FISH OPERATIONS PLAN IMPLEMENTATION REPORT

April 2018

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 January 8, 2018 Order (Court Order) from the U.S. District Court for the District of Oregon and 2018 Spring Fish Operations Plan[1] (2018 Spring FOP). The 2018 Spring FOP describes the Corps' project operations for fish passage at its Federal Columbia River Power System (FCRPS) dams during the spring fish migration season, generally April 3 through June 20, 2018. To the extent Corps project operations are not specified in the Court Order or the 2018 Spring FOP, the FCRPS operations will be consistent with the 2014 NOAA Fisheries Supplemental Biological Opinion (2014 Supplemental BiOp), the U.S. Fish and Wildlife Service's 2000 and 2006 Biological Opinions, and/or other operative documents, including the 2018 Water Management Plan (WMP), WMP seasonal updates, and the 2018 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2018 Spring FOP during the month of April 2018 in accordance with the Court Order. In particular, information in this report includes the following:

- total flow: the total hourly river flow rate;
- generation flow: the hourly flow through the powerhouse units;
- target spill: the spill target for that hour, i.e. the spill cap[2];
- adjusted spill: the hourly 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 routine operational adjustments that limit the ability to spill to the target spill (see 2018 Spring FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,

[1] The 2018 Spring FOP was posted to the Technical Management Team (TMT) website on March 1, 2018 (http://pweb.crohms.org/tmt/documents/fpp/2018/).

[2] The terms "spill caps" and "target spill" are typically synonymous and both mean the maximum spill level at each project that is estimated to meet, but not exceed, the gas cap (the applicable state TDG water quality standard) in the tailrace and the downstream forebay; however, in the event the spill cap is constrained (e.g. 150 kcfs maximum spill for Bonneville Dam or containing fish passage spill within the spillwall (bays 1-8) at The Dalles), the monthly FOP Implementation Reports plots will display this level of spill rather than the gas cap spill level. In these specified instances in which the target spill differs from the spill cap, the Corps will provide the spill cap information at the regularly scheduled TMT meetings and reflected in the monthly FOP Implementation Reports.

- the resultant 12-hour average TDG for the tailwater at each project and for the next project's forebay downstream.[3]

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2018 Spring FOP in April 2018.

Data Reporting

I. For each project providing fish passage operations, this report contains a graph displaying the performance of the spring fish passage spill program for the month of April, with hourly spill, target spill, generation, and total flows. The monthly graphs begin on April 1 and end on April 30 and reflect the following operations for the lower Snake River and the lower Columbia River projects:

- 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 generation 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 target spill, i.e., the spill cap.
- The thick green line represents the adjusted spill: the hourly 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 routine operational adjustments that limit the ability to spill to the target spill (2018 Spring FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the April 2018 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 (i.e., controlling limit, labelled "comb" for combined).

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 actual spill levels are below or above the level specified in the 2018 Spring FOP, the dotted pink line will be below or above the thick green line in the figures.[4] When actual spill varied from target spill levels during periods of voluntary

[3] 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. See 2018 Spring FOP section 2.1.

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

spill, the change in spill level is described below in the April 2018 Spill Variance Table (Table 1).[5] The Spill Variance Table includes average hourly data; but when spill varies from target spill for a portion of an hour, it is characterized as a variance for a full hour. There are instances when the hourly target 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 target spill to the extent practicable. Other routine activities that changed spill levels and had been coordinated with regional partners are identified in the monthly Pre-Coordinated Operations Table (Table 2).

"Low flow" operations at the lower Columbia and Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target 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.

Actual spill levels at Corps projects may vary up to ±2 kcfs within the hour (except as otherwise noted in the 2018 Spring FOP for Bonneville and The Dalles dams,[6] which may range up to ±3 kcfs) as compared to a target spill. 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).

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 average to slightly above average air temperatures and above average precipitation across most of the Columbia River Basin. The NOAA Northwest River Forecast Center[7] indicated that the observed April 2018 adjusted runoff for the lower Snake River at Lower Granite was 131% of the 30-year average (1981-2010) with a volume of 5.97 MAF (Million Acre Feet). The April 2018 adjusted runoff for the lower Columbia River at The

[5] 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, passing debris, etc.
[6] As specified in the 2018 Spring FOP section 3.
[7] Retrieved May 2, 2018: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php?date=05/02/2018

Dalles was 119% of the 30-year average (1981-2010) with a volume of 16.5 MAF. The April 2018 observed precipitation was 104% of average on the lower Snake River above Ice Harbor and 118% of average on the lower Columbia River above The Dalles.

During the April 2018 reporting period, the planned 2018 Spring FOP spill operations were carried out as follows:

- Lower Granite Dam – April 3 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.
- Little Goose Dam – April 3 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.
- Lower Monumental Dam – April 3 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.
- Ice Harbor Dam – April 3 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.
- McNary – April 10 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.
- John Day Dam – April 10 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.
- The Dalles Dam – April 10 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.
- Bonneville Dam – April 10 – April 30: spill cap[2] to achieve the 120%/115% Gas Cap.

The 2018 spring fish passage spill operation at the Corps' eight lower Snake and lower Columbia River projects is a more complex operation to implement than the past years' operations. In its implementation of the 2018 Spring FOP in April, the Corps evaluated conditions every day to establish spill caps at a level that was estimated to meet, but not exceed, the gas cap in the tailrace and the next downstream forebay (see Table 3).[8] This evaluation considered: environmental conditions (e.g., river flow, wind, water temperature, barometric pressure, incoming TDG from upstream, and water travel time) and project operations (e.g., spill level, spill pattern, tailwater elevation, proportion of flow through the turbines, and project configuration). For the month of April 2018, conditions constraining the spill cap at Bonneville and The Dalles dams did not occur.[2]

Operational Adjustments

There are no operational adjustments to report for April 2018.

[8] See 2018 Spring FOP section 2.2 and attachment "Procedure for Setting 2018 Spring Spill Caps."

Table 1: Spill Variance Table – April 2018 (4/1 to 4/30)

Project	Parameter	Date	Time[9]	Hours	Type	Reason
Ice Harbor	Reduced Spill	4/3/18	0200	1	Operational Limitation	Hourly spill was below adjusted spill while minimum generation exceeded the range for Unit 1 (8.4 – 9.8 kcfs[10]) to 10.1 -10.2 kcfs. Normal system operations and river conditions can cause small changes in turbine flow which can result in operations outside the minimum generation flow range.
		"	0900	1		
		"	1100-1400	4		
		"	2300	1		
		4/4/18	0100	1		
		"	0700	1		
		"	1400	1		
		"	1600-2000	5		
		"	2300-2400	2		
		4/5/18	0200-0600	5		
McNary	Reduced Spill	4/10/18	0700-1100	5	Human Error	Hourly spill was 178 kcfs (less than the target spill of 190 kcfs), while generation ranged from 75 to 107 kcfs due to a miscalculation of spill.
John Day	Additional Spill	4/13/18	1500	1	Human Error	Hourly spill was 143 kcfs (greater than the target spill of 140 kcfs), due to implementing spill cap change earlier than scheduled.

[9] Data collected for reporting spill variances and pre-coordinated operations is reported using hourly-averaged data. Therefore, while spill may be increased or decreased for only a portion of an hour, it is represented as an hour.

[10] Range does not include ± 2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Ice Harbor turbine unit 1, the range is 8.2 – 10.0 kcfs. See 2018 Spring FOP section 4.3.1.

Table 2: Pre-Coordinated Operations – April 2018 (4/1 to 4/30)

Project	Parameter	Date	Time[9]	Hours	Type	Reason
Little Goose	Additional Spill	4/17/18	1000-1100	2	Maintenance	Hourly spill increased to 48 and 44 kcfs (above the target spill of 37 kcfs) while removing debris from trashracks which necessitated a generation flow decrease. Regionally coordinated via 2018 FPP, page LGS-12, Section 2.3.2.1.v.
Lower Monumental	Reduced Spill	4/15/18 4/22/18 4/24/18 4/25/18 4/26/18 4/27/18 4/30/18	1600 1400 1900-2100 1900-2100 1900-2100 1800-2000 1800	1 1 3 3 3 3 1	Navigation	Hourly spill reduced below target spill for safe navigation. Regionally coordinated via 2018 Spring FOP, Sections 4.1 and 4.6.

Table 3: April 2018 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	Comb	WA	Comb	WA	Comb	WA	Comb
4/1/2018	105	107	107	107	105	105	104	107	105	104	104	103	104	104	105	112
4/2/2018	105	107	107	107	105	105	104	107	105	105	104	103	103	104	104	112
4/3/2018	103	117	105	118	104	116	104	115	103	107	103	103	103	107	104	111
4/4/2018	103	118	105	118	105	116	104	115	103	108	103	103	103	106	106	110
4/5/2018	103	119	105	117	116	117	112	116	105	112	104	104	104	107	107	111
4/6/2018	104	119	111	118	119	117	116	116	107	112	105	105	105	108	110	113
4/7/2018	106	120	117	117	120	117	118	118	108	113	106	106	105	108	110	113
4/8/2018	105	120	117	117	119	118	118	119	108	113	106	110	105	108	109	113
4/9/2018	104	118	115	116	114	118	113	120	107	114	106	111	106	110	108	114
4/10/2018	104	119	116	116	117	118	116	120	109	118	108	120	114	118	111	120
4/11/2018	106	119	118	116	118	118	117	121	112	120	108	119	116	120	116	121
4/12/2018	106	119	118	116	118	118	117	121	112	120	108	118	115	120	118	120
4/13/2018	104	118	114	114	114	117	113	120	107	119	108	119	114	118	116	120
4/14/2018	103	118	112	115	113	118	113	120	108	120	111	119	116	119	118	120
4/15/2018	106	118	116	116	117	118	116	121	111	120	112	119	118	120	120	121
4/16/2018	106	118	117	116	117	118	116	121	111	120	112	119	118	119	120	121
4/17/2018	106	118	115	116	115	117	113	120	109	120	112	119	114	117	115	119
4/18/2018	103	118	111	116	114	117	112	119	106	120	113	119	116	119	117	120
4/19/2018	104	118	113	116	116	117	114	119	110	120	112	119	116	119	118	120
4/20/2018	105	119	116	116	117	117	116	119	113	120	111	119	116	117	118	120
4/21/2018	105	118	116	116	117	117	116	119	113	120	113	118	116	117	117	120
4/22/2018	105	118	116	116	116	116	115	118	112	120	115	118	117	118	116	119
4/23/2018	105	118	116	116	116	116	116	118	113	120	116	118	117	118	116	120
4/24/2018	106	118	118	116	117	117	117	118	114	120	116	118	118	118	117	120
4/25/2018	106	117	119	116	118	116	117	119	115	120	118	118	118	118	118	120
4/26/2018	107	117	119	116	118	116	118	119	116	120	121	118	118	117	118	121
4/27/2018	107	117	120	117	119	116	119	120	117	119	121	118	119	118	118	121
4/28/2018	107	115	119	116	119	117	118	119	116	119	120	117	115	115	114	120
4/29/2018	105	115	115	117	116	119	115	119	112	118	117	119	114	120	113	122
4/30/2018	104	115	112	118	116	119	115	119	113	120	113	119	113	119	116	123

Figure 1

Lower Granite Dam - Hourly Spill and Flow

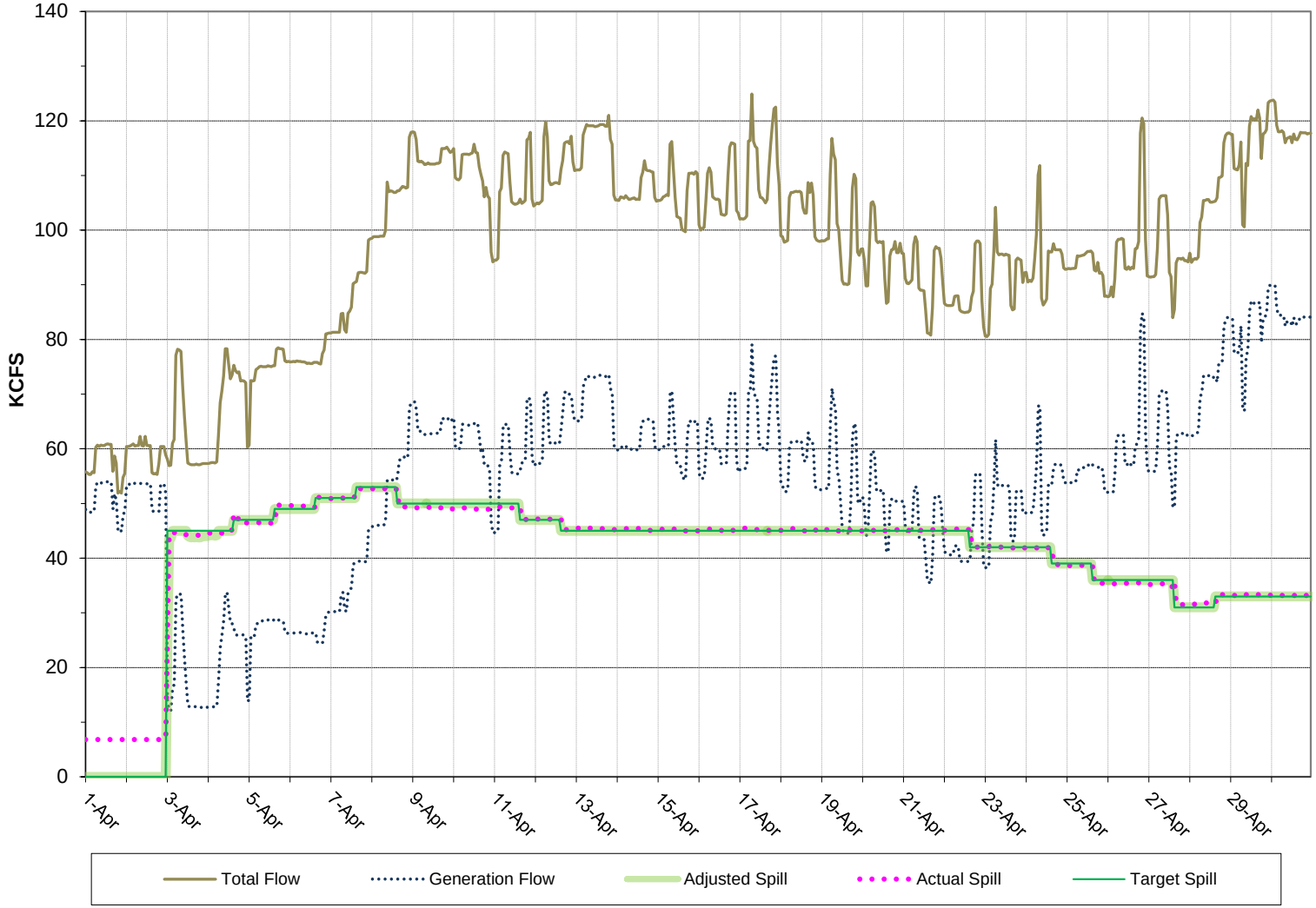


Figure 2

Little Goose Dam - Hourly Spill and Flow

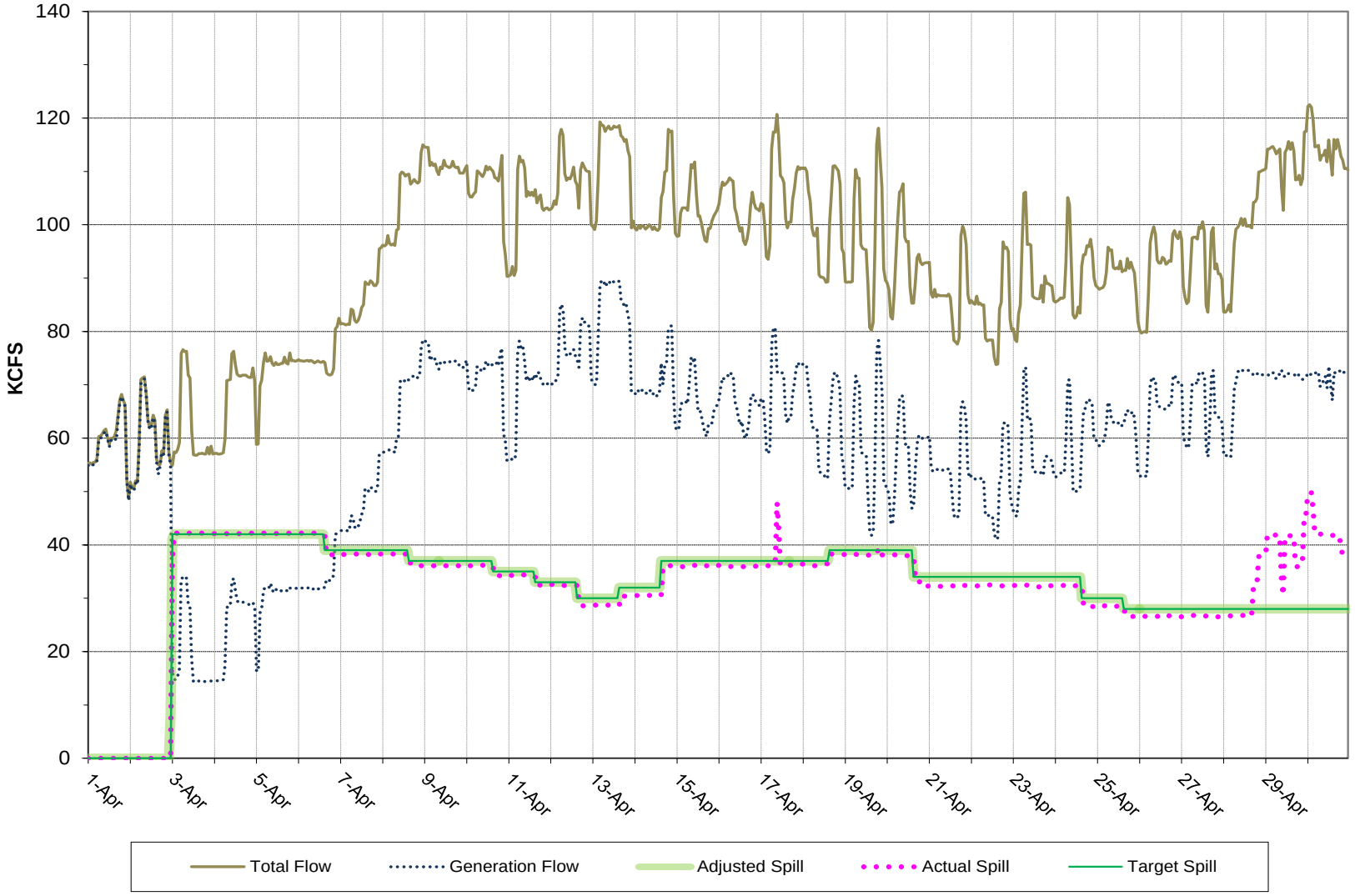


Figure 3

Lower Monumental Dam - Hourly Spill and Flow

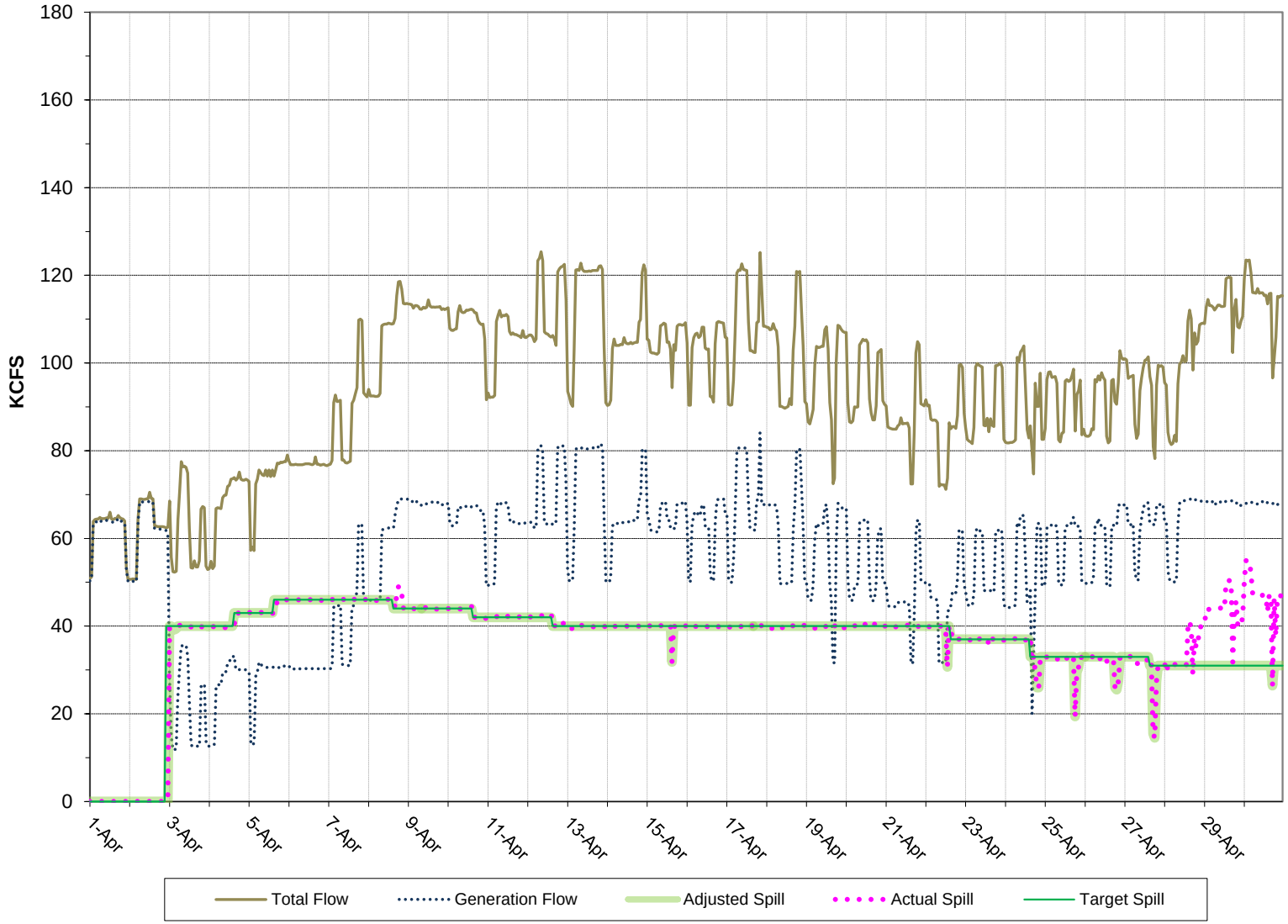


Figure 4

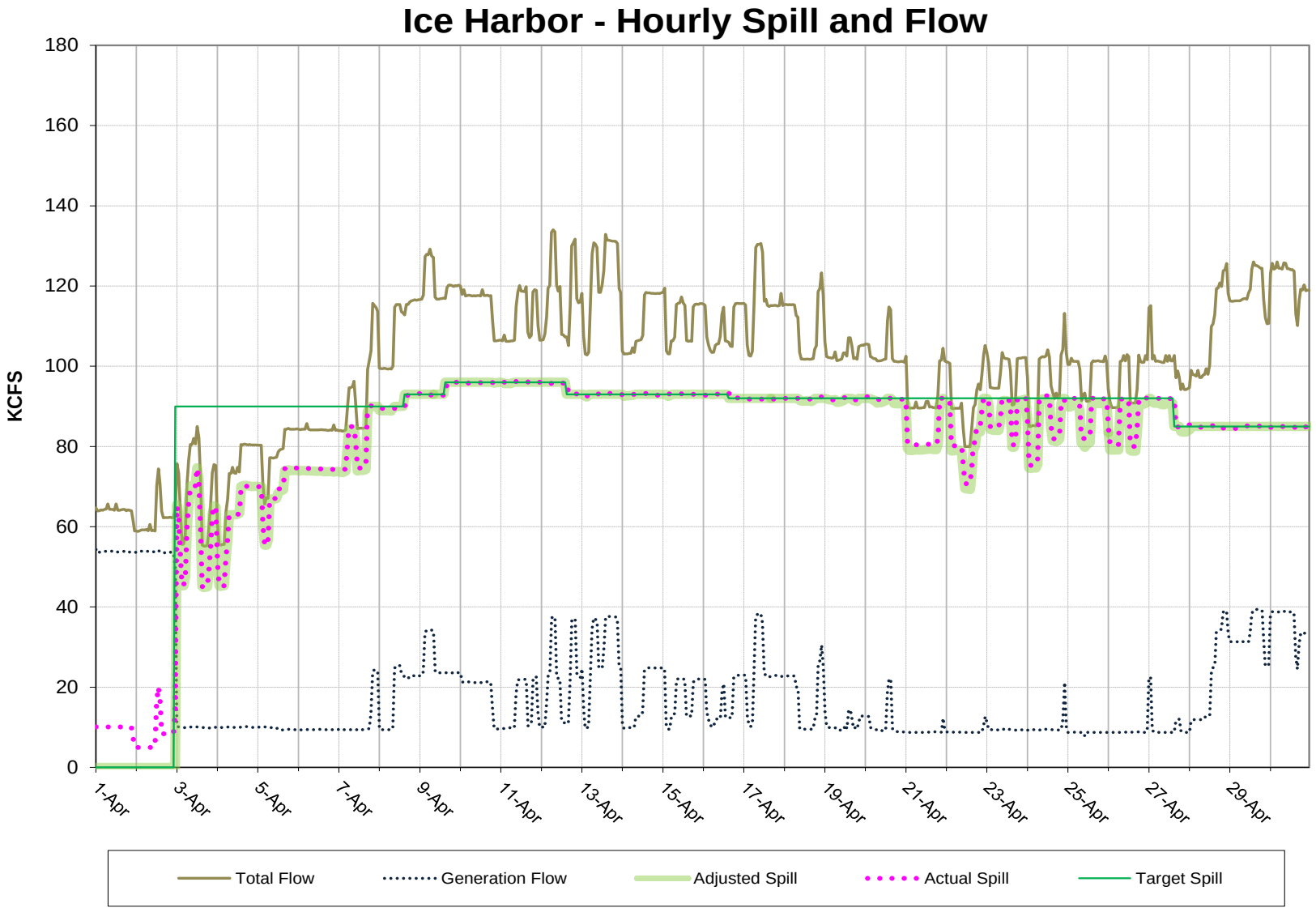

Ice Harbor - Hourly Spill and Flow
KCFS
180
160
140
120
100
80
60
40
20
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted Spill
Actual Spill
Target Spill

Figure 5

McNary Dam - Hourly Spill and Flow

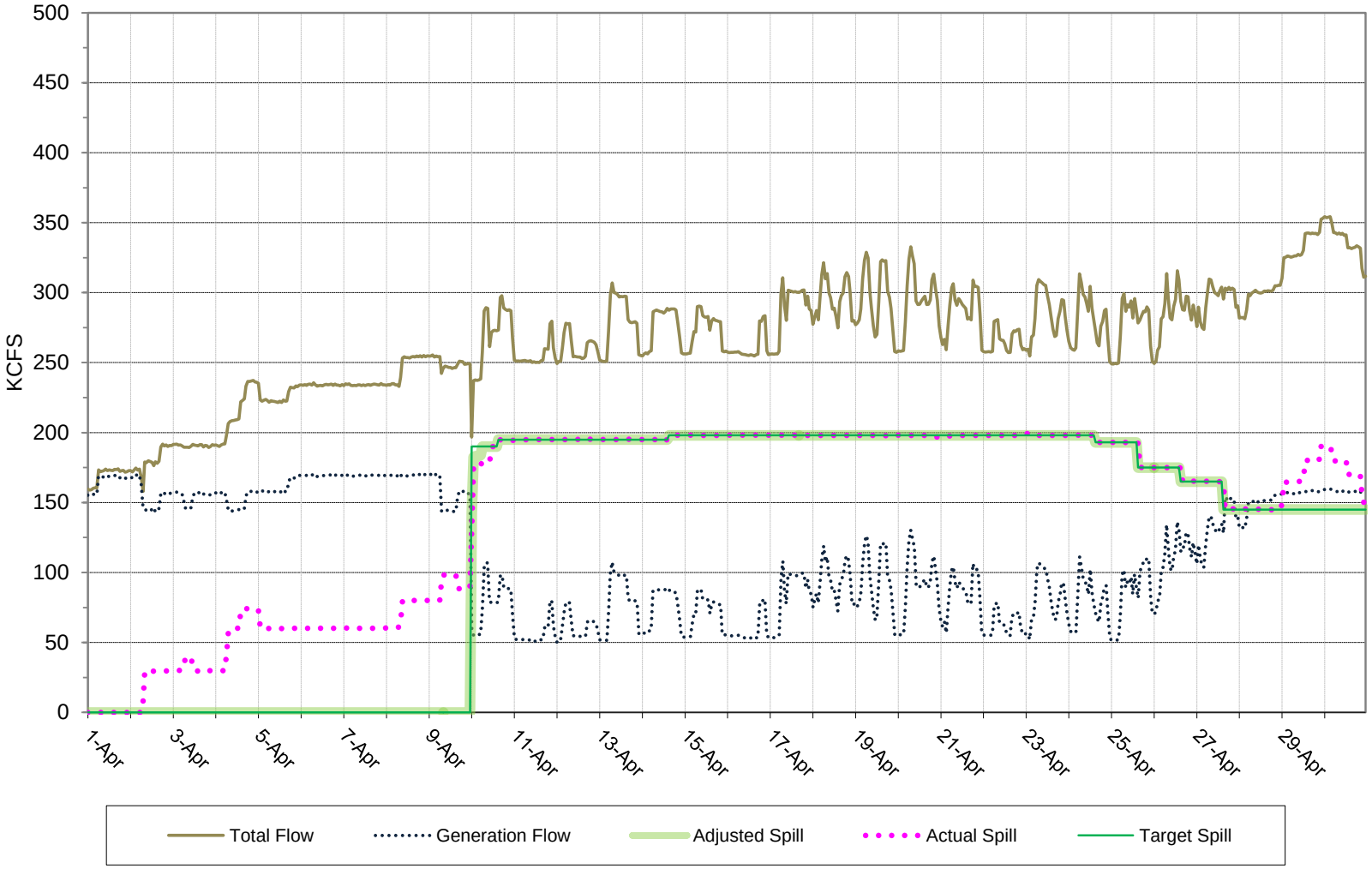


Figure 6

John Day Dam - Hourly Spill and Flow

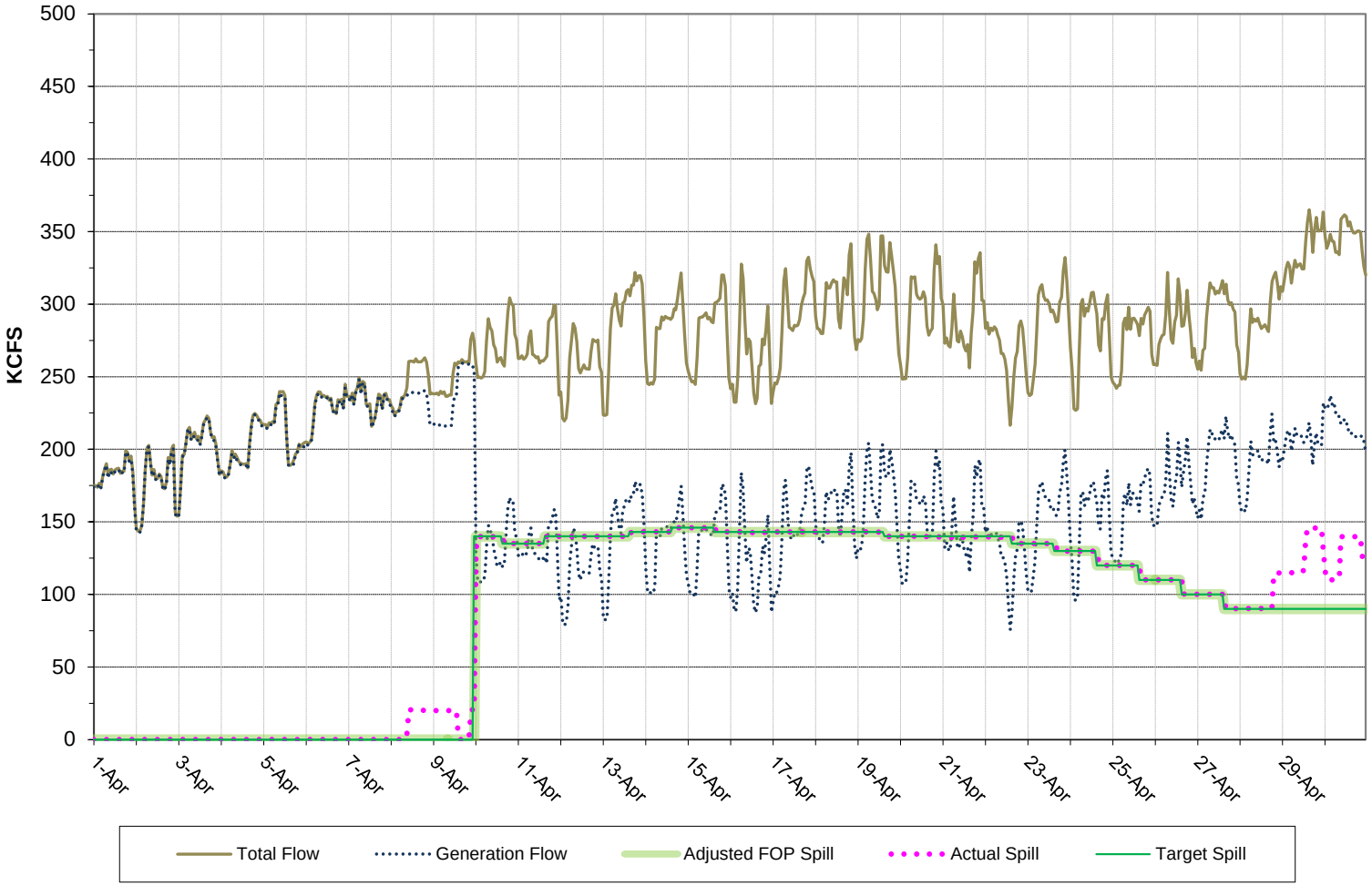


Figure 7

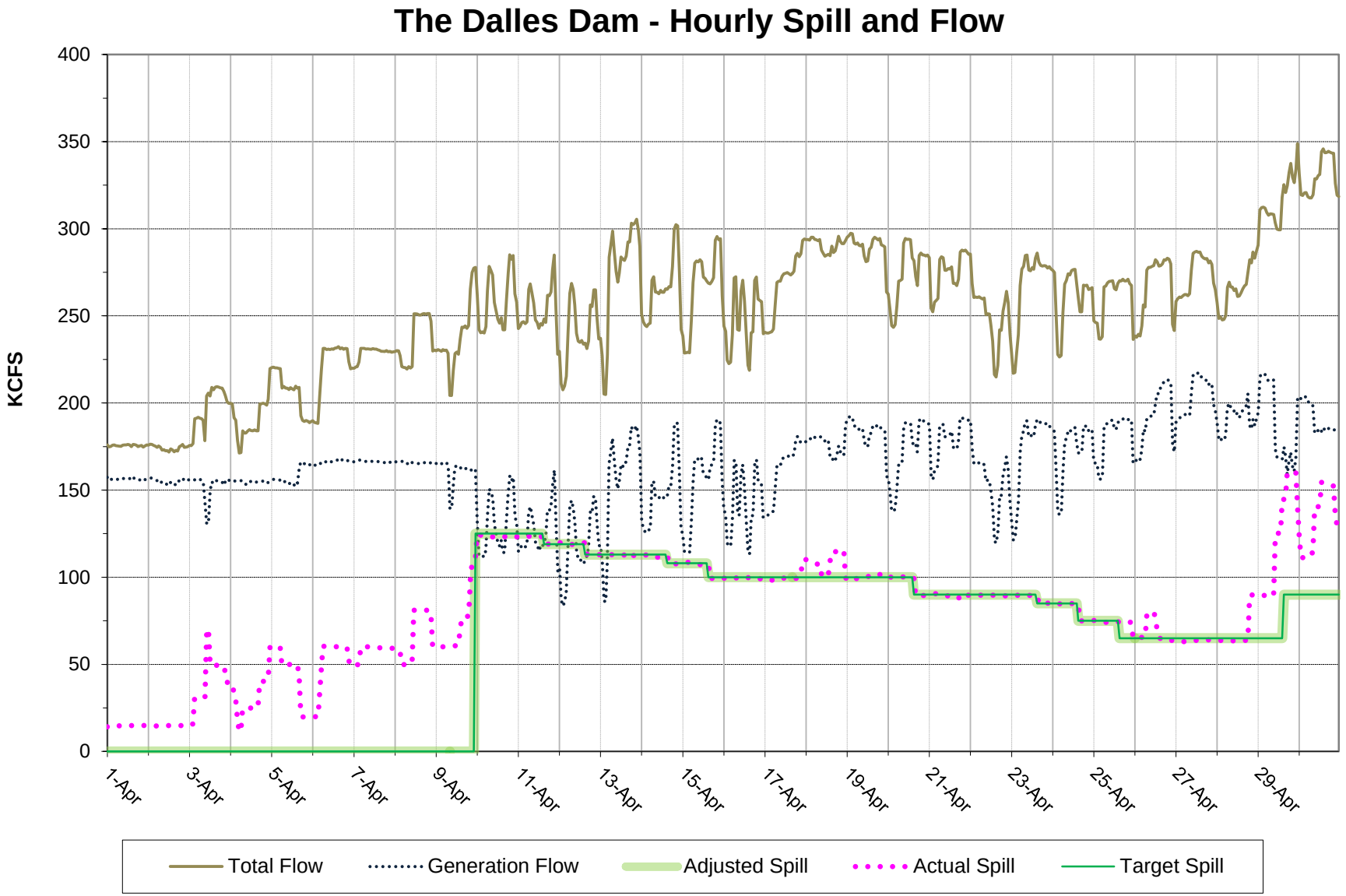
