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.

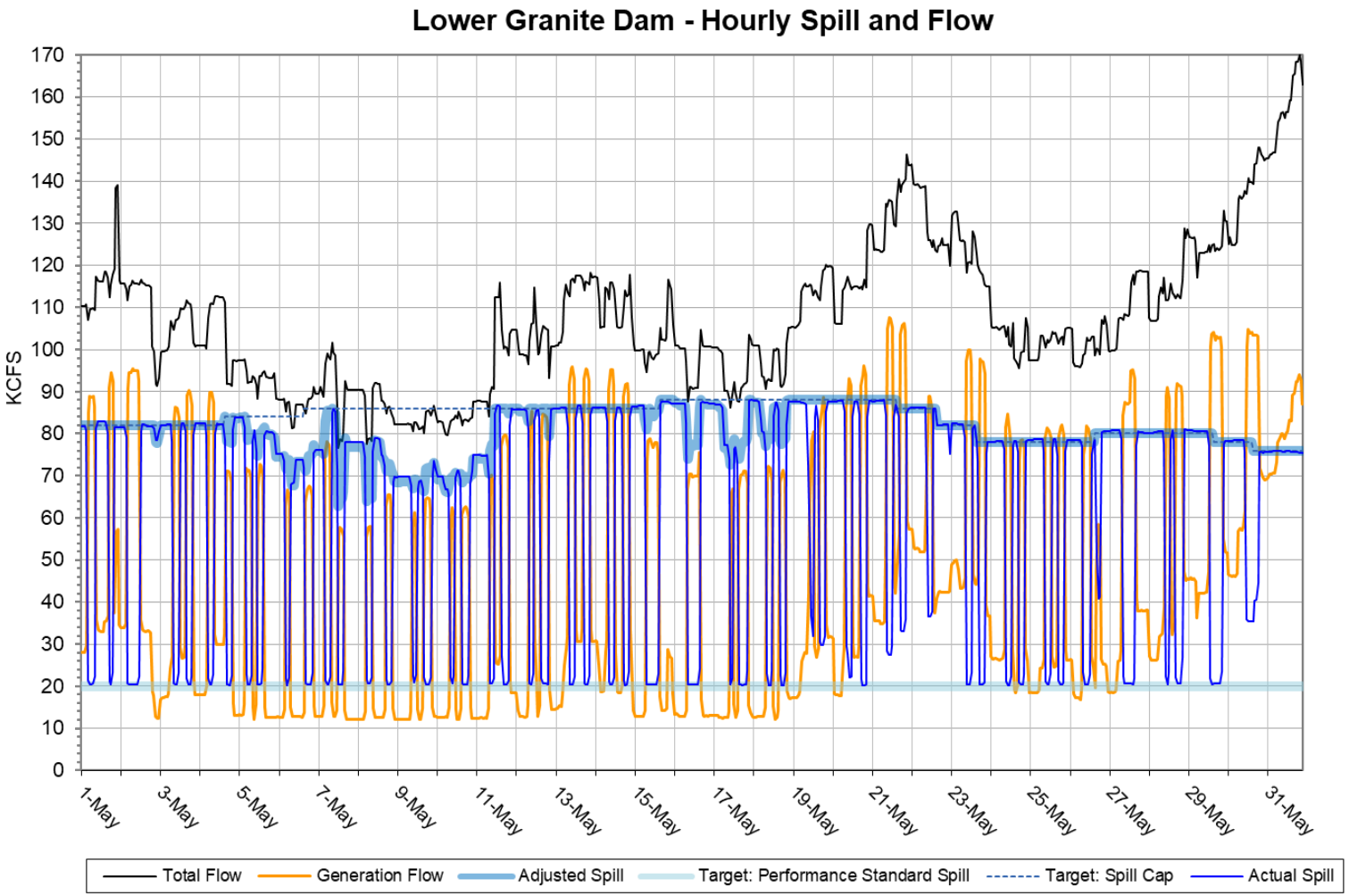
[13] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Ice Harbor turbine Unit 1, the range is 8.2-10.3 kcfs. See 2020 FOP section 4.3.1.

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)

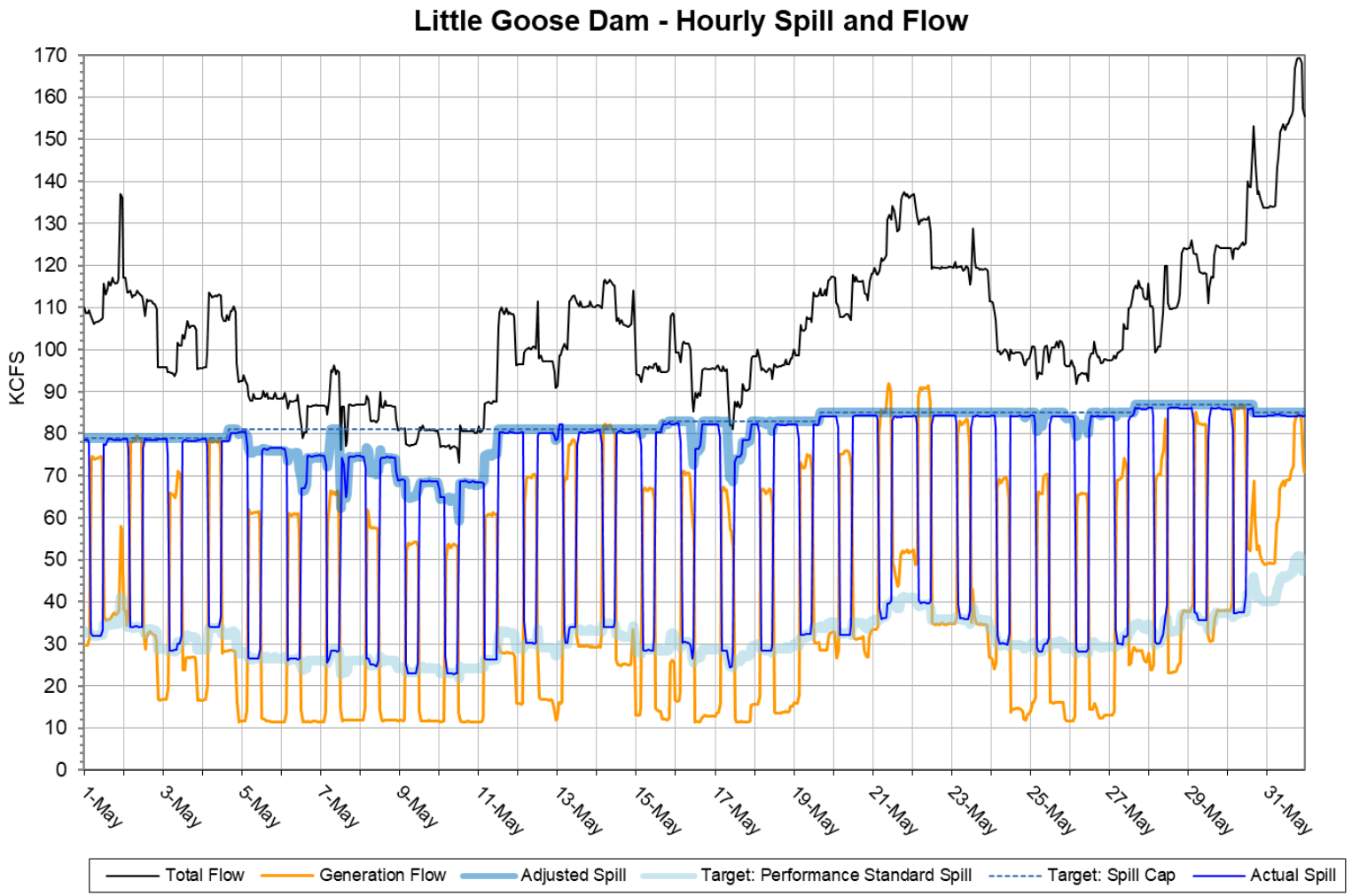
Date	FIXED MONITORING STATIONS															
	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW	JDY	JHAW	TDA	TDDO	BON	CCIW
	Lower Granite FB	Lower Granite TW	Little Goose FB	Little Goose TW	Lower Monumental FB	Lower Monumental TW	Ice Harbor FB	Ice Harbor TW	McNary FB	McNary TW	John Day FB	John Day TW	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]



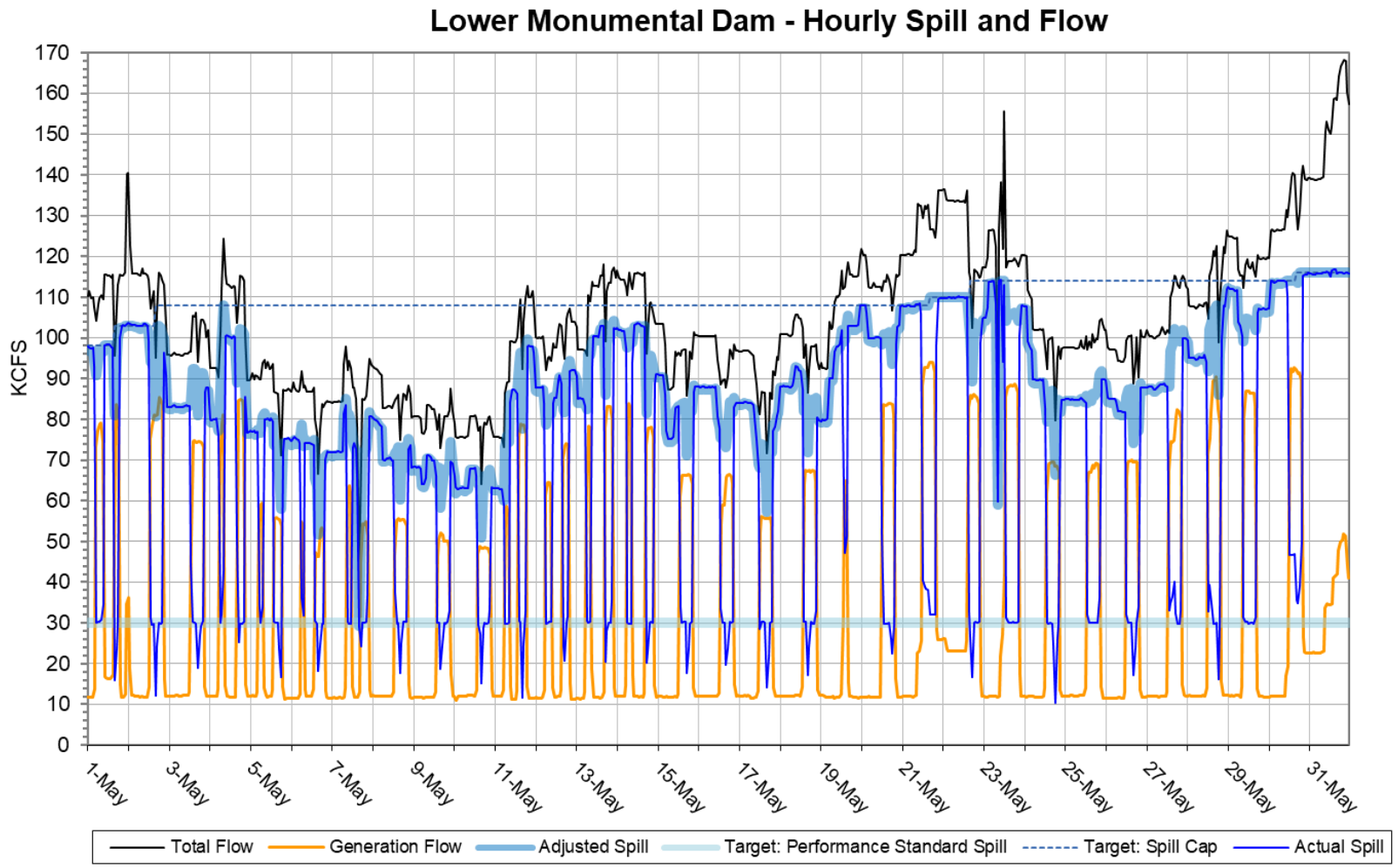
