FISH OPERATIONS PLAN IMPLEMENTATION REPORT

April 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' April 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 April 2017.

Data Reporting

I. For each project providing fish passage operations, this report contains one graph per operational month (April) displaying the performance of the fish passage spill program, with hourly spill, FOP spill, generation, and total flows. The monthly graphs begin on April 1 and end on April 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 April 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 April 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 April 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

[2] For the month of April, the plots for Little Goose and John Day dams 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.

the hourly FOP spill levels are not achievable due to mechanical limitations in setting spill gates 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

[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.

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.

April Operations

The month of April was characterized by above average flows for the lower Snake and lower Columbia Rivers along with below average air temperatures and above average precipitation across most of the Columbia Basin. The NOAA Northwest River Forecast Center[7] indicated that the observed April 2017 adjusted runoff for the Snake River at Lower Granite was 173% of the 30-year average (1981-2010) with a volume of 7.89 MAF (Million Acre Feet). The April 2017 adjusted runoff for the Columbia River at The Dalles was 158% of the 30-year average (1981-2010) with a volume of 21.8 MAF. The April 2017 observed precipitation was 122% of average on the Snake River above Ice Harbor and 129% of average on the Columbia River above The Dalles. The high flows resulted in involuntary spill across the Basin.

During the April 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.
- 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.
- Ice Harbor Dam - April 3–April 28: The hourly target spill level was 45 kcfs during the daytime and the %TDG cap during the nighttime. Starting April 28: 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.
- John Day Dam - April 10–28: The hourly target spill level was 30% of total project outflow, 24 hours/day. Starting on April 27: at 2000 hours, 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.

[7] Retrieved May 1, 2017: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php?date=05/01/2017

Operational Adjustments

1. Lower Monumental Dam.

On April 28 from 1000-1030, spill at Lower Monumental Dam was reduced below the 2017 FOP spring spill operation to the %TDG cap in order to minimize wave activity at the dock to facilitate repair of the fish transport barge dock in the tailrace. On that date, the %TDG cap spill level (i.e., spill cap) was set at 55 kcfs. Due to the spill reduction, hourly average spill from 10:00-11:00 was 27 kcfs and day average spill was 53 kcfs. The Corps coordinated this operation with TMT on April 19 and with Fish Passage Operation and Maintenance (FPOM) Team on April 27. TMT and FPOM members did not object to this operation.

Table 1: Spill Variance Table – April 2017 (4/1 to 4/30)

Project	Parameter	Date	Time[8]	Hours	Type	Reason
There are no reportable spill variances in April						

Table 2: Pre-Coordinated Operations – April 2017 (4/1 to 4/30)

Project	Date	Type	Description of Event	Regional Coordination
Lower Monumental	4/28/17	Maintenance	Spill was reduced for 30 minutes during the repair of the fish transport barge dock floating mooring bits at the Juvenile Fish Facility.	April 19, 2017 TMT and FPOM on April 27, 2017.

[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: April 2017 Average Percent TDG Values Table (4/1 to 4/30)

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
4/1/2017	109	129	121	121	122	129	126	127	119	129	~~129~~	118	121	~~120~~	117	~~121~~	121	121	126	~~126~~
4/2/2017	109	128	121	120	122	125	124	126	119	~~127~~	128	117	122	~~122~~	116	~~119~~	119	120	~~126~~	126
4/3/2017	108	127	119	121	119	123	121	123	117	~~126~~	127	118	~~122~~	122	117	121	~~121~~	121	127	~~126~~
4/4/2017	108	127	120	120	121	123	120	124	117	125	~~125~~	121	122	~~122~~	118	123	~~123~~	122	~~126~~	126
4/5/2017	110	126	122	121	121	121	121	122	118	~~123~~	124	124	~~124~~	124	122	124	~~124~~	124	127	~~127~~
4/6/2017	111	126	123	121	124	121	121	121	119	124	~~124~~	125	~~122~~	122	122	125	~~125~~	126	~~126~~	126
4/7/2017	112	124	123	121	125	121	121	121	119	~~124~~	124	125	~~121~~	122	122	~~123~~	125	126	~~124~~	125
4/8/2017	110	127	121	121	121	121	119	121	116	124	~~124~~	122	122	~~122~~	118	121	~~120~~	124	~~123~~	123
4/9/2017	108	128	117	119	119	122	117	122	113	~~125~~	125	117	123	~~123~~	118	122	~~122~~	122	124	~~124~~
4/10/2017	108	126	118	118	118	121	118	121	114	~~123~~	125	115	~~122~~	123	118	~~121~~	122	123	~~124~~	124
4/11/2017	109	124	119	119	118	121	118	120	115	125	~~125~~	116	122	~~122~~	119	123	~~123~~	122	122	~~122~~
4/12/2017	110	123	120	122	120	125	119	122	116	126	~~126~~	119	122	~~122~~	119	~~122~~	123	124	123	~~123~~
4/13/2017	111	122	121	123	122	126	121	123	116	~~126~~	126	119	123	~~123~~	119	~~121~~	122	124	124	~~124~~
4/14/2017	109	121	119	120	122	122	121	121	116	~~123~~	124	119	124	~~124~~	120	~~121~~	121	122	~~123~~	123
4/15/2017	107	118	116	123	119	•	•	•	113	~~123~~	123	118	123	~~123~~	120	121	~~121~~	124	~~123~~	123
4/16/2017	109	116	116	117	124	120	119	120	116	123	~~123~~	119	~~121~~	123	120	121	~~121~~	124	~~123~~	123
4/17/2017	110	119	116	117	122	118	119	120	117	~~122~~	123	118	~~121~~	121	120	121	~~121~~	125	124	~~124~~
4/18/2017	109	120	113	116	117	119	118	120	116	123	~~123~~	119	122	~~122~~	119	122	~~121~~	123	~~123~~	124
4/19/2017	107	121	115	117	115	119	116	121	115	~~121~~	122	119	124	~~124~~	119	~~120~~	121	124	124	~~124~~
4/20/2017	107	121	116	123	116	119	116	121	115	~~121~~	121	119	~~124~~	124	118	~~118~~	119	124	~~124~~	124
4/21/2017	107	122	116	123	120	120	115	120	113	122	~~122~~	117	128	~~127~~	119	122	~~122~~	120	~~123~~	123
4/22/2017	109	122	117	119	123	120	119	120	115	~~121~~	122	118	~~122~~	127	119	123	~~123~~	124	~~124~~	124
4/23/2017	110	122	120	118	122	120	119	120	117	121	~~121~~	116	~~120~~	122	116	~~121~~	122	125	~~122~~	123
4/24/2017	109	122	120	119	118	120	119	120	117	121	~~121~~	118	119	~~119~~	116	121	~~121~~	123	124	~~124~~
4/25/2017	108	122	118	119	118	120	117	120	116	~~120~~	120	117	121	~~121~~	116	~~121~~	121	121	~~123~~	123
4/26/2017	107	122	117	118	118	121	116	120	114	~~122~~	122	116	~~126~~	127	116	121	~~121~~	122	~~122~~	122
4/27/2017	107	120	116	118	117	121	116	120	113	~~121~~	121	114	122	~~122~~	115	~~119~~	121	119	122	~~122~~
4/28/2017	105	119	115	117	116	120	115	120	112	120	~~120~~	111	~~122~~	122	112	119	~~118~~	117	~~122~~	122
4/29/2017	106	118	114	117	117	120	116	120	114	121	~~121~~	109	124	~~124~~	113	121	~~121~~	119	123	~~123~~
4/30/2017	107	117	114	116	117	119	117	120	115	~~120~~	121	110	~~120~~	123	113	~~120~~	121	119	~~122~~	123

