FISH OPERATIONS PLAN IMPLEMENTATION REPORT

June 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' June 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 June 2017.

Data Reporting

I. For each project providing fish passage operations, this report contains one graph per operational month (June) displaying the performance of the fish passage spill program, with hourly spill, FOP spill, generation, and total flows. The monthly graphs begin on June 1 and end on June 30 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 June 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 June 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 June 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] For the month of June, the plots for John Day Dam (Figure 6) and The Dalles Dam (Figure 7) show actual spill (dotted pink line) at the adjusted FOP spill level (thick green line). As a result of setting spill caps to manage TDG, the adjusted spill level was below FOP spill level (thin green line).

[3] The actual thickness of the heavy green line (adjusted FOP spill) is not representative of the spill cap range; if the dotted pink line is slightly outside the thick green line, 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 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 in intermittent generation can occur at any hour of the day. Occasionally, several hours after

[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 (p. 14), this applies when the spill level is below 40% of total flow at The Dalles Dam.

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.

June Operations

The month of June was characterized by above average flows for the lower Snake and lower Columbia rivers along with normal to above average air temperatures and widely varied precipitation across the Columbia Basin. The NOAA Northwest River Forecast Center[7] reported the June 2017 adjusted runoff for the Snake River at Lower Granite at 136% of the 30-year average (1981-2010) with a volume of 8.3 MAF (Million Acre Feet). The June 2017 adjusted runoff for the Columbia River at The Dalles was 124% of average with a volume of 32.3 MAF. The June 2017 observed precipitation was 84% of average for the Snake River above Ice Harbor and 69% of average for the Columbia River above The Dalles. The June 2017 observed temperatures were 1.5°F above average for the Snake River above Ice Harbor and 1.3°F above average for the Columbia River above The Dalles.

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

- Lower Granite Dam - The hourly target spill level was 20 kcfs, 24 hours/day through June 20. The operation transitioned to the summer hourly target spill level of 18 kcfs, 24 hours/day on June 21.
- Little Goose Dam - The hourly target spill level was 30% of total project outflow, 24 hours/day.
- Lower Monumental Dam - The hourly target spill level was the %TDG cap, 24 hours/day through June 20. The operation transitioned to the summer hourly target spill level of 17 kcfs, 24 hours/day on June 21.
- Ice Harbor Dam - The hourly target spill level was alternated between two day treatments of 30% of total project outflow, 24 hours/day vs. 45 kcfs during the daytime and the %TDG cap during the nighttime. Nighttime spill hours are 1800–0500.
- McNary Dam - The hourly target spill level was 40% of total project outflow, 24 hours/day through June 15. The operation transitioned to the summer hourly target spill level of 50%, 24 hours/day on June 16.
- John Day Dam - The hourly target spill level was alternated between two day treatments of 30% and 40% of total project outflow, 24 hours/day. Spill level changes occur at 2000 hours.
- The Dalles Dam - The hourly target spill level was 40% of total project outflow, 24 hours/day.
- Bonneville Dam - The hourly target spill level was 100 kcfs, 24 hours/day through June 15.

[7] Retrieved July 3, 2017 from: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

On June 16 at 0430, the operation transitioned to the summer hourly target spill level alternating between two day blocks of 95 kcfs, 24 hours/day vs. 85 kcfs during the day and 121 kcfs during the nighttime. Nighttime hours are 2130-0430 through June 30.

Operational Adjustments

1. Little Goose Dam.

From June 2 through June 14, the Action Agencies coordinated with the TMT to develop and implement an operation intended to reduce high levels of involuntary spill at Little Goose Dam (LGS) during peak adult fish passage hours in order to improve adult passage. Prior to the operation, high Snake River flows resulted in involuntary spill at LGS in the range of 50-53%, which is above the 30% spill target defined in the 2017 FOP. The adult spring Chinook count differential between Lower Monumental and Little Goose dams was approximately 8,200 on June 1, indicating that adult fish migration was delayed. TMT discussed the likelihood that the delay was due to poor tailrace conditions associated with the higher spill levels, which impaired the adults from finding the fish ladder entrances.

On June 2, TMT recommended an operation to reduce spill and prompt adult migration. The proposal was to maintain LGS spill at 40% from 0400-1000 hours, which would require filling the forebay above MOP range during some hours due to high Snake River flows. This operation was implemented for three days (June 3-5); however, adult fish passage at LGS did not increase (Figure 2).

On June 5, the TMT reconvened and modified the operation to maintain spill at 30% from 0400-1000 hours for two days (June 6-7) by filling into the forebay above the MOP range as necessary. Adult spring Chinook counts increased to 1,876 on June 6 (more than double the previous day's count of 746) and 1,644 on June 7. Based on these results and hourly fish passage counts, TMT recommended extending 30% spill until 1200 hours each day and continuing the operation through June 21 (Figure 2). As Snake River flows and involuntary spill decreased, the project was able to achieve the 30% FOP spill target and maintain the forebay within the MOP range intermittently during other hours starting on June 14. On June 22 the 30% FOP spill operation and MOP range was maintained during all hours.

Table 1: Spill Variance Table – June 2017 (6/1 to 6/30)

Project	Parameter	Date	Time[8]	Hours	Type	Reason
The Dalles	Reduced Spill	6/16/17	0400-0500	2	Human Error	Hourly spill decreased to 119 and 121 kcfs (below 130 kcfs ± 3 kcfs range) due to a miscalculation of spill. Daily average spill was 41%.
John Day	Additional Spill	6/25/17	0100	1	Human Error	Hourly spill increased to 42% (above 40% ± 1% range) due to a delay in reducing spill to 114 kcfs. Daily average spill was 40%.

[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.

John Day	Reduced Spill	6/26/17	1800	1	Transmission Stability	Hourly spill decreased to 38% (below 40% ± 1% range) during rapidly changing load and/or intermittent generation (see p. 3-4).
The Dalles	Additional Spill	6/23/17	1100	1	Transmission Stability	Hourly spill increased to 42% (above 40% ± 1% range) due to an FCRPS response to transmission system disturbance. John Day and The Dalles were allocated more load for part of the hour to assure system reliability. 24 hr avg. spill was 40%.

Table 2: Pre-Coordinated Operations – June 2017 (6/1 to 6/30)

Project	Date	Type	Description of Event	Regional Coordination
Lower Monumental	Every other day from 6/1 through 6/30	Navigation	Spill was reduced for safe passage of fish barges crossing project tailwater.	2017 FOP, pages 2, 4, 7 and 12

Table 3: June 2017 Average Percent TDG Values Table (6/1 to 6/30)[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
6/1/2017	108	129	118	127	126	127	121	126	118	~~125~~	125	119	~~125~~	125	119	~~122~~	122	121	~~126~~	127
6/2/2017	108	129	120	128	128	127	124	128	118	126	~~126~~	117	128	~~127~~	119	122	~~122~~	122	126	~~126~~
6/3/2017	110	128	123	128	130	126	125	128	122	~~125~~	126	119	~~126~~	128	120	~~122~~	122	123	126	~~126~~
6/4/2017	110	129	123	128	130	127	125	130	122	~~125~~	125	119	~~123~~	124	118	~~120~~	121	119	•	•
6/5/2017	109	128	121	128	128	127	123	127	118	125	~~125~~	117	127	~~126~~	121	123	~~123~~	121	•	•
6/6/2017	110	128	122	130	131	126	126	129	121	~~125~~	125	118	~~126~~	126	121	~~124~~	124	125	•	•
6/7/2017	111	126	124	130	132	128	127	127	123	~~125~~	125	123	~~126~~	126	122	124	~~124~~	125	•	•
6/8/2017	111	124	124	125	132	128	128	124	123	126	~~125~~	123	~~124~~	125	122	~~123~~	124	123	•	•
6/9/2017	109	124	120	125	125	126	126	126	119	126	~~125~~	121	126	~~126~~	120	123	~~123~~	122	125	~~125~~
6/10/2017	107	123	118	126	125	126	123	126	116	~~125~~	126	119	126	~~126~~	119	~~122~~	122	122	126	~~126~~
6/11/2017	107	121	116	123	124	117	120	123	116	~~123~~	123	116	~~121~~	125	118	~~120~~	121	121	~~125~~	126
6/12/2017	108	118	117	119	124	116	122	120	117	~~123~~	123	115	120	~~120~~	116	~~118~~	119	120	125	~~125~~
6/13/2017	107	117	117	118	121	119	121	119	117	121	~~121~~	114	~~119~~	120	111	~~115~~	116	114	~~123~~	123
6/14/2017	106	120	112	118	115	120	116	120	112	122	~~122~~	111	121	~~121~~	113	118	~~118~~	115	125	~~124~~
6/15/2017	106	117	112	118	117	120	116	120	116	123	~~123~~	110	~~121~~	121	114	119	~~118~~	119	~~123~~	124
6/16/2017	107	116	114	116	118	120	117	119	116	~~121~~	123	111	~~119~~	120	113	~~118~~	118	119	123	~~123~~
6/17/2017	107	116	113	116	115	120	116	119	116	~~120~~	120	114	~~119~~	119	114	118	~~118~~	117	~~122~~	123
6/18/2017	106	117	112	116	116	120	117	119	116	120	~~120~~	115	119	~~119~~	116	119	~~119~~	118	122	~~122~~
6/19/2017	107	115	114	119	117	120	118	119	117	121	~~121~~	117	120	~~120~~	117	~~119~~	119	120	123	~~123~~
6/20/2017	108	118	115	118	119	120	118	119	117	~~119~~	120	117	~~118~~	118	117	~~119~~	119	120	~~121~~	123
6/21/2017	107	117	113	119	119	119	118	119	117	119	~~119~~	115	118	~~118~~	114	117	~~117~~	115	121	~~121~~
6/22/2017	106	117	113	119	117	120	117	120	117	~~119~~	119	115	118	~~118~~	116	119	~~119~~	116	~~121~~	121
6/23/2017	106	116	113	116	118	118	117	119	116	119	~~119~~	115	~~117~~	118	116	~~118~~	119	119	~~119~~	120
6/24/2017	106	114	113	116	117	116	118	119	116	119	~~119~~	116	117	~~117~~	115	~~118~~	118	120	120	~~120~~
6/25/2017	107	114	113	115	118	115	118	118	118	~~118~~	118	118	118	~~118~~	117	119	~~119~~	119	121	~~121~~
6/26/2017	108	112	113	115	118	118	118	117	118	121	~~121~~	119	~~118~~	118	118	~~119~~	119	119	~~118~~	120
6/27/2017	107	110	112	114	117	118	117	116	118	~~121~~	121	118	~~115~~	116	113	~~116~~	117	115	~~117~~	117
6/28/2017	107	109	110	114	114	118	•	116	115	~~120~~	121	115	~~115~~	115	111	~~115~~	116	111	118	~~118~~
6/29/2017	105	109	109	114	112	117	113	116	112	120	~~120~~	111	115	~~115~~	111	116	~~116~~	111	118	~~118~~
6/30/2017	104	109	109	112	113	117	114	116	114	~~118~~	119	111	115	~~115~~	112	116	~~116~~	116	~~117~~	118

- 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

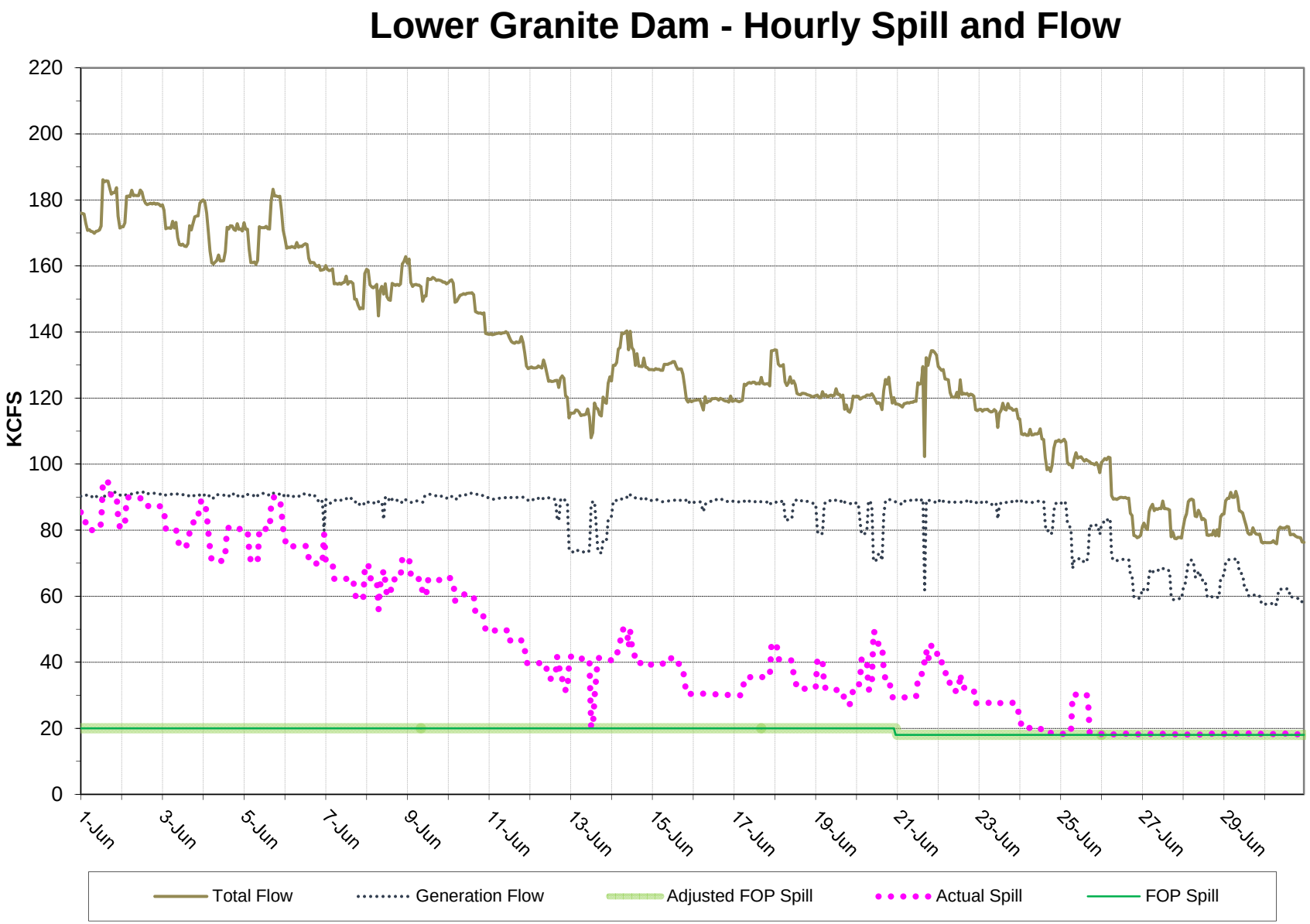

Lower Granite Dam - Hourly Spill and Flow
KCFS
220
200
180
160
140
120
100
80
60
40
20
0
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 2

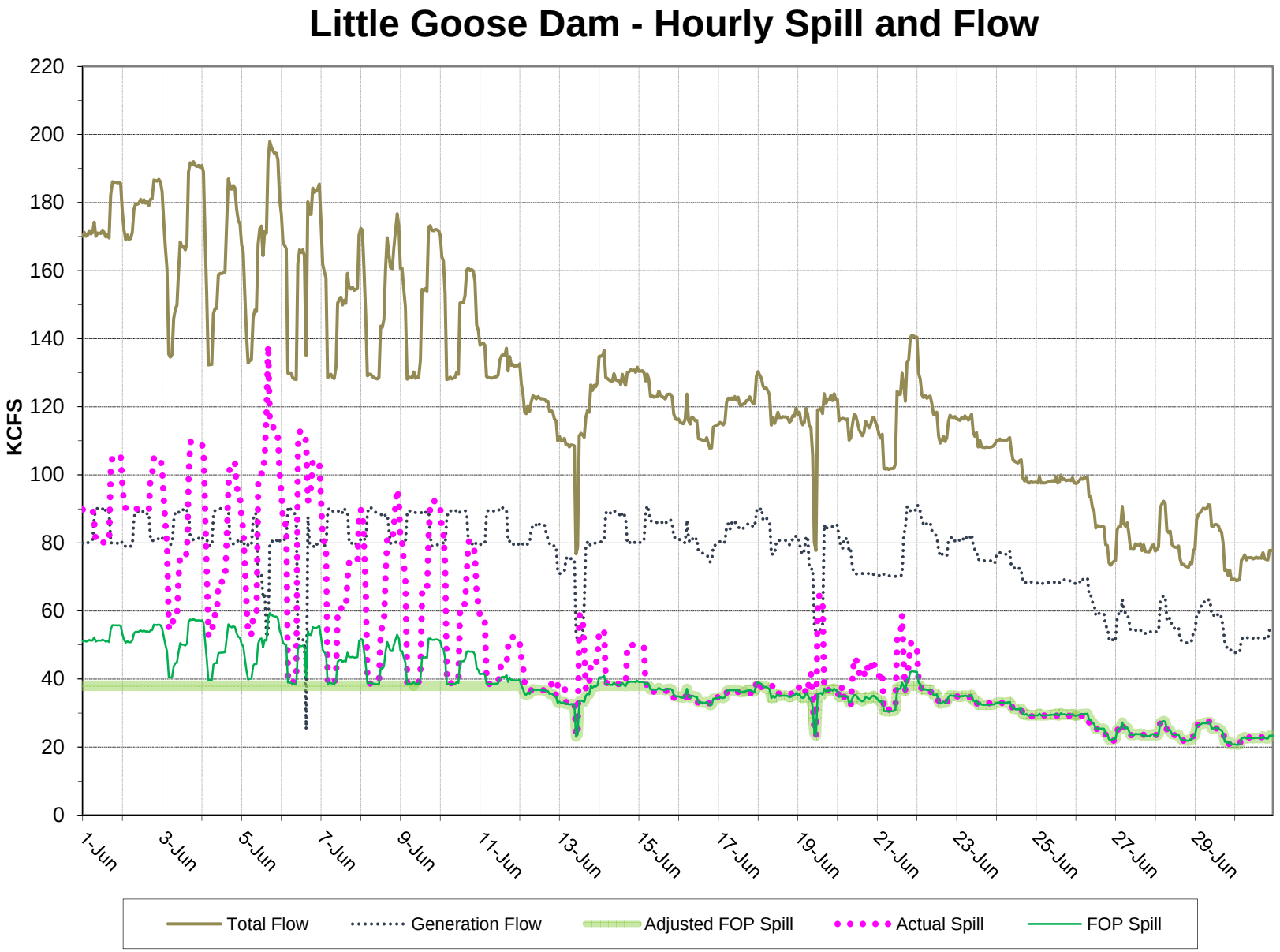

Little Goose Dam - Hourly Spill and Flow
KCFS
220
200
180
160
140
120
100
80
60
40
20
0
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 3