[14] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 2[15]



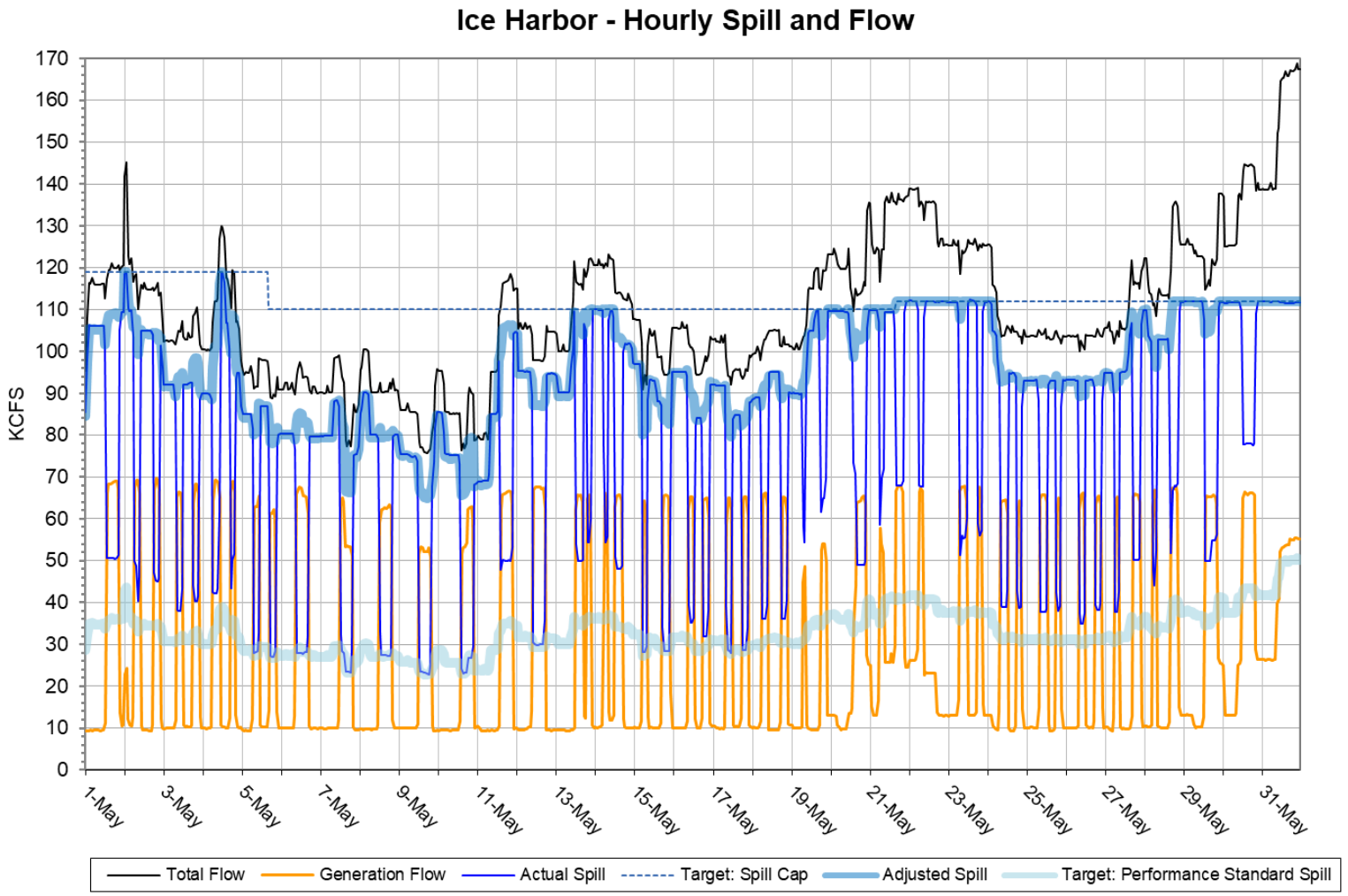
[15] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 3[16]



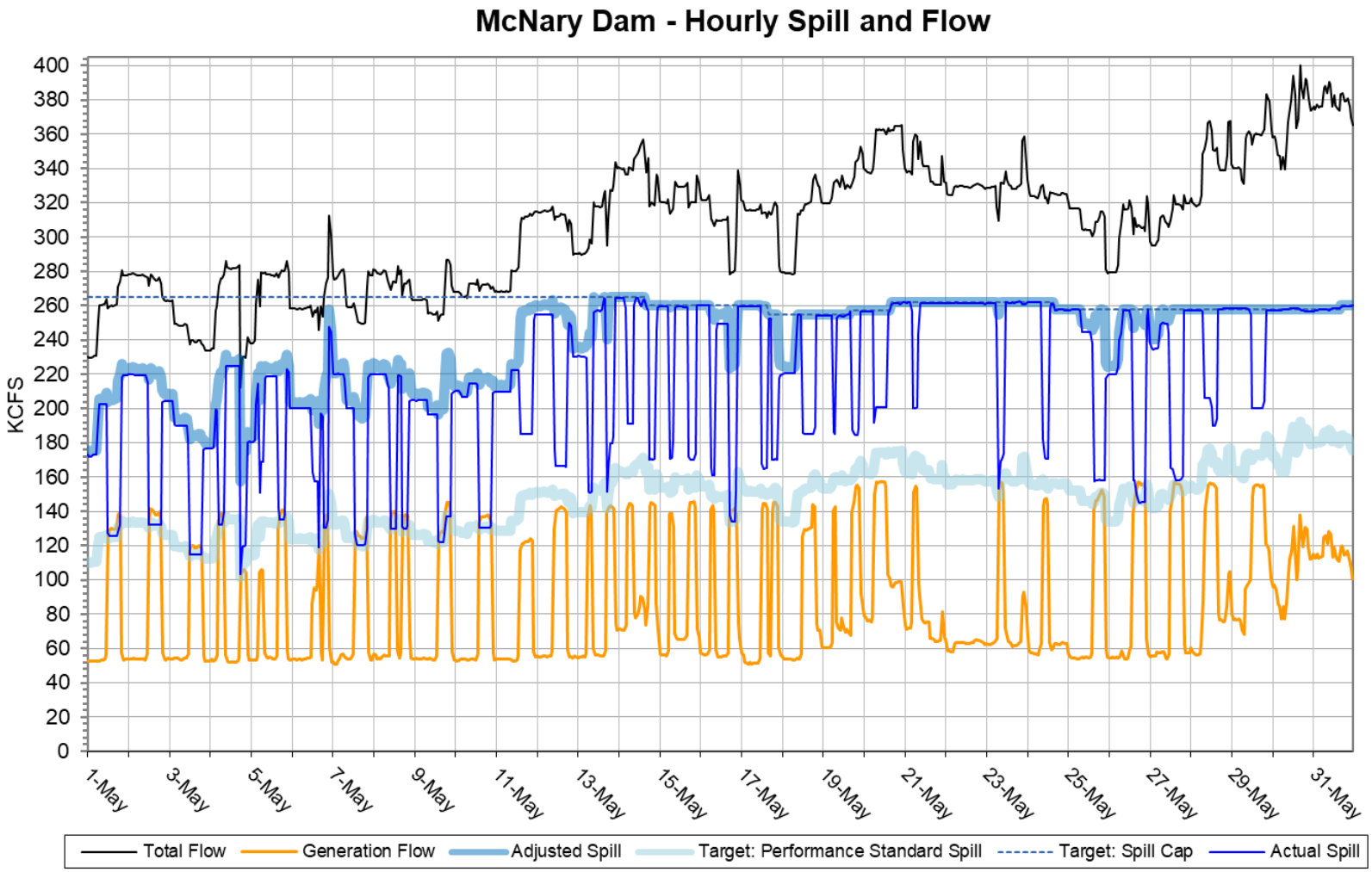
[16] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 4[17]



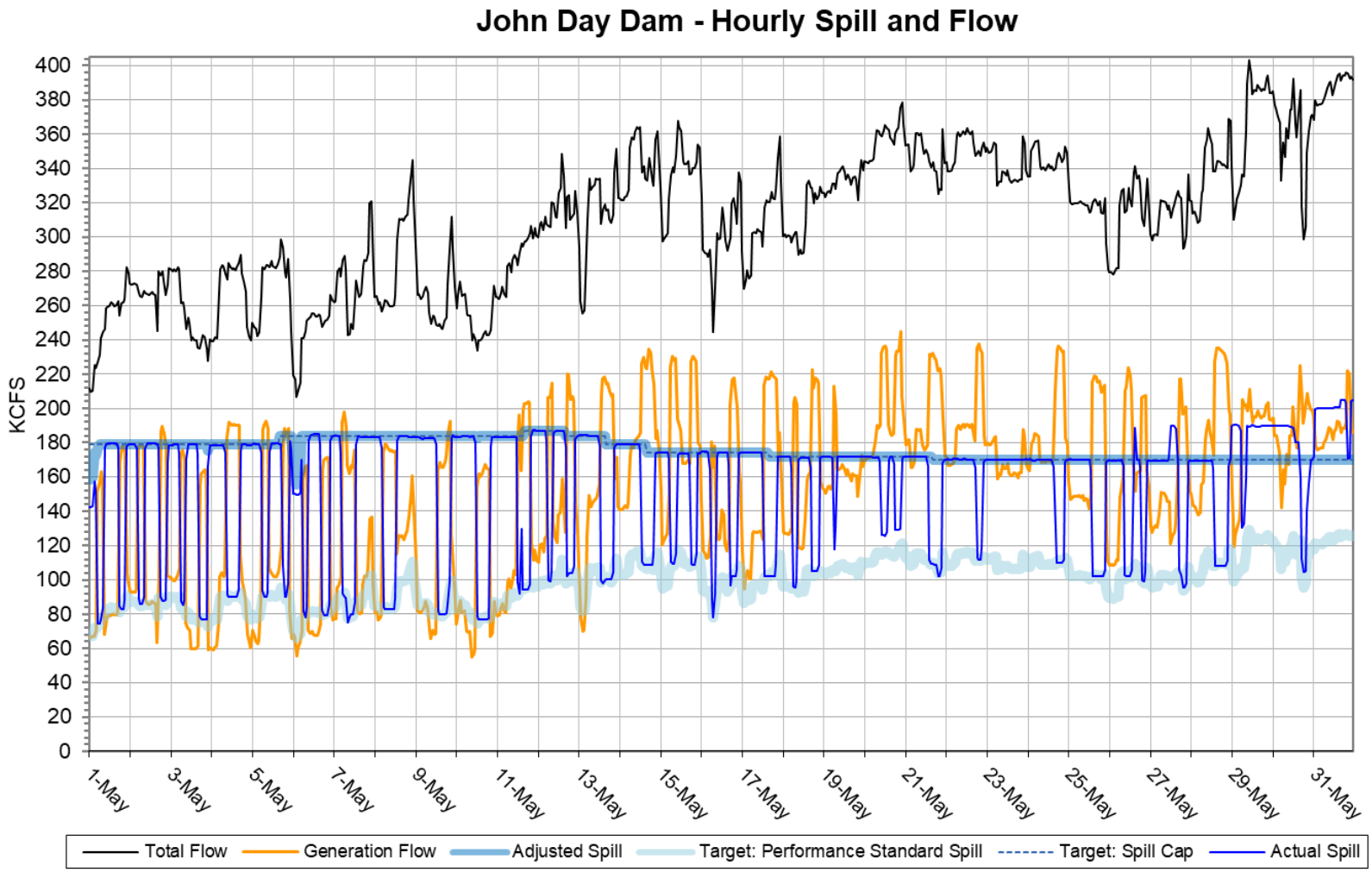
[17] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 5[18]



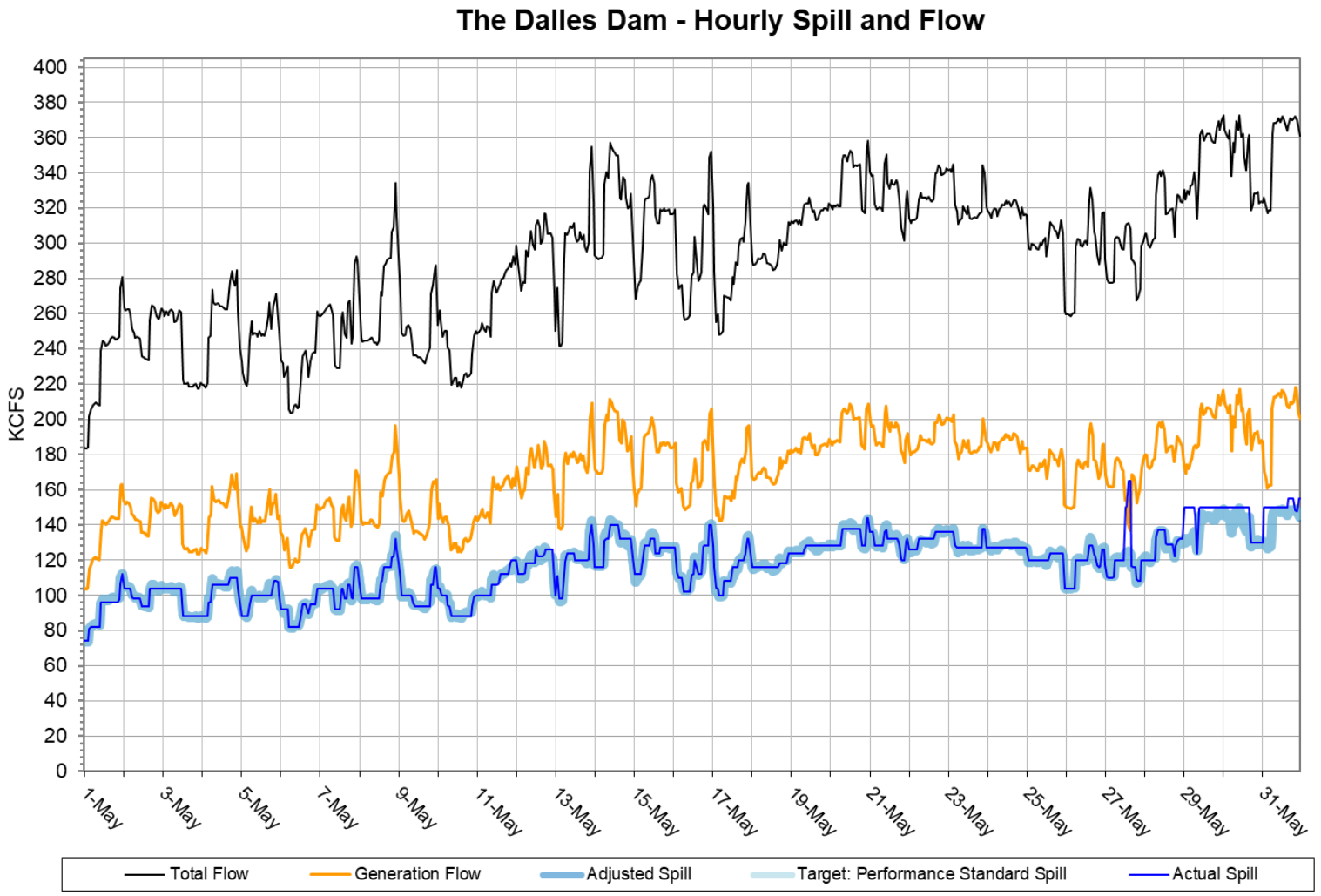
[18] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 6[19]



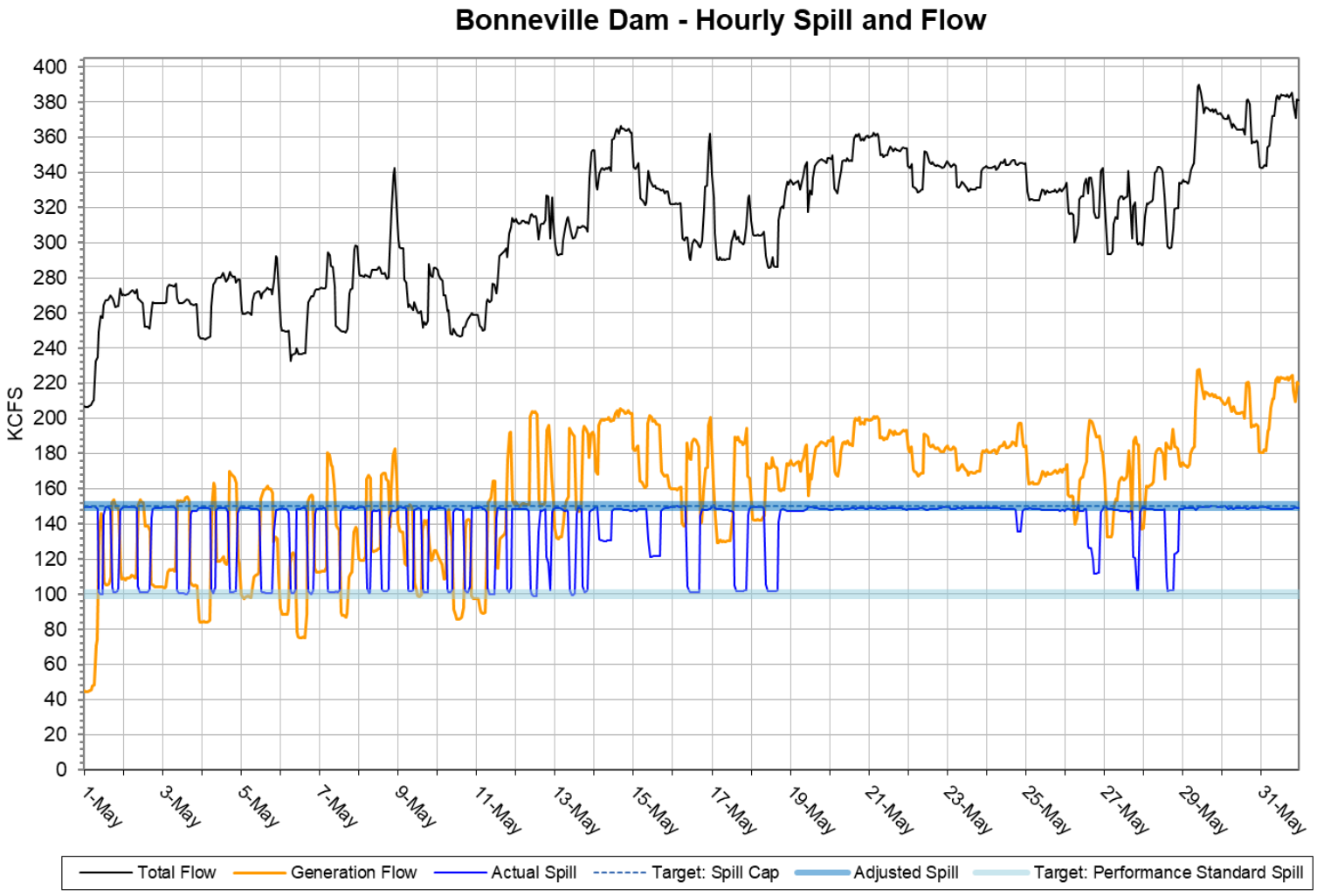
[19] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

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.