- Red shaded cells indicate no data due to malfunctioning gauge

Figure 1

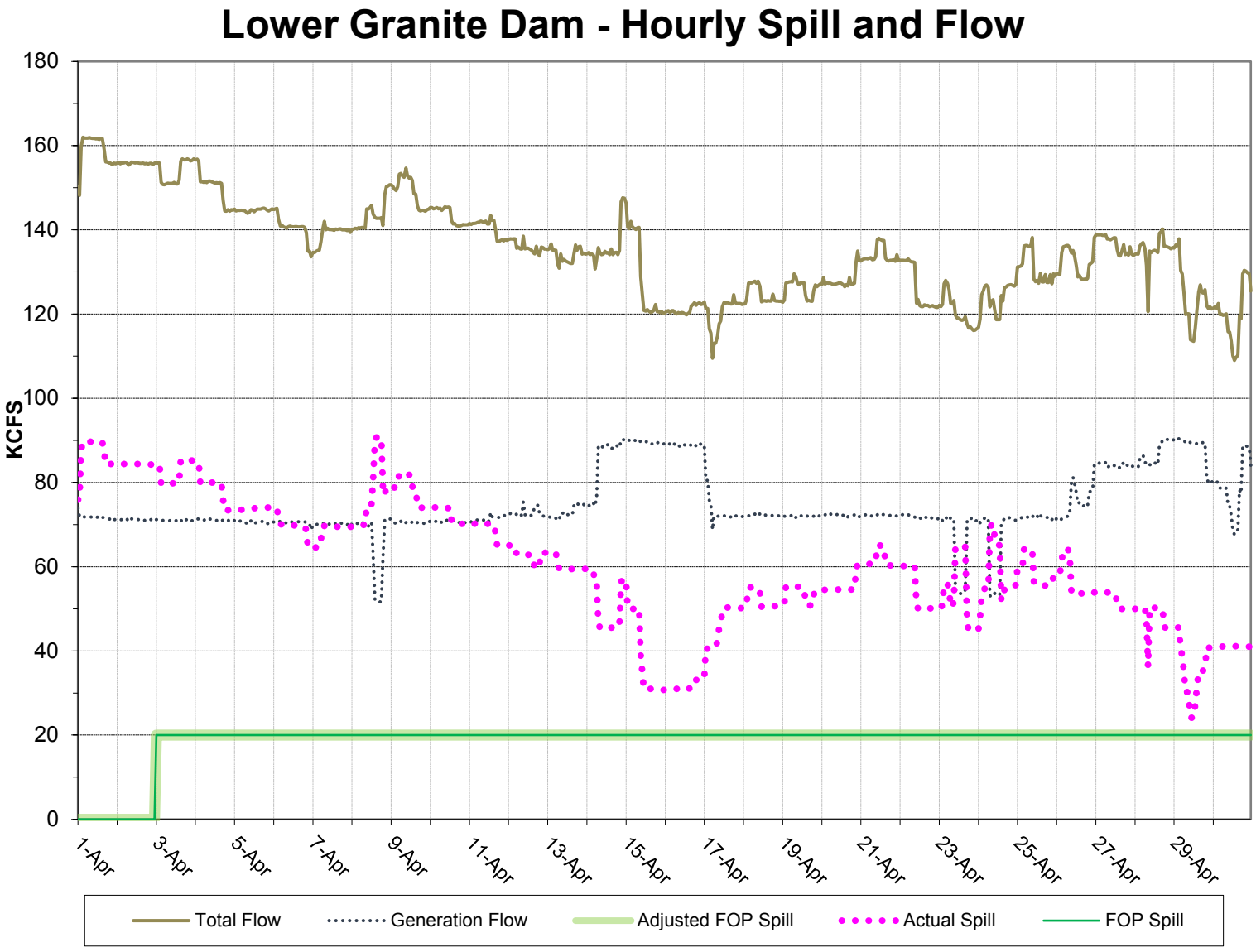

Lower Granite Dam - Hourly Spill and Flow
KCFS
180
160
140
120
100
80
60
40
20
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 2

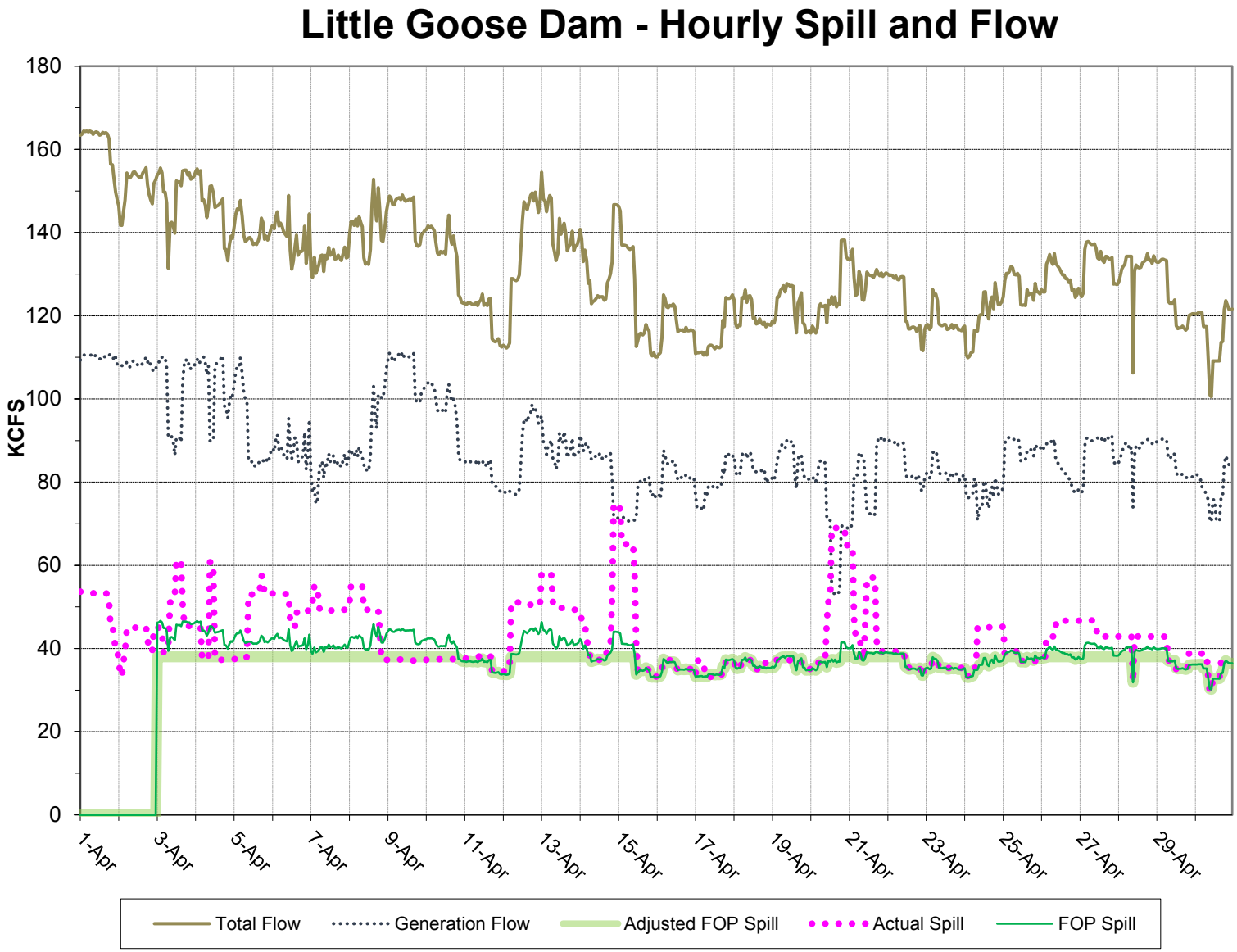

Little Goose Dam - Hourly Spill and Flow
KCFS
180
160
140
120
100
80
60
40
20
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 3

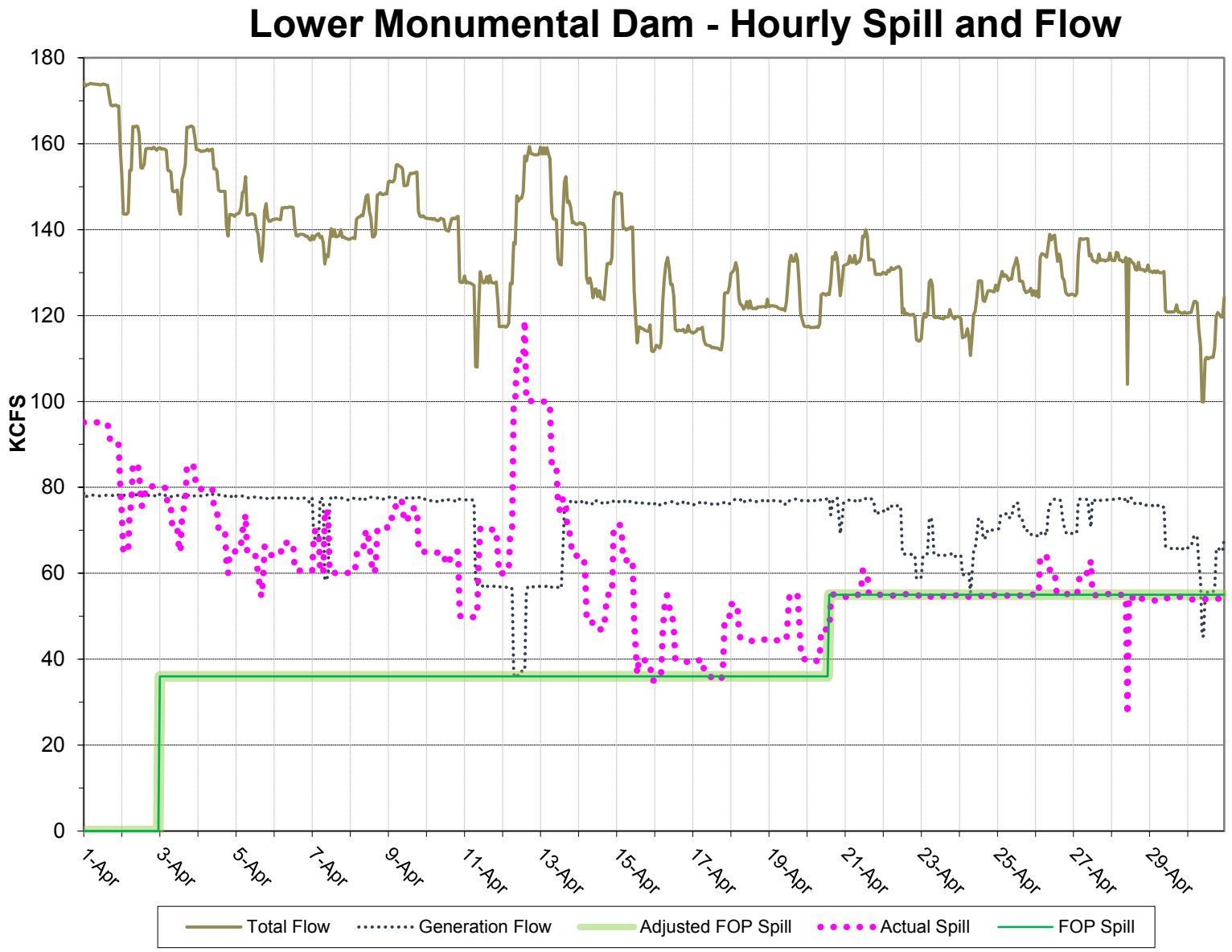

Lower Monumental Dam - Hourly Spill and Flow
KCFS
180
160
140
120
100
80
60
40
20
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 4

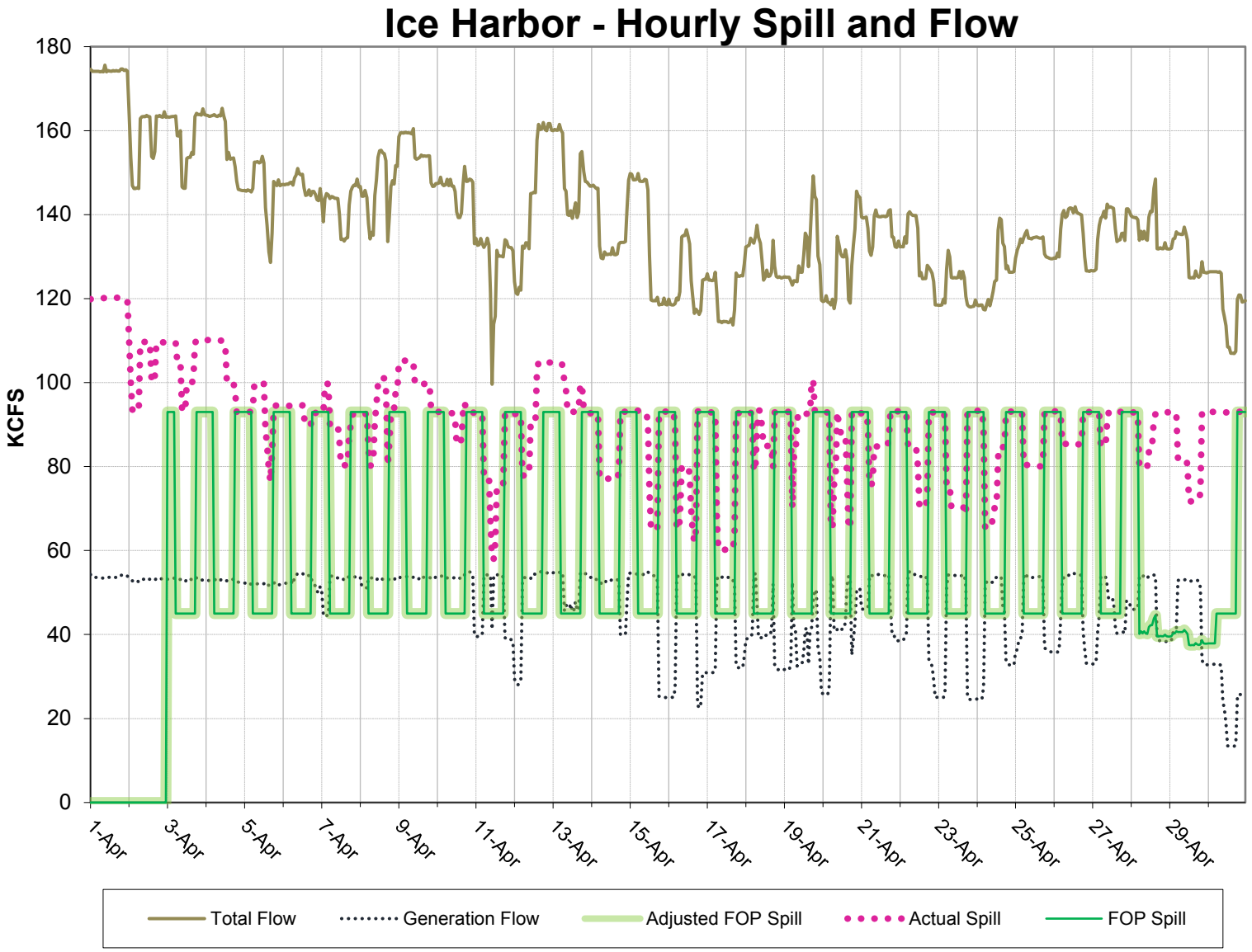

Ice Harbor - Hourly Spill and Flow
KCFS
180
160
140
120
100
80
60
40
20
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 5

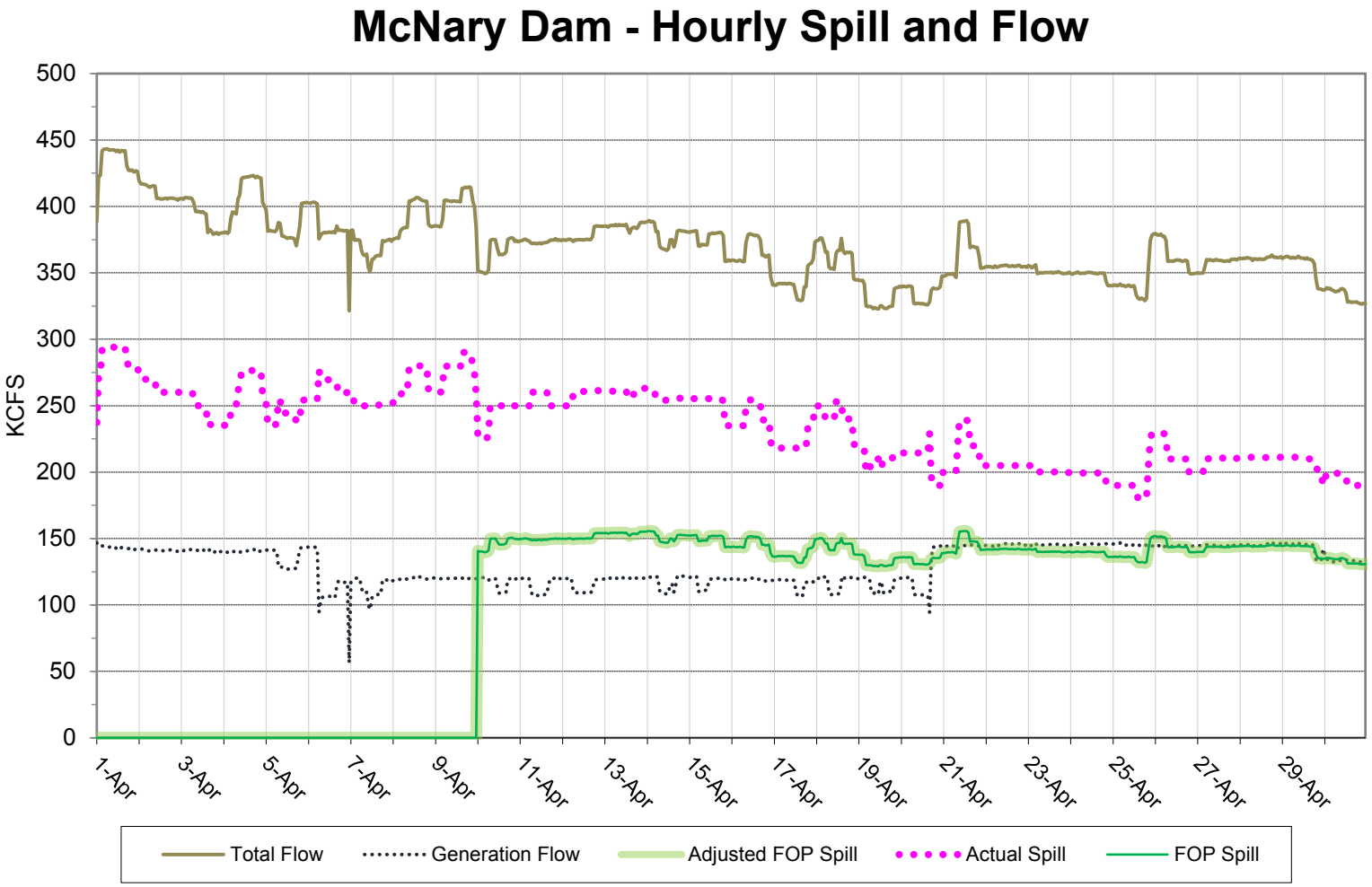

McNary Dam - Hourly Spill and Flow
KCFS
500
450
400
350
300
250
200
150
100
50
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 6

John Day Dam - Hourly Spill and Flow

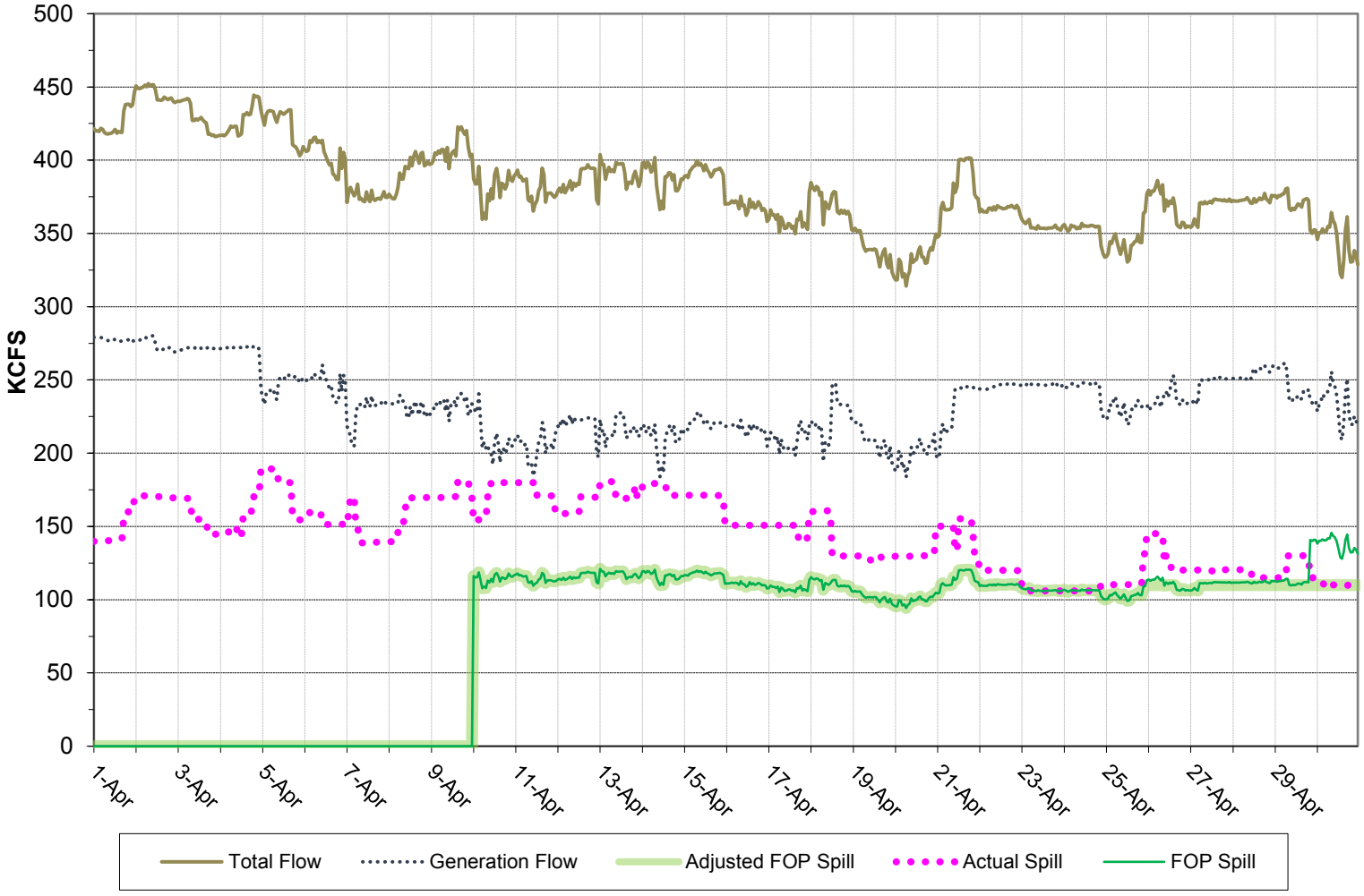


Figure 7

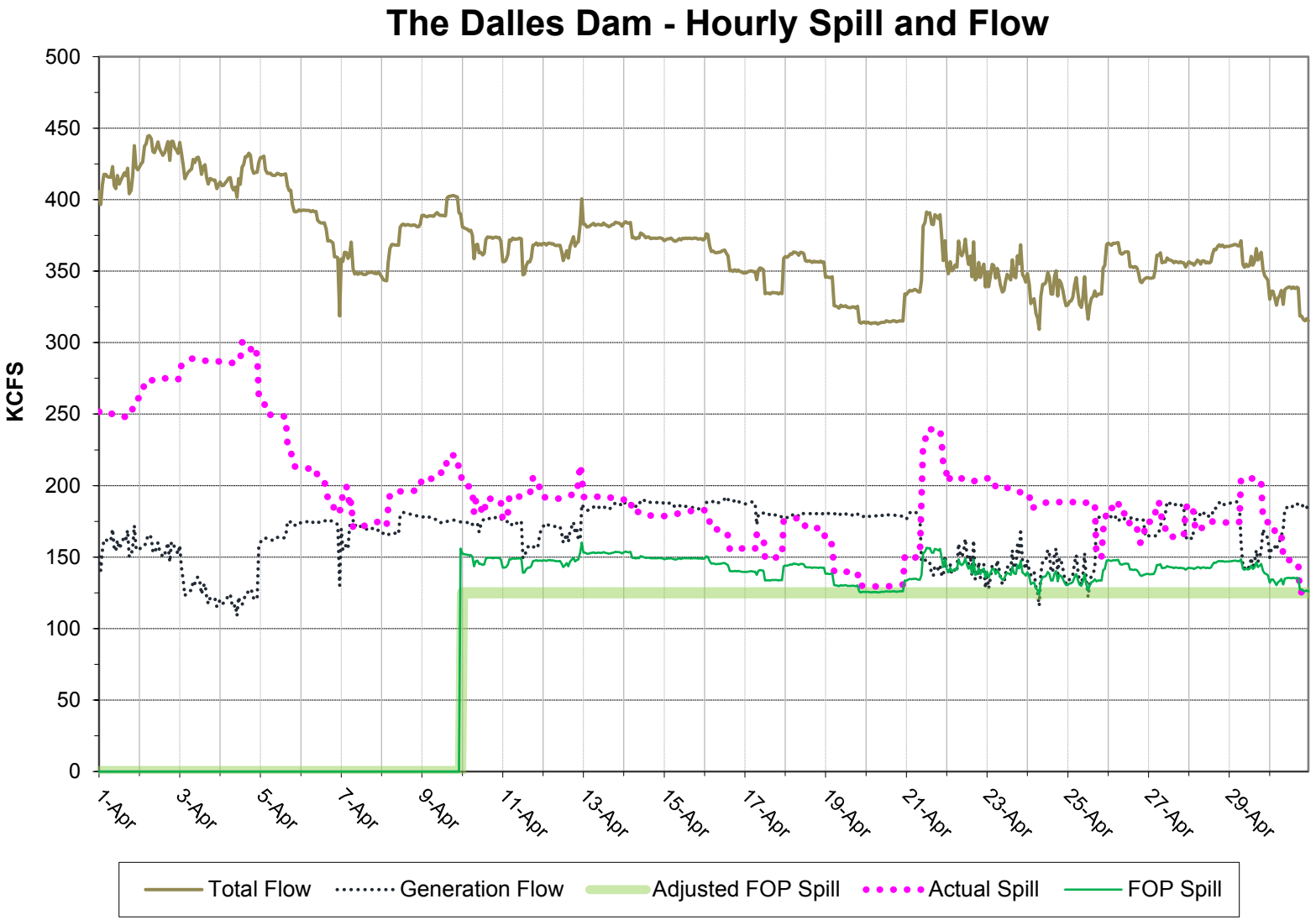
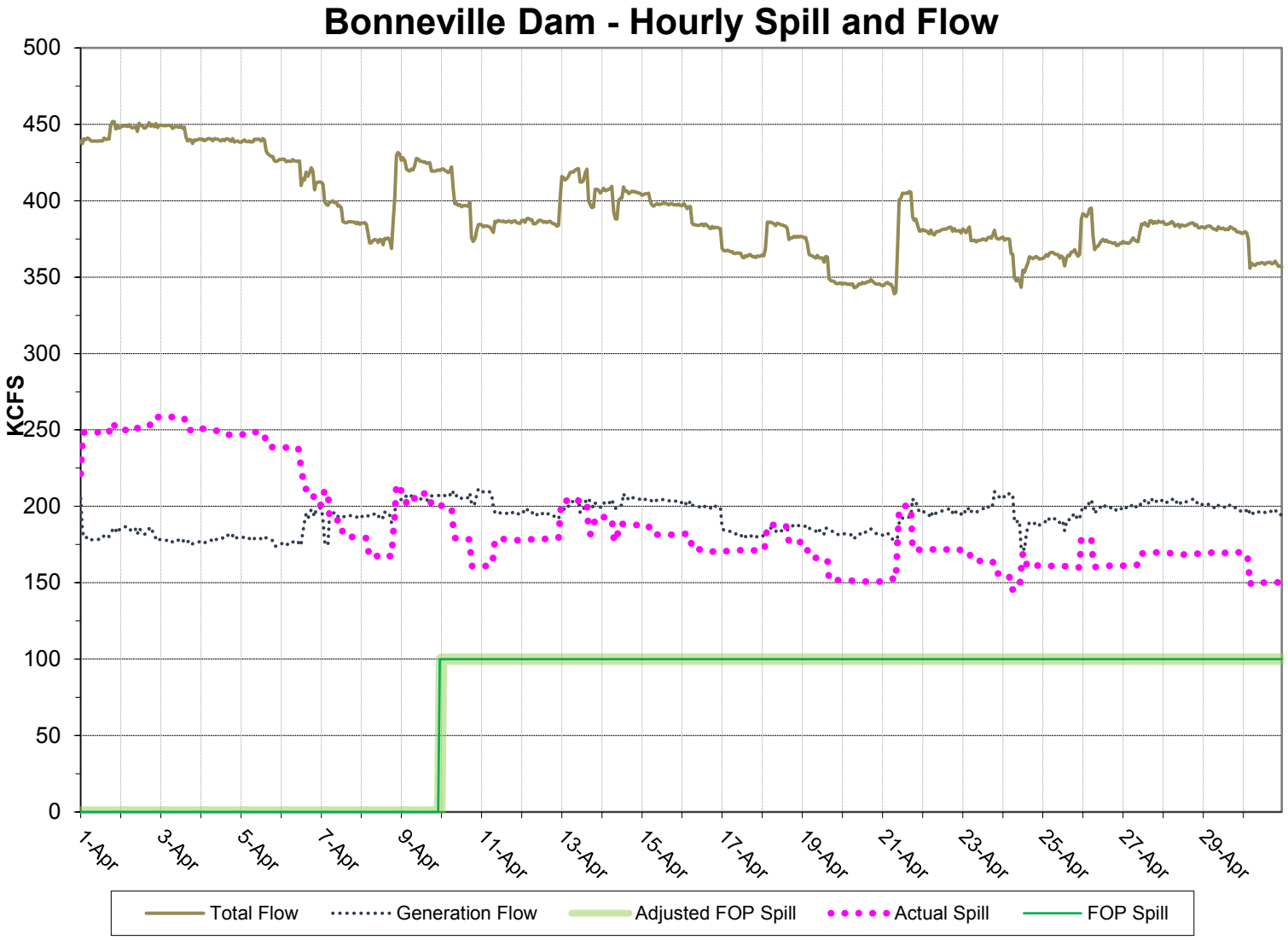

The Dalles Dam - Hourly Spill and Flow
KCFS
500
450
400
350
300
250
200
150
100
50
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 8


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