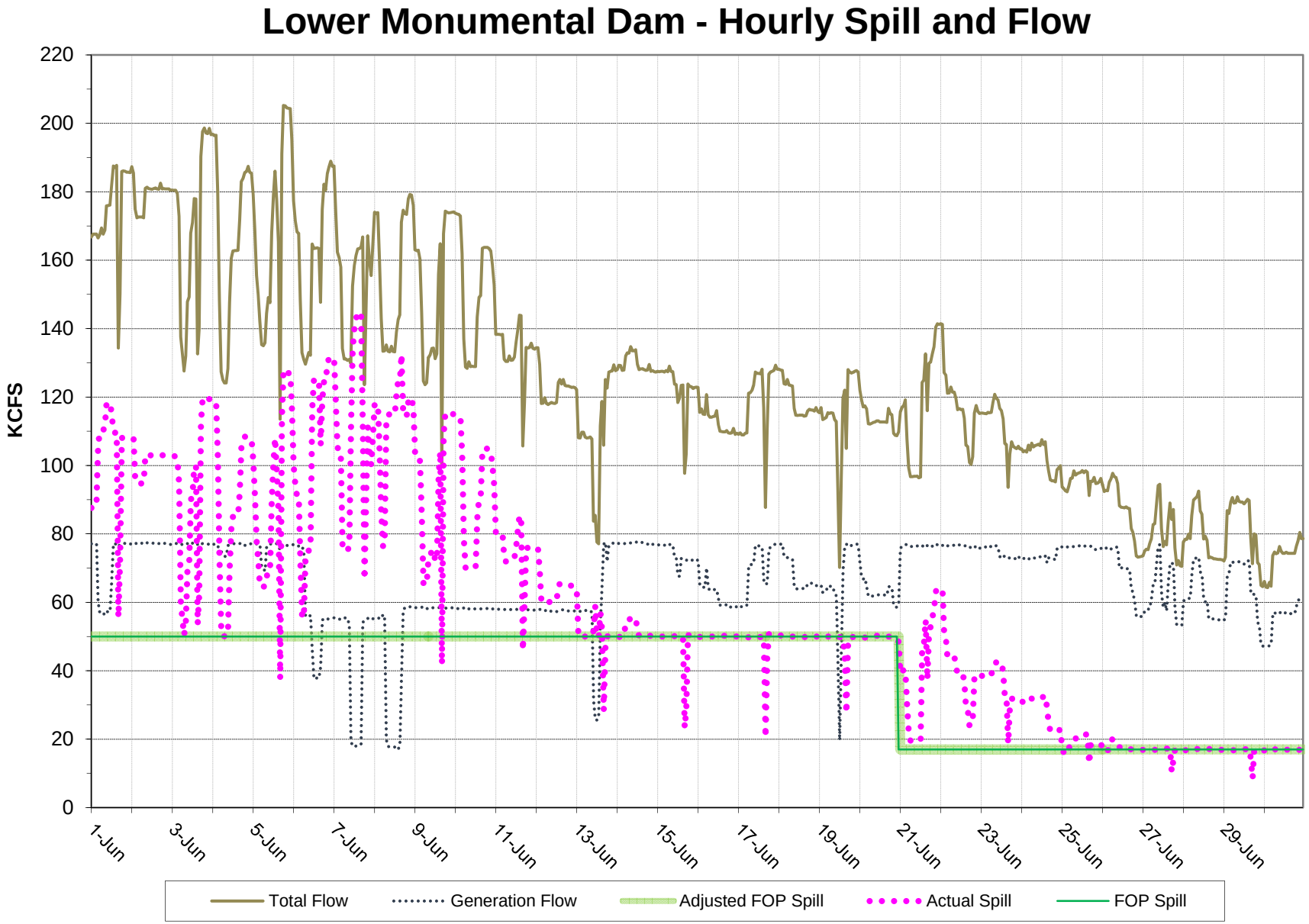

Lower Monumental Dam - Hourly Spill and Flow
KCFS
220
200
180
160
140
120
100
80
60
40
20
0
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 4

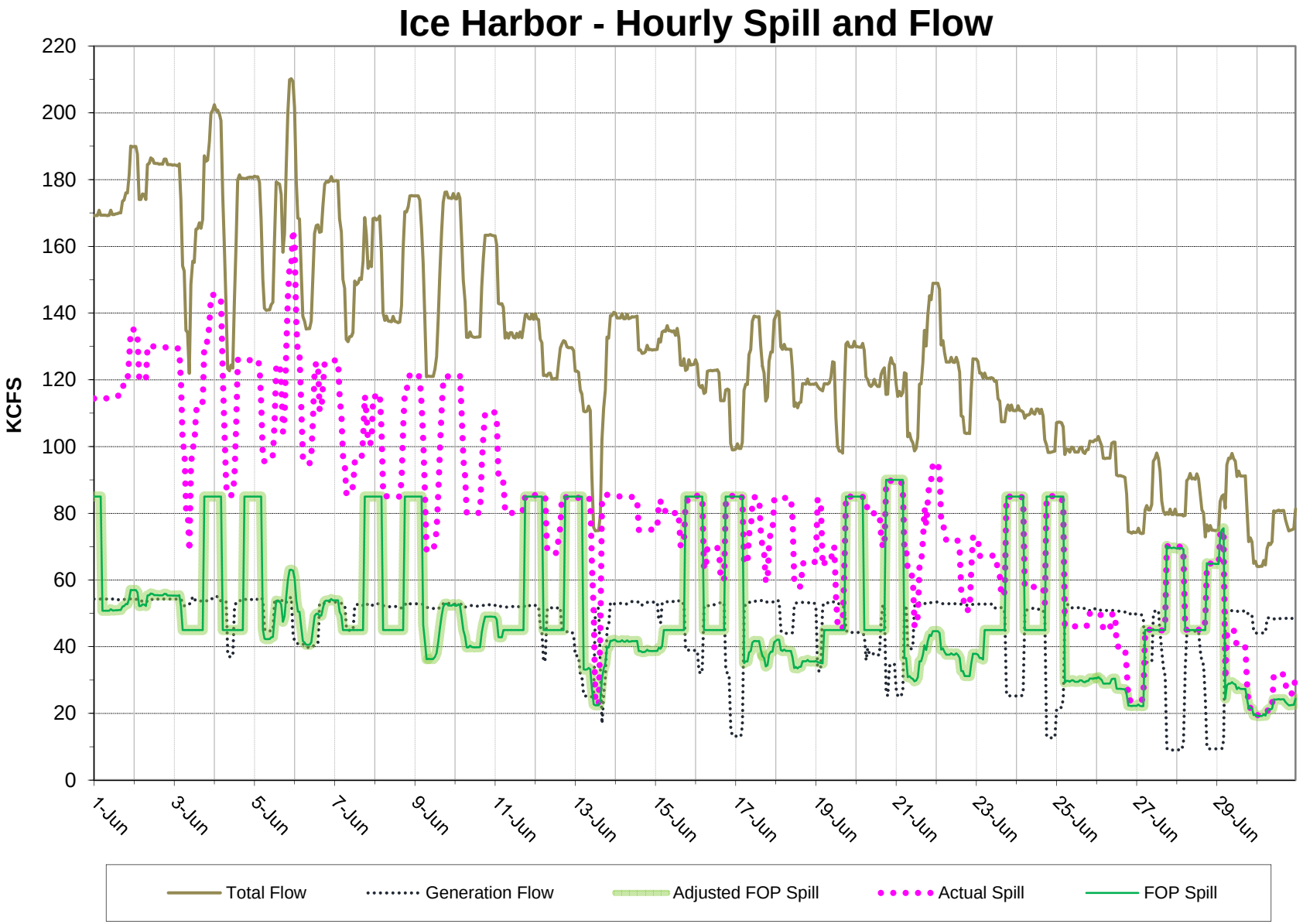

Ice Harbor - Hourly Spill and Flow
KCFS
220
200
180
160
140
120
100
80
60
40
20
0
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 5

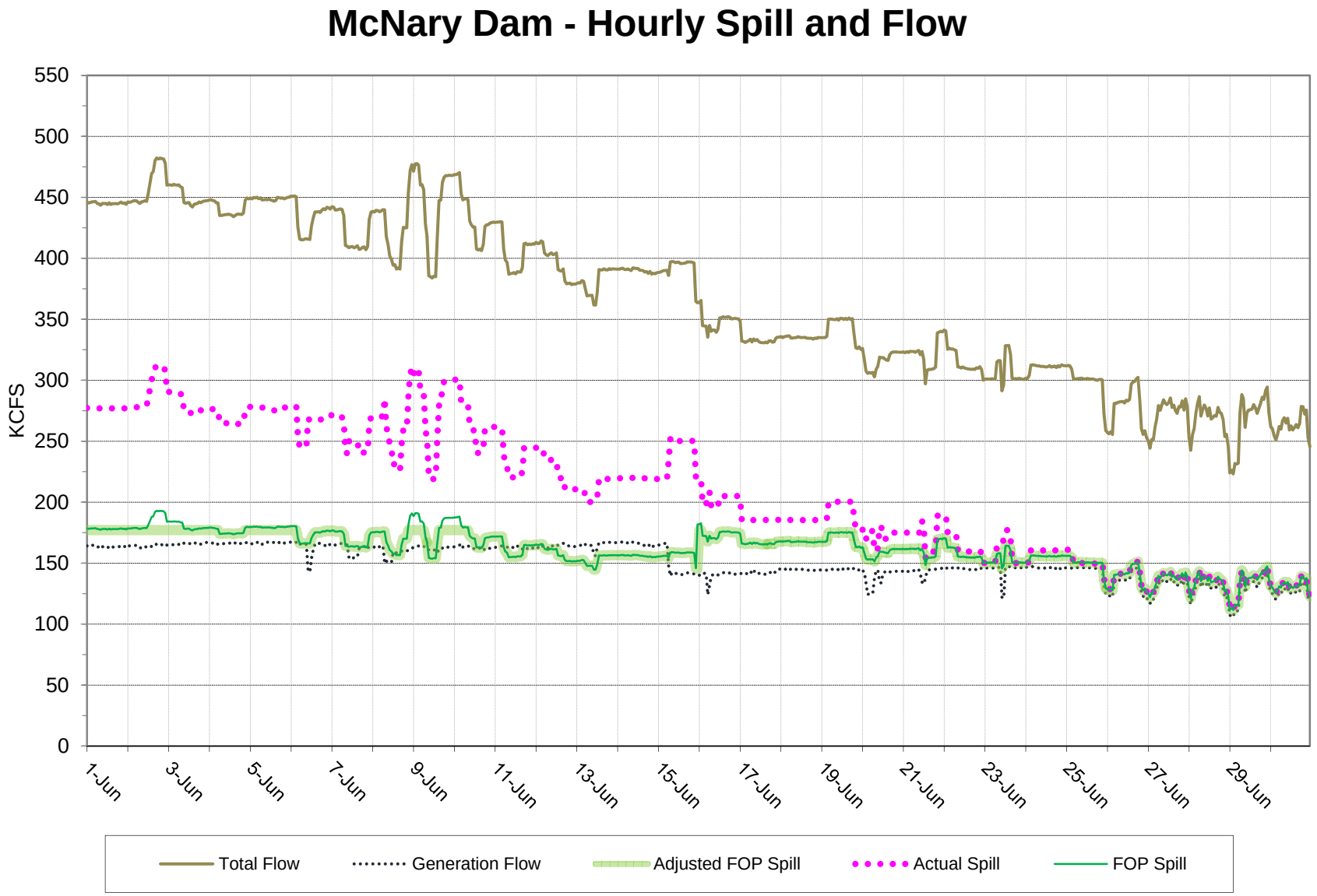

McNary Dam - Hourly Spill and Flow
KCFS
550
500
450
400
350
300
250
200
150
100
50
0
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 6