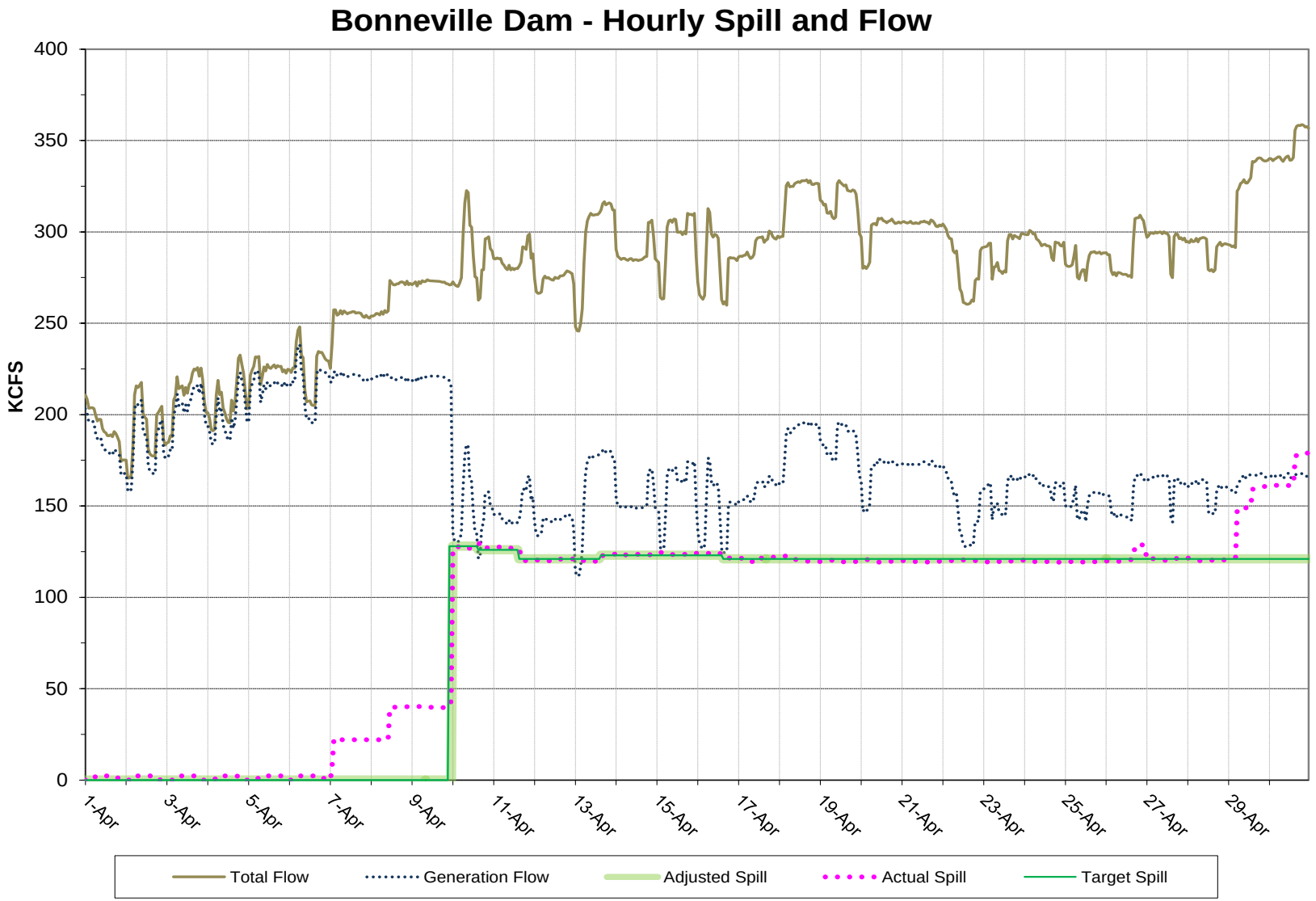

The Dalles Dam - Hourly Spill and Flow
KCFS
400
350
300
250
200
150
100
50
0
1-Apr
3-Apr
5-Apr
7-Apr
9-Apr
11-Apr
13-Apr
15-Apr
17-Apr
19-Apr
21-Apr
23-Apr
25-Apr
27-Apr
29-Apr
Total Flow
Generation Flow
Adjusted Spill
Actual Spill
Target Spill

Figure 8


Bonneville Dam - Hourly Spill and Flow
KCFS
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 Spill
Actual Spill
Target Spill