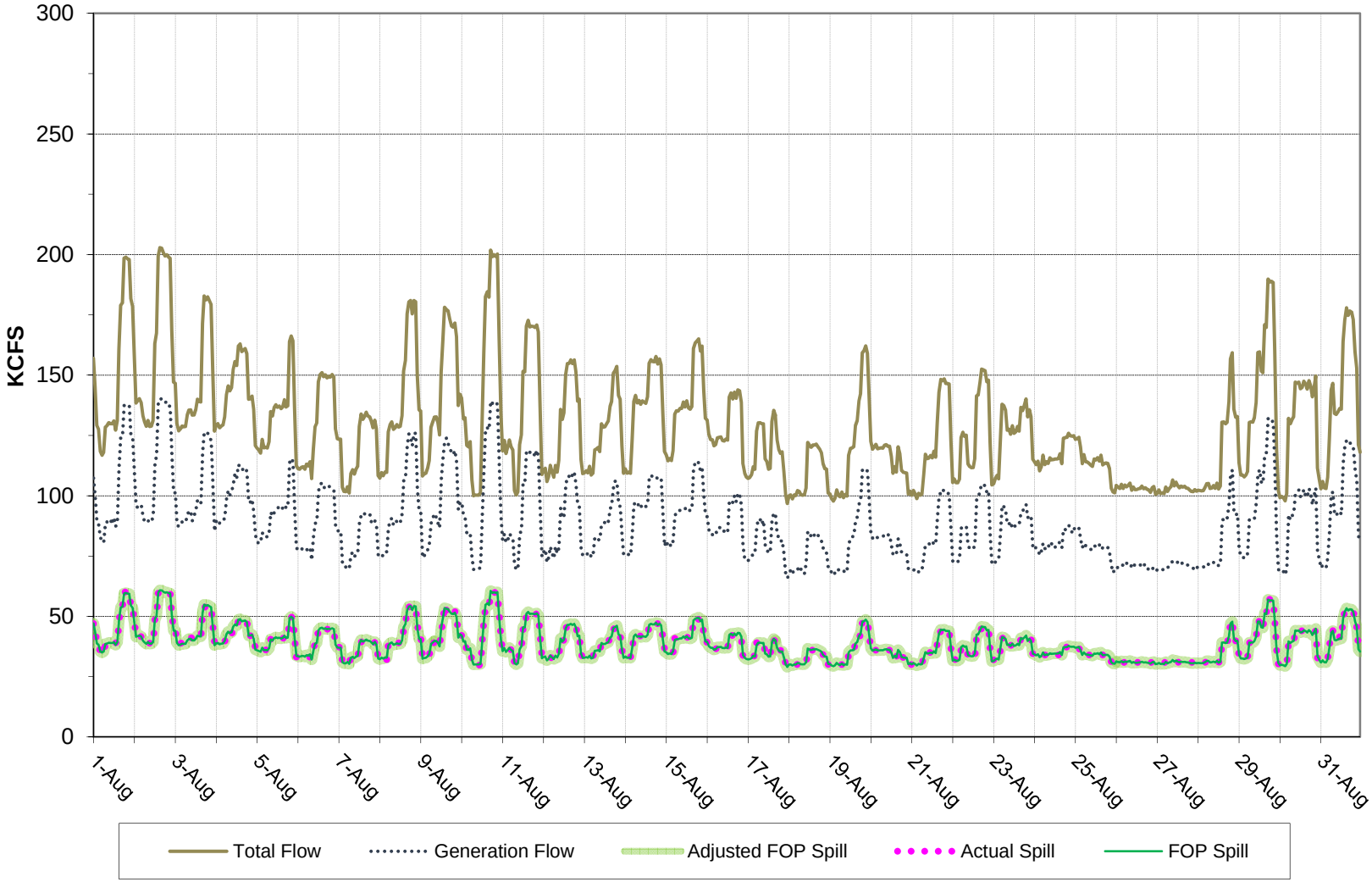


Figure 7

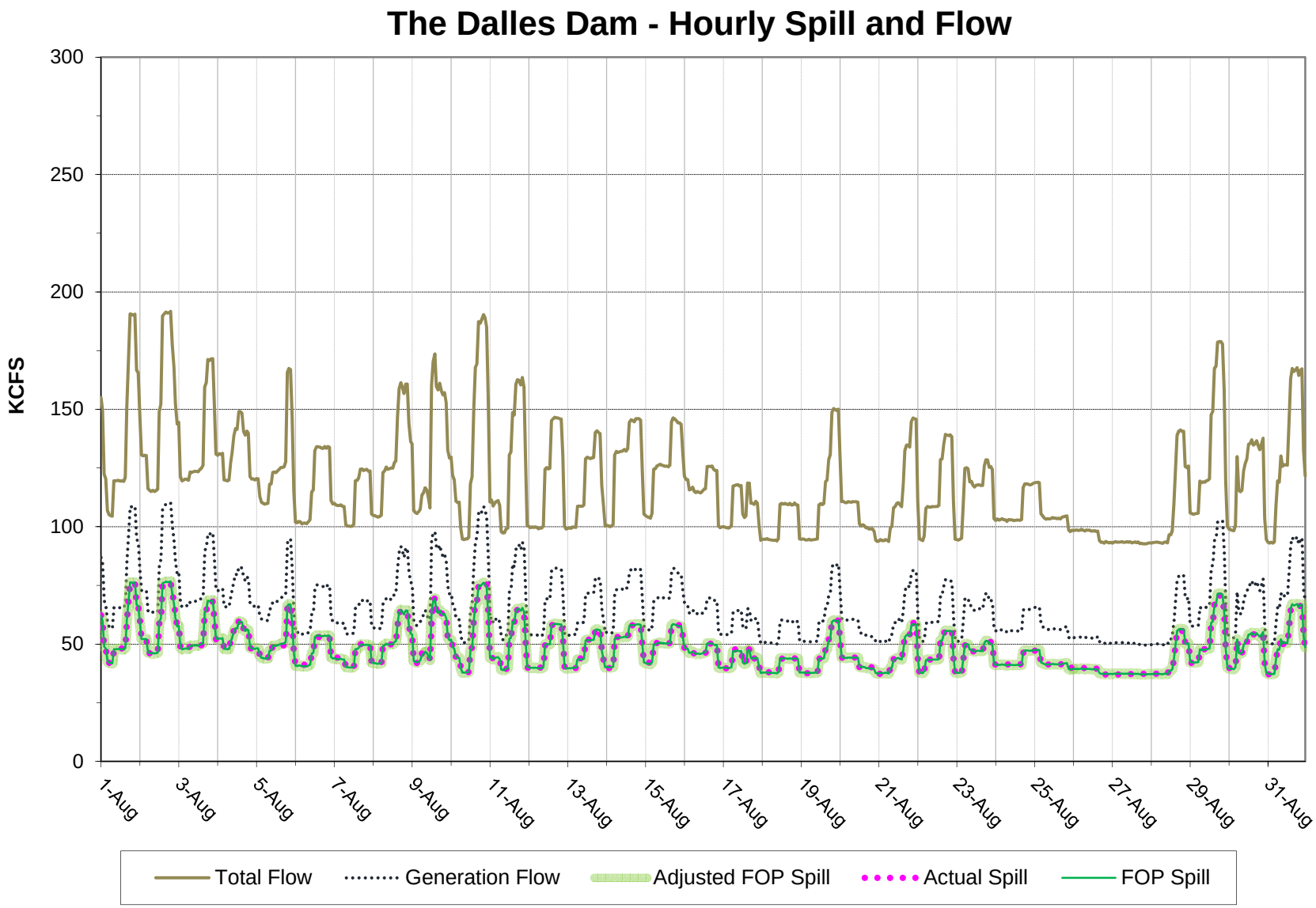
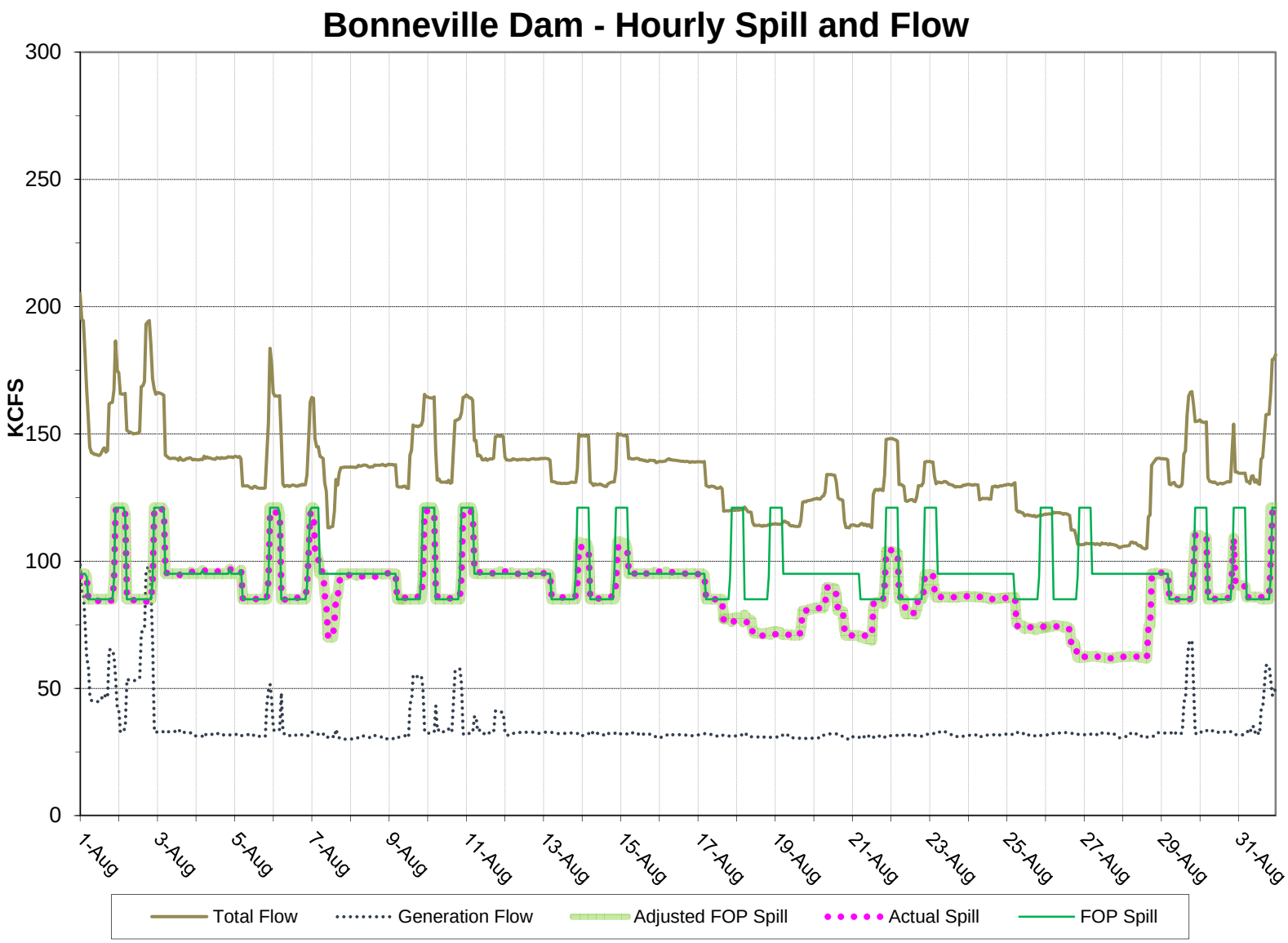

The Dalles Dam - Hourly Spill and Flow
KCFS
300
250
200
150
100
50
0
1-Aug
3-Aug
5-Aug
7-Aug
9-Aug
11-Aug
13-Aug
15-Aug
17-Aug
19-Aug
21-Aug
23-Aug
25-Aug
27-Aug
29-Aug
31-Aug
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 8


Bonneville Dam - Hourly Spill and Flow
KCFS
300
250
200
150
100
50
0
1-Aug
3-Aug
5-Aug
7-Aug
9-Aug
11-Aug
13-Aug
15-Aug
17-Aug
19-Aug
21-Aug
23-Aug
25-Aug
27-Aug
29-Aug
31-Aug
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill