Appendix C

2020 FOP Implementation Reports

With Hourly Spill, Flow and Generation Graphs

FISH OPERATIONS PLAN IMPLEMENTATION REPORT

April 2020

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

Introduction

The U.S. Army Corps of Engineers (Corps) developed this report in accordance with the 2020 Fish Operations Plan[1] (2020 FOP). The 2020 FOP describes the Corps' planned operations for juvenile fish passage at its four lower Snake River and four lower Columbia River dams during the 2020 spring and summer fish migration seasons, generally April 3 through August 31. The 2020 FOP is consistent with spill operations for juvenile fish passage and the regional forum process for adaptive management and in-season management provisions outlined in the 2019 NOAA Fisheries Columbia River System Biological Opinion (2019 BiOp)[2], the 2018 Extensions of the 2008 Columbia Basin Fish Accords (Accord Extensions), the 2019-2021 Spill Operation Agreement (Agreement) and subsequent Addendum, the Corps' requirements under the Endangered Species Act (ESA), and is the subject of ongoing consultation and communications with the relevant wildlife agencies to ensure consistency with the ESA. Other project operations and water management actions not specifically addressed in this document will be consistent with the 2019 BiOp and other guiding operative documents, including the 2020 Water Management Plan (WMP), seasonal WMP updates, and the 2020 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2020 FOP during the month of April 2020. 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 (Table 1);
- 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 2020 FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,
- resultant 12-hour average TDG for the tailwater at each project.

[1] The 2020 FOP was posted to the Technical Management Team (TMT) website on March 23, 2020 (http://pweb.crohms.org/tmt/documents/fpp/2020/).
[2] The Corps, in coordination with the other Action Agencies, and National Marine Fisheries Service (NMFS), employs the Regional Implementation Oversight Group (RIOG) and technical teams including the Technical Management Team (TMT) and Fish Passage Operations & Maintenance (FPOM), to coordinate with state, tribal and other federal experts for recommendations for implementing operations consistent with NMFS' Columbia River System Biological Opinions.

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2020 FOP in April 2020.

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, adjusted 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 black line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The orange line represents the average hourly generation flow through the powerhouse each hour in kcfs.
- The thin solid blue line represents the actual average hourly spill level through the spillway in kcfs.
- The dashed blue line represents the spill cap portion of the target spill estimated to reach the gas cap or target TDG.
- The thick light blue line represents the performance standard spill level portion of the target spill.
- The thick dark blue line represents the adjusted spill cap spill: the hourly spill cap 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 (2020 FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the April 2020 Average Percent TDG Values Table (Table 4). The numbers in red indicate the project exceeded the %TDG cap - i.e. 125% (tailwater) for each project.

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the adjusted spill due to various conditions as described below. When actual spill varied from adjusted spill levels during periods of voluntary spill, the change in spill level is described below in the April 2020 Spill Variance Table (Table 2).[3] The Spill Variance Table includes average hourly data; but when spill varies from adjusted spill for a portion of an hour, it is characterized as a variance for a full hour. There are instances when the hourly adjusted 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 adjusted spill to the extent practicable. Other routine activities that changed spill levels, which were coordinated with regional partners, are identified in the monthly Pre-Coordinated Operations Table (Table 3).

[3] 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.

"Low flow" operations at the lower Columbia and lower Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target spill levels. For this report, the decrease in target spill is represented as adjusted spill. 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 2020 FOP for Bonneville and The Dalles dams,[4] 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). Transition periods between gas cap spill and performance standard spill hours may result in actual hourly spill levels that are slightly higher or lower than target spill levels.

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 below average precipitation and below average flows for the lower Snake and lower Columbia Rivers. The April 2020 observed precipitation was 67% of average on the Snake River above Ice Harbor and 62% of average on the Columbia River above The Dalles. The NOAA Northwest River Forecast Center runoff summary for April indicated that the adjusted runoff for the Snake River at Lower Granite was 80% of the 30-year average (1981-2010) with a volume of 3.6 MAF (Million acre-feet)[5]. The April 2020 adjusted runoff for the Columbia River at The Dalles was 76% of the 30-year average (1981-2010) with a volume of 13.8 MAF[6].

Spring spill operations occur April 3–June 20 at the four lower Snake River projects, and April 10–June 15 at the four lower Columbia River projects. Target spill levels for April 2020 at each project are defined in Table 1.

[4] As specified in the 2020 FOP section 3.

[5] Retrieved May 4, 2020: https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=5

[6] Retrieved May 4, 2020: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

Table 1: Summary of 2020 spring target spill levels at lower Snake River and lower Columbia River projects.

PROJECT	FLEX SPILL (16 hours per day)[A, B, C, E]	PERFORMANCE STANDARD SPILL (8 hours per day)[B, D, E]
Lower Granite[E]	125% Gas Cap	20 kcfs
Little Goose[F, G]	125% Gas Cap	30%
Lower Monumental	125% Gas Cap (uniform spill pattern)	30 kcfs (bulk spill pattern[H])
Ice Harbor	125% Gas Cap	30%
McNary	125% Gas Cap	48%
John Day	120% TDG target	32%
The Dalles[I]	40%	40%
Bonneville[J]	125% Gas Cap	100 kcfs

A. Attempts should be made to minimize in-season changes to the proposed operations; however, if serious deleterious impacts are observed, existing adaptive management processes may be employed to help address serious issues that may arise in-season as a result of implementing these proposed spill operations.

B. Spill may be temporarily reduced at any project if necessary to ensure navigation safety or transmission reliability. In order to operate consistently with state water quality standards, spill may be also reduced if observed Gas Bubble Trauma (GBT) levels exceed those identified in state water quality standards (see WASH. ADMIN. CODE §173-201A-200(l)(f))).

C. 125% Gas Cap spill is spill to the maximum level that meets, but does not exceed, the TDG criteria allowed under state laws. This includes a criterion for not exceeding 126% TDG for the average of the two greatest hourly values within a day.

D. The 8 hours of performance standard spill may occur with some flexibility (with the exception of Little Goose and Lower Granite operations described in the next key points). Other than at TDA, performance standard spill occurs in either a single 8-hour block or up to two separate blocks per calendar day. No more than 5 hours of performance standard spill may occur between sunset and sunrise, as defined in Fish Passage Plan (FPP) Table BON-5. Performance standard spill is not be implemented between 2200-0300 hours. No ponding above current MOP assumptions except as noted below.

E. Lower Granite Exception One - If adult passage delays are observed at Lower Granite Dam, the Corps may implement performance standard spill at Lower Granite Dam for at least 4 hours in the AM (beginning at 0500 hours). Implementation of this modification may also trigger in-season reevaluation of options to balance power principle.

F. Little Goose Exception One - As soon as practicable (and, in any event, no more than 24 hours) after a cumulative total of 25 adult spring Chinook salmon (not including jacks) pass Lower Monumental Dam, operate Little Goose spill at 30% spill for 8 consecutive am hours (April 3-15 start at 0500 hours; April 16-June 20 start at 0400 hours).

G. Little Goose Exception Two - During periods of involuntary spill, spill at 30% for 8 hours/day during the hours described in footnote F above and store additional inflows that exceed hydraulic capacity in the forebay above MOP if necessary. When it is necessary to pond water to achieve the lower spill levels due to high inflow, water stored above MOP should be drafted out over the remaining hours by increasing spill to pass inflow from 1200-1600 hours (or 1300-1700 hours from April 3-15), then increasing spill as necessary from 1600-0400 (or 1700-0500 hours from April 3-15) to draft the pool back to MOP. If it is forecast that the drafting spill will generate TDG levels in the tailrace in excess of 130% TDG, use all 16 hours to return the pool to MOP.

H. If the specified spill level at bulk pattern exceeds the gas cap, then spill pattern will be changed to uniform.

I. Fish passage spill at The Dalles should be limited to spillbays 1-8 unless river flow exceeds 350 kcfs, then spill outside the spillwall is permitted. TDG levels in The Dalles tailrace may fluctuate up to 125% TDG prior to reducing spill at upstream projects or reducing spill below 40% at The Dalles.

J. Fish passage spill at Bonneville Dam should not exceed 150 kcfs due to erosion concerns.

In its implementation of the 2020 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 or target TDG in the tailrace (see Table 4).[7] 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).

Starting on April 21 at 0001 hours, Little Goose transitioned to the spring spill operation to maintain spill at 30% of outflow for an 8-hour block each day from 0400 through 1200 hours. This operation was triggered by a cumulative total count of more than 25 adult Chinook at Lower Monumental on April 20, pursuant to criteria in the 2020 FOP (see Table 1 above, footnotes F and G). This operation will continue for the remainder of spring spill.

Operational Adjustments

1. Little Goose

Beginning April 16 at 1800 hours and continuing for the remainder of spring juvenile fish passage spill (through June 20), the operation to manually restrict Little Goose Dam turbine unit 1 to the upper 1% operating range (approximately 16–18 kcfs) was modified to no longer apply during hours of spill to the 125% TDG cap. This modification was requested by regional salmon managers at the FPOM meeting on April 9, then coordinated further via FPOM conference calls on April 14 and April 16 (see FPOM Memo of Coordination 20 LGS 03). The intent of the operation was to allow Unit 1 to operate in the lower 1% range (approximately 11–12 kcfs) during minimum generation in order to pass more flow through the spillway. During hours of 30% spill, the operation of Unit 1 in the upper 1% was maintained in order to prioritize powerhouse flow through the southernmost units to the extent possible and push out the eddy that forms in the tailrace when spilling through the adjustable spillway weir (ASW), per criteria in the 2020 FPP section 4.2.3.

[7] See 2020 FOP section 2.2

Table 2: Spill Variance Table – April 2020 (4/1 to 4/30)

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Lower Granite	Reduced Spill	4/8	0000-0300	4	Program Error	Hourly spill decreased to 29.5 kcfs (less than adjusted spill of 29.6 kcfs) while generation was 13.3 kcfs, greater than the minimum generation range for Unit 1 (11.8-12.9 kcfs[9]).
Little Goose	Reduced Spill	4/3 4/5 4/16 4/17	1900-2300 1400-2300 2200-2400 0100-0500	5 10 3 5	Human Error	Hourly spill decreased to between 9 kcfs and 36 kcfs (less than adjusted spill of between 13 and 37 kcfs), while generation was between 12.1 and 16.0 kcfs, greater than the minimum range for Unit 1 (11.3-11.8 kcfs[10])due to incorrect settings for operations.[11]
Little Goose	Reduced Spill	4/8	1200	1	Human Error	Hourly spill decreased to 27.8% of total flow (less than adjusted spill of 30% ± 1%) due to a miscommunication of the planned spill operation.

[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.
[9] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Lower Granite turbine Unit 1, the range is 11.6 – 13.2 kcfs. See 2020 FOP section 4.3.1.
[10] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Lower Monumental turbine Unit 1, the range is 11.1 – 12.0 kcfs. See 2020 FOP section 4.3.1.
[11] Minimum generation range changed with hourly flow rate, see 2020 FOP section 4.3.1. Corrective action was taken with project staff.

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Little Goose	Additional Spill	4/8	1400-1800	5	Human Error	Hourly spill increased to between 30 kcfs and 39 kcfs (greater than adjusted spill of 24 -33 kcfs), while generation was 12 kcfs, less than the minimum range for Unit 1 (16 – 18 kcfs), due to incorrect use of minimum generation range.
Little Goose	Additional Spill	4/13	0700-1800	12	Maintenance	Hourly spill increased to between 45 kcfs and 55 kcfs (greater than adjusted spill of between 30 and 35 kcfs). During a planned transmission line outage, the unit relied upon for generation (Unit 6) malfunctioned. No other units were available.
Little Goose	Reduced Spill	4/16	1200-1400	3	Maintenance	Hourly spill held at 36 kcfs (less than adjusted spill between 37 and 39 kcfs) while generation was 21 kcfs, greater than the minimum generation range for Unit 1 (16-18 kcfs) due to unscheduled testing of Unit 6 because of a malfunction..

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Ice Harbor	Reduced Spill	4/8	0300	1	Human Error	Hourly spill decreased to 25.1 kcfs (less than adjusted spill of 25.2 kcfs) while generation was 10.4 kcfs, greater than the minimum generation range for Unit 1 (8.4 – 10.1 kcfs[12]).
John Day	Additional Spill	4/30	1100	1	Program Error	Hourly spill was 149 kcfs (greater than adjusted spill of 147 kcfs) while generation was 48 kcfs, less than the minimum generation range of 50 – 60 kcfs[13], due to a change in generation to respond to a malfunctioning forebay gauge.
Bonneville	Reduced Spill	4/15	1900-2200	4	Program Error	Hourly spill decreased to 96 kcfs (less than adjusted spill target of 100 +/- 3 kcfs). The program that sets gate position based on spill patterns was not correctly configured with one gate out of service due to lack of power.

[12] 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 8.2-10.3 kcfs. See 2020 FOP section 4.3.1.

[13] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges, the range is 49 – 61 kcfs. See 2020 FOP section 4.3.1.

Table 3: Pre-Coordinated Operations – April 2020 (4/1 to 4/30)

Project	Parameter	Date	Time[14]	# of Hours	Type	Reason
Lower Monumental	Reduced Spill	4/24 4/25 4/26 4/27 4/28 4/29 4/30	1900-2000 1900-2000 1800-1900 1800-1900 1700-1900 1700-1800 1800-1900	2 2 2 2 3 2 2	Navigation	Hourly spill decreased to between 20 kcfs and 27 kcfs (less than the spill target of 30 kcfs) for safe navigation. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
Ice Harbor	Reduced Spill	4/22	1600-1700	2	Maintenance	Hourly spill decreased to 43 kcfs (less than adjusted spill target of 46-48 kcfs) while performing a fish screen inspection. Unit 2 was operating at minimum generation during this time. Regionally coordinated via 2020 FPP, page IHR-10, Section 2.3.2.2.

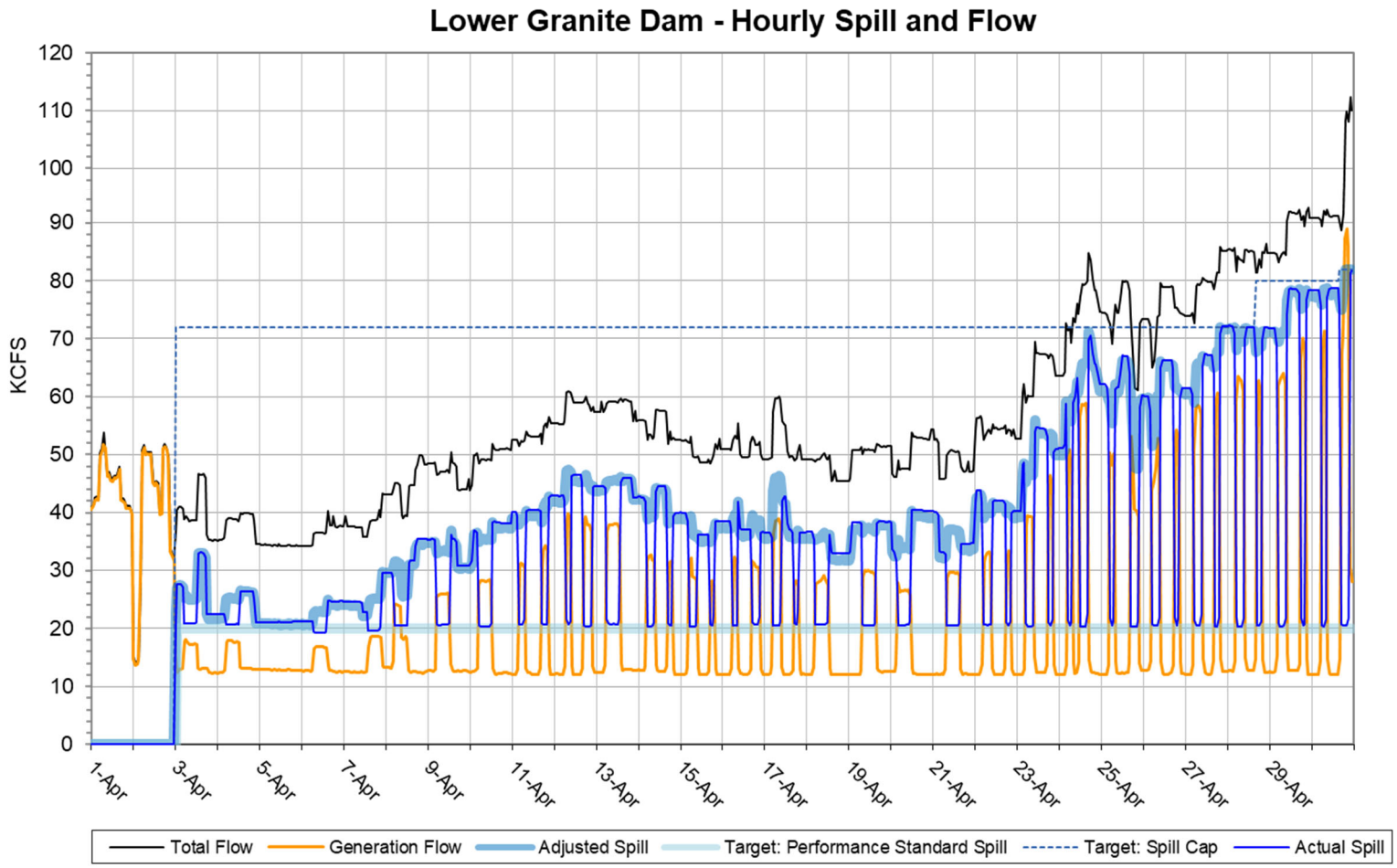
[14] Note: Data collected for reporting spill variances is reported using hourly-averaged data. Therefore, while spill may be increased or decreased for only a portion of an hour, it is represented in the Spill Variance Table as an hour.

Project	Parameter	Date	Time[14]	# of Hours	Type	Reason
John Day	Reduced Spill	4/10	0100-0500, 2400	6	Transmission Reliability	Hourly spill decreased to between 40 and 150 kcfs (less than adjusted spill target of 69 to 156 kcfs) due to an increase in generation in order to provide contingency reserves. Regionally coordinated via 2020 FOP, Section 4.4.1.
		4/11	0100-0700, 1300-1800, 2200-2400	16		
		4/12	0100-0700, 2200-2400	10		
		4/13	0100-0600, 1200-1700, 2100-2400	16		
		4/14	0100-0500, 1000-1800, 2300-2400	16		
		4/15	0100-0500, 2200-2400	8		
		4/16	0100-0500, 0900-1700, 2300-2400	16		
		4/17	0100-0500, 1100-1800, 2200-2400	16		
		4/18	0100-0900, 2200-2400	12		
		4/19	0100-0500, 1000-1800	14		
		4/21	1100-1500	5		
		4/23	0800-1700, 2300-2400	12		
		4/24	0100-0500, 0900-1600	13		
		4/27	2300-2400	2		
		4/28	0100-1000	10		
		4/30	2300-2400	2		
The Dalles	Additional Spill	4/19	2200	1	Transmission Reliability	Hourly spill increased to 42% of total flow (greater than adjusted spill target of 40% ± 1%) due to a generation increase in order to provide reserves. Daily average spill was 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.

Table 4: April 2020 Average Percent TDG Values Table (4/1 to 4/30)

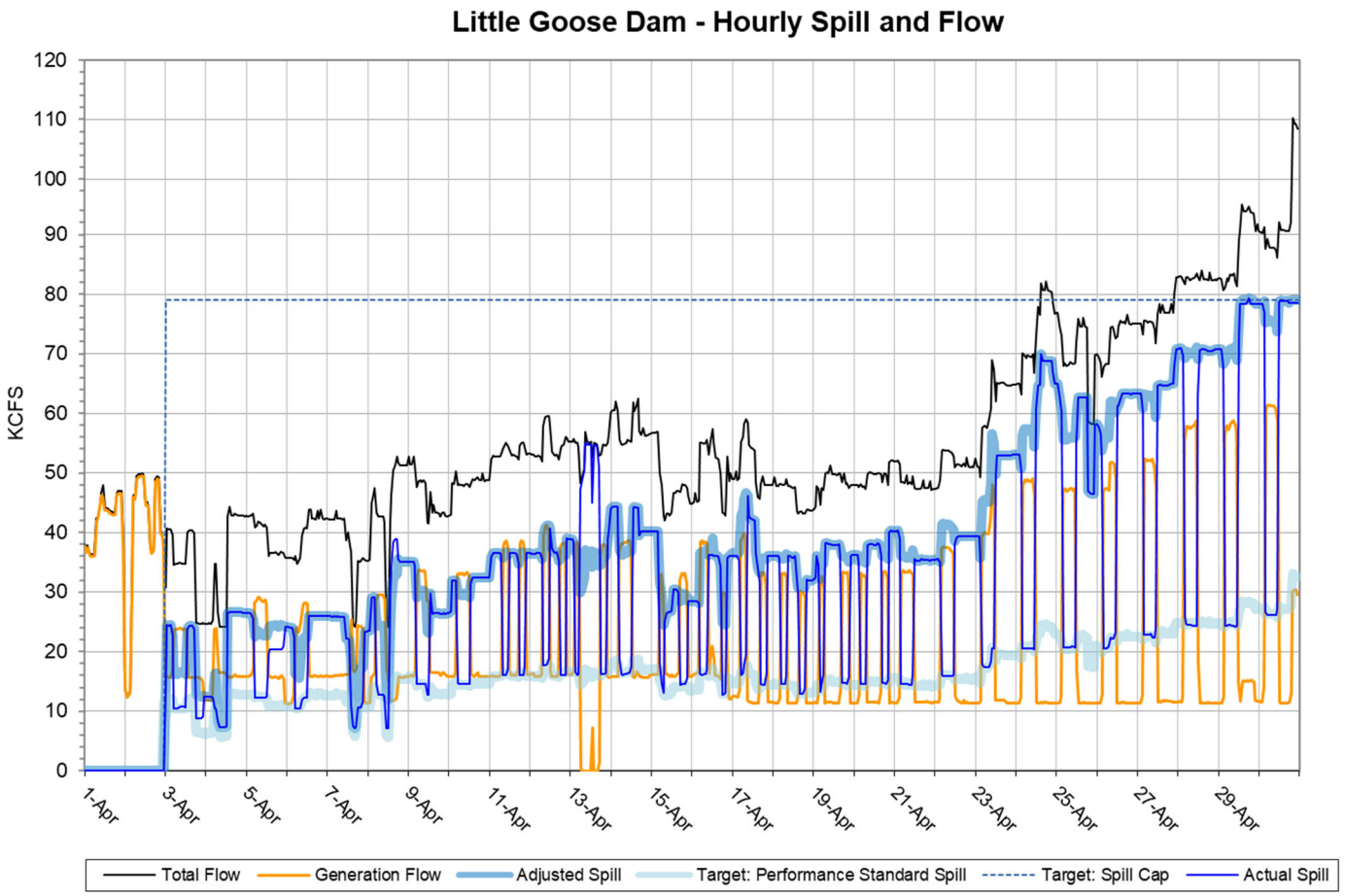
Date	FIXED MONITORING STATIONS															
	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW	JDY	JHAW	TDA	TDDO	BON	CCIW
	Lower Granite FB	Lower Granite TW	Little Goose FB	Little Goose TW	Lower Monumental FB	Lower Monumental TW	Ice Harbor FB	Ice Harbor TW	McNary FB	McNary TW	John Day FB	John Day TW	The Dalles FB	The Dalles TW	Bonneville FB	Bonneville TW
Gas Cap %	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
4/1/2020	100	101	102	101	101	101	101	102	103	104	104	103	104	104	104	112
4/2/2020	100	102	101	100	100	101	101	101	102	105	103	103	103	104	104	112
4/3/2020	100	114	102	116	101	120	102	113	103	102	103	104	104	105	104	112
4/4/2020	101	115	102	117	102	121	102	113	105	106	105	105	104	105	105	115
4/5/2020	101	114	102	115	102	122	103	113	105	107	105	105	105	106	105	116
4/6/2020	101	114	102	115	104	120	106	113	104	105	104	105	104	105	105	116
4/7/2020	101	115	102	114	110	119	112	114	105	106	103	104	104	105	104	115
4/8/2020	101	116	103	116	113	120	115	115	108	107	104	104	104	105	104	116
4/9/2020	102	116	106	115	113	122	117	115	108	109	105	105	105	106	106	116
4/10/2020	102	116	110	117	114	121	118	115	109	117	106	114	105	112	106	116
4/11/2020	102	116	110	118	115	120	118	115	108	116	104	114	108	113	105	116
4/12/2020	101	117	111	118	113	120	117	116	109	116	104	113	110	115	107	116
4/13/2020	100	117	112	121	113	120	116	116	108	115	105	113	112	116	110	117
4/14/2020	100	117	113	119	115	120	116	116	108	116	105	113	112	116	112	117
4/15/2020	100	116	112	116	116	117	116	114	108	116	105	115	110	115	110	117
4/16/2020	101	116	113	117	117	120	116	115	110	115	106	115	113	117	111	117
4/17/2020	103	116	116	118	117	120	117	116	110	116	109	116	115	118	114	119
4/18/2020	103	116	115	117	116	121	116	114	111	115	109	116	113	116	114	118
4/19/2020	102	116	115	118	115	120	116	114	108	115	110	115	110	115	112	117
4/20/2020	103	116	115	118	116	119	116	114	108	116	110	117	113	117	112	117
4/21/2020	103	116	115	118	115	120	116	115	107	116	109	117	112	116	111	118
4/22/2020	103	117	114	118	115	120	116	114	108	115	109	117	112	117	112	118
4/23/2020	103	118	113	121	115	120	116	116	107	116	109	117	113	117	111	120
4/24/2020	103	120	113	123	115	121	115	116	108	117	108	117	114	117	113	120
4/25/2020	103	120	114	122	118	121	117	116	109	116	108	117	116	119	115	120
4/26/2020	103	120	115	124	120	120	118	117	111	116	108	118	117	119	116	119
4/27/2020	103	121	115	123	120	121	118	116	111	116	108	118	116	119	116	120
4/28/2020	103	122	114	124	119	122	116	117	110	118	109	118	117	120	116	120
4/29/2020	104	123	116	125	122	123	119	118	111	119	112	119	117	121	117	121
4/30/2020	104	124	116	125	122	122	120	119	111	119	111	118	115	119	116	120
Exceedances:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 1[15]



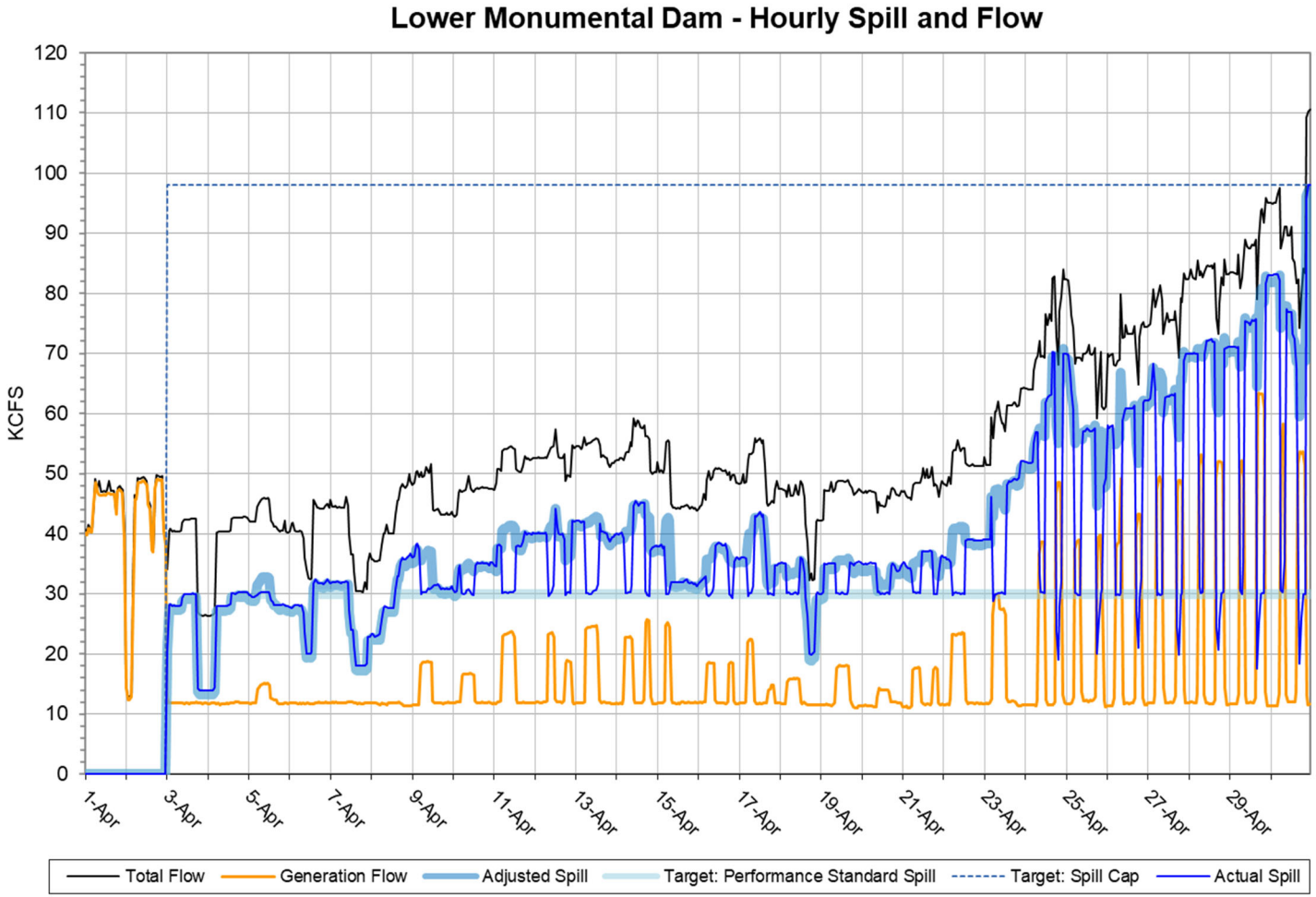
[15] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 2[16]



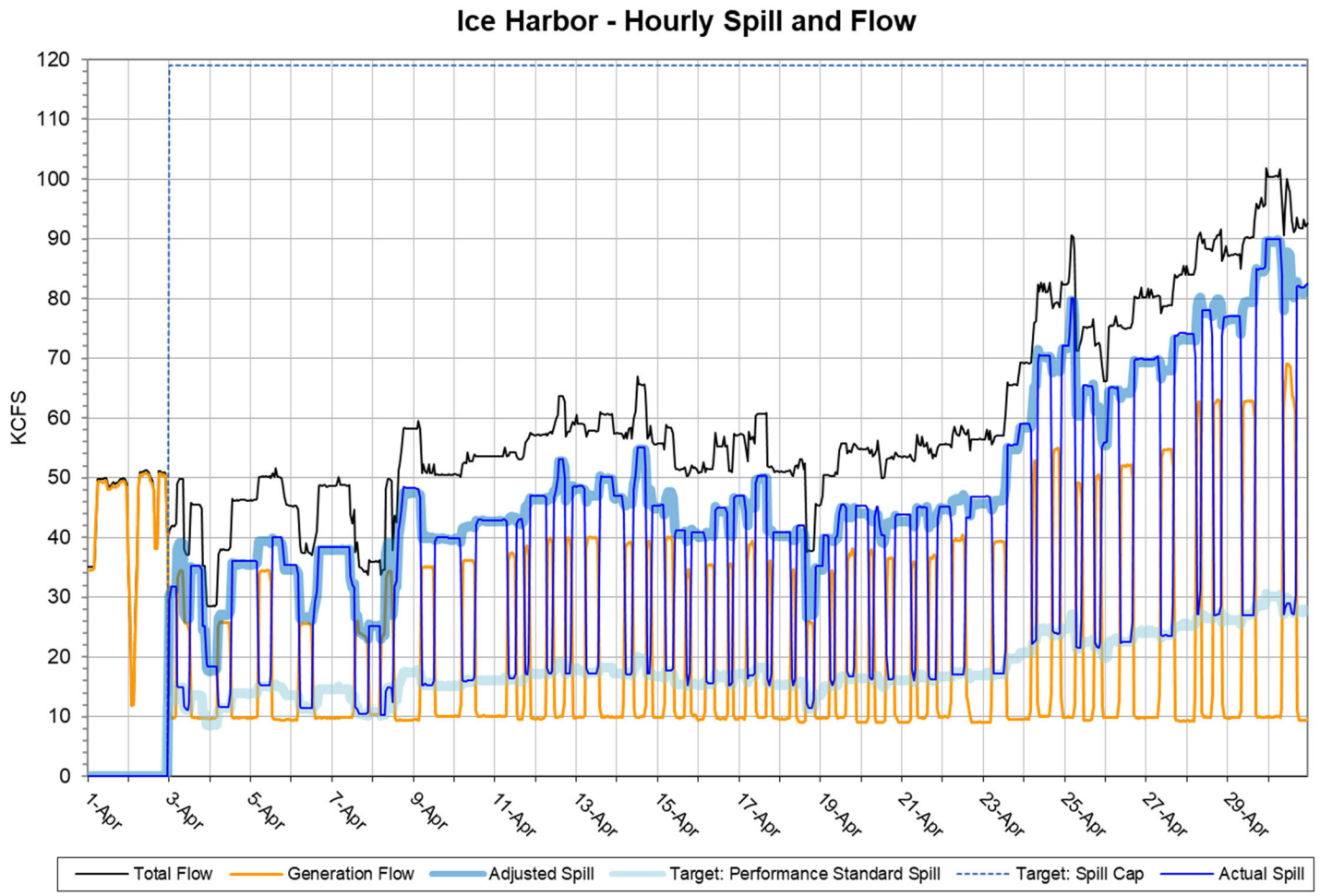
[16] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 3[17]



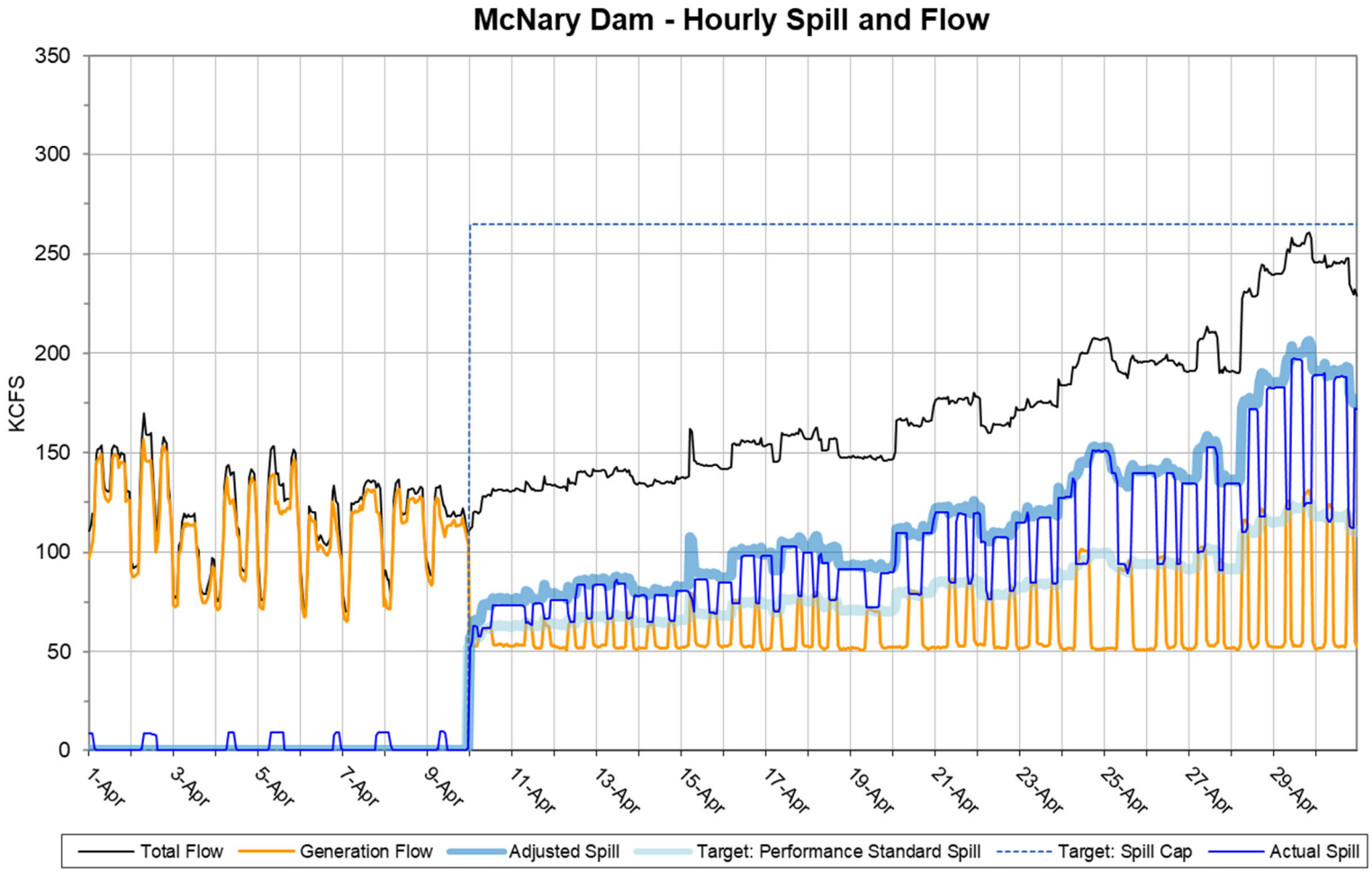
[17] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 4[18]



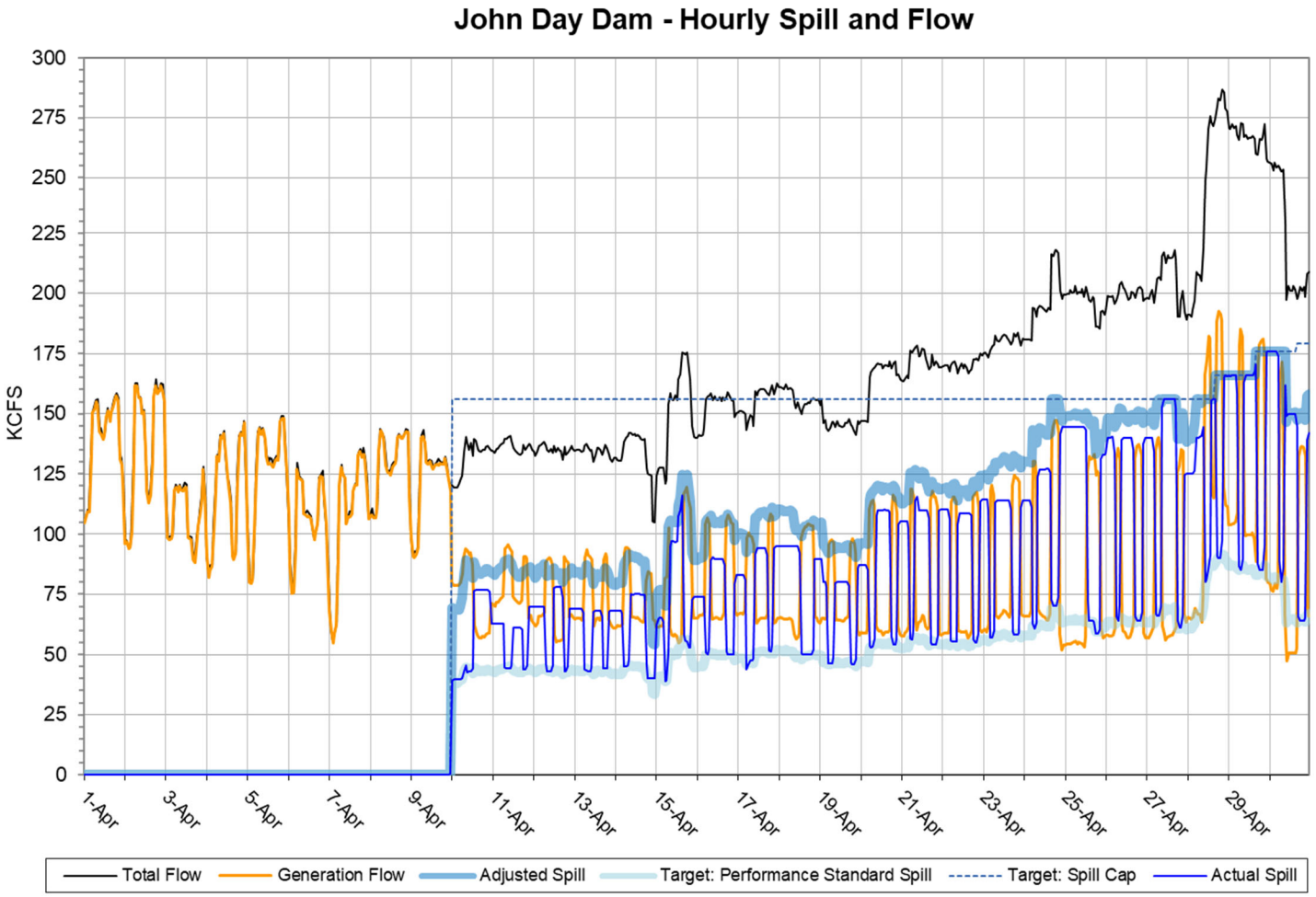
[18] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 5[19]



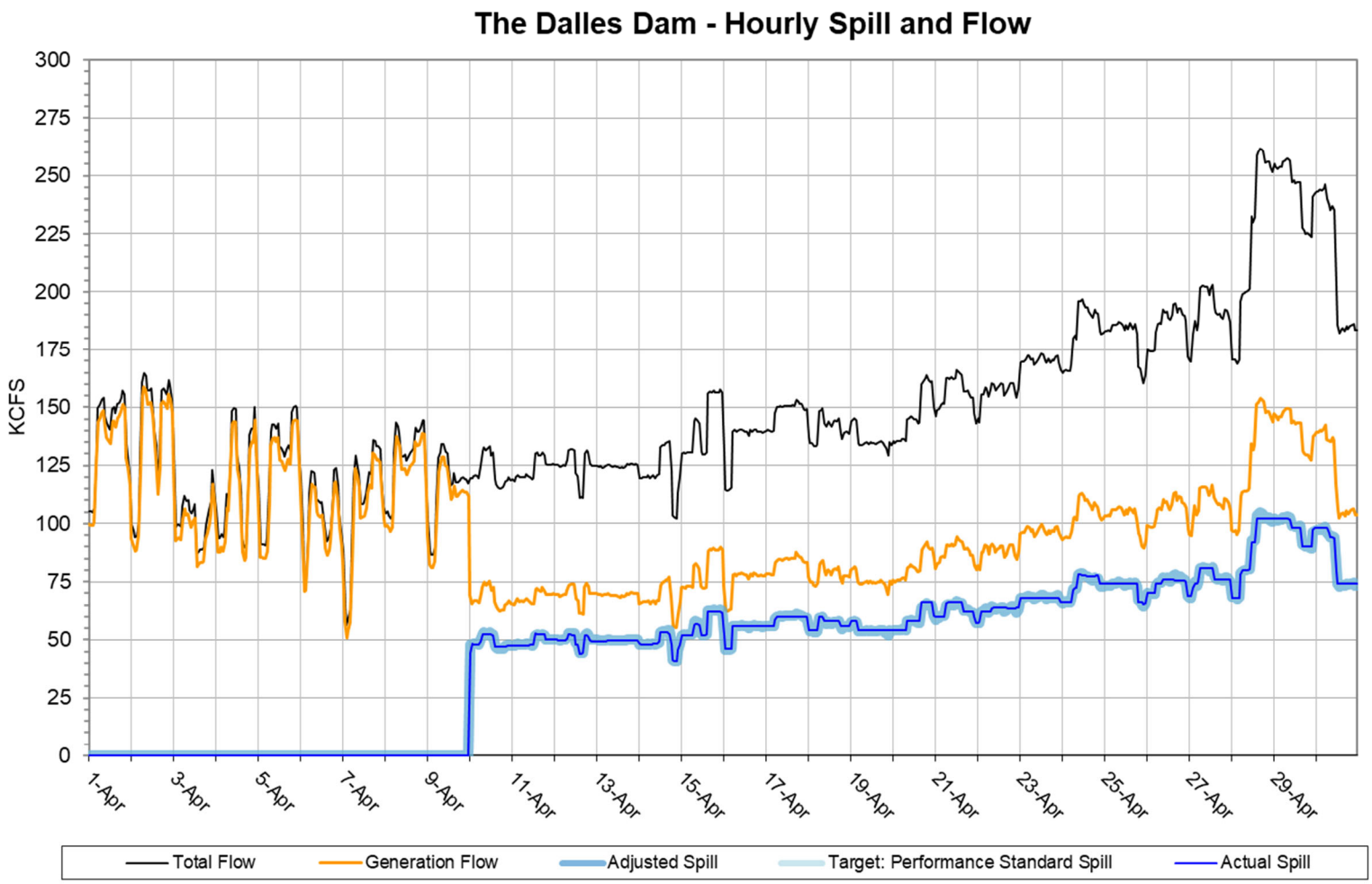
[19] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 6[20]



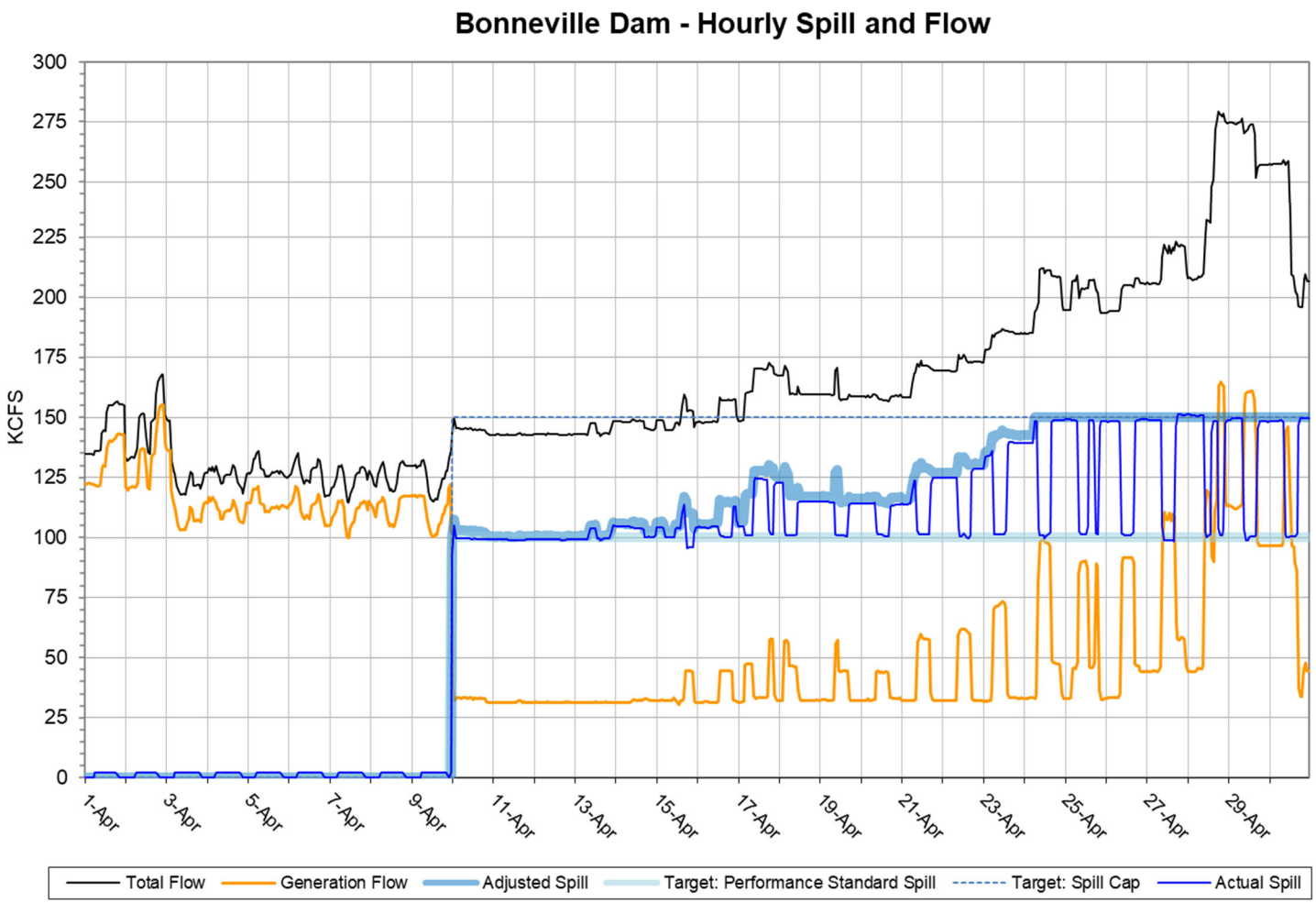
[20] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 7[21]



[21] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 8[22]



[22] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

FISH OPERATIONS PLAN IMPLEMENTATION REPORT

May 2020

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

Introduction

The U.S. Army Corps of Engineers (Corps) developed this report in accordance with the 2020 Fish Operations Plan[1] (2020 FOP). The 2020 FOP describes the Corps' planned operations for juvenile fish passage at its four lower Snake River and four lower Columbia River dams during the 2020 spring and summer fish migration seasons, generally April 3 through August 31. The 2020 FOP is consistent with spill operations for juvenile fish passage and the regional forum process for adaptive management and in-season management provisions outlined in the 2019 NOAA Fisheries Columbia River System Biological Opinion (2019 BiOp)[2], the 2018 Extensions of the 2008 Columbia Basin Fish Accords (Accord Extensions), the 2019-2021 Spill Operation Agreement (Agreement) and subsequent Addendum, the Corps' requirements under the Endangered Species Act (ESA), and is the subject of ongoing consultation and communications with the relevant wildlife agencies to ensure consistency with the ESA. Other project operations and water management actions not specifically addressed in this document will be consistent with the 2019 BiOp and other guiding operative documents, including the 2020 Water Management Plan (WMP), seasonal WMP updates, and the 2020 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2020 FOP during the month of May 2020. 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 (Table 1);
- 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 2020 FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,
- resultant 12-hour average TDG for the tailwater at each project.

[1] The 2020 FOP was posted to the Technical Management Team (TMT) website on March 23, 2020 (http://pweb.crohms.org/tmt/documents/fpp/2020/).

[2] The Corps, in coordination with the other Action Agencies, and National Marine Fisheries Service (NMFS), employs the Regional Implementation Oversight Group (RIOG) and technical teams including the Technical Management Team (TMT) and Fish Passage Operations & Maintenance (FPOM), to coordinate with state, tribal and other federal experts for recommendations for implementing operations consistent with NMFS' Columbia River System Biological Opinions.

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2020 FOP in May 2020.

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 May, with hourly spill, target spill, adjusted spill, generation, and total flows. The monthly graphs begin on May 1 and end on May 31 and reflect the following operations for the lower Snake River and the lower Columbia River projects:

- The black line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The orange line represents the average hourly generation flow through the powerhouse each hour in kcfs.
- The thin solid blue line represents the actual average hourly spill level through the spillway in kcfs.
- The dashed blue line represents the spill cap portion of the target spill estimated to reach the gas cap or target TDG.
- The thick light blue line represents the performance standard spill level portion of the target spill.
- The thick dark blue line represents the adjusted spill cap spill: the hourly spill cap 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 (2020 FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the May 2020 Average Percent TDG Values Table (Table 4). The numbers in red indicate the project exceeded the %TDG cap - i.e. 125% (tailwater) for each project.

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the adjusted spill due to various conditions as described below. When actual spill varied from adjusted spill levels during periods of voluntary spill, the change in spill level is described below in the May 2020 Spill Variance Table (Table 2).[3] The Spill Variance Table includes average hourly data; but when spill varies from adjusted spill for a portion of an hour, it is characterized as a variance for a full hour. There are instances when the hourly adjusted 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 adjusted spill to the extent practicable. Other routine activities that changed spill levels, which were coordinated with regional partners, are identified in the monthly Pre-Coordinated Operations Table (Table 3).

[3] 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.

"Low flow" operations at the lower Columbia and lower Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target spill levels. For this report, the decrease in target spill is represented as adjusted spill. 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 2020 FOP for Bonneville and The Dalles dams,[4] 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). Transition periods between gas cap spill and performance standard spill hours may result in actual hourly spill levels that are slightly higher or lower than target spill levels.

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

May Operations

The month of May was characterized by above average precipitation and above average flows for the lower Snake and lower Columbia Rivers. The May 2020 observed precipitation was 117% of average on the Snake River above Ice Harbor and 137% of average on the Columbia River above The Dalles. The NOAA Northwest River Forecast Center runoff summary for May indicated that the adjusted runoff for the Snake River at Lower Granite was 111% of the 30-year average (1981-2010) with a volume of 7.7 MAF (Million acre-feet)[5]. The May 2020 adjusted runoff for the Columbia River at The Dalles was 113% of the 30-year average (1981-2010) with a volume of 28.7 MAF.[6] Spring spill operations occur April 3–June 20 at the four lower Snake River projects, and April 10–June 15 at the four lower Columbia River projects. Target spill levels for May 2020 at each project are defined in Table 1.

[4] As specified in the 2020 FOP section 3.
[5] Retrieved June 2, 2020: https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=5
[6] Retrieved June 2, 2020: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

Table 1: Summary of 2020 spring target spill levels at lower Snake River and lower Columbia River projects.

PROJECT	FLEX SPILL (16 hours per day)[A, B, C, E]	PERFORMANCE STANDARD SPILL (8 hours per day)[B, D, E]
Lower Granite[E]	125% Gas Cap	20 kcfs
Little Goose[F, G]	125% Gas Cap	30%
Lower Monumental	125% Gas Cap (uniform spill pattern)	30 kcfs (bulk spill pattern[H])
Ice Harbor	125% Gas Cap	30%
McNary	125% Gas Cap	48%
John Day	120% TDG target	32%
The Dalles[I]	40%	40%
Bonneville[J]	125% Gas Cap	100 kcfs

A. Attempts should be made to minimize in-season changes to the proposed operations; however, if serious deleterious impacts are observed, existing adaptive management processes may be employed to help address serious issues that may arise in-season as a result of implementing these proposed spill operations.

B. Spill may be temporarily reduced at any project if necessary to ensure navigation safety or transmission reliability. In order to operate consistently with state water quality standards, spill may be also reduced if observed Gas Bubble Trauma (GBT) levels exceed those identified in state water quality standards (see WASH. ADMIN. CODE §173-201A-200(l)(f))).

C. 125% Gas Cap spill is spill to the maximum level that meets, but does not exceed, the TDG criteria allowed under state laws. This includes a criterion for not exceeding 126% TDG for the average of the two greatest hourly values within a day.

D. The 8 hours of performance standard spill may occur with some flexibility (with the exception of Little Goose and Lower Granite operations described in the next key points). Other than at TDA, performance standard spill occurs in either a single 8-hour block or up to two separate blocks per calendar day. No more than 5 hours of performance standard spill may occur between sunset and sunrise, as defined in Fish Passage Plan (FPP) Table BON-5. Performance standard spill is not be implemented between 2200-0300 hours. No ponding above current MOP assumptions except as noted below.

E. Lower Granite Exception One - If adult passage delays are observed at Lower Granite Dam, the Corps may implement performance standard spill at Lower Granite Dam for at least 4 hours in the AM (beginning at 0500 hours). Implementation of this modification may also trigger in-season reevaluation of options to balance power principle.

F. Little Goose Exception One - As soon as practicable (and, in any event, no more than 24 hours) after a cumulative total of 25 adult spring Chinook salmon (not including jacks) pass Lower Monumental Dam, operate Little Goose spill at 30% spill for 8 consecutive am hours (April 3-15 start at 0500 hours; April 16-June 20 start at 0400 hours).

G. Little Goose Exception Two - During periods of involuntary spill, spill at 30% for 8 hours/day during the hours described in footnote F above and store additional inflows that exceed hydraulic capacity in the forebay above MOP if necessary. When it is necessary to pond water to achieve the lower spill levels due to high inflow, water stored above MOP should be drafted out over the remaining hours by increasing spill to pass inflow from 1200-1600 hours (or 1300-1700 hours from April 3-15), then increasing spill as necessary from 1600-0400 (or 1700-0500 hours from April 3-15) to draft the pool back to MOP. If it is forecast that the drafting spill will generate TDG levels in the tailrace in excess of 130% TDG, use all 16 hours to return the pool to MOP.

H. If the specified spill level at bulk pattern exceeds the gas cap, then spill pattern will be changed to uniform.

I. Fish passage spill at The Dalles should be limited to spillbays 1-8 unless river flow exceeds 350 kcfs, then spill outside the spillwall is permitted. TDG levels in The Dalles tailrace may fluctuate up to 125% TDG prior to reducing spill at upstream projects or reducing spill below 40% at The Dalles.

J. Fish passage spill at Bonneville Dam should not exceed 150 kcfs due to erosion concerns.

In its implementation of the 2020 FOP in May, the Corps evaluated conditions every day to establish spill caps at a level that was estimated to meet, but not exceed, the gas cap or target TDG in the tailrace (see Table 4).[7] 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).

Operational Adjustments

None.

[7] See 2020 FOP section 2.2

Table 2: Spill Variance Table – May 2020 (5/1 to 5/31)

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Little Goose	Reduced Spill	5/5	1500	1	Program Error[9]	Hourly spill decreased to 76.3 kcfs (less than adjusted spill of 76.4 kcfs) while generation was 12.1 kcfs, greater than the minimum generation range for Unit 1 (11.3 – 11.8 kcfs[10]).
Little Goose	Reduced Spill	5/29	1400	1	Maintenance	Hourly spill decreased to 84 kcfs (less than adjusted spill of 87 kcfs) due to the malfunction of a spillbay gate.
Ice Harbor	Reduced Spill	5/1 5/2 5/11 5/16 5/17 5/18 5/19 5/24	2300-2400 0300-0400 0100 2400 0100-0200, 1500, 1700 2400 0100 0400	2 2 1 1 4 1 1 1	Program Error[9]	Hourly spill decreased to between 68.8 and 110.3 kcfs (less than adjusted spill of 69.0 to 112.0 kcfs) while generation was between 10.4 and 12.0 kcfs, greater than the minimum generation range for Unit 1 (8.4 – 10.1 kcfs[11]).
McNary	Reduced Spill	5/14	1300-1400	2	Human Error	Hourly spill was between 261 kcfs and 262 kcfs (less than the target spill of 265 kcfs) due to implementing the spill cap change earlier than scheduled.
John Day	Reduced Spill	5/5	1700-1800	2	Human Error	Hourly spill remained at 179 kcfs (less than adjusted spill of 184 kcfs) due to a delay in changing to the appropriate target.

[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.

[9] The minimum generation flow range (kcfs) through the turbines is a function of power output (megawatts), turbine efficiency, and project head. Despite hourly updates and corrective operational actions, variable and changing conditions can lead to a turbine's flow rate drifting outside the minimum generation flow range identified in Table 1 of the 2020 FOP. The minimum generation flow ranges are evaluated annually and will be re-evaluated based on conditions observed when implementing the 2020 FOP.

[10] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Little Goose turbine Unit 1, the range is 11.1-12.0 kcfs. See 2020 FOP section 4.3.1.

[11] 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 8.2-10.3 kcfs. See 2020 FOP section 4.3.1.

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
The Dalles	Reduced Spill	5/5	0100	1	Program Error	Hourly spill decreased to 38% of total flow (less than adjusted spill target of 40% ± 1%) due to a malfunction of the program that manages generation. Daily average spill was 40% of the total flow.
The Dalles	Additional Spill	5/17	1400	1	Human Error	Hourly spill increased to 42% (more than adjusted spill target of 40% ± 1%) due to data entry error that resulted in additional spill.

Table 3: Pre-Coordinated Operations – May 2020 (5/1 to 5/31)

Project	Parameter	Date	Time[12]	# of Hours	Type	Reason
Lower Granite	Reduced Spill	5/23	0100	1	Navigation	Hourly spill decreased to 75 kcfs (less than the spill target of 82 kcfs) for safe navigation. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
Lower Monumental	Reduced Spill	5/1 5/2 5/3 5/4 5/5 5/6 5/7 5/8 5/9 5/10 5/11 5/12 5/13 5/14 5/15 5/16 5/17 5/18 5/20 5/22 5/23 5/24 5/26 5/28	1700-1800 1700-1800 1800-1900 1800 1800-1900 1700-1800 1700-1800 1700-1800 1700-1800 1600-1700 1700-1800 1700-1800 1800 1800-1900 1800-1900 1700-1800 1700-1800 1700-1800 1800-1900 1700-1800 1200 1800-2000 1700-1800 1900	2 2 2 1 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 1 3 2 1	Navigation	Hourly spill decreased to between 10 kcfs and 27 kcfs (less than the spill target of 30 kcfs) for safe navigation. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
Ice Harbor	Reduced Spill	5/2 5/3	0500 1500	1 1	Navigation	Hourly spill decreased to between 92.0 kcfs and 109.8 kcfs (less than the spill target of 92.1 to 109.9 kcfs) while generation was 10.4 kcfs, greater than the minimum generation range for Unit 1 (8.4 – 10.1 kcfs[13]) for safe navigation. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.

[12] 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.

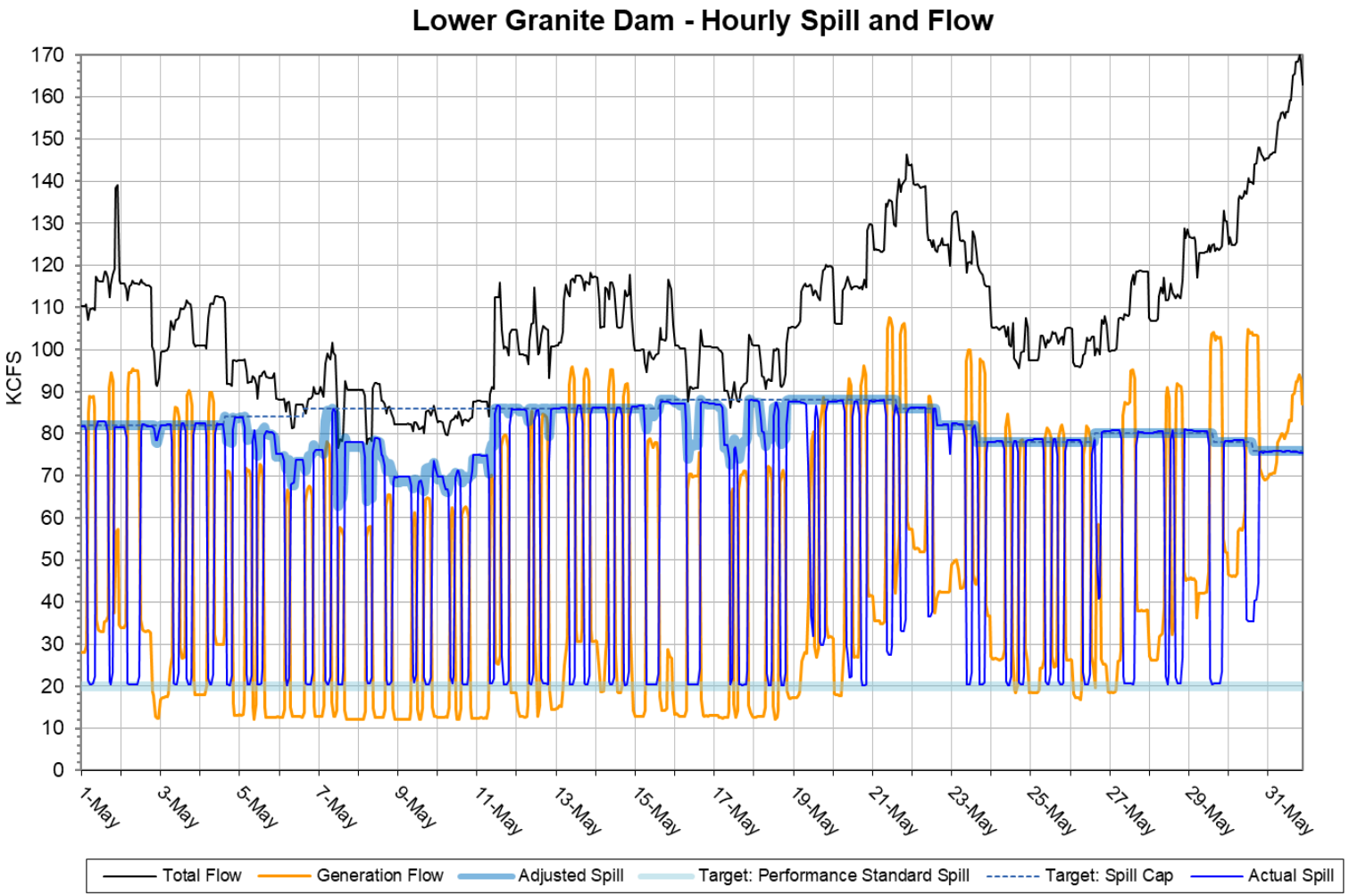
[13] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Ice Harbor turbine Unit 1, the range is 8.2-10.3 kcfs. See 2020 FOP section 4.3.1.

Project	Parameter	Date	Time[12]	# of Hours	Type	Reason
Ice Harbor	Reduced Spill	5/20	1300	1	Maintenance	Hourly spill decreased to 101 kcfs (less than adjusted spill target of 105 kcfs) while performing a fish screen inspection. Unit 6 was operating at minimum generation during this time. Regionally coordinated via 2020 FPP, page IHR-10, Section 2.3.2.2.
John Day	Reduced Spill	5/1 5/5 5/6	0100-0500 2300-2400 0100-0200, 0500-0600	5 2 4	Transmission Reliability	Hourly spill decreased to between 142 and 176 kcfs (less than adjusted spill target of 148 to 184 kcfs) due to an increase in generation in order to provide reserves. Regionally coordinated via 2020 FOP, Section 4.4.1.
The Dalles	Reduced Spill	5/5 5/9 5/11 5/12 5/13	1800 2200 1100 1000 0600	1 1 1 1 1	Transmission Reliability	Hourly spill decreased to 38% of total flow (less than adjusted spill target of 40% ± 1%) due to an increase in generation in order to provide reserves. Daily average spill was 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
The Dalles	Additional Spill	5/5 5/11 5/12 5/15	2300 2200, 2400 2300 0200	1 2 1 1	Transmission Reliability	Hourly spill increased to between 42% and 46% of total flow (greater than adjusted spill target of 40% ± 1%) in order to provide reserves. Daily average spill was 40 to 43% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.

Table 4: May 2020 Average Percent TDG Values Table (5/1 to 5/31)

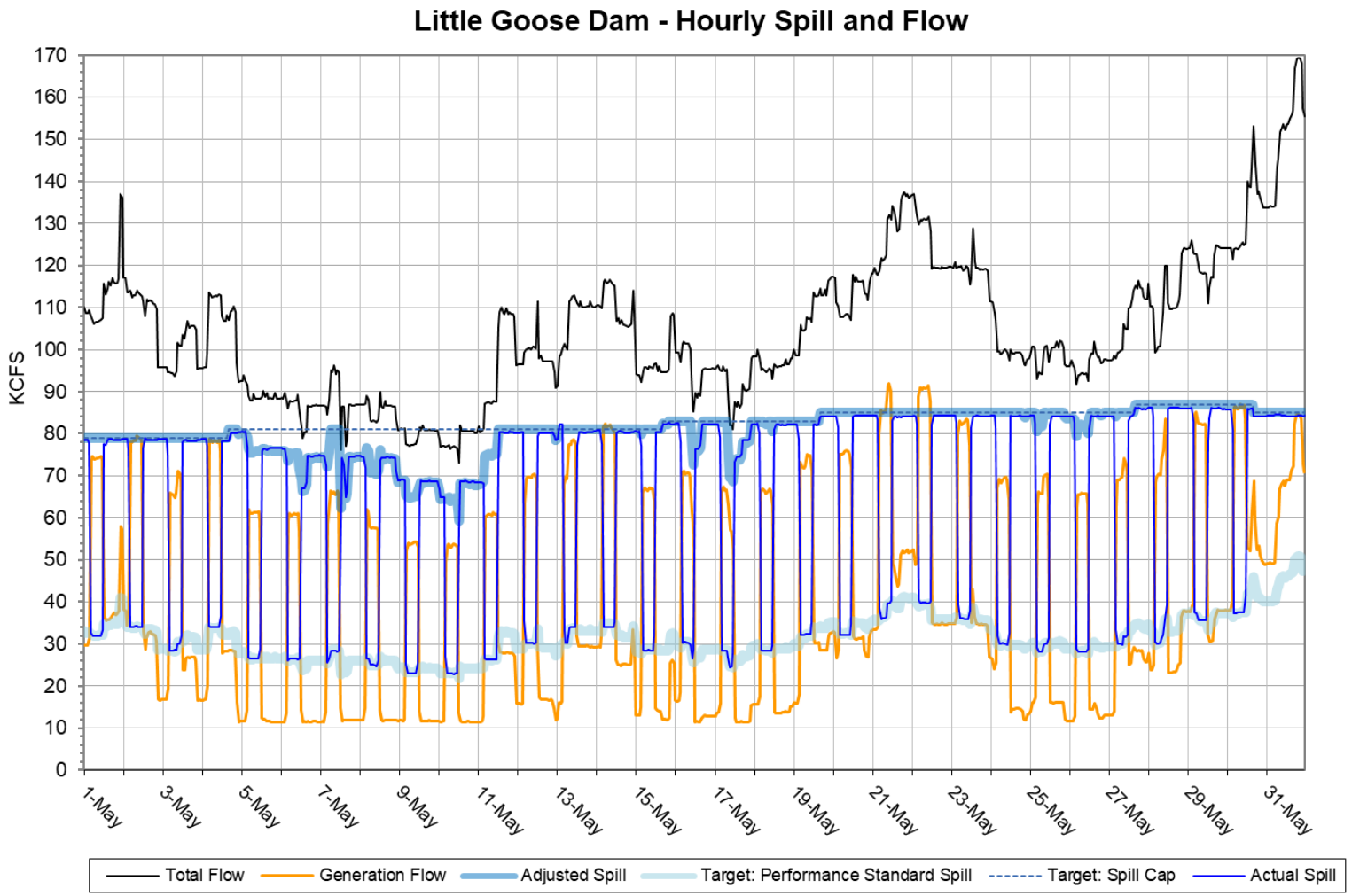
Date	FIXED MONITORING STATIONS															
	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW	JDY	JHAW	TDA	TDDO	BON	CCIW
	Lower Granite FB	Lower Granite TW	Little Goose FB	Little Goose TW	Lower Monumental FB	Lower Monumental TW	Ice Harbor FB	Ice Harbor TW	McNary FB	McNary TW	John Day FB	John Day TW	The Dalles FB	The Dalles TW	Bonneville FB	Bonneville TW
Gas Cap %:		**125**		**125**		**125**		**125**		**125**		**125**		**125**		**125**
5/1/2020	103	125	116	125	121	124	119	124	111	119	111	119	116	120	115	120
5/2/2020	103	125	117	125	124	123	122	125	113	120	112	120	119	122	117	121
5/3/2020	103	124	115	124	123	122	120	119	113	119	111	120	117	120	116	121
5/4/2020	103	124	114	124	121	123	119	123	111	120	111	119	120	122	116	121
5/5/2020	104	123	118	124	124	123	122	119	113	120	114	119	120	122	120	121
5/6/2020	104	122	117	124	123	122	120	117	113	119	112	119	116	119	116	121
5/7/2020	103	123	115	123	119	122	117	118	109	120	111	119	118	121	115	121
5/8/2020	103	123	115	124	122	123	120	118	111	120	113	120	121	123	118	123
5/9/2020	105	122	116	122	124	123	121	117	113	120	114	120	122	123	120	122
5/10/2020	106	122	119	122	124	122	122	118	115	120	114	119	122	123	121	121
5/11/2020	106	124	120	125	123	123	121	120	114	122	119	120	122	124	123	122
5/12/2020	105	125	119	125	122	123	119	121	114	124	118	121	120	123	121	123
5/13/2020	104	125	117	125	123	123	118	122	113	124	116	121	120	122	120	123
5/14/2020	103	125	115	124	122	123	118	124	111	**126**	114	121	118	122	119	124
5/15/2020	103	124	114	124	123	122	120	121	113	125	114	121	117	121	120	123
5/16/2020	105	124	118	124	125	123	122	121	114	**126**	116	121	119	123	121	123
5/17/2020	105	124	118	124	126	122	122	119	116	**126**	117	120	120	123	121	123
5/18/2020	105	124	121	124	125	123	121	120	115	123	118	120	118	122	120	123
5/19/2020	103	125	120	125	123	123	120	124	113	124	118	120	116	121	116	123
5/20/2020	103	125	118	125	124	123	120	124	113	124	115	121	114	120	114	123
5/21/2020	103	**126**	117	125	123	123	120	124	111	125	111	120	114	119	115	123
5/22/2020	103	**126**	114	125	122	124	118	125	109	**126**	109	121	112	119	114	123
5/23/2020	103	**126**	113	125	122	124	120	125	110	**126**	107	120	114	119	115	123
5/24/2020	104	124	117	125	124	122	122	122	112	**126**	109	120	116	120	116	123
5/25/2020	104	124	120	125	127	123	123	120	114	125	113	120	116	121	118	123
5/26/2020	105	124	119	124	125	123	122	120	114	124	116	120	117	122	118	123
5/27/2020	104	125	119	125	124	123	122	122	114	124	119	120	120	124	119	123
5/28/2020	104	125	119	125	126	123	123	124	116	125	120	120	121	124	123	123
5/29/2020	105	**126**	121	**126**	128	124	124	**126**	119	124	121	123	122	125	124	124
5/30/2020	106	**127**	123	**126**	128	124	126	**126**	119	125	123	122	121	124	121	125
5/31/2020	104	125	118	**126**	123	**126**	120	125	112	123	116	124	117	122	115	124
Exceedances:		**5**		**3**		**1**		**2**		**6**		**0**		**0**		**0**

Figure 1[14]



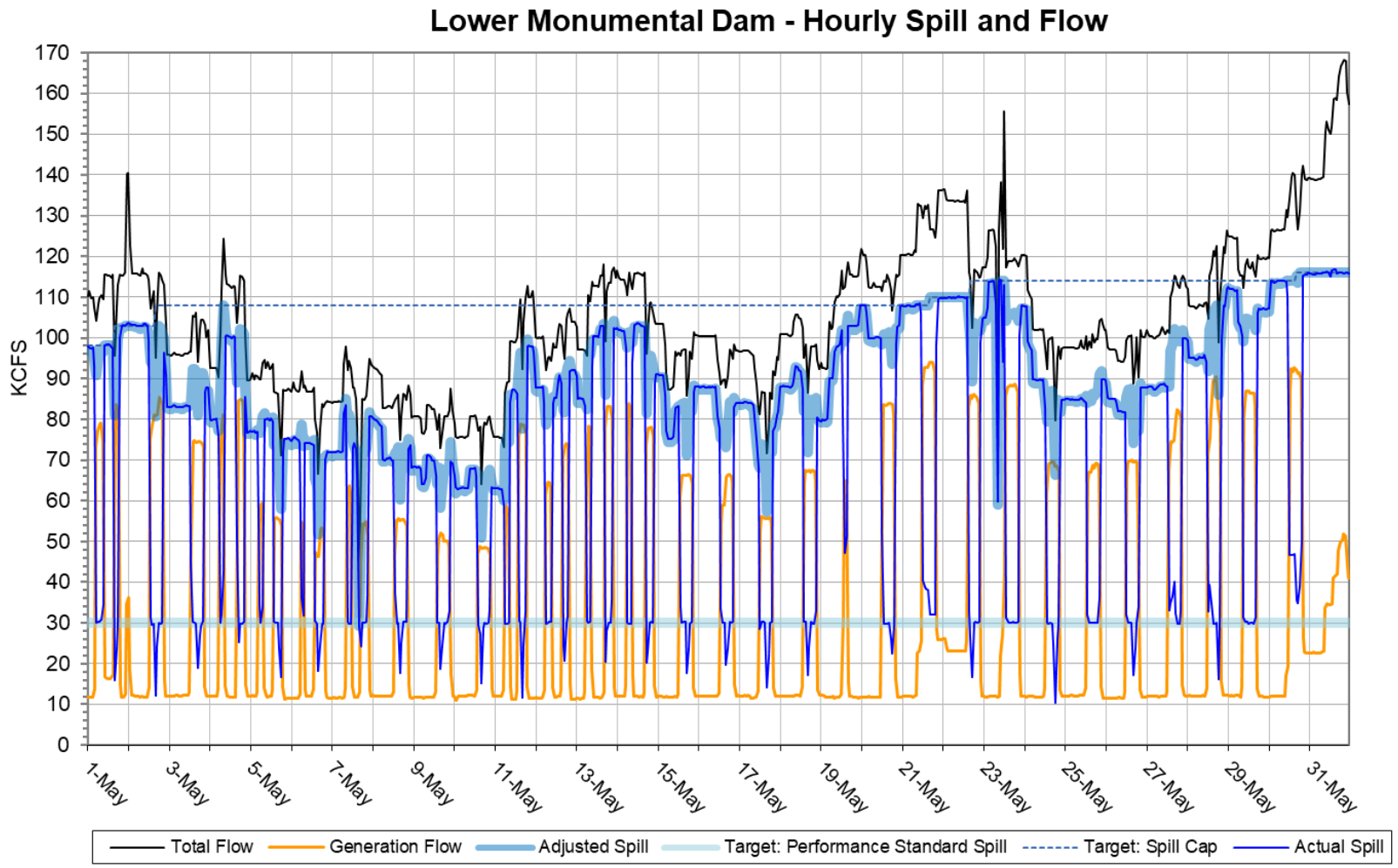
[14] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 2[15]



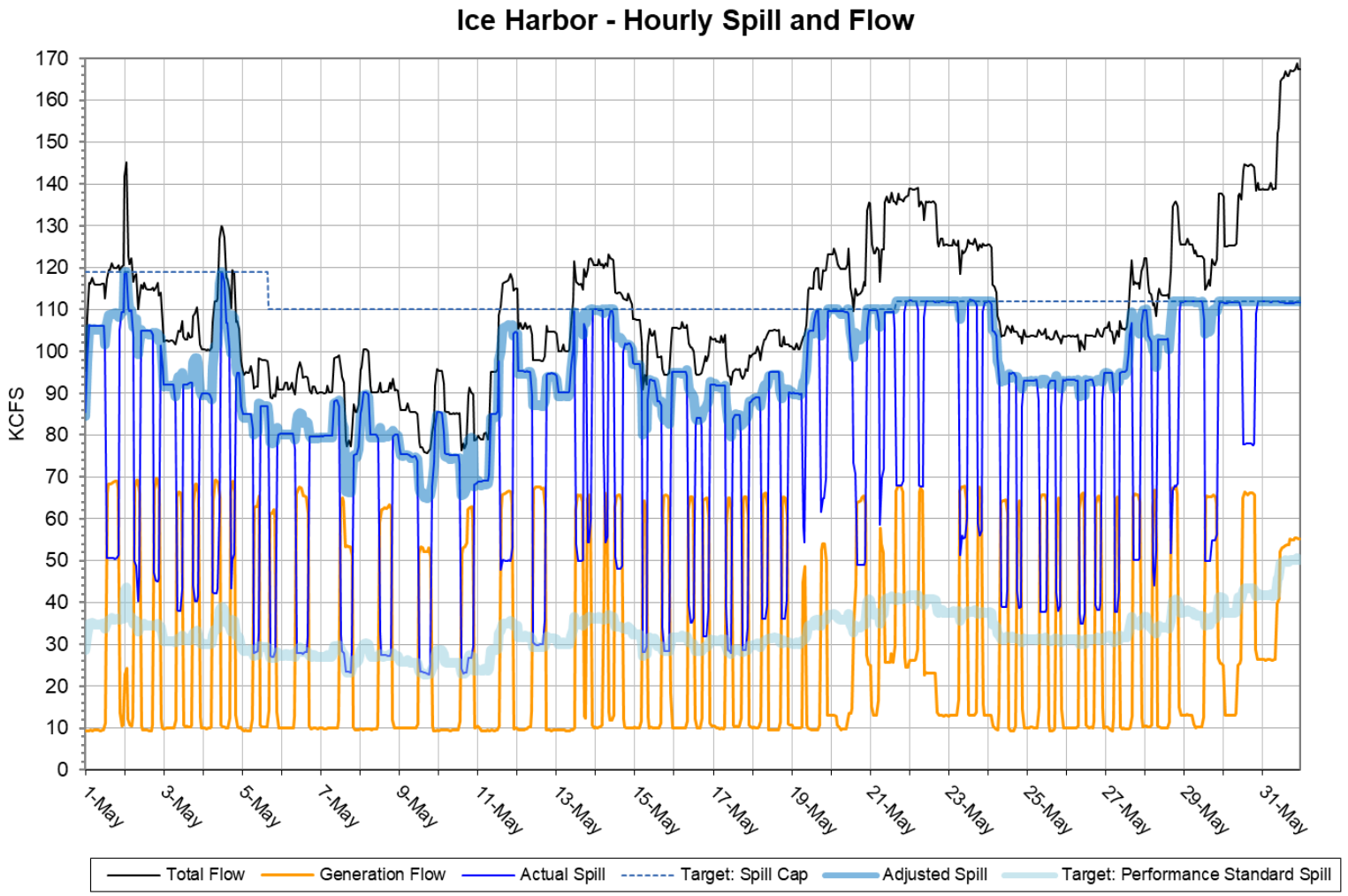
[15] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 3[16]



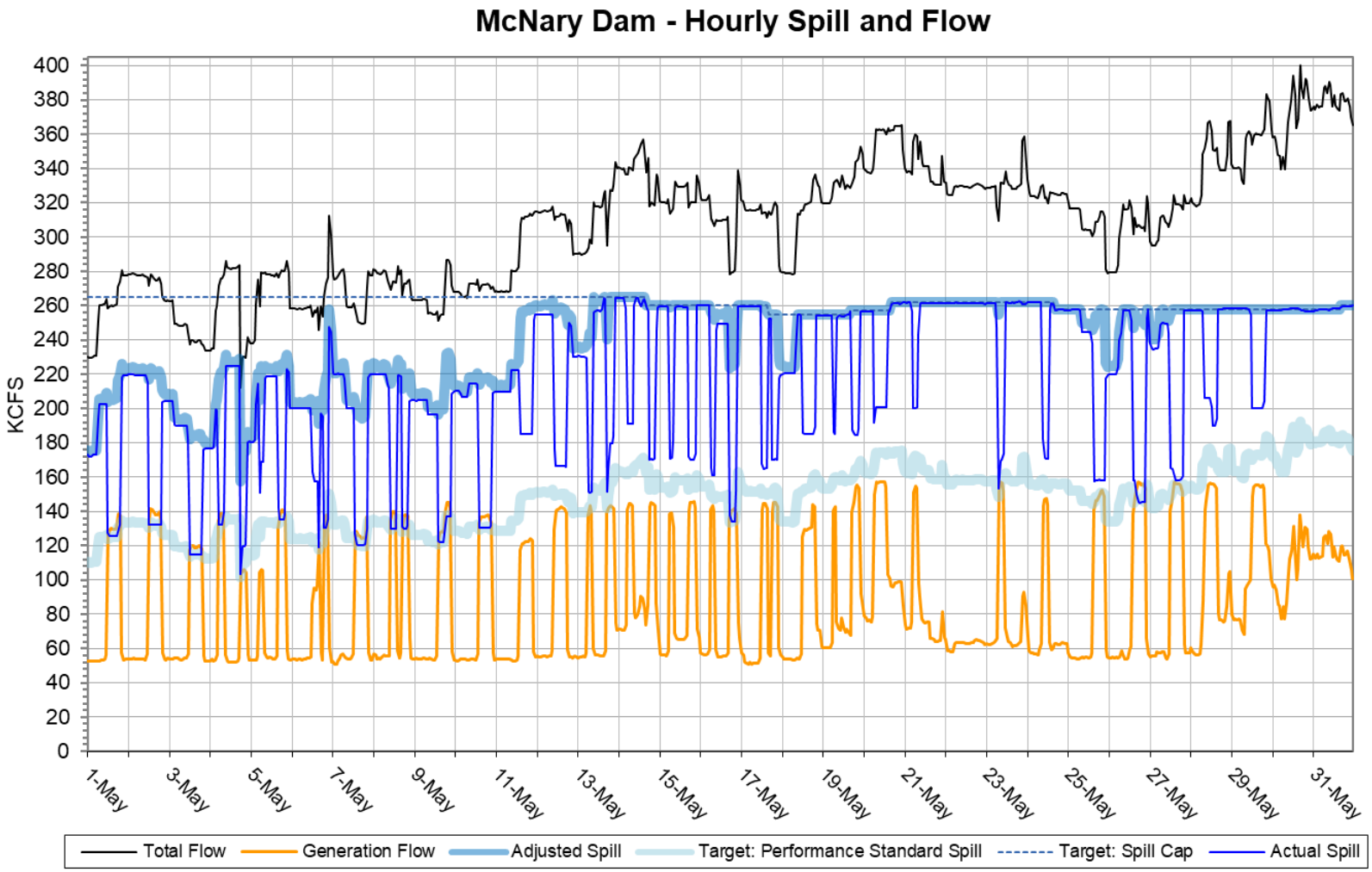
[16] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 4[17]



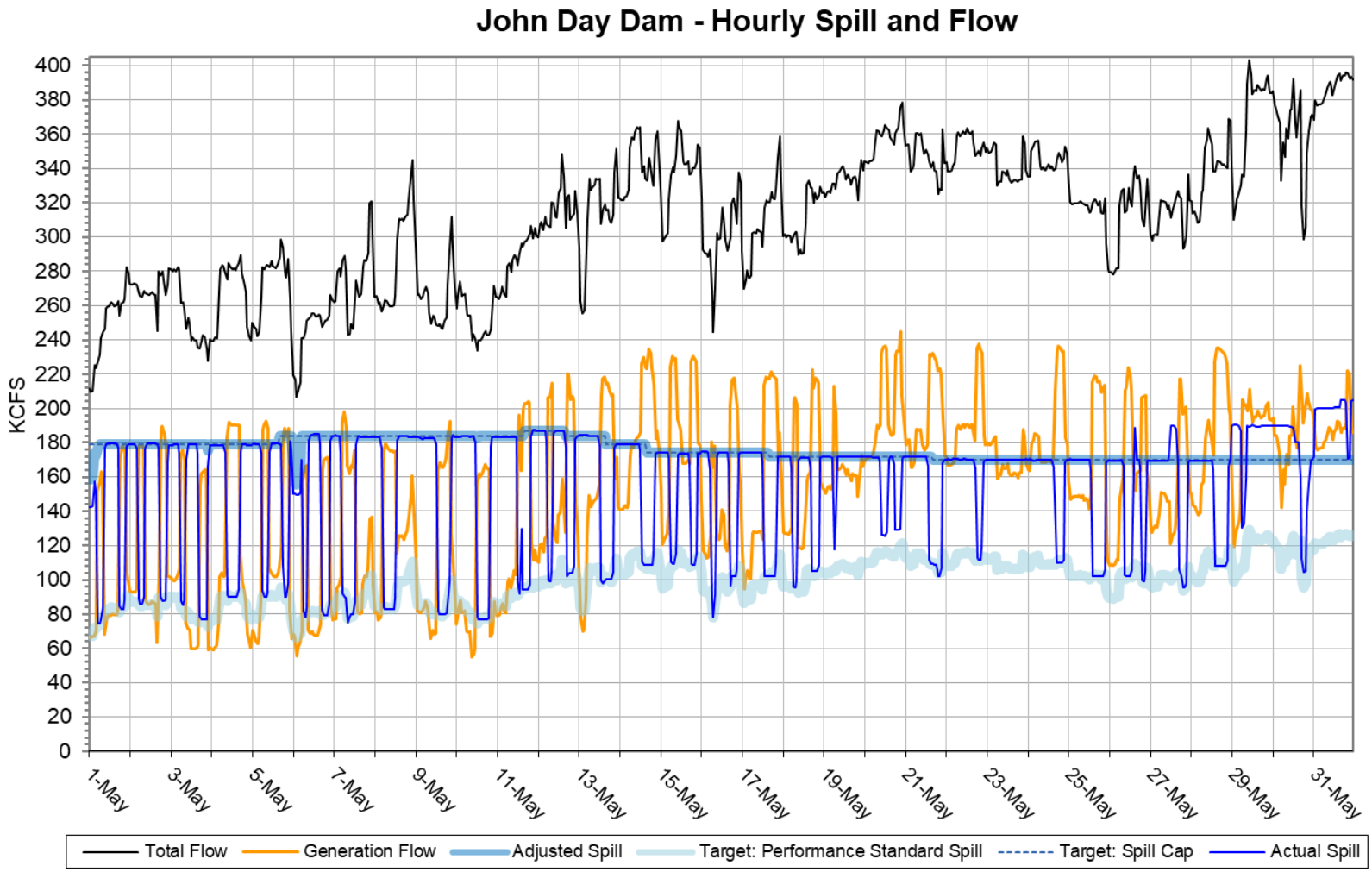
[17] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 5[18]



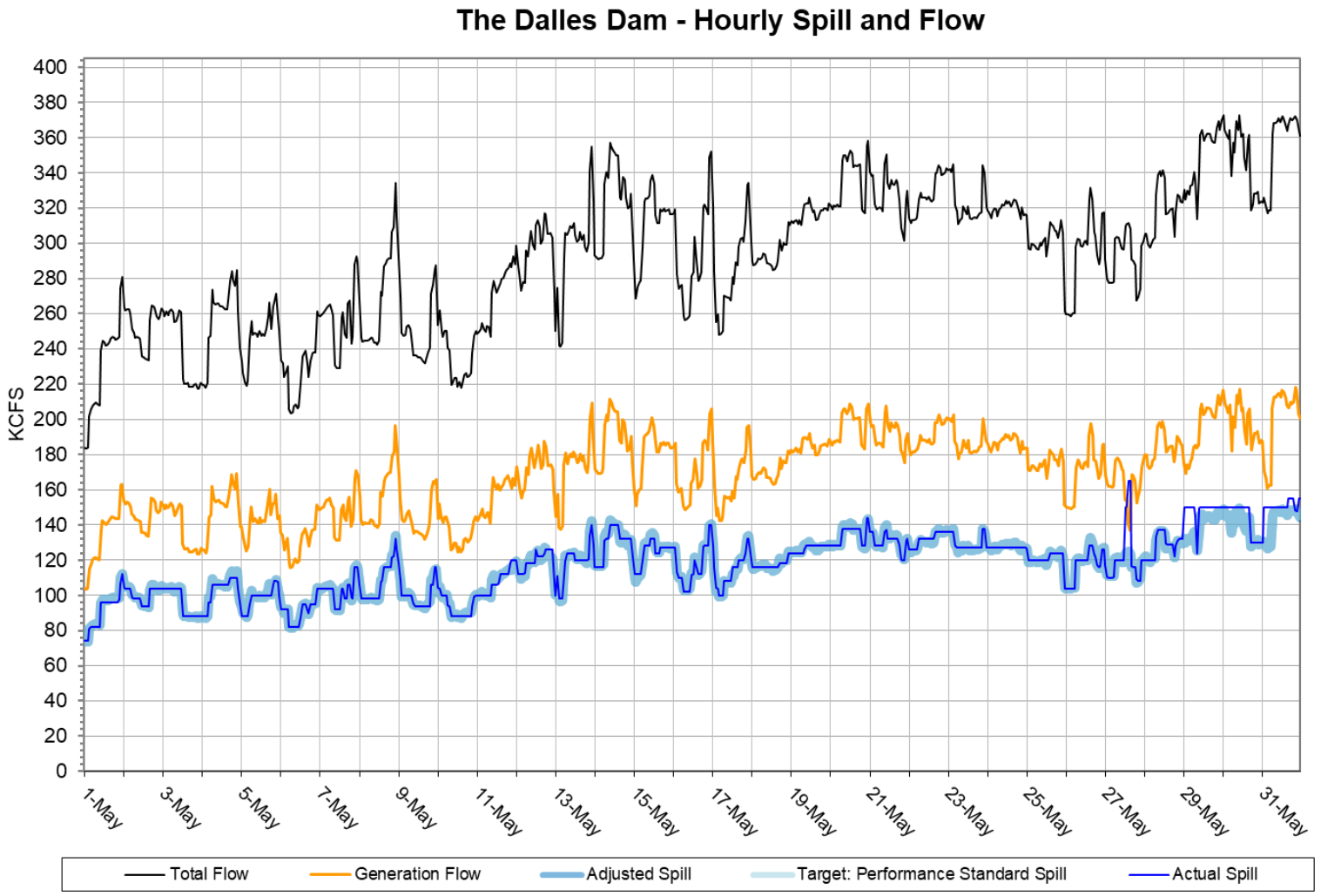
[18] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 6[19]



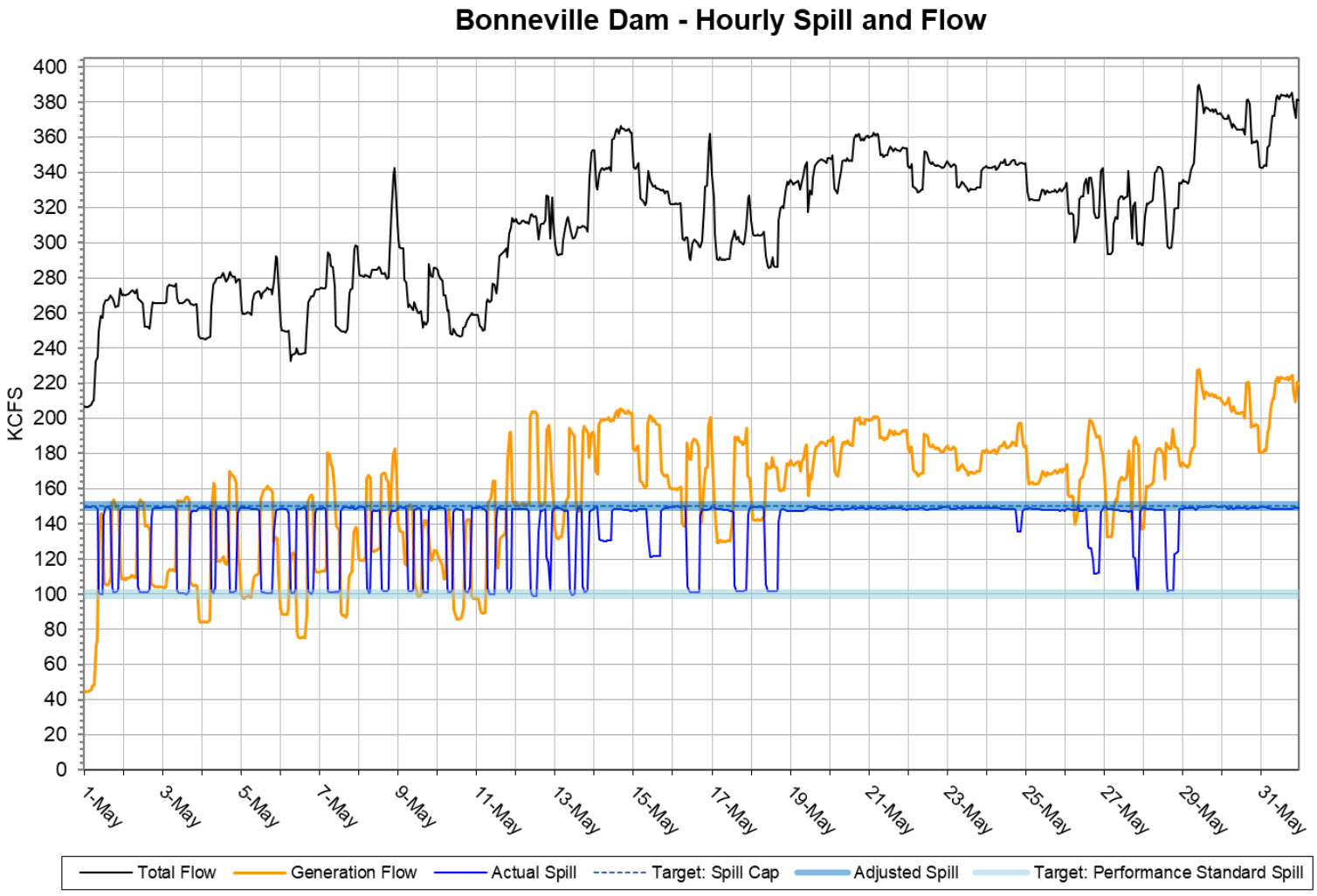
[19] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 7[20]



[20] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 8[21]



[21] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

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Portland, OR.

Introduction

The U.S. Army Corps of Engineers (Corps) developed this report in accordance with the 2020 Fish Operations Plan[1] (2020 FOP). The 2020 FOP describes the Corps' planned operations for juvenile fish passage at its four lower Snake River and four lower Columbia River dams during the 2020 spring and summer fish migration seasons, generally April 3 through August 31. The 2020 FOP is consistent with spill operations for juvenile fish passage and the regional forum process for adaptive management and in-season management provisions outlined in the 2019 NOAA Fisheries Columbia River System Biological Opinion (2019 BiOp)[2], the 2018 Extensions of the 2008 Columbia Basin Fish Accords (Accord Extensions), the 2019-2021 Spill Operation Agreement (Agreement) and subsequent Addendum, the Corps' requirements under the Endangered Species Act (ESA), and is the subject of ongoing consultation and communications with the relevant wildlife agencies to ensure consistency with the ESA. Other project operations and water management actions not specifically addressed in this document will be consistent with the 2019 BiOp and other guiding operative documents, including the 2020 Water Management Plan (WMP), seasonal WMP updates, and the 2020 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2020 FOP during the month of June 2020. 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 (Tables 1 and 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, including spill caps. (see 2020 FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,
- resultant 12-hour average TDG for the tailwater at each project.

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2020 FOP in June 2020.

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[1] The 2020 FOP was posted to the Technical Management Team (TMT) website on March 23, 2020 (http://pweb.crohms.org/tmt/documents/fpp/2020/).

[2] The Corps, in coordination with the other Action Agencies, and National Marine Fisheries Service (NMFS), employs the Regional Implementation Oversight Group (RIOG) and technical teams including the Technical Management Team (TMT) and Fish Passage Operations & Maintenance (FPOM), to coordinate with state, tribal and other federal experts for recommendations for implementing operations consistent with NMFS' Columbia River System Biological Opinions.

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 June, with hourly spill, target spill, adjusted spill, generation, and total flows. The monthly graphs begin on June 1 and end on June 30 and reflect the following operations for the lower Snake River and the lower Columbia River projects:

- The black line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The orange line represents the average hourly generation flow through the powerhouse each hour in kcfs.
- The thin solid blue line represents the actual average hourly spill level through the spillway in kcfs.
- The dashed blue line represents the spill cap portion of the target spill estimated to reach the gas cap or target TDG (spring only).
- The thick light blue line represents the performance standard spill level portion of the target spill (spring only).
- The dotted blue line represents the hourly target summer spill in kcfs (summer only).
- The thick dark blue line represents the adjusted spill cap spill: the hourly spill cap 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 (2020 FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the June 2020 Average Percent TDG Values Table (Table 4). The numbers in red indicate the project exceeded the %TDG cap - i.e. 125% (tailwater) for each project during spring spill and 120% (tailwater), 115% (forebay of the next downstream dam) during summer spill.

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the adjusted spill due to various conditions as described below. When actual spill varied from adjusted spill levels during periods of voluntary spill, the change in spill level is described below in the June 2020 Spill Variance Table (Table 2).[3] The Spill Variance Table includes average hourly data; but when spill varies from adjusted spill for a portion of an hour, it is characterized as a variance for a full hour. There are instances when the hourly adjusted 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 adjusted spill to the extent practicable. Other routine activities that changed spill levels, which were coordinated with regional partners, are identified in the monthly Pre-Coordinated Operations Table (Table 3).

[3] 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.

"Low flow" operations at the lower Columbia and lower Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target spill levels. For this report, the decrease in target spill is represented as adjusted spill. 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 2020 FOP for Bonneville and The Dalles dams,[4] 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). Transition periods between gas cap spill and performance standard spill hours may result in actual hourly spill levels that are slightly higher or lower than target spill levels.

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 precipitation with average flows on the lower Snake River and above average flows on the Lower Columbia river. The June 2020 observed precipitation was 190% of average on the Snake River above Ice Harbor and 150% of average on the Columbia River above The Dalles[5]. The NOAA Northwest River Forecast Center runoff summary for June indicated that the adjusted runoff for the Snake River at Lower Granite was 98% of the 30-year average (1981-2010) with a volume of 5.9 MAF (Million acre-feet). The June 2020 adjusted runoff for the Columbia River at The Dalles was 112% of the 30-year average (1981-2010) with a volume of 29.2 MAF.[6]

Spring spill operations occur April 3–June 20 at the four lower Snake River projects, and April 10–June 15 at the four lower Columbia River projects. Spring target spill levels for June 2020 through the dates listed above at each project are defined in Table 1.

[4] As specified in the 2020 FOP section 3.
[5] Retrieved July 2, 2020: https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=5
[6] Retrieved July 2, 2020: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

Table 1: Summary of 2020 spring target spill levels at lower Snake River (until June 20) and lower Columbia River (until June 15) projects.

PROJECT	FLEX SPILL (16 hours per day)[A, B, C, E]	PERFORMANCE STANDARD SPILL (8 hours per day)[B, D, E]
Lower Granite[E]	125% Gas Cap	20 kcfs
Little Goose[F, G]	125% Gas Cap	30%
Lower Monumental	125% Gas Cap (uniform spill pattern)	30 kcfs (bulk spill pattern[H])
Ice Harbor	125% Gas Cap	30%
McNary	125% Gas Cap	48%
John Day	120% TDG target	32%
The Dalles[I]	40%	40%
Bonneville[J]	125% Gas Cap	100 kcfs

A. Attempts should be made to minimize in-season changes to the proposed operations; however, if serious deleterious impacts are observed, existing adaptive management processes may be employed to help address serious issues that may arise in-season as a result of implementing these proposed spill operations.

B. Spill may be temporarily reduced at any project if necessary to ensure navigation safety or transmission reliability. In order to operate consistently with state water quality standards, spill may be also reduced if observed Gas Bubble Trauma (GBT) levels exceed those identified in state water quality standards (see WASH. ADMIN. CODE §173-201A-200(l)(f))).

C. 125% Gas Cap spill is spill to the maximum level that meets, but does not exceed, the TDG criteria allowed under state laws. This includes a criterion for not exceeding 126% TDG for the average of the two greatest hourly values within a day.

D. The 8 hours of performance standard spill may occur with some flexibility (with the exception of Little Goose and Lower Granite operations described in the next key points). Other than at TDA, performance standard spill occurs in either a single 8-hour block or up to two separate blocks per calendar day. No more than 5 hours of performance standard spill may occur between sunset and sunrise, as defined in Fish Passage Plan (FPP) Table BON-5. Performance standard spill is not be implemented between 2200-0300 hours. No ponding above current MOP assumptions except as noted below.

E. Lower Granite Exception One - If adult passage delays are observed at Lower Granite Dam, the Corps may implement performance standard spill at Lower Granite Dam for at least 4 hours in the AM (beginning at 0500 hours). Implementation of this modification may also trigger in-season reevaluation of options to balance power principle.

F. Little Goose Exception One - As soon as practicable (and, in any event, no more than 24 hours) after a cumulative total of 25 adult spring Chinook salmon (not including jacks) pass Lower Monumental Dam, operate Little Goose spill at 30% spill for 8 consecutive am hours (April 3-15 start at 0500 hours; April 16-June 20 start at 0400 hours).

G. Little Goose Exception Two - During periods of involuntary spill, spill at 30% for 8 hours/day during the hours described in footnote F above and store additional inflows that exceed hydraulic capacity in the forebay above MOP if necessary. When it is necessary to pond water to achieve the lower spill levels due to high inflow, water stored above MOP should be drafted out over the remaining hours by increasing spill to pass inflow from 1200-1600 hours (or 1300-1700 hours from April 3-15), then increasing spill as necessary from 1600-0400 (or 1700-0500 hours from April 3-15) to draft the pool back to MOP. If it is forecast that the drafting spill will generate TDG levels in the tailrace in excess of 130% TDG, use all 16 hours to return the pool to MOP.

H. If the specified spill level at bulk pattern exceeds the gas cap, then spill pattern will be changed to uniform.

I. Fish passage spill at The Dalles should be limited to spillbays 1-8 unless river flow exceeds 350 kcfs, then spill outside the spillwall is permitted. TDG levels in The Dalles tailrace may fluctuate up to 125% TDG prior to reducing spill at upstream projects or reducing spill below 40% at The Dalles.

J. Fish passage spill at Bonneville Dam should not exceed 150 kcfs due to erosion concerns.

Summer spill operations occur June 21–August 31 at the four lower Snake River projects, and June 16–August 31 at the four lower Columbia River projects (Table 2).

Table 1: Summary of 2020 summer target spill levels at lower Snake River and lower Columbia River projects.

PROJECT	2020 SUMMER SPILL[A] (June 21/16 – August 14) (24 hrs/day)	2020 SUMMER SPILL[A] (August 15 – August 31) (24 hrs/day)
Lower Granite[B]	18 kcfs	Spillway weir (SW) flow or ~7 kcfs spill
Little Goose[B]	30%	SW flow or ~7 kcfs spill
Lower Monumental[B]	17 kcfs	SW flow or ~7 kcfs spill
Ice Harbor[B]	30%	SW flow or ~8.5 kcfs spill
McNary	57%	20 kcfs
John Day	35%	20 kcfs
The Dalles	40%	30%
Bonneville	95 kcfs	50 kcfs

A. Spill may be temporarily reduced below the FOP target summer spill level at any project if necessary to ensure navigation safety or transmission reliability, or to avoid exceeding State TDG standards.
B. Summer spill from August 15-August 31 may be through the SW or through conventional spillbays using the appropriate FPP spill pattern for each project. The SWs will be operated consistent with the SW operational criteria in the FPP.

In its implementation of the 2020 FOP in June, the Corps evaluated conditions every day to establish spill caps at a level that was estimated to meet, but not exceed, the gas cap or target TDG in the tailrace (see Table 5).[7] 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).

Operational Adjustments

1. Little Goose Dam

From June 6, through June 20, the 8 hours of performance standard spill (30%) per day identified in the 2020 Fish Operations Plan (FOP) was changed from a morning fixed start time (0400 hours) to an adjustable start time (could occur after 0400 hours). The operational adjustment was made in order to minimize the upstream migration delay of adult spring Chinook salmon passing Little Goose Dam. This operational adjustment did not change the number of performance standard spill hours per day identified in the FOP, it only changed the performance standard spill start time from fixed to adjustable. This operation was coordinated at the Flex Spill Working

[7] See 2020 FOP section 2.2

Group meeting on June 5, and the TMT meeting on June 8, and regional sovereigns either supported or did not object to this operational adjustment.

2. Lower Monumental Dam

From June 2, through June 5, the 8 hours of performance standard spill (30 kcfs) per day identified in the 2020 FOP was changed from flexible (as defined in Table 1, footnote D) to a fixed 8-hour block from 0600 to 1400 each day. The operational adjustment was made in order to improve tailrace conditions during hours of peak adult fish passage. This operational adjustment did not change the number of performance standard spill hours per day identified in the FOP, it only changed the performance standard spill hours from adjustable to fixed. This operation was coordinated at the TMT meeting on May 29, and regional sovereigns either supported or did not object to this operational adjustment.

Table 3: Spill Variance Table – June 2020 (6/1 to 6/30)

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Little Goose	Reduced Spill	6/9	2300	1	Human Error	Hourly spill decreased to 69.7 kcfs (less than adjusted spill of 71.7 kcfs) while generation was 14.0 kcfs, greater than the minimum generation range for Unit 1 (11.3 – 11.8 kcfs[9]) due to a delay in changing to the requested generation flow.
Little Goose	Reduced Spill	6/10 6/11 6/12 6/13 6/14 6/17	2000-2300 1400-1600 2300-2400 0100-0300 1400-1800 1400-1700, 1900-2300	4 3 2 3 5 9	Program Error [10]	Hourly spill decreased to 68.5 to 78.3 kcfs (less than adjusted spill of 68.6 to 78.6 kcfs) while generation was between 12.1 and 12.4 kcfs, greater than the minimum generation range for Unit 1 (11.3 – 11.8 kcfs[9]).

[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.

[9] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Little Goose turbine Unit 1, the range is 11.1-12.0 kcfs. See 2020 FOP section 4.3.1.

[10] The minimum generation flow range (kcfs) through the turbines is a function of power output (megawatts), turbine efficiency, and project head. Despite hourly updates and corrective operational actions, variable and changing conditions can lead to a turbine's flow rate drifting outside the minimum generation flow range identified in Table 1 of the 2020 FOP. The minimum generation flow ranges are evaluated annually and will be re-evaluated based on conditions observed when implementing the 2020 FOP.

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Lower Monumental	Reduced Spill	6/8 6/11	0800-0900 1100	2 1	Program Error[10]	Hourly spill decreased to between 45.1 and 96.8 kcfs (less than adjusted spill target of 45.7 to 97.6 kcfs) while generation flow was between 12.6 and 13.1 kcfs, greater than the minimum generation range for Unit 1 (11.1 – 12.3 kcfs[11]).
Ice Harbor	Reduced Spill	6/2 6/9	1200 0700-0900	1 3	Program Error[10]	Hourly spill decreased to between 91.7 and 109.4 kcfs (less than adjusted spill target of 91.8 to 109.7 kcfs) while generation flow was between 10.4 and 10.6 kcfs, greater than the minimum generation range for Unit 1 (8.4 – 10.1 kcfs[12]).
The Dalles	Additional Spill	6/10	0100	1	Human Error	Hourly spill increased to 42% (greater than adjusted spill target of 40% ± 1%) due to a delay in changing to the appropriate target. Daily average spill was 40% of the total flow.

[11] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Lower Monumental turbine Unit 1, the range is 10.9-12.5 kcfs. See 2020 FOP section 4.3.1.

[12] 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 8.2-10.3 kcfs. See 2020 FOP section 4.3.1.

Table 4: Pre-Coordinated Operations – June 2020 (6/1 to 6/30)

Project	Parameter	Date	Time[13]	# of Hours	Type	Reason
Lower Monumental	Reduced Spill	6/1 6/3 6/7 6/9 6/11 6/13 6/15 6/17 6/19 6/21	1800-2000 1700-1800 1700 1900-2000 1700-1800 1800-1900 1700-1800 1900-2000 1600-1700 1900-2000	3 2 1 2 2 2 2 2 2 2	Navigation	Hourly spill decreased to between 15 and 105 kcfs (less than the spill target of 30 to 114 kcfs) for safe navigation. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
Lower Monumental	Reduced Spill	6/6 6/7	0800 0900-1100, 1300	1 4	Transmission Reliability	Hourly spill decreased to between 45 and 97 kcfs (less than adjusted spill target of 46 to 98 kcfs) while generation flow was between 12.6 and 13.2 kcfs, greater than the minimum generation range for Unit 1 (11.1 – 12.3 kcfs[14]).in order to provide reserves. Regionally coordinated via 2020 FOP, Section 4.4.1.
Ice Harbor	Reduced Spill	6/8	1000-1500	6	Maintenance	Hourly spill decreased to between 70 and 80 kcfs (less than adjusted spill target of 72 to 89 kcfs) while generation increased in order to perform GDAC testing of Units 2 and 4. Regionally coordinated via the 2020 FOP Section 4.5.

[13] 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.

[14] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Lower Monumental turbine Unit 1, the range is 10.9-12.5 kcfs. See 2020 FOP section 4.3.1.

Project	Parameter	Date	Time[13]	# of Hours	Type	Reason
McNary	Additional Spill	6/19 6/30	2300-2400 1500	2 1	Transmission Reliability	Hourly spill increased to 59% (greater than adjusted spill target of 57% ± 1%) in order to provide reserves. Regionally coordinated via 2020 FOP, Section 4.4.1. Daily average spill was between 53% and 55% of the total flow due to multiple operations.
McNary	Reduced Spill	6/20	0400	1	Transmission Reliability	Hourly spill decreased to 55% (less than adjusted spill target of 57% ± 1%) in order to provide reserves. Regionally coordinated via 2020 FOP, Section 4.4.1. Daily average spill was 54% of the total flow due to multiple operations.
John Day	Additional Spill	6/1 6/2 6/3 6/8 6/17 6/19 6/20	0100-2400 0100-2400 0100-2200 0600-2300 2000 2300 1100-1300, 1900,2200	24 24 22 18 1 1 5	Transmission Reliability	Hourly spill increased to between 92 and 210 kcfs (greater than adjusted spill target of between 87 and 170 kcfs) in order to provide reserves. Regionally coordinated via 2020 FOP, Section 4.4.1.

Project	Parameter	Date	Time[13]	# of Hours	Type	Reason
The Dalles	Additional Spill	6/5 6/8 6/30	1800 0600-2400 1300-1500	1 19 3	Transmission Reliability	Hourly spill increased to between 42% and 49% (greater than adjusted spill target of 40% ± 1%) in order to provide reserves. Daily average spill was 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
The Dalles	Reduced Spill	6/9	0100, 0300, 0500-0800	6	Transmission Reliability	Hourly spill decreased to 38% of total flow (less than adjusted spill target of 40% ± 1%) due to an increase in generation in order to deploy reserves. Daily average spill was 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.

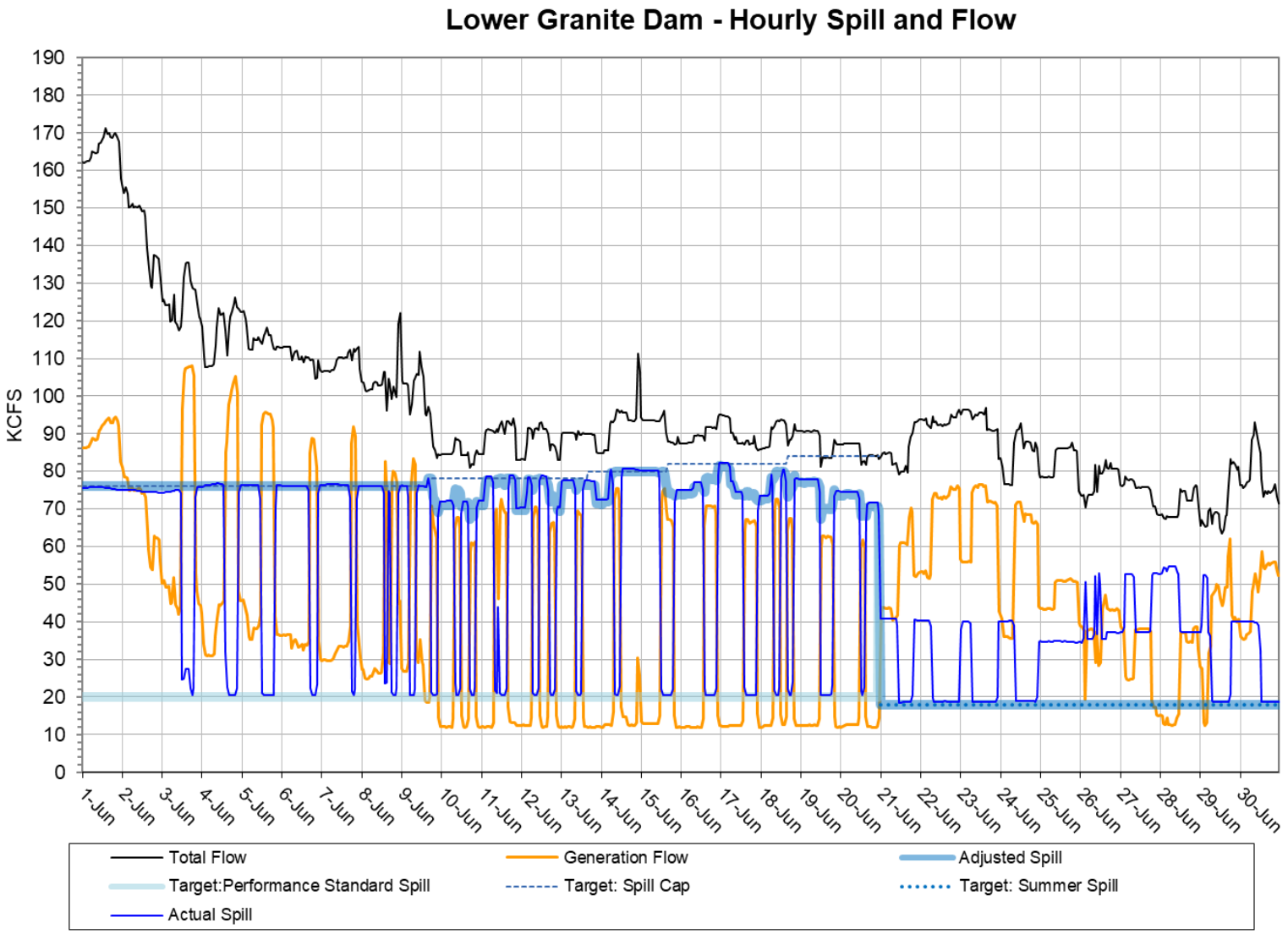
Table 5: June 2020 Average Percent TDG Values Table (6/1 to 6/30)

FIXED MONITORING STATIONS																
Station:	**LWG**	**LGNW**	**LGSA**	**LGSW**	**LMNA**	**LMNW**	**IHRA**	**IDSW**	**MCNA**	**MCPW**	**JDY**	**JHAW**	**TDA**	**TDDO**	**BON**	**CCIW**
Gas Cap %:	**115**[15]	**125 120**	**115**	**125 120**	**115**	**125 120**	**115**	**125 120**	**115**	**125 120**	**115**	**125 120**	**115**	**125 120**	**115**	**125 120**
6/1/2020	105	125	116	**126**	**128**	**126**	123	125	114	123	114	125	118	123	118	124
6/2/2020	106	125	120	**126**	**129**	**126**	125	124	117	124	110	125	118	124	121	124
6/3/2020	107	125	121	**126**	**127**	124	124	124	118	**126**	115	122	119	124	121	124
6/4/2020	107	125	122	125	**127**	123	124	125	119	**128**	117	121	119	124	120	124
6/5/2020	106	125	123	124	**127**	123	124	125	120	124	120	121	119	123	121	125
6/6/2020	106	125	119	124	**126**	123	123	123	118	125	119	123	119	122	118	124
6/7/2020	104	125	116	124	123	122	120	120	113	**126**	118	123	116	125	117	124
6/8/2020	102	124	113	124	119	123	116	124	110	**131**	111	124	116	123	116	123
6/9/2020	102	124	113	124	121	122	117	122	112	**130**	108	119	116	121	121	123
6/10/2020	104	123	115	123	123	121	121	119	116	•[16]	110	119	118	121	121	122
6/11/2020	105	123	117	124	125	120	122	118	117	**126**	114	120	118	122	119	122
6/12/2020	106	123	119	124	124	121	122	118	118	121	122	120	118	122	118	123
6/13/2020	106	123	119	124	122	122	120	118	117	124	122	120	116	120	116	122
6/14/2020	103	123	116	124	120	121	116	118	112	124	117	120	117	121	116	122
6/15/2020	102	123	115	124	120	122	117	120	111	123	114	120	118	122	118	122
6/16/2020	102	122	116	124	122	122	118	117	113	119	111	117	115	120	**118**	119
6/17/2020	102	123	117	124	121	122	118	118	112	119	109	118	112	117	115	119
6/18/2020	103	122	116	124	122	120	119	118	114	119	111	117	113	118	114	119
6/19/2020	104	123	118	124	125	121	120	118	115	120	113	118	115	119	**117**	120
6/20/2020	105	122	119	125	125	122	121	118	**116**	120	113	118	114	118	**117**	120
6/21/2020	105	118	**118**	116	**122**	120	**119**	117	114	119	114	118	114	119	114	119
6/22/2020	103	114	**118**	116	**122**	118	**118**	117	113	119	113	119	**117**	120	114	119
6/23/2020	105	114	**120**	116	**119**	120	**119**	118	**117**	120	114	120	**119**	**122**	**119**	120
6/24/2020	106	116	**118**	117	**119**	120	**120**	119	**118**	120	114	119	**116**	**121**	**119**	120
6/25/2020	105	117	114	113	**118**	119	**117**	118	115	120	115	119	**117**	120	115	120
6/26/2020	105	119	114	116	**117**	119	**117**	118	**116**	120	**116**	119	**116**	119	115	120
6/27/2020	105	120	114	119	**116**	119	**117**	118	**116**	120	114	119	113	118	114	120
6/28/2020	104	120	114	**121**	115	118	**116**	119	114	120	110	120	114	120	111	120
6/29/2020	103	118	114	116	115	119	114	119	113	120	109	120	113	119	112	120
6/30/2020	102	118	112	116	**116**	120	114	120	113	120	108	**121**	113	119	111	120
Exceedances:	**0**	**0**	**4**	**4**	**14**	**2**	**8**	**0**	**5**	**6**	**1**	**1**	**5**	**2**	**5**	**0**

[15] The State water quality standards for the summer state that TDG must not exceed an average of 115% as measured in the forebays of the next downstream dams and must not exceed an average of 120% as measured in the tailraces of each dam.

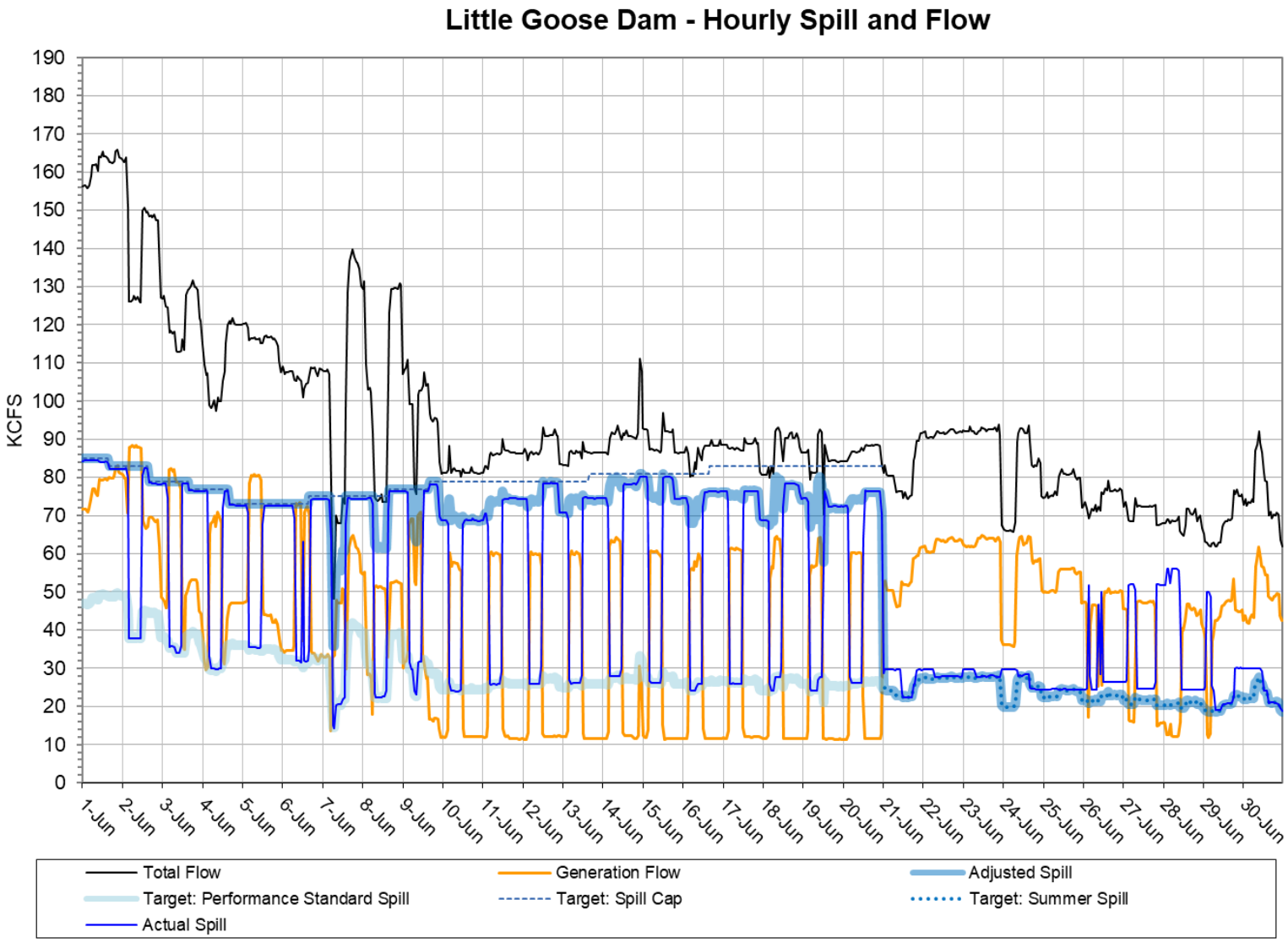
[16] Red shaded cells indicate no data due to malfunctioning gauge.

Figure 1[17]



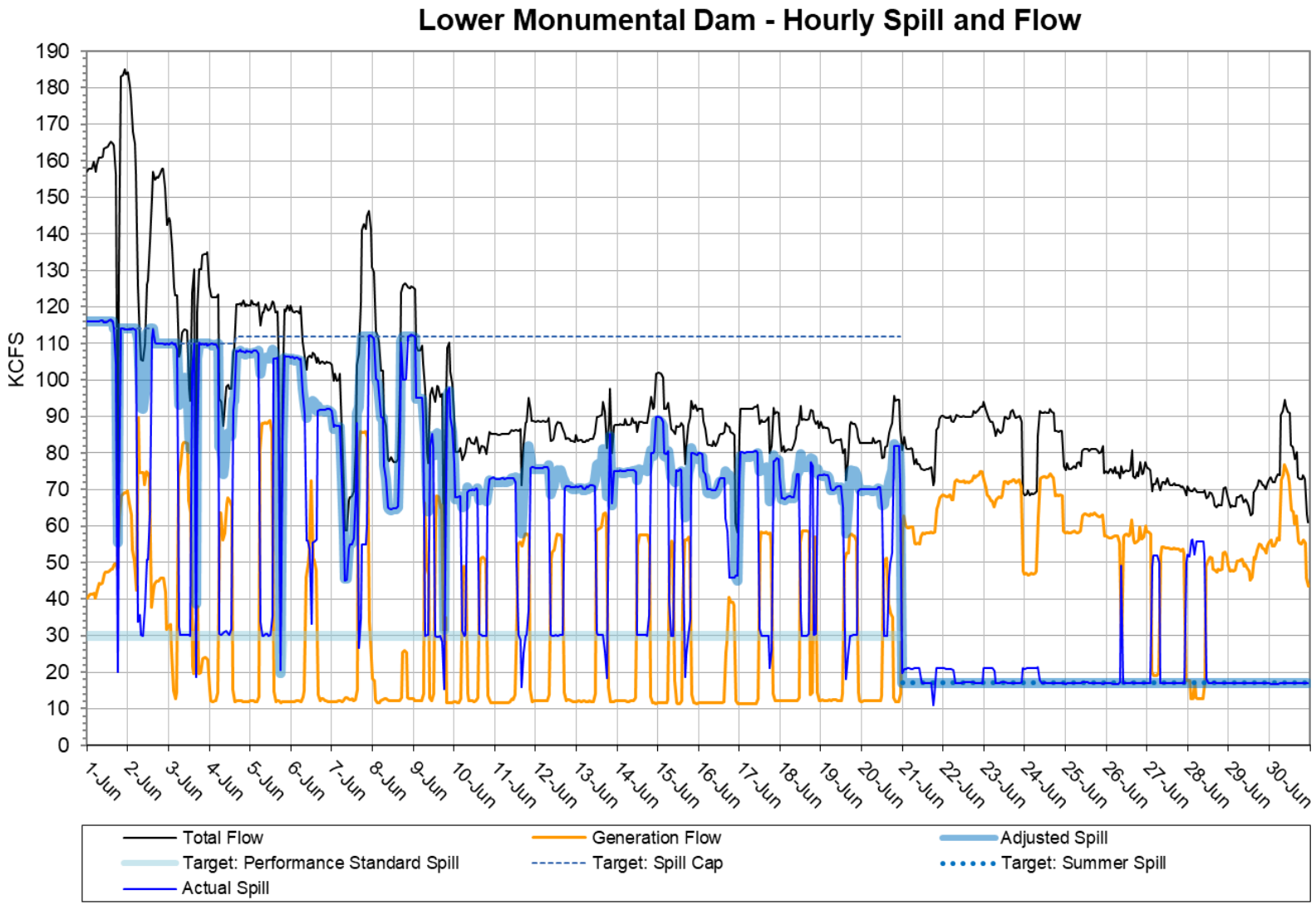
[17] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 2[18]



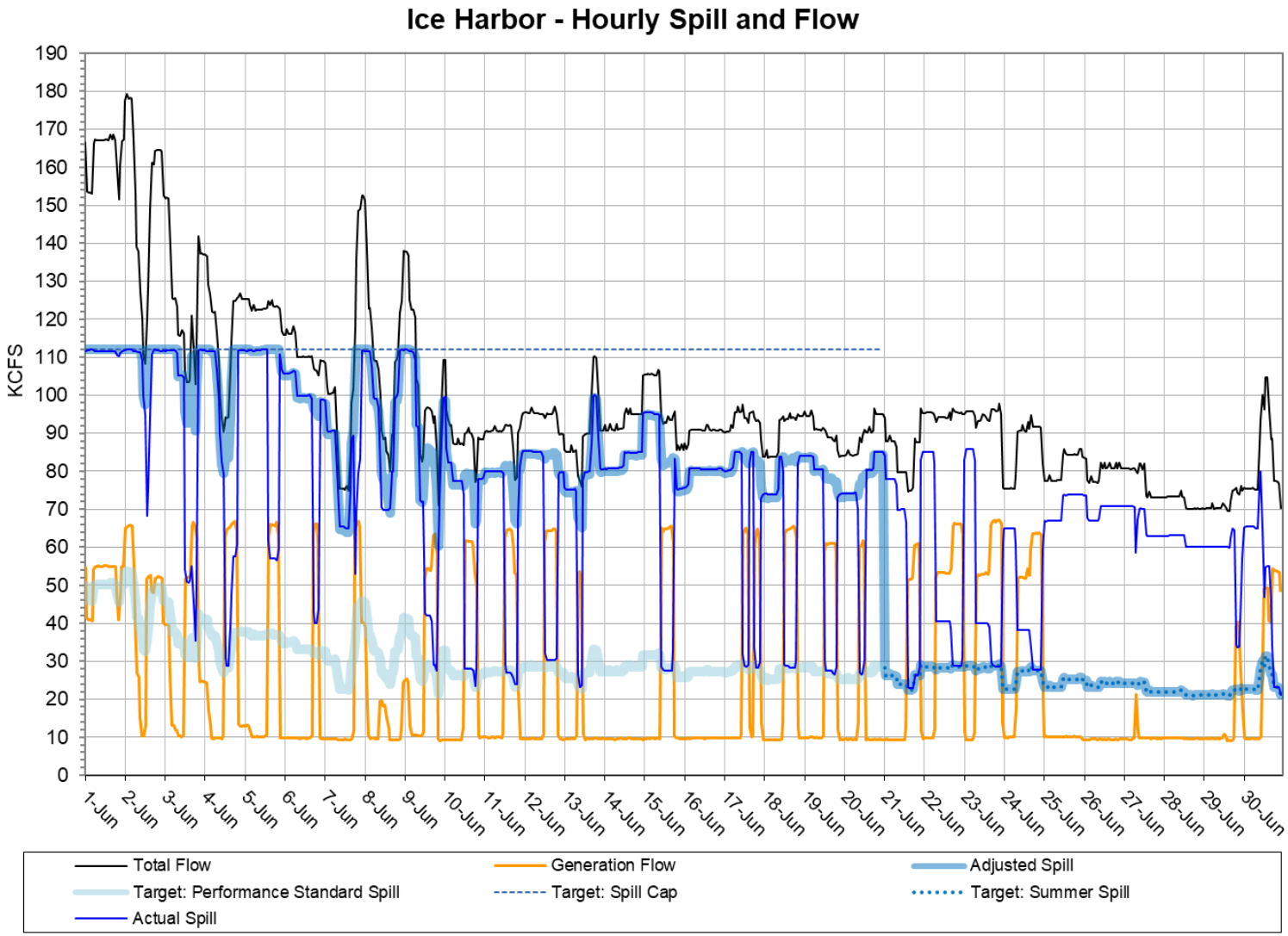
[18] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 3[19]



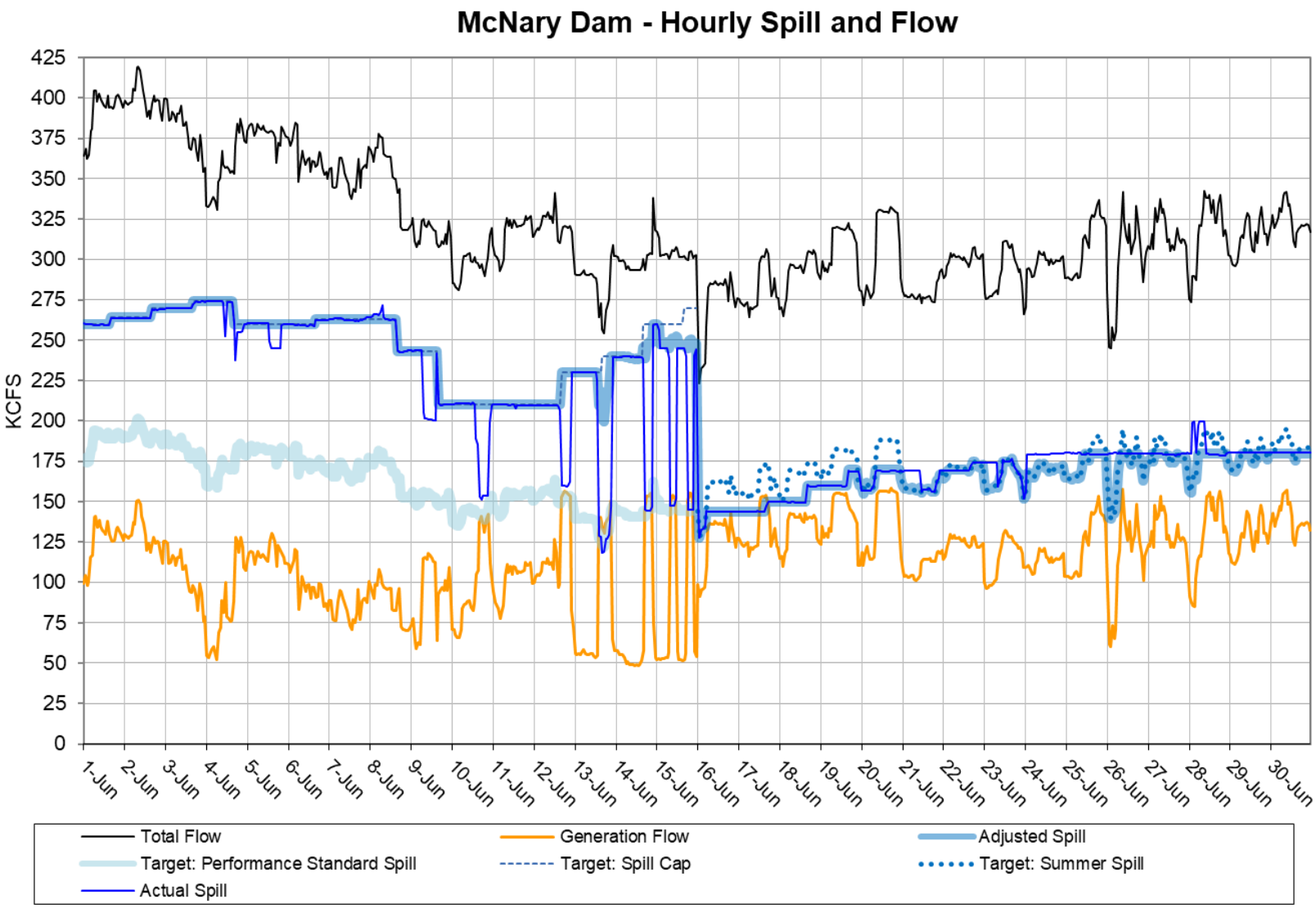
[19] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 4[20]



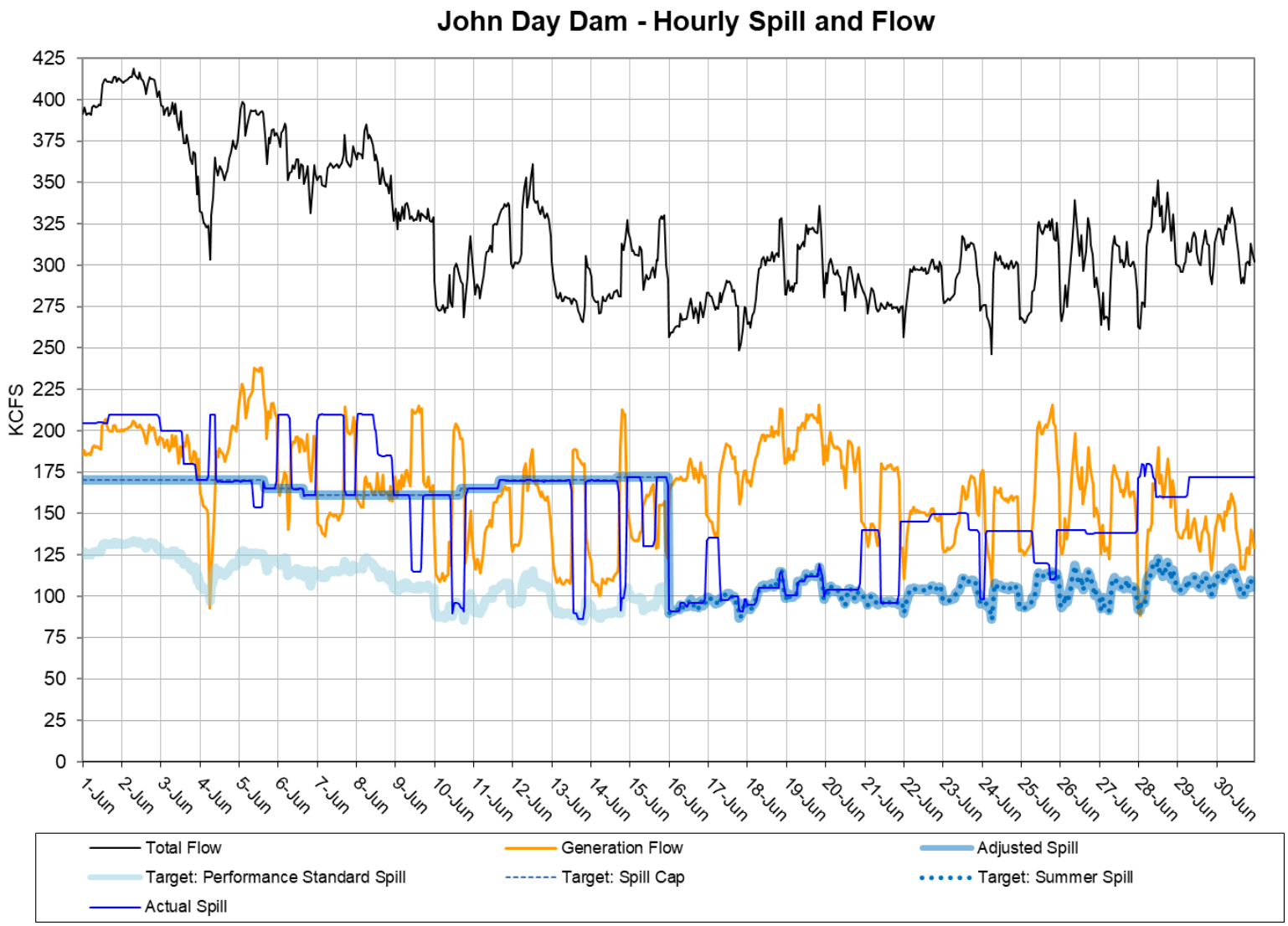
[20] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 5[21]



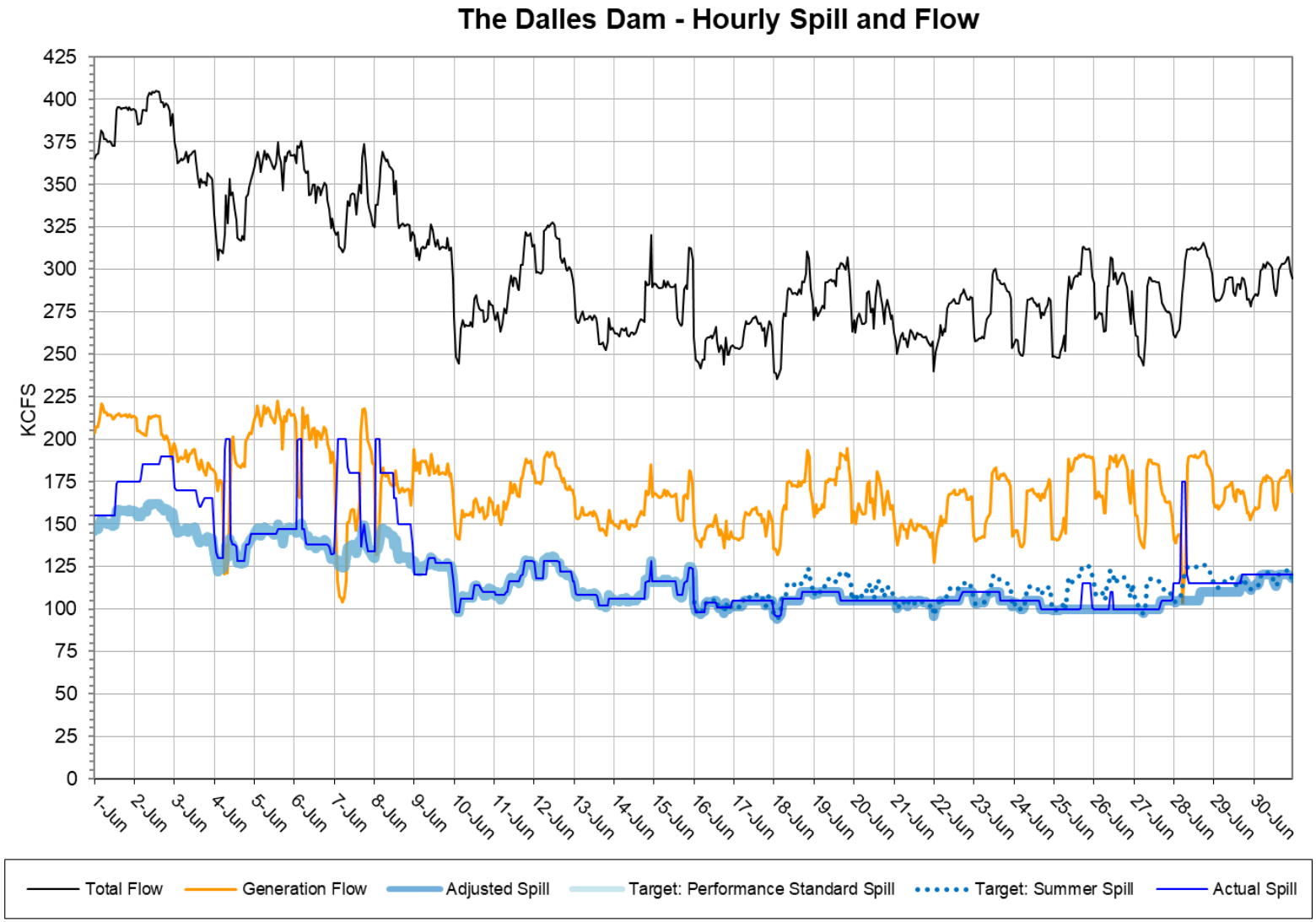
[21] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 6[22]



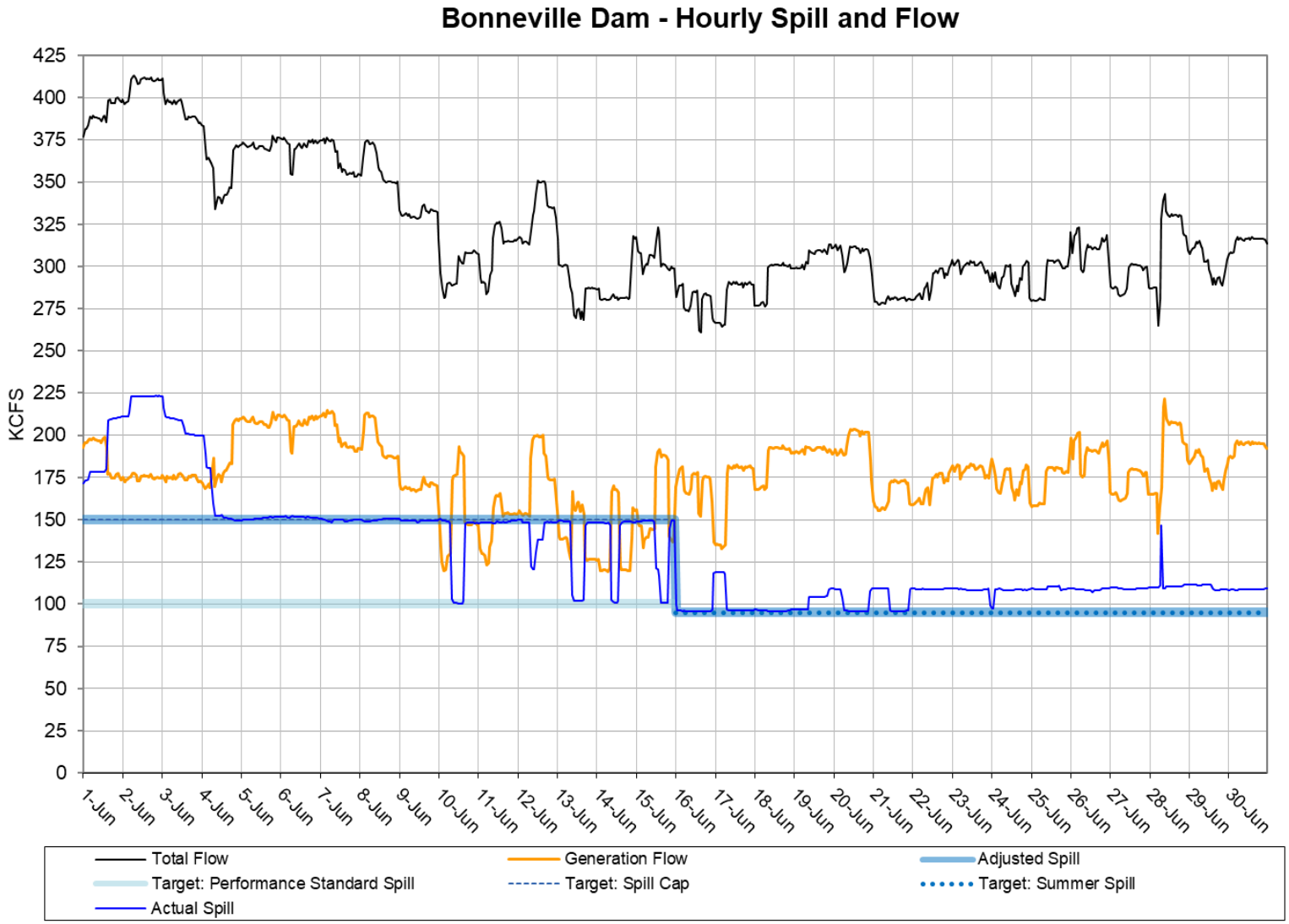
[22] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 7[23]



[23] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 8[24]



[24] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

FISH OPERATIONS PLAN IMPLEMENTATION REPORT

July 2020

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

Introduction

The U.S. Army Corps of Engineers (Corps) developed this report in accordance with the 2020 Fish Operations Plan[1] (2020 FOP). The 2020 FOP describes the Corps' planned operations for juvenile fish passage at its four lower Snake River and four lower Columbia River dams during the 2020 spring and summer fish migration seasons, generally April 3 through August 31. The 2020 FOP is consistent with spill operations for juvenile fish passage and the regional forum process for adaptive management and in-season management provisions outlined in the 2019 NOAA Fisheries Columbia River System Biological Opinion (2019 BiOp)[2], the 2018 Extensions of the 2008 Columbia Basin Fish Accords (Accord Extensions), the 2019-2021 Spill Operation Agreement (Agreement) and subsequent Addendum, the Corps' requirements under the Endangered Species Act (ESA), and is the subject of ongoing consultation and communications with the relevant wildlife agencies to ensure consistency with the ESA. Other project operations and water management actions not specifically addressed in this document will be consistent with the 2019 BiOp and other guiding operative documents, including the 2020 Water Management Plan (WMP), seasonal WMP updates, and the 2020 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2020 FOP during the month of July 2020. 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 (Table 1);
- 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, including spill caps. (see 2020 FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,
- resultant 12-hour average TDG for the tailwater and next downstream forebay at each project.

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2020 FOP in July 2020.

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[1] The 2020 FOP was posted to the Technical Management Team (TMT) website on March 23, 2020 (http://pweb.crohms.org/tmt/documents/fpp/2020/).

[2] The Corps, in coordination with the other Action Agencies, and National Marine Fisheries Service (NMFS), employs the Regional Implementation Oversight Group (RIOG) and technical teams including the Technical Management Team (TMT) and Fish Passage Operations & Maintenance (FPOM), to coordinate with state, tribal and other federal experts for recommendations for implementing operations consistent with NMFS' Columbia River System Biological Opinions.

Data Reporting

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

- The black line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The orange line represents the average hourly generation flow through the powerhouse each hour in kcfs.
- The thin solid blue line represents the actual average hourly spill level through the spillway in kcfs.
- The dotted blue line represents the hourly target summer spill in kcfs (summer only).
- The thick dark blue line represents the adjusted spill cap spill: the hourly spill cap 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 (2020 FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the July 2020 Average Percent TDG Values Table (Table 4). The numbers in red indicate the project exceeded the %TDG cap - i.e. 120% (tailwater), 115% (forebay of the next downstream dam) during summer spill.

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the adjusted spill due to various conditions as described below. When actual spill varied from adjusted spill levels during periods of voluntary spill, the change in spill level is described below in the July 2020 Spill Variance Table (Table 2).[3] The Spill Variance Table includes average hourly data; but when spill varies from adjusted spill for a portion of an hour, it is characterized as a variance for a full hour. There are instances when the hourly adjusted 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 adjusted spill to the extent practicable. Other routine activities that changed spill levels, which were coordinated with regional partners, are identified in the monthly Pre-Coordinated Operations Table (Table 3).

"Low flow" operations at the lower Columbia and lower Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target spill levels. For this report, the decrease in target spill is represented as adjusted spill. In these situations, the projects operate at minimum generation and pass the remainder of project outflow 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 non-federal projects upstream are variable and

[3] 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.

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 2020 FOP for Bonneville and The Dalles dams,[4] 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.

July Operations

The month of July was characterized by below average precipitation and above average flows on the lower Snake and Columbia Rivers. The July 2020 observed precipitation was 53% of average on the Snake River above Ice Harbor and 57% of average on the Columbia River above The Dalles[5]. The NOAA Northwest River Forecast Center runoff summary for July indicated that the adjusted runoff for the Snake River at Lower Granite was 108% of the 30-year average (1981-2010) with a volume of 2.5 MAF (Million acre-feet). The July 2020 adjusted runoff for the Columbia River at The Dalles was 111% of the 30-year average (1981-2010) with a volume of 16.2 MAF.[6]

[4] As specified in the 2020 FOP section 3.
[5] Retrieved August 3, 2020: https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=5
[6] Retrieved August 3, 2020: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

Summer spill operations occur June 21–August 31 at the four lower Snake River projects, and June 16–August 31 at the four lower Columbia River projects (Table 1).

Table 1: Summary of 2020 summer target spill levels at lower Snake River and lower Columbia River projects.

PROJECT	2020 SUMMER SPILL[A] (June 21/16 – August 14) (24 hrs/day)	2020 SUMMER SPILL[A] (August 15 – August 31) (24 hrs/day)
Lower Granite[B]	18 kcfs	Spillway weir (SW) flow or ~7 kcfs spill
Little Goose[B]	30%	SW flow or ~7 kcfs spill
Lower Monumental[B]	17 kcfs	SW flow or ~7 kcfs spill
Ice Harbor[B]	30%	SW flow or ~8.5 kcfs spill
McNary	57%	20 kcfs
John Day	35%	20 kcfs
The Dalles	40%	30%
Bonneville	95 kcfs	50 kcfs

A. Spill may be temporarily reduced below the FOP target summer spill level at any project if necessary to ensure navigation safety or transmission reliability, or to avoid exceeding State TDG standards.
B. Summer spill from August 15-August 31 may be through the SW or through conventional spillbays using the appropriate FPP spill pattern for each project. The SWs will be operated consistent with the SW operational criteria in the FPP.

In its implementation of the 2020 FOP in July, the Corps evaluated conditions every day to establish spill caps at a level that was estimated to meet, but not exceed, the gas cap or target TDG in the tailrace (see Table 4).[7] 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).

Operational Adjustments

1. Lower Monumental Dam

From July 24 at 1500 hours through July 28 at 1700 hours, a new spill pattern[8] was applied to spill at Lower Monumental Dam. This action was in response to TDG exceeding state standards in the Ice Harbor Dam forebay resulting from summer spill (17 kcfs) at Lower Monumental dam using the bulk spill pattern[9]. Actual forebay elevations were different than the assumptions made in the coordinated spill pattern, and prevented the project from spilling to the intended pattern. However, the new spill pattern was corrected on July 28, and the total summer spill amount (17

[7] See 2020 FOP section 2.2
[8] See TMT meeting agenda from 7/24 for coordinated spill patterns: http://pweb.crohms.org/tmt/agendas/2020/0724_Agenda.html
[9] See FPP, Table LMN-7, Lower Monumental Dam Bulk Spill Patterns with RSW.

kcfs) was maintained. This operation was coordinated at the TMT meeting on July 24, and regional sovereigns either supported or did not object to this operational adjustment.

On July 28 at 1700 hours, an alternate spill pattern was applied[10] to spill at Lower Monumental due to dam safety concerns. This action was in response to the discovery of a potential cable failure at the project's floating navigation guide wall. This change was reported to TMT at the July 29 TMT meeting. On August 4 at 1100 hours, the project resumed spill under the bulk spill pattern[9].

[10] Table LMN-8, Lower Monumental Dam Uniform Spill Patterns with RSW was modified to take the RSW out of service due to dam safety concerns.

Table 2: Spill Variance Table – July 2020 (7/1 to 7/31)

Project	Parameter	Date	Time[11]	# of Hours	Type	Reason
Little Goose	Additional Spill	7/6	2300	1	Human Error	Hourly spill increased to 33% (greater than adjusted spill target of 30% ± 1%) due to a delay in changing to the appropriate target. Daily average spill was 30% of the total flow.
Little Goose	Additional Spill	7/7	1200	1	Human Error	Hourly spill increased to 32% (greater than adjusted spill target of 30% ± 1%) due to incorrect spillway gate settings. Daily average spill was 30% of the total flow.
Ice Harbor	Additional Spill	7/21 7/22 7/23	2400 0100, 1600-2400 0100-0200, 1300-1400	1 10 4	Maintenance	Hourly spill increased to between 34% and 54% (greater than adjusted spill target of 30% ± 1%) due to a forced unit outage resulting from emergency maintenance to the station service governor. Daily average spill was between 31% and 41% of the total flow.
Ice Harbor	Reduced Spill	7/27	1500, 1800	2	Maintenance	Hourly spill decreased to 28% (less than adjusted spill target of 30% ± 1%) due to unscheduled testing of Unit 1 following station service governor repair. Daily average spill was 32% of the total flow.
McNary	Additional Spill	7/4	1100	1	Human Error	Hourly spill remained at the target spill of 188 kcfs (greater than adjusted spill target of 185 ± 2 kcfs).
John Day	Reduced Spill	7/18	0800	1	Human Error	Hourly spill decreased to 33% (less than adjusted spill target of 35% ± 1%) due to a miscalculation of spill. Daily average spill was 35% of the total flow.

[11] 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: Pre-Coordinated Operations – July 2020 (7/1 to 7/31)

Project	Parameter	Date	Time[12]	# of Hours	Type	Reason
Little Goose	Reduced Spill	7/16	1100	1	Navigation	Hourly spill decreased to 28% (less than adjusted spill target of 30% ± 1%) for safe navigation. Daily average spill was 30% of the total flow. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
Little Goose	Reduced Spill	7/23	0800	1	Maintenance	Hourly spill decreased to 28% of total flow (less than 30% ±1% range) due to pre-annual testing of Unit 4. Daily average spill was 30%. Regionally coordinated via the 2020 FOP Section 4.5.
Little Goose	Additional Spill	7/27	0600-1900	14	Maintenance	Hourly spill increased to between 33% and 96% of total flow (greater than adjusted spill target of 30% ±1 %) while generation was reduced to speed no load (5 kcfs) for station service due to units taken offline to perform Doble testing. Daily average spill was 58% of total flow. Regionally coordinated via the 2020 FPP LGS Section 4.3.10 and Appendix A.
Lower Monumental	Additional Spill	7/27 7/28 7/29 7/30 7/31	0700-1800 0600-1700 0600-1600 0600-1400 0600-1500	12 12 11 9 10	Maintenance	Hourly spill increased to between 15 and 30 kcfs (greater than adjusted spill target of 8 to 17 kcfs) while generation was reduced to speed no load (5 kcfs) for station service due to units taken offline to perform transformer maintenance. Regionally coordinated via the 2020 FPP Appendix A.
Ice Harbor	Reduced Spill	7/6 7/17 7/27 7/30	0400 1300 1600 1100, 1600	1 1 1 2	Navigation	Hourly spill decreased to between 24% and 28% (less than adjusted spill target of 30% ± 1%) for safe navigation. Daily average spill was between 30% and 32% of the total flow. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
McNary	Additional Spill	7/2 7/3	2300-2400 0500	2 1	Transmission Reliability	Hourly spill increased to 59% (greater than adjusted spill target of 57% ± 1%) in order to provide reserves. Daily average spill was between 57 and 58% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1

[12] 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.

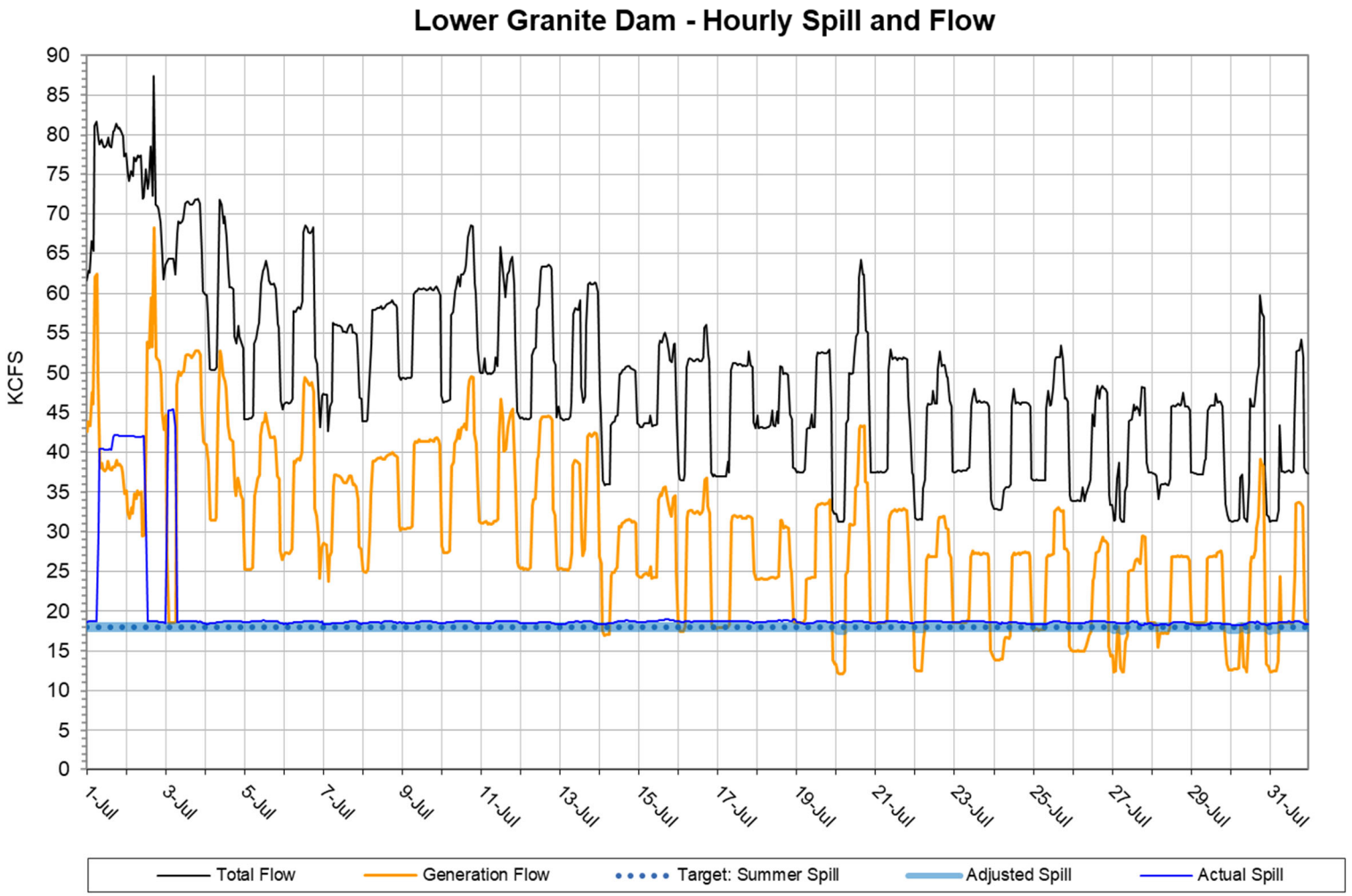
Project	Parameter	Date	Time[12]	# of Hours	Type	Reason
McNary	Additional Spill	7/3	1200-1300	2	Transmission Reliability	Hourly spill increased to between 193 and 194 kcfs (greater than adjusted spill target of 185 ± 2 kcfs which was limited by the spill cap) in order to provide reserves. Regionally coordinated via 2020 FOP, Section 4.4.1.
John Day	Additional Spill	7/9 7/11 7/21 7/22 7/23 7/24 7/27 7/28	2300 1400-1600 1900, 2300 0100-0200, 2200 0200-0300, 0900,1600-1700, 2400 0400, 0900 2300-2400 2400	1 3 2 3 6 2 2 1	Transmission Reliability	Hourly spill increased to between 37% and 41% (greater than adjusted spill target of 35%) in order to provide reserves. Daily average spill was between 35% and 36% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
John Day	Reduced Spill	7/12 7/21	1900 0700	1 1	Transmission Reliability	Hourly spill decreased to 33% (less than adjusted spill target of 35% ± 1%) due to an increase in generation in order to deploy reserves. Daily average spill was 35% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
The Dalles	Additional Spill	7/4 7/11 7/21 7/22 7/23 7/27 7/28	0000-0100 1400-1600 2300 0200 0200-0300, 0900 2300-2400 2400	2 3 1 1 3 2 1	Transmission Reliability	Hourly spill increased to between 42% and 45% (greater than adjusted spill target of 40% ± 1%) in order to provide reserves. Daily average spill was 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
The Dalles	Reduced Spill	7/4 7/10 7/11 7/12 7/21 7/28	1000 1100 1200 1900, 2300 0700 0600	1 1 1 2 1 1	Transmission Reliability	Hourly spill decreased to 38% (less than adjusted spill target of 40% ± 1%) due to an increase in generation in order to deploy reserves. Daily average spill was 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.

Table 4: July 2020 Average Percent TDG Values Table (7/1 to 7/31)

FIXED MONITORING STATIONS																
Station:	**LWG**	**LGNW**	**LGSA**	**LGSW**	**LMNA**	**LMNW**	**IHRA**	**IDSW**	**MCNA**	**MCPW**	**JDY**	**JHAW**	**TDA**	**TDDO**	**BON**	**CCIW**
Gas Cap %:	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**
7/1/2020	101	118	111	113	113	119	112	117	111	119	106	120	114	120	112	119
7/2/2020	101	118	109	113	111	118	110	115	109	120	105	120	115	120	114	120
7/3/2020	102	114	108	111	110	118	109	115	111	119	105	120	115	120	115	120
7/4/2020	102	111	109	113	110	118	110	115	113	119	106	117	114	119	114	120
7/5/2020	103	112	112	113	111	118	112	115	114	118	107	116	110	116	114	118
7/6/2020	103	112	113	113	112	117	113	116	114	119	109	115	109	116	112	117
7/7/2020	103	112	111	112	113	117	113	114	113	118	108	115	108	115	109	117
7/8/2020	103	112	111	112	112	118	112	114	110	118	108	115	110	116	110	117
7/9/2020	103	112	111	112	111	117	112	114	111	119	108	116	110	116	111	117
7/10/2020	102	112	110	112	112	118	113	114	110	119	107	117	111	117	112	118
7/11/2020	103	112	112	113	112	118	114	113	111	119	107	117	111	117	113	118
7/12/2020	103	112	111	113	112	118	114	114	111	119	108	116	109	116	111	117
7/13/2020	103	112	110	113	111	118	114	113	111	119	110	115	110	117	112	117
7/14/2020	103	114	110	113	111	117	113	112	111	120	111	116	112	118	113	117
7/15/2020	102	114	110	113	112	118	114	112	112	120	111	115	112	118	113	117
7/16/2020	102	113	110	114	112	118	115	113	112	119	111	115	111	116	112	117
7/17/2020	102	114	111	114	112	118	115	113	112	119	110	[13]	109	115	109	117
7/18/2020	103	113	113	115	112	119	115	112	111	118	111		109	116	109	117
7/19/2020	103	114	113	115	111	118	114	113	111	118	111		113	118	111	117
7/20/2020	103	114	112	115	113	119	114	114	112	119	112		113	118	113	117
7/21/2020	103	114	111	114	114	119	**116**	113	113	119	113	115	113	118	114	117
7/22/2020	103	114	113	115	113	119	**117**	114	113	119	111	115	110	116	111	117
7/23/2020	104	114	112	115	113	119	**117**	114	111	118	110	115	108	115	109	117
7/24/2020	103	114	111	114	112	117	115	113	110	117	108	115	107	114	106	116
7/25/2020	103	114	110	114	110	114	114	112	108	117	107	115	108	115	107	117
7/26/2020	102	114	109	113	109	114	113	112	108	118	108	115	111	118	110	117
7/27/2020	102	114	108	118	111	116	113	112	109	118	107	115	111	117	114	117
7/28/2020	101	114	109	114	113	115	114	113	110	117	107	115	110	116	114	117
7/29/2020	102	114	109	114	112	116	114	114	111	119	108	115	109	116	111	117
7/30/2020	105	114	111	114	113	114	114	114	111	118	110	115	111	117	111	117
7/31/2020	105	115	112	114	113	115	114	113	110	117	111	114	111	116	110	117
Exceedances:							**3**									

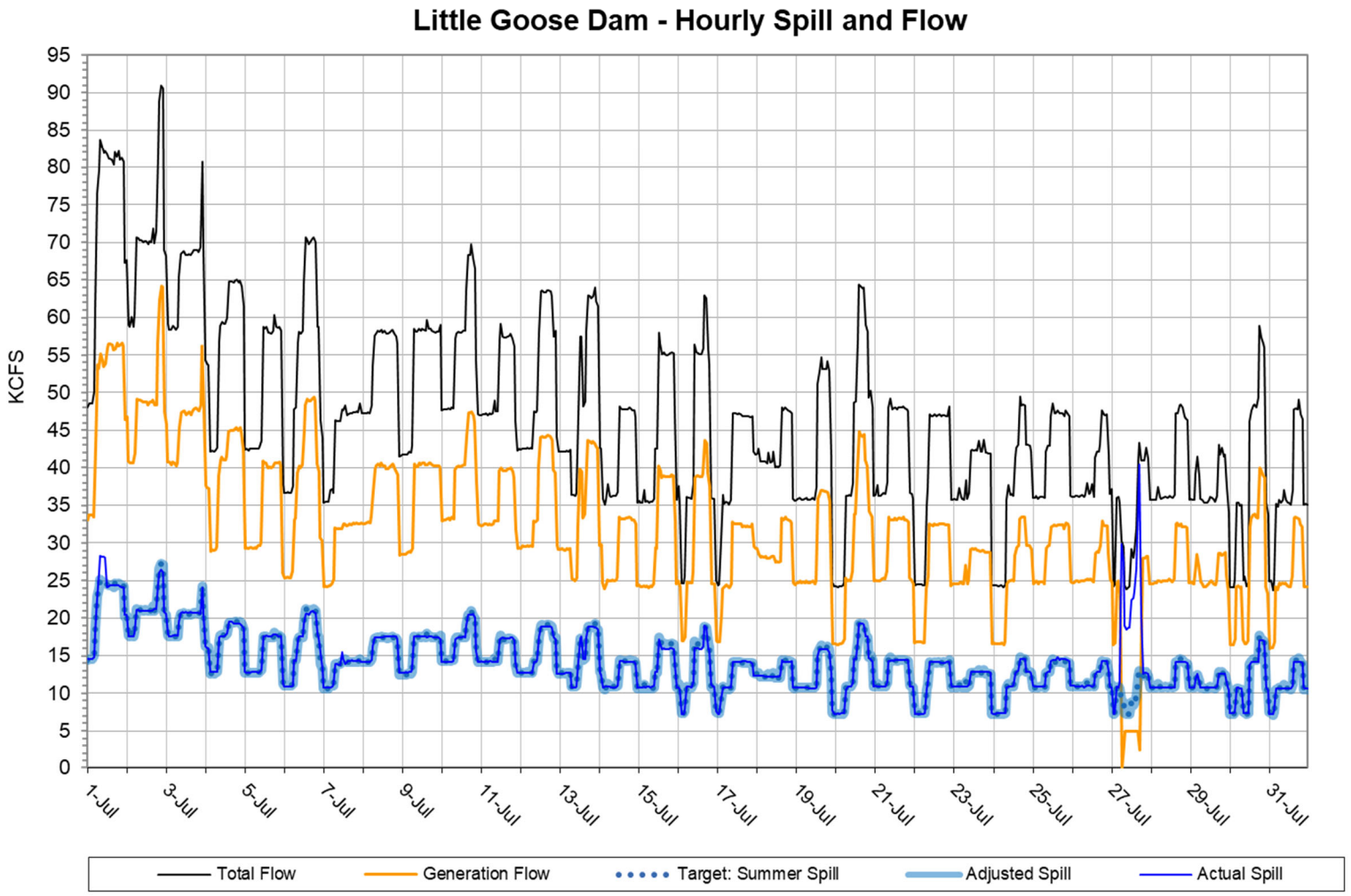
[13] Red shaded cells indicate no data due to malfunctioning gauge from a torn membrane.

Figure 1[14]



[14] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 2[15]



[15] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 3[16]

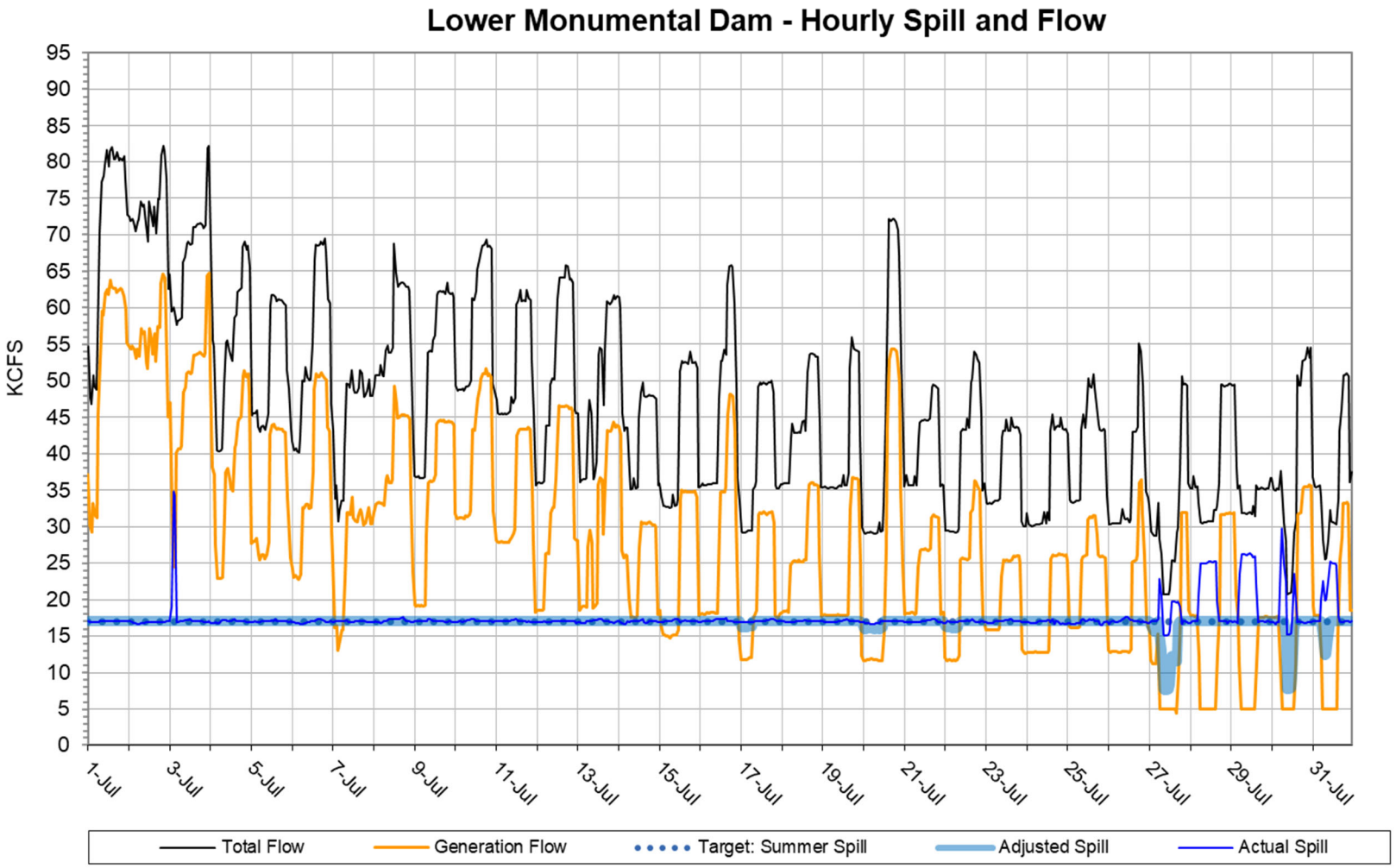


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Figure 4[17]

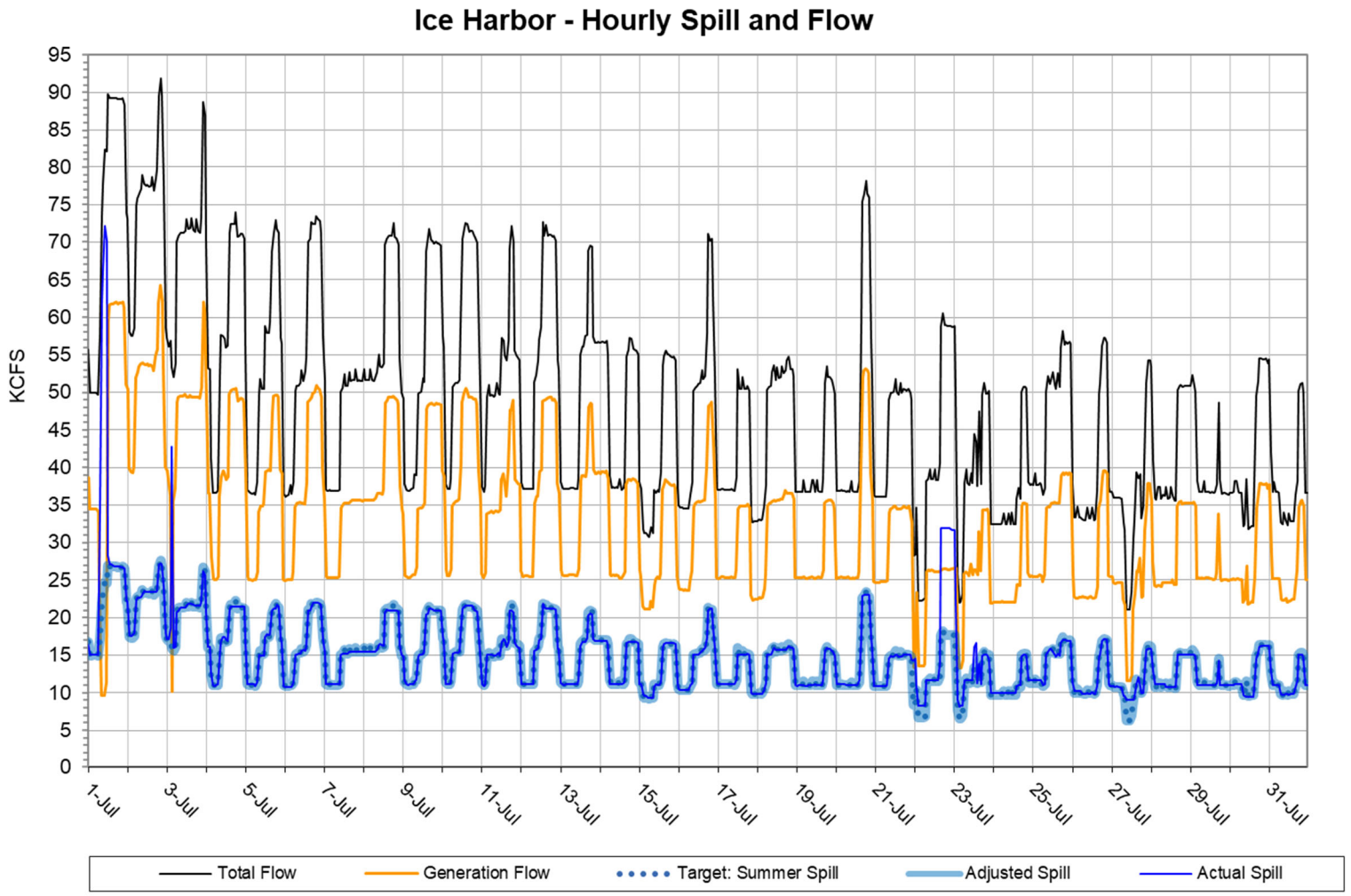

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Figure 5[18]

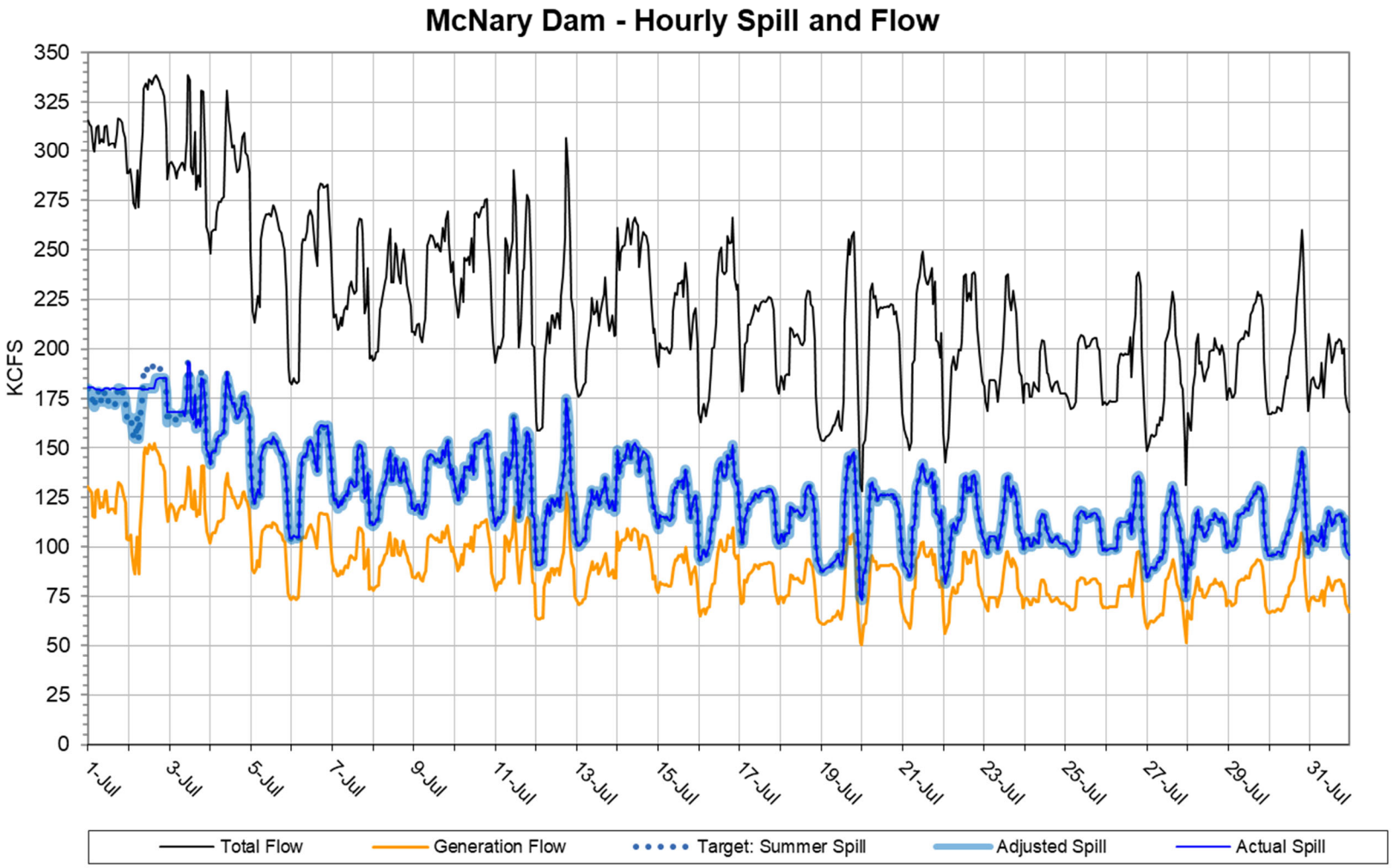

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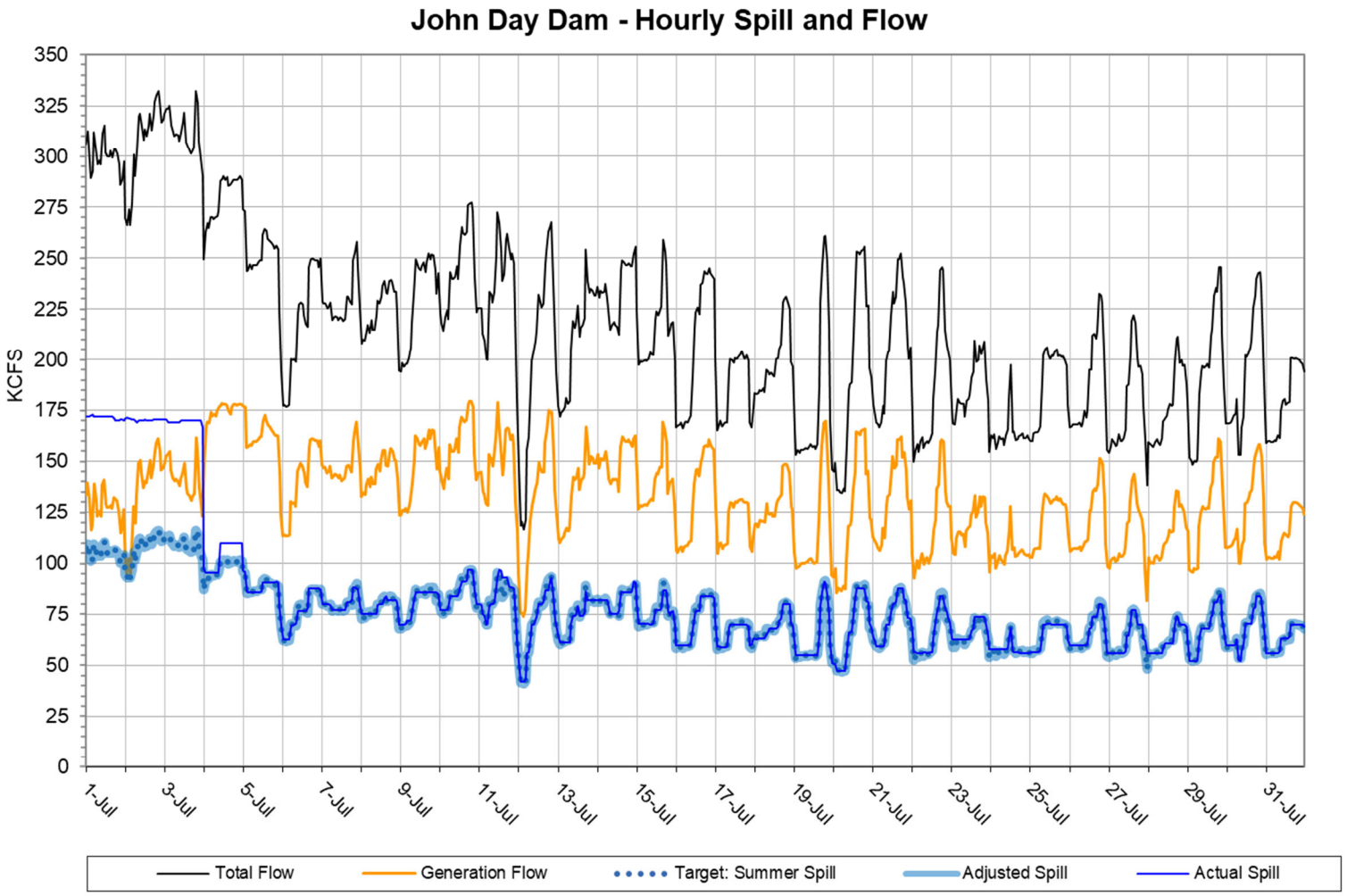
Figure 6[19]



[19] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 7[20]

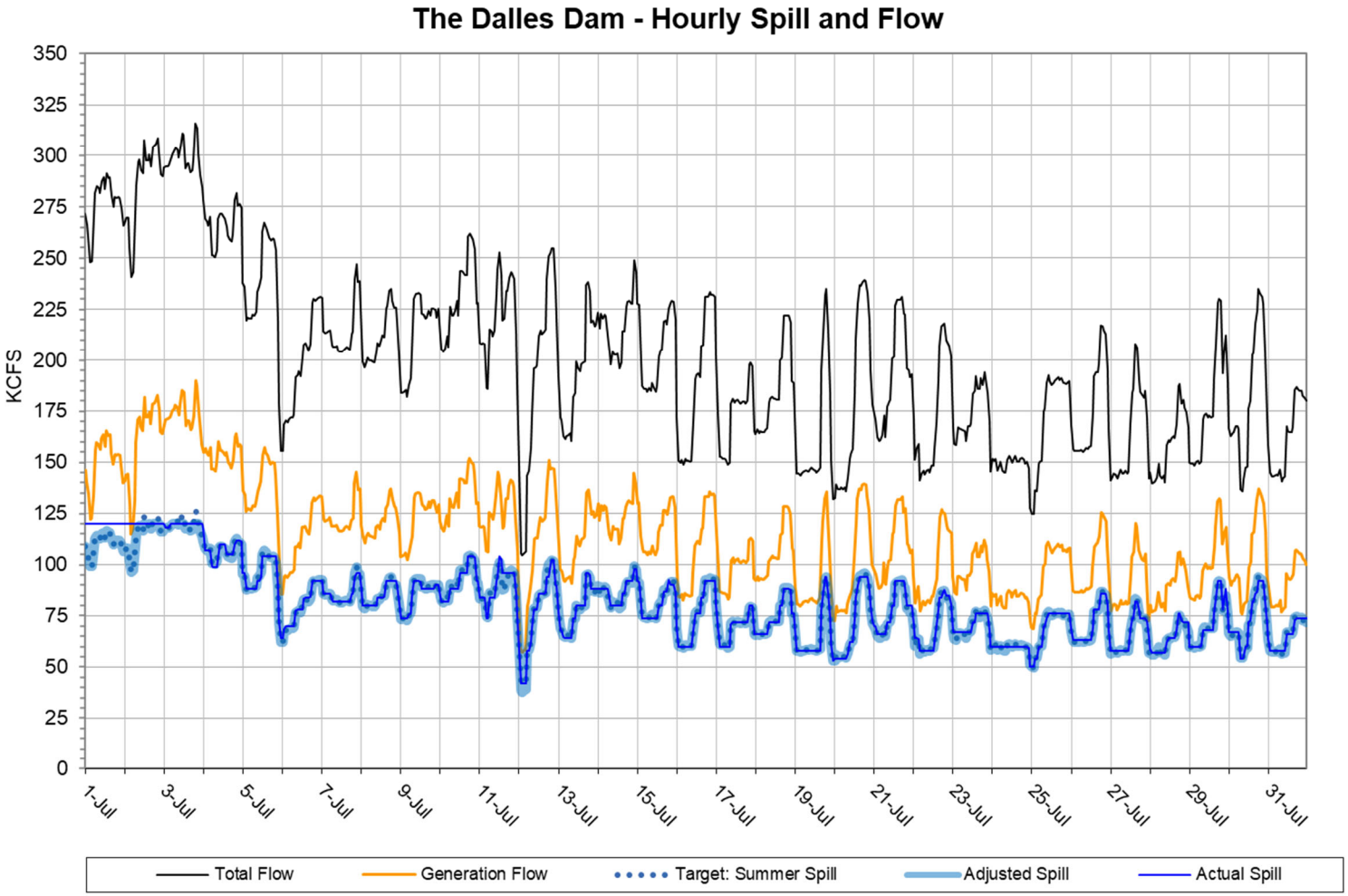


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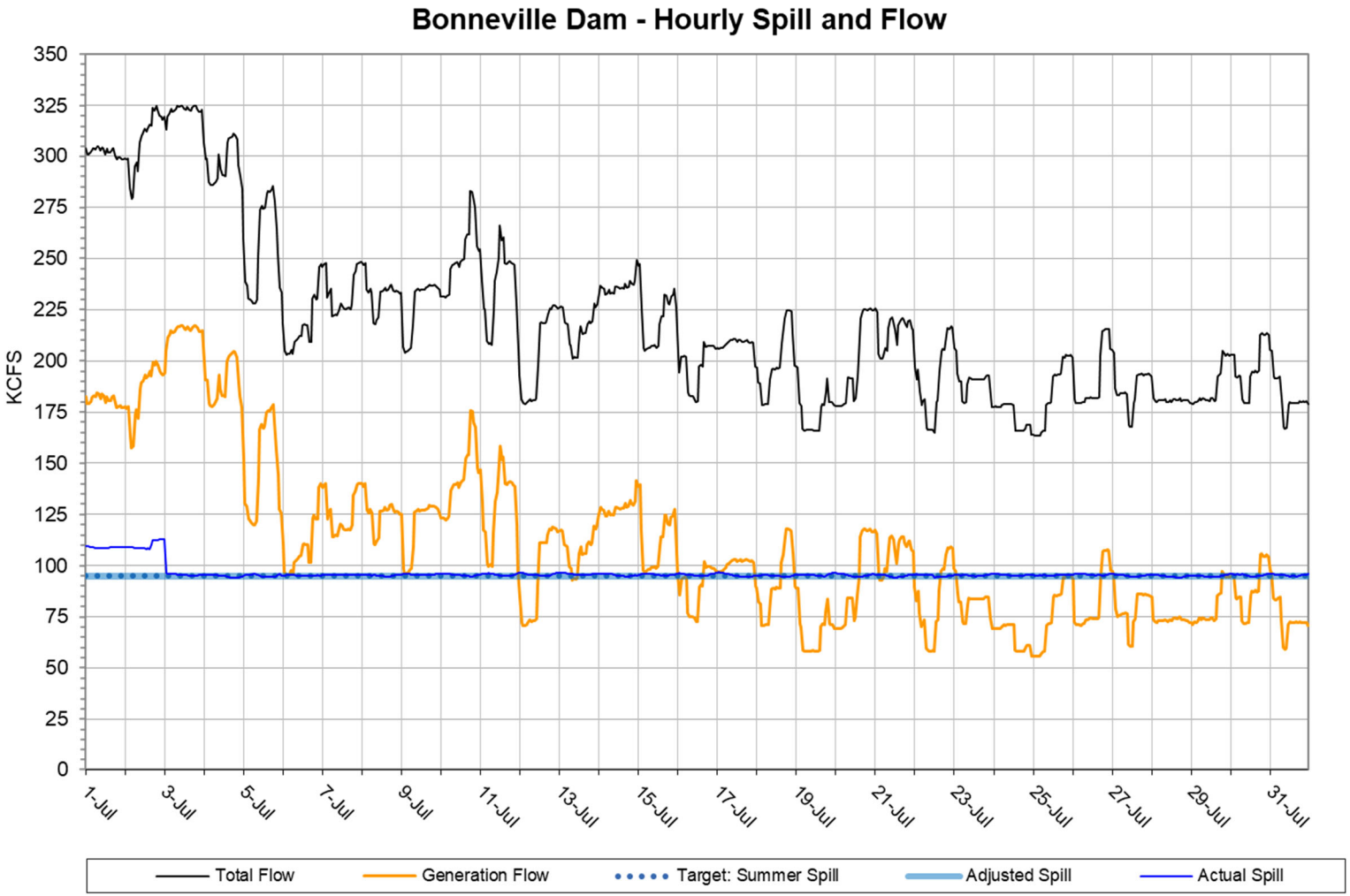
Figure 8[21]



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August 2020

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Portland, OR.

Introduction

The U.S. Army Corps of Engineers (Corps) developed this report in accordance with the 2020 Fish Operations Plan[1] (2020 FOP). The 2020 FOP describes the Corps' planned operations for juvenile fish passage at its four lower Snake River and four lower Columbia River dams during the 2020 spring and summer fish migration seasons, generally April 3 through August 31. The 2020 FOP is consistent with spill operations for juvenile fish passage and the regional forum process for adaptive management and in-season management provisions outlined in the 2019 NOAA Fisheries Columbia River System Biological Opinion (2019 BiOp)[2], the 2018 Extensions of the 2008 Columbia Basin Fish Accords (Accord Extensions), the 2019-2021 Spill Operation Agreement (Agreement) and subsequent Addendum, the Corps' requirements under the Endangered Species Act (ESA), and is the subject of ongoing consultation and communications with the relevant wildlife agencies to ensure consistency with the ESA. Other project operations and water management actions not specifically addressed in this document will be consistent with the 2019 BiOp and other guiding operative documents, including the 2020 Water Management Plan (WMP), seasonal WMP updates, and the 2020 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2020 FOP during the month of August 2020. 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 (Table 1);
- 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, including spill caps. (see 2020 FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,
- resultant 12-hour average TDG for the tailwater and next downstream forebay at each project.

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2020 FOP in August 2020.

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[1] The 2020 FOP was posted to the Technical Management Team (TMT) website on March 23, 2020 (http://pweb.crohms.org/tmt/documents/fpp/2020/).

[2] The Corps, in coordination with the other Action Agencies, and National Marine Fisheries Service (NMFS), employs the Regional Implementation Oversight Group (RIOG) and technical teams including the Technical Management Team (TMT) and Fish Passage Operations & Maintenance (FPOM), to coordinate with state, tribal and other federal experts for recommendations for implementing operations consistent with NMFS' Columbia River System Biological Opinions.

Data Reporting

I. For each project providing fish passage operations, this report contains a graph displaying the performance of the summer fish passage spill program for the month of August, with hourly spill, target spill, adjusted spill, generation, and total flows. The monthly graphs begin on August 1 and end on August 31 and reflect the following operations for the lower Snake River and the lower Columbia River projects:

- The black line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The orange line represents the average hourly generation flow through the powerhouse each hour in kcfs.
- The thin solid blue line represents the actual average hourly spill level through the spillway in kcfs.
- The dotted blue line represents the hourly target summer spill in kcfs (summer only).
- The thick dark blue line represents the adjusted spill cap spill: the hourly spill cap 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 (2020 FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the August 2020 Average Percent TDG Values Table (Table 4). The numbers in red indicate the project exceeded the %TDG cap - i.e. 120% (tailwater), 115% (forebay of the next downstream dam) during summer spill.

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the adjusted spill due to various conditions as described below. When actual spill varied from adjusted spill levels during periods of voluntary spill, the change in spill level is described below in the August 2020 Spill Variance Table (Table 2).[3] The Spill Variance Table includes average hourly data; but when spill varies from adjusted spill for a portion of an hour, it is characterized as a variance for a full hour. There are instances when the hourly adjusted 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 adjusted spill to the extent practicable. Other routine activities that changed spill levels, which were coordinated with regional partners, are identified in the monthly Pre-Coordinated Operations Table (Table 3).

"Low flow" operations at the lower Columbia and lower Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target spill levels. For this report, the decrease in target spill is represented as adjusted spill. In these situations, the projects operate at minimum generation and pass the remainder of project outflow 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 non-federal projects upstream are variable and

[3] 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.

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 2020 FOP for Bonneville and The Dalles dams,[4] 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.

August Operations

The month of August was characterized by below average precipitation and flows on the lower Snake and Columbia Rivers. The August 2020 observed precipitation was 33% of average on the Snake River above Ice Harbor and 31% of average on the Columbia River above The Dalles[5]. The NOAA Northwest River Forecast Center runoff summary for August indicated that the adjusted runoff for the Snake River at Lower Granite was 86% of the 30-year average (1981-2010) with a volume of 1.1 MAF (Million acre-feet). The August 2020 adjusted runoff for the Columbia River at The Dalles was 95% of the 30-year average (1981-2010) with a volume of 72.6 MAF.[6]

[4] As specified in the 2020 FOP section 3.
[5] Retrieved September 1, 2020: https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=5
[6] Retrieved September 1, 2020: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

Summer spill operations occur June 21–August 31 at the four lower Snake River projects, and June 16–August 31 at the four lower Columbia River projects (Table 1).

Table 1: Summary of 2020 summer target spill levels at lower Snake River and lower Columbia River projects.

PROJECT	2020 SUMMER SPILL[A] (June 21/16 – August 14) (24 hrs/day)	2020 SUMMER SPILL[A] (August 15 – August 31) (24 hrs/day)
Lower Granite[B]	18 kcfs	Spillway weir (SW) flow or ~7 kcfs spill
Little Goose[B]	30%	SW flow or ~7 kcfs spill
Lower Monumental[B]	17 kcfs	SW flow or ~7 kcfs spill
Ice Harbor[B]	30%	SW flow or ~8.5 kcfs spill
McNary	57%	20 kcfs
John Day	35%	20 kcfs
The Dalles	40%	30%
Bonneville	95 kcfs	50 kcfs

A. Spill may be temporarily reduced below the FOP target summer spill level at any project if necessary to ensure navigation safety or transmission reliability, or to avoid exceeding State TDG standards.
B. Summer spill from August 15-August 31 may be through the SW or through conventional spillbays using the appropriate FPP spill pattern for each project. The SWs will be operated consistent with the SW operational criteria in the FPP.

In its implementation of the 2020 FOP in August, the Corps evaluated conditions every day to establish spill caps at a level that was estimated to meet, but not exceed, the gas cap or target TDG in the tailrace (see Table 4).[7] 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).

Operational Adjustments

1. Lower Granite Dam

Effective August 7 through August 31, the Corps revised the Lower Granite Dam (LWG) criteria used to change the spill pattern as described in the 2020 Fish Passage Plan. The Corps changed the spill pattern criteria based on receipt of System Operational Request 2020-5, LWG Removable Surface Weir (RSW), dated August 6, 2020. This operational adjustment only changed the criteria used to change the spill pattern, and did not change the spill operation that was maintained at approximately 7 kcfs as specified in the 2020 FOP. This operation was coordinated during the August 7, TMT Meeting, and Regional Sovereigns either supported or did not object to this operational adjustment.

[7] See 2020 FOP section 2.2

Table 2: Spill Variance Table – August 2020 (8/1 to 8/31)

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Little Goose	Reduced Spill	8/7	0300-0500	3	Human Error	Hourly spill remained at 7 kcfs (less than adjusted spill target of 11 ± 1 kcfs) due to a delay in changing to the appropriate target.
Little Goose	Additional Spill	8/10	0300-0700	5	Human Error	Hourly spill remained at 11 kcfs (greater than adjusted spill target of 9 ± 1 kcfs) due to a delay in changing to the appropriate target.[9]
Ice Harbor	Additional Spill	8/2	0500	1	Human Error	Hourly spill increased to 33% (greater than adjusted spill target of 30% ± 1%) due to a delay in changing to the appropriate target. Daily average spill was 30% of the total flow.
Ice Harbor	Additional Spill	8/9 8/10	0100-1500, 2100-2400 0100-1300	19 13	Human Error	Hourly spill increased to between 35% and 40% (greater than adjusted spill target of 30% ± 1%) due to a delay in closing the removable spillway weir (RSW).[10] Daily average spill was between 34% and 37% of the total flow.
John Day	Additional Spill	8/31	1300	1	Human Error	Hourly spill increased to 24 kcfs (greater than adjusted spill target of 20 kcfs ± 2 kcfs) due to a premature opening of spill gates during the annual closure of one of the temporary spillway weirs (TSW).

[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.

[9] Per the 2020 FOP section 8.2.3, during the 30% spill operation when project outflows are ≤ 32 kcfs, the spill operation will transition from 30% to a constant spill level of approximately 7-11 kcfs to help stabilize project outflow, meet Lower Monumental target spill levels, and maintain MOP elevation at Little Goose. The constant spill level will be based on the previous day's average total project outflow, as follows: 11 kcfs when total outflow is 28.0 to 32.0 kcfs, 9 kcfs when total outflow is 24.0 to 27.9 kcfs, and 7 kcfs when total outflow is ≤ 23.9 kcfs. Actual spill may range up to ±1 kcfs from the target spill level. The Corps Reservoir Control Center monitors previous day average total outflow and communicates the appropriate spill target as necessary with the project.

[10] Per the 2020 FPP section 2.3.2.7, the SW is to be closed when day average outflow is below 30 kcfs and forecasted to stay below 30 kcfs for at least 3 days. In 2020, the RSW should have been closed on 8/9 by 0300 based on these specifications. The RSW was instead closed the following day (8/10) once the error was detected.

Table 3: Pre-Coordinated Operations – August 2020 (8/1 to 8/31)

Project	Parameter	Date	Time[11]	# of Hours	Type	Reason
Lower Granite	Additional Spill	8/3 8/4 8/5 8/6 8/8	0700-2400 0100-2400 0700-2000, 2200 0700-1900 0900-1300	18 24 15 13 5	Maintenance	Hourly spill increased to between 18 and 30 kcfs (greater than adjusted spill target of 10 to 18 kcfs) while generation was reduced due to units taken offline to perform transformer maintenance. Regionally coordinated via the 2020 FPP Appendix A.
Little Goose	Reduced Spill	8/4 8/5 8/7	0300, 1900, 2400 1300 0100	3 1 1	Navigation	Hourly spill decreased to 28% (less than adjusted spill target of 30% ± 1%) for safe navigation. Daily average spill was 30% of the total flow. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
Little Goose	Additional Spill	8/6	0600-1800	13	Maintenance	Hourly spill increased to between 36% and 99% of total flow (greater than adjusted spill target of 30% ±1 %) while generation was reduced for station service due to units taken offline to perform transformer maintenance. Daily average spill was 59% of total flow. Regionally coordinated via the 2020 FPP LGS Section 4.3.10 and Appendix A.
Ice Harbor	Reduced Spill	8/4 8/5 8/6 8/7 8/8 8/10 8/11 8/12 8/13 8/14	0200,1500 1600 1100 1000-1100, 2100 1600-1700 1500 0800 1700 0400, 0700, 1600 0100, 0300, 1000, 1300-1400, 1600	2 1 1 3 2 1 1 1 3 6	Navigation	Hourly spill decreased to between 27% and 28% (less than adjusted spill target of 30% ± 1%) for safe navigation. Daily average spill was between 30% and 34% of the total flow. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
John Day	Reduced Spill	8/3	1200	1	Navigation	Hourly spill decreased to 33% (less than adjusted spill target of 35% ± 1%) for safe navigation. Daily average spill was 35% of the total flow. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.

[11] 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.

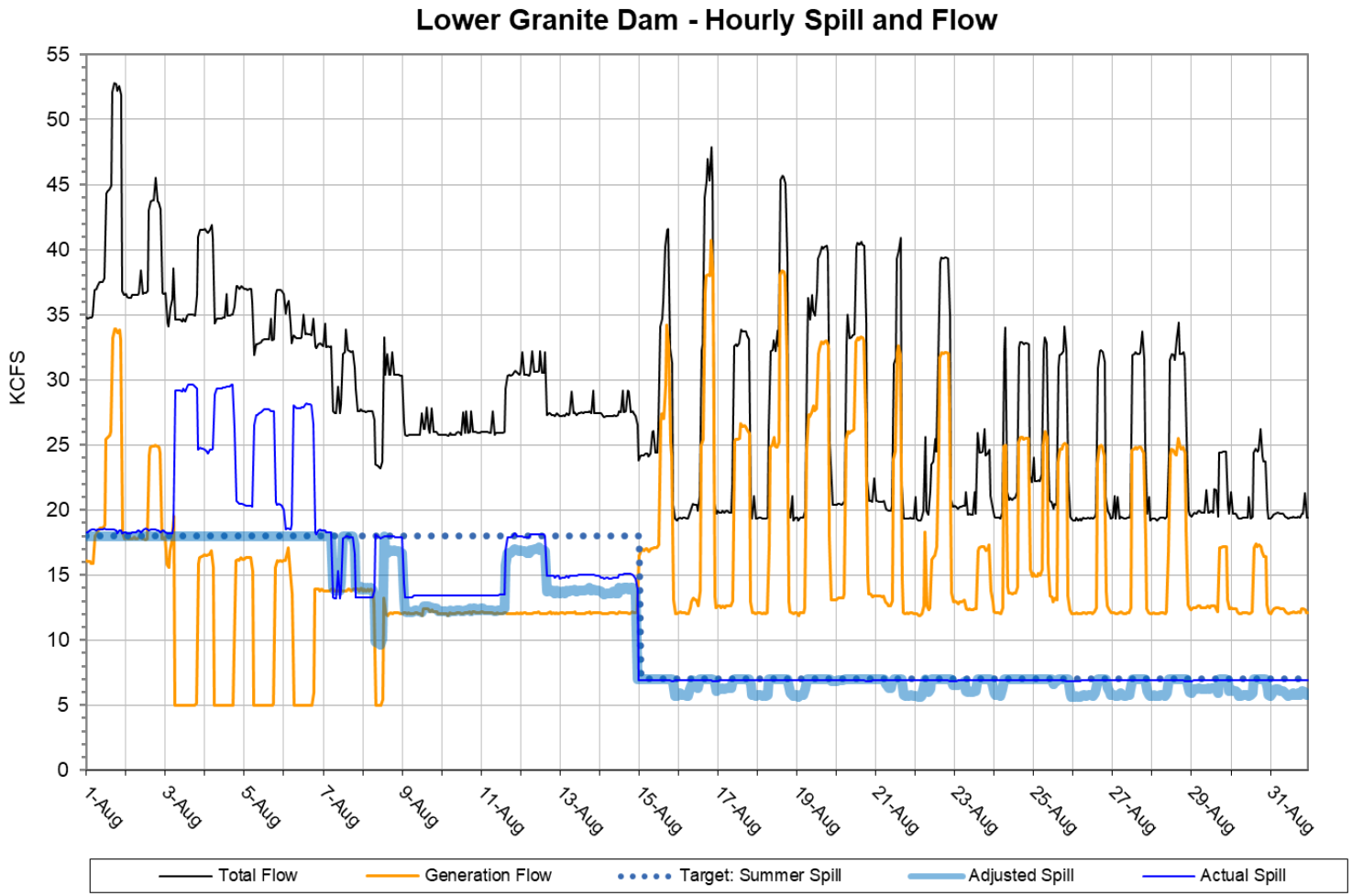
Project	Parameter	Date	Time[11]	# of Hours	Type	Reason
John Day	Reduced Spill	8/3	1500	1	Transmission Reliability	Hourly spill decreased to 32% (less than adjusted spill target of 35% ± 1%) due to an increase in generation in order to deploy reserves. Daily average spill was 35% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
John Day	Additional Spill	8/5	2000	1	Transmission Reliability	Hourly spill increased to 37% (greater than adjusted spill target of 35% ± 1%) in order to provide reserves. Daily average spill was 35% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
The Dalles	Reduced Spill	8/3 8/7 8/31	1200-1300 0600 0700	2 1 1	Transmission Reliability	Hourly spill decreased to 28% and 38% (less than adjusted spill target of 30% and 40% ± 1%) due to an increase in generation in order to deploy reserves. Daily average spill was 30% and 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.
The Dalles	Additional Spill	8/30	0200	1	Transmission Reliability	Hourly spill increased to 32% (greater than adjusted spill target of 30% ± 1%) in order to provide reserves. Daily average spill was 30% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.

Table 4: August 2020 Average Percent TDG Values Table (8/1 to 8/31)

FIXED MONITORING STATIONS																
Station:	**LWG**	**LGNW**	**LGSA**	**LGSW**	**LMNA**	**LMNW**	**IHRA**	**IDSW**	**MCNA**	**MCPW**	**JDY**	**JHAW**	**TDA**	**TDDO**	**BON**	**CCIW**
Gas Cap %:	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**	**115**	**120**
8/1/2020	104	114	111	114	112	113	113	113	109	118	109	115	107	114	107	117
8/2/2020	105	114	111	114	111	113	111	112	109	117	109	115	108	114	107	116
8/3/2020	104	118	110	114	110	113	109	111	108	117	107	116	108	115	107	117
8/4/2020	104	118	111	115	110	117	109	112	108	119	107	116	110	116	109	117
8/5/2020	105	117	111	114	111	117	110	112	110	118	108	115	111	116	109	117
8/6/2020	104	117	112	117	111	117	110	111	109	116	106	115	108	113	108	117
8/7/2020	102	115	109	113	109	117	108	111	107	116	105	114	106	114	106	117
8/8/2020	103	116	109	110	110	115	109	111	106	116	104	114	108	114	106	117
8/9/2020	102	116	109	109	108	115	109	111	106	116	104	115	106	113	106	117
8/10/2020	101	117	110	110	109	115	110	111	107	118	106	115	110	116	108	117
8/11/2020	101	117	110	110	109	115	112	108	108	117	105	115	109	115	108	116
8/12/2020	101	114	108	109	108	114	111	107	108	116	104	115	106	113	106	117
8/13/2020	101	114	107	109	106	113	110	108	106	116	103	115	106	112	105	117
8/14/2020	101	114	107	109	106	113	110	108	106	116	104	115	107	114	106	117
8/15/2020	101	112	107	109	105	110	109	108	106	111	105	113	110	114	108	114
8/16/2020	101	113	108	109	105	109	109	108	106	111	107	114	109	113	112	114
8/17/2020	100	111	107	109	106	110	109	108	107	112	106	113	108	113	112	114
8/18/2020	102	112	107	109	107	110	110	108	108	113	106	113	108	113	110	114
8/19/2020	102	112	108	109	107	110	110	107	109	112	107	114	107	112	108	113
8/20/2020	103	112	108	109	107	110	109	107	110	112	108	116	107	112	107	113
8/21/2020	104	113	109	109	107	110	109	107	109	112	108	116	109	112	107	113
8/22/2020	102	113	107	109	106	110	108	106	108	112	106	115	108	113	107	113
8/23/2020	103	113	108	109	107	110	108	106	109	112	106	114	110	113	109	113
8/24/2020	103	113	108	109	106	110	107	105	108	111	105	113	107	[12]	108	113
8/25/2020	103	112	108	109	106	110	107	106	107	112	106	113	106	111	106	113
8/26/2020	102	113	108	109	106	110	106	106	107	111	106	113	106	111	105	113
8/27/2020	101	113	108	109	106	110	106	105	106	111	105	112	107	111	104	113
8/28/2020	101	112	108	109	106	110	107	106	106	110	105	112	106	112	105	113
8/29/2020	101	113	109	109	106	110	107	106	106	110	105	113	106	111	105	113
8/30/2020	100	112	107	108	106	110	106	105	104	110	104	112	104	109	103	113
8/31/2020	100	113	107	107	106	110	107	105	104	111	103	112	106	110	103	113
Exceedances:																

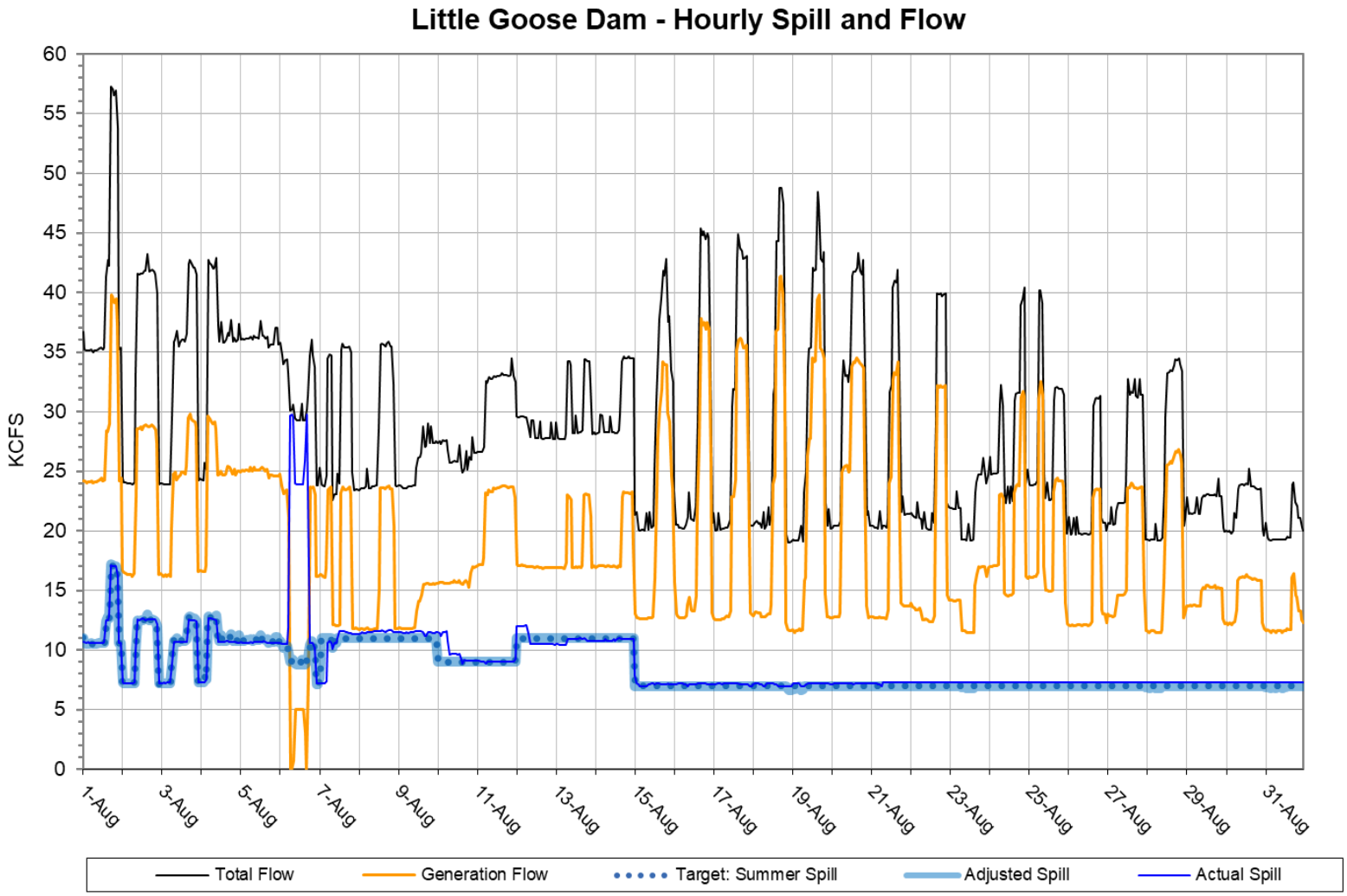
[12] Red shaded cells indicate no data due to malfunctioning gauge from a torn membrane.

Figure 1[13]



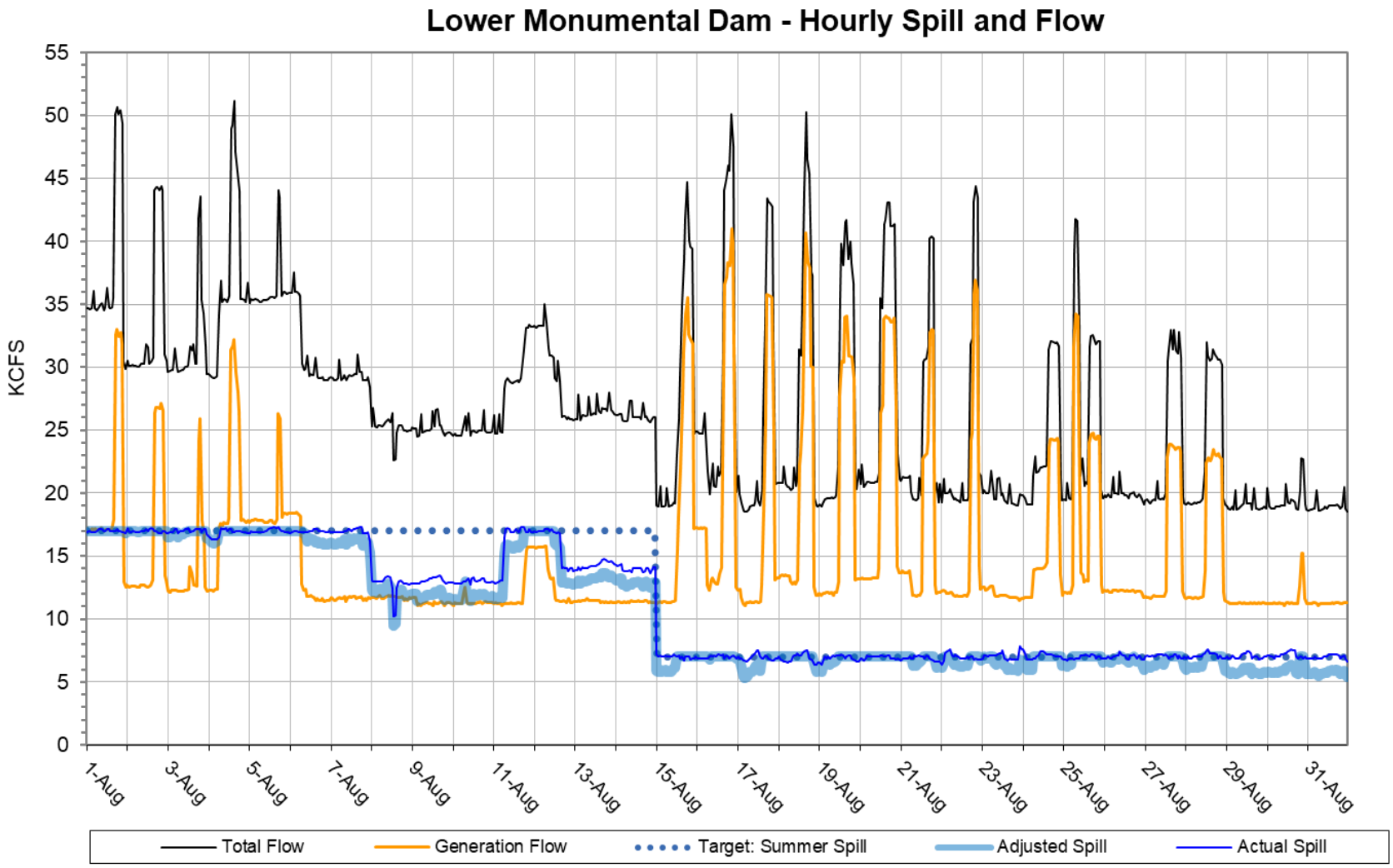
[13] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 2[14]



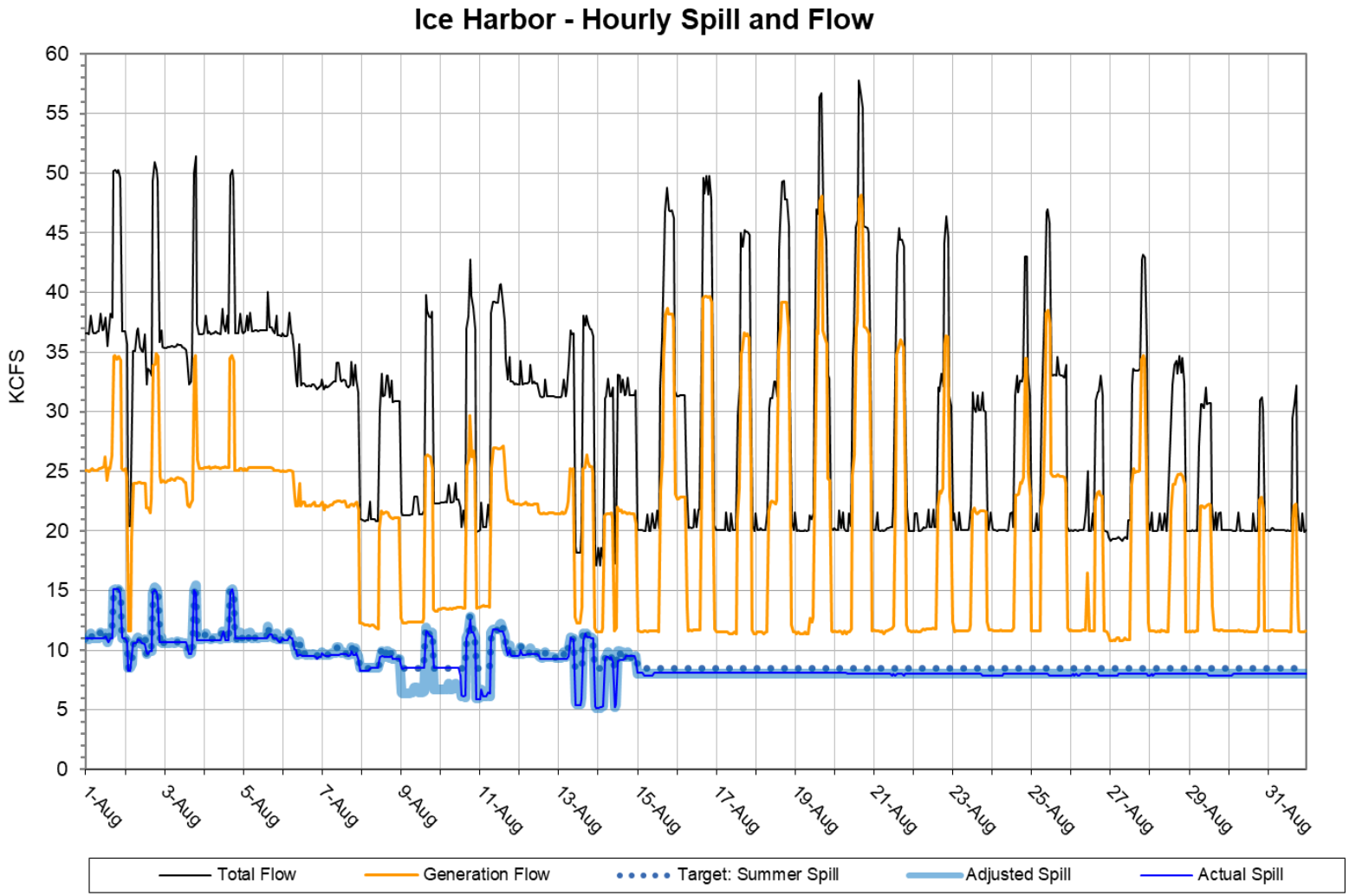
[14] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 3[15]



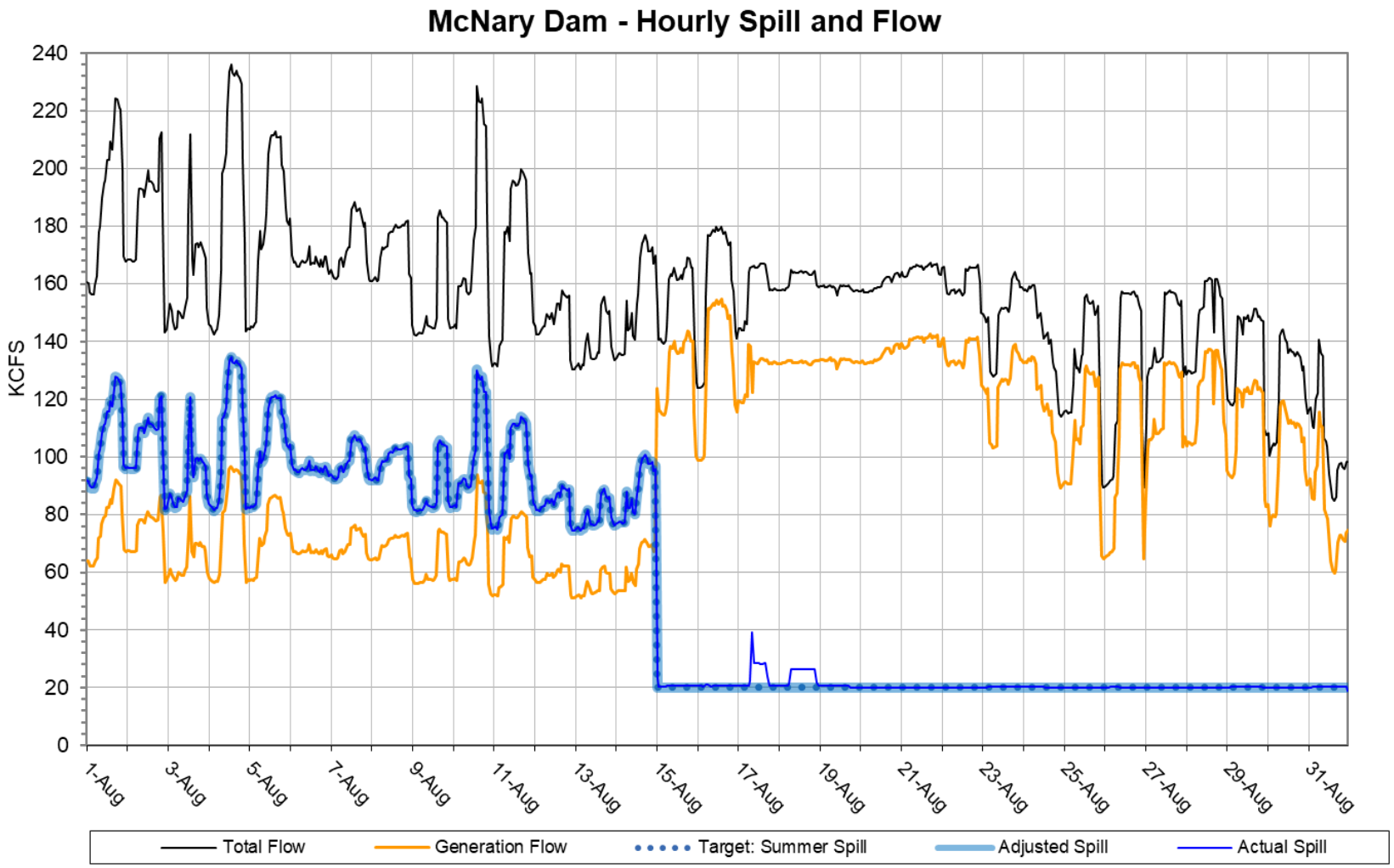
[15] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 4[16]



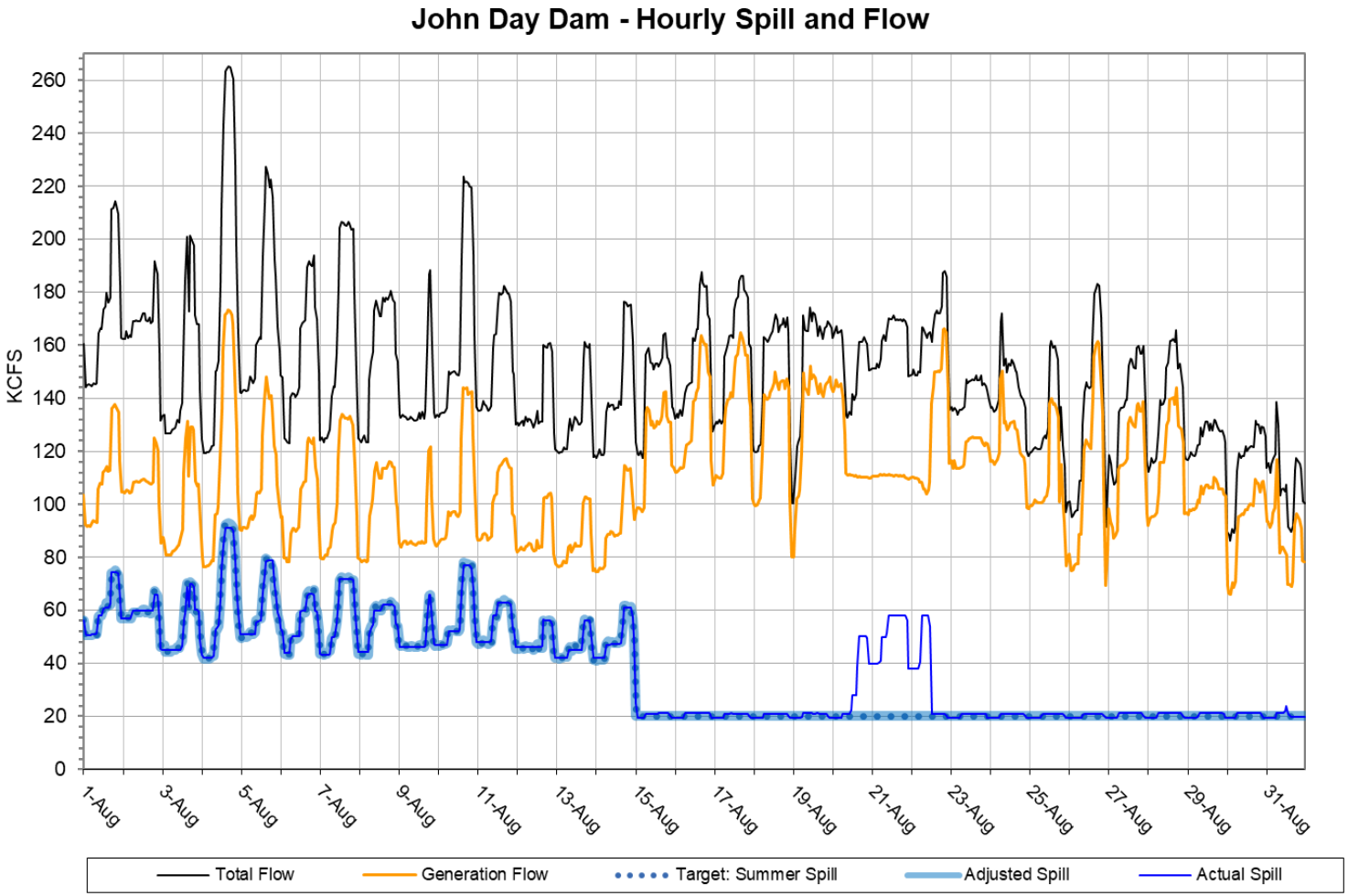
[16] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 5[17]



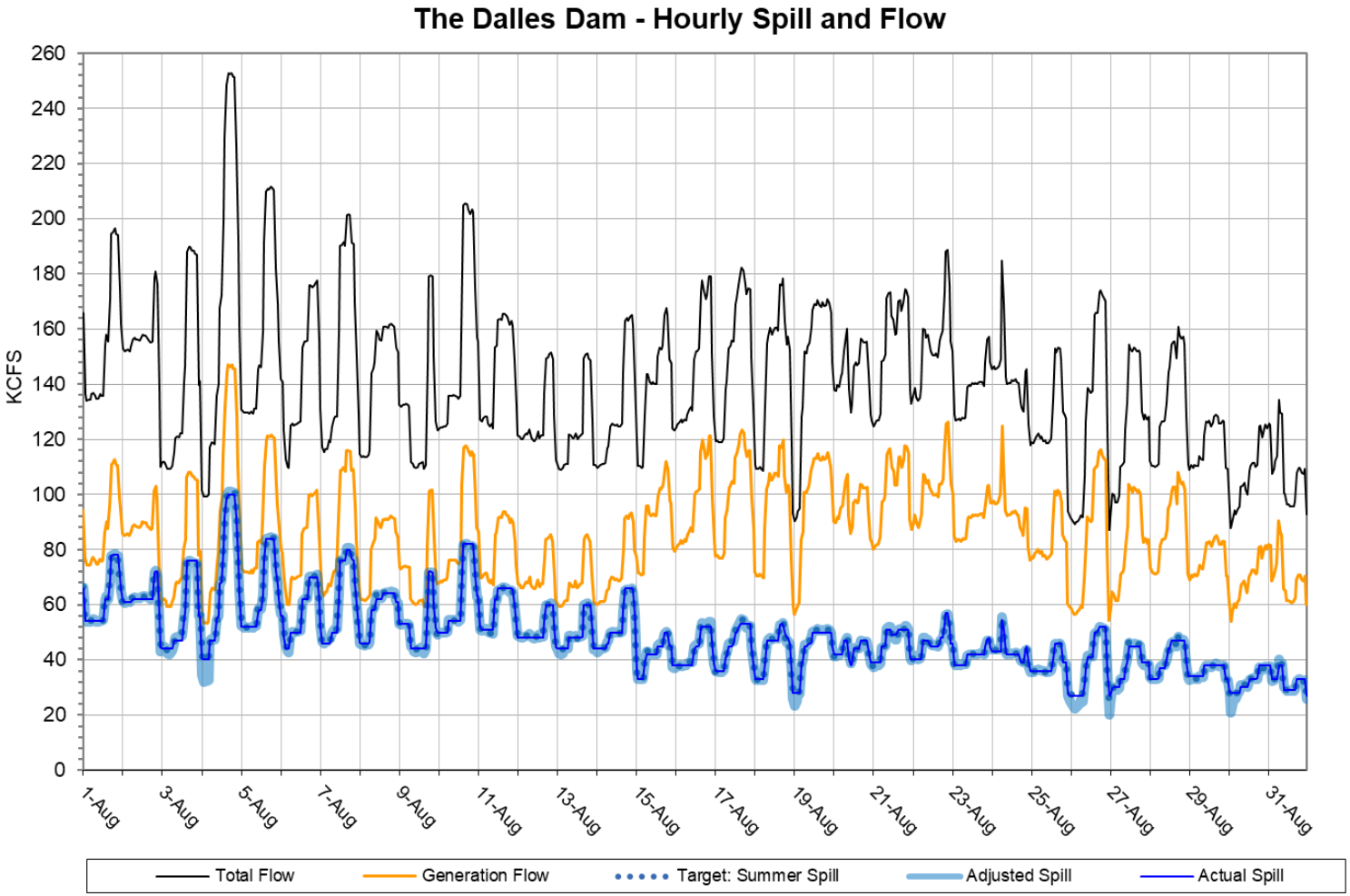
[17] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 6[18]



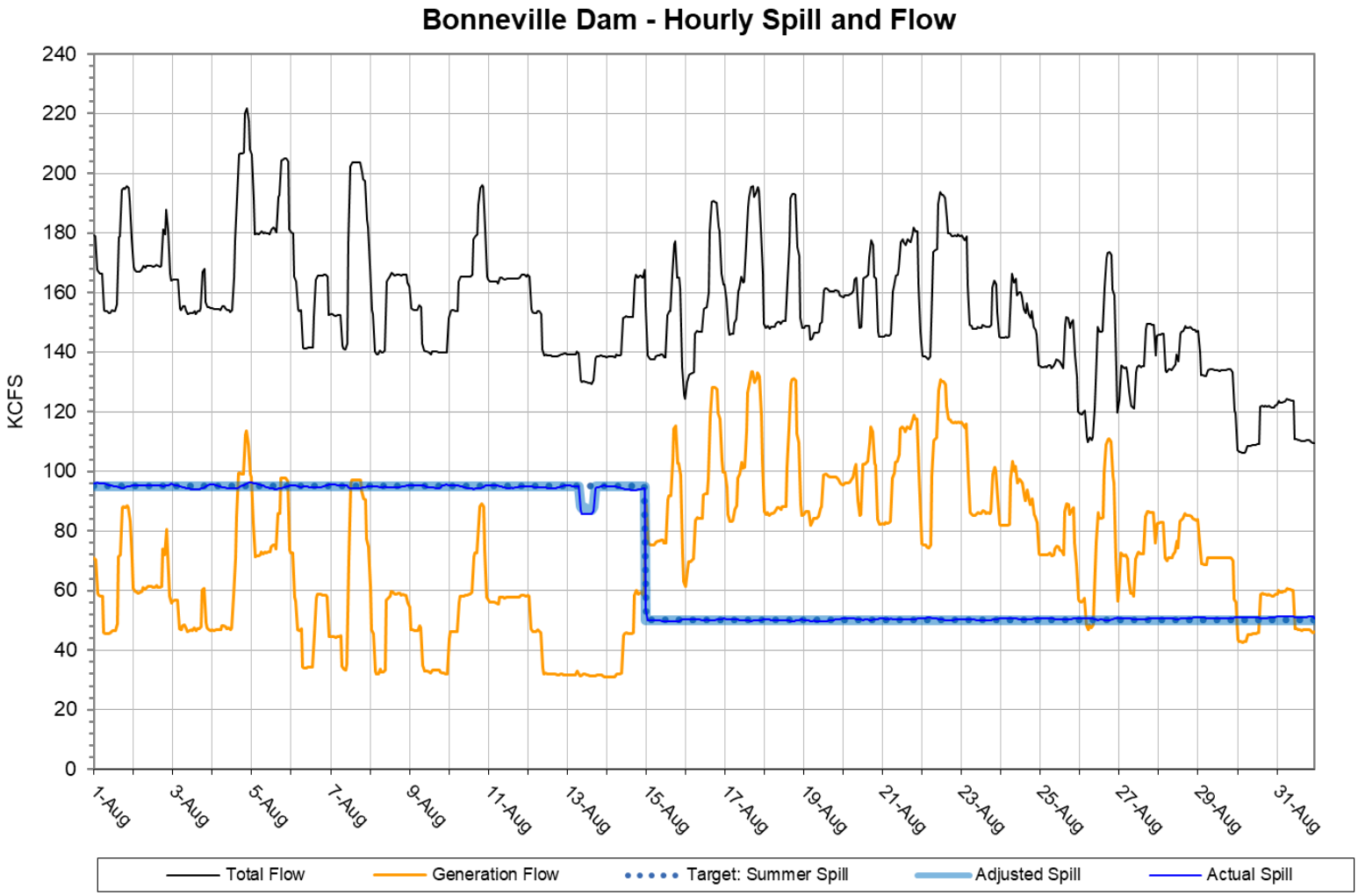
[18] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 7[19]



[19] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 8[20]



[20] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.