John Day Dam - Hourly Spill and Flow

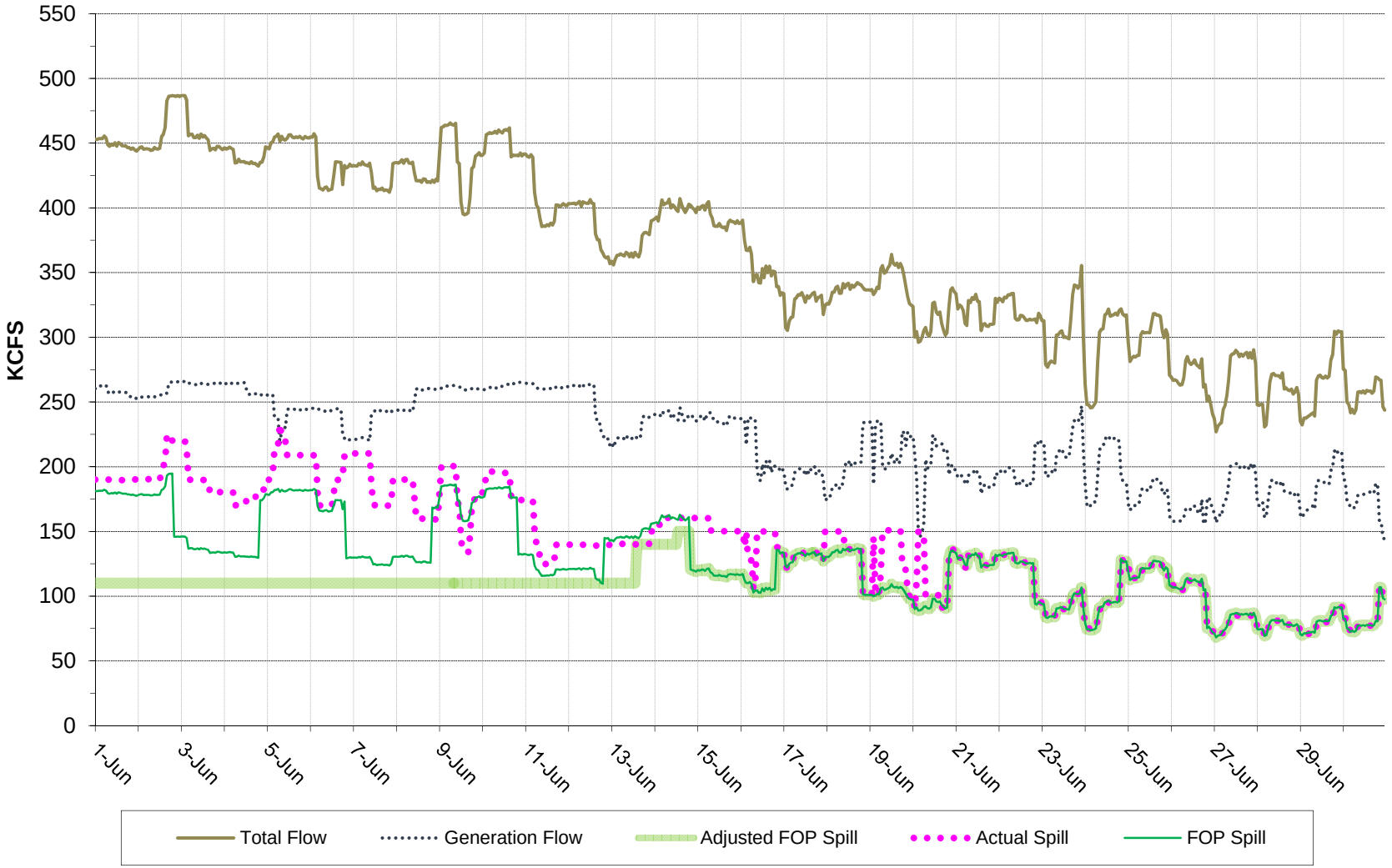


Figure 7

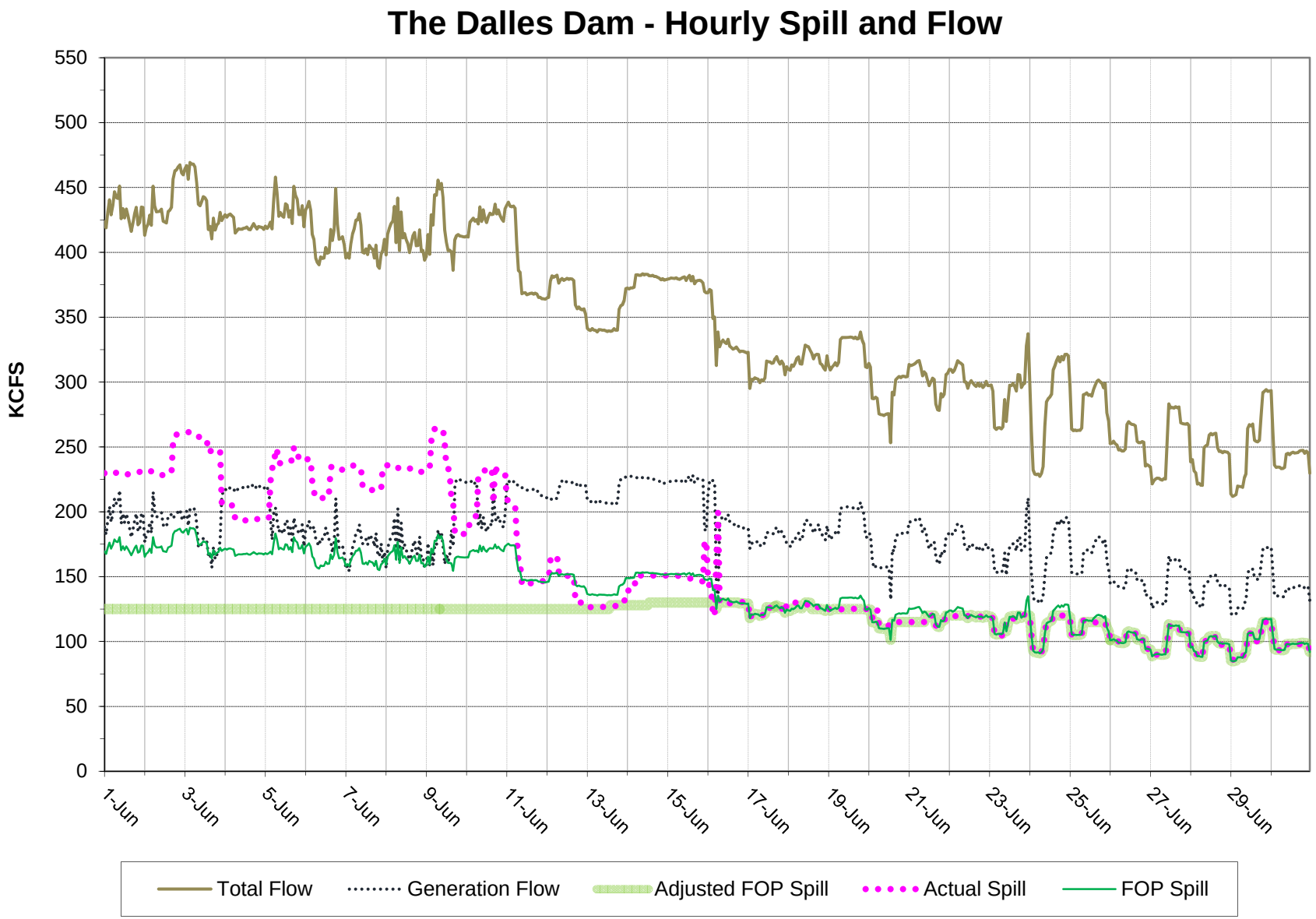
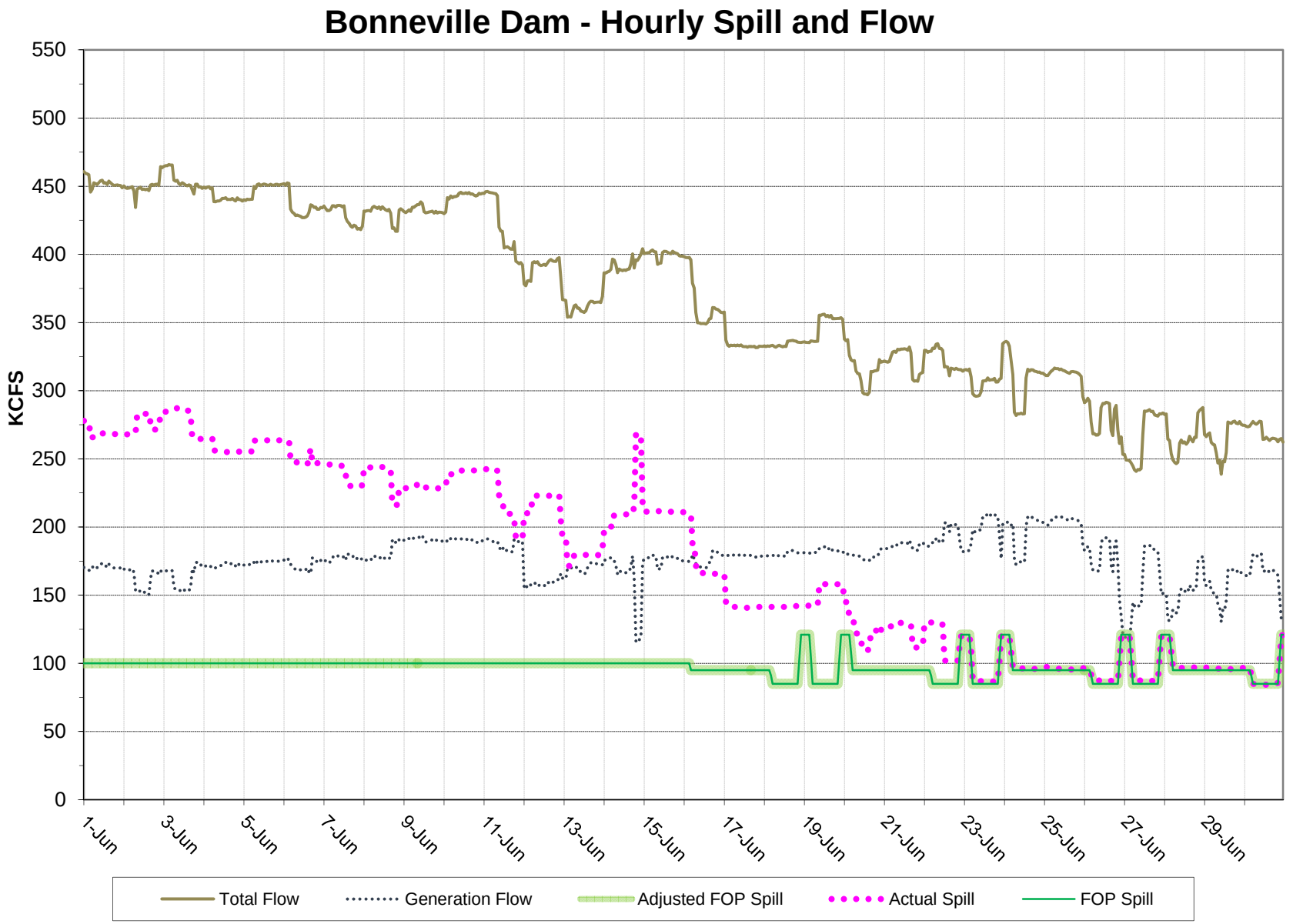

The Dalles Dam - Hourly Spill and Flow
KCFS
550
500
450
400
350
300
250
200
150
100
50
0
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 8


Bonneville Dam - Hourly Spill and Flow
KCFS
550
500
450
400
350
300
250
200
150
100
50
0
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill