FLOW RECORDS FOR FIVE DISCHARGE STRUCTURES AT THE LA GRANGE PROJECT TECHNICAL MEMORANDUM

LA GRANGE HYDROELECTRIC PROJECT FERC NO. 14581

Prepared for:
Turlock Irrigation District – Turlock, California
Modesto Irrigation District – Modesto, California

Prepared by:
HDR, Inc.

September 2017

1.0 BACKGROUND

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) own the La Grange Diversion Dam (LGDD) located on the Tuolumne River in Stanislaus County, California. On February 2, 2015, the Federal Energy Regulatory Commission (the Commission or FERC) issued its Study Plan Determination (SPD) for the La Grange Hydroelectric Project (Project; FERC No. 14581). In its SPD, FERC directed the Districts to continue monitoring existing flow conduits where flow monitoring is already occurring, conduct two years of flow monitoring at flow conduits not currently monitored (i.e., the Modesto hillside discharge and LGDD sluice gate), develop estimates of historical flows, data permitting, for each of the five flow conduits at the Project. The SPD also directed the Districts to characterize the magnitude and rate of flow and stage changes when Project conduits are shut down, to the extent information is available to do so.

On February 2, 2016, the Districts filed with FERC the Initial Study Report (ISR) for the La Grange Project. In its April 4, 2016 comments on the ISR, the National Marine Fisheries Service (NMFS) requested the underlying data supporting the February 2016 Flow Records for Five Discharge Structures at the La Grange Project Technical Memorandum. On May 23, 2016, the Districts mailed NMFS a CD containing spreadsheets that provide hourly flow data for La Grange powerhouse Units 1 and 2, TID sluice gates 1 and 2, the sum of flows at the MID hillside discharge and Portal 1, and the La Grange Diversion Dam spillway flows for the period of January 2005 through October 2015. On May 26, 2016, the Districts provided a copy of this CD to FERC.

The flow records included herein are provided in accordance with the SPD. In addition to the records provided herein, the Districts note that as part of the Don Pedro Hydroelectric Project (FERC No. 2299) relicensing, a list of available flow information for the La Grange Project was provided in the Initial Study Report (TID/MID 2013). Further, an assessment of rates of change of flow as measured at the U.S. Geological Survey (USGS) La Grange gage located downstream of the tailrace of TID's La Grange powerhouse was provided in the Updated Study Report (TID/MID 2014).

On February 1, 2017, the Districts filed the Updated Study Report (USR) for the La Grange Hydroelectric Project. The USR included a February 2017 version of the Flow Records for Five Discharge Structures at the La Grange Project Technical Memorandum that reported the results of flow record monitoring through the end of water year 2016. The same February 2017 version of this Technical Memorandum was also filed as an attachment to the La Grange Hydroelectric Project Draft License Application (DLA) on April 24, 2017.

The Districts continued flow monitoring through December 2016. The results of the 2016 flow monitoring are reported in this technical memorandum, which was filed as an attachment to the La Grange Hydroelectric Project Final License Application (FLA). The FLA was filed with FERC on October 11, 2017, in accordance with the Districts' Request for Extension of Time granted by FERC on September 1, 2017. Spreadsheets that provide hourly flow data for La Grange powerhouse Units 1 and 2, TID sluice gates 1 and 2, the sum of flows at the MID hillside discharge and Portal 1, and the La Grange Diversion Dam spillway are now available for the

two-year period of January 2015 through December 2016. These spreadsheets are available upon request.

2.0 STUDY AREA

The study encompasses five discharge structures of the La Grange Project through which water can be passed downstream to the Tuolumne River. The structures are as follows:

- TID La Grange powerhouse structure, Units 1 and 2
- TID sluice gate structure, Gates 1 and 2
- MID hillside discharge gate structure
- Portal 1 gate located in the dam near the MID abutment (i.e., the LGDD sluice gate)
- LGDD spillway

Figure 2.0-1 shows the location of each discharge structure. Portals 3, 4, and 5 were used during construction and are no longer in use. The maximum powerhouse flow capacity is approximately 580 cubic feet per second (cfs) with both units operating; the TID sluice gate capacity is approximately 550 cfs with both gates open full; the MID hillside gate has a reported capacity of approximately 350 cfs; and the Portal 1 gate can pass approximately 200 cfs when fully open and water level in the La Grange pool is at or near the spillway crest.

Figure 2.0-1. Location of five discharge structures at the La Grange Project.

3.0 DATA AVAILABILITY AND ANALYSIS

Flow data available for the La Grange Project were identified in the Don Pedro Hydroelectric Project Initial Study Report (TID/MID 2013). Data consist of flow records for the two units in the TID powerhouse, sluice gate openings as a percent of full open, and LGDD headpond level. Flows from the five conduits join together upstream of the USGS La Grange gage. The USGS La Grange gage is the only continuous record of both river flow and river stage; therefore, records of the rate of stage change in the tailrace or in the plunge pool below the LGDD are not available.

Flow records for either the MID hillside gate or the Portal 1 gate do not exist. Records of operation of the MID hillside gate and the Portal 1 gate are limited to narrative text of changes to the gate openings for the period April through December 2013 and calendar years 2014 and 2015. Narrative descriptions of changes to gate openings and approximate flow targets were provided for 2016 for purposes of this report. When the Tainter gates that control flow to the MID hillside gates are closed, a constant leakage of approximately 5 to 10 cfs occurs, and this flow is discharged at the hillside gates (see Figure 3.0-1).

Figure 3.0-1. Hillside gates which pass flow from the MID canal to the plunge pool below LGDD.

For purposes of the current analysis, the flow record was divided into two time periods: 2014 through 2016 and 2005 through 2013. The former period had a record of gate changes for the hillside and Portal 1 gates, while the latter period only had records for the TID powerhouse and TID sluice gate openings.

The flow data analysis for 2014 through 2016 was conducted assuming the USGS La Grange gage is the most reliable indicator of total flow being passed to the Tuolumne River at the La Grange Project. The flow from each of the TID generating units at the La Grange powerhouse is recorded; the flow from each of the TID sluice gates can be calculated based on gate position when open. The flows at the MID hillside and Portal 1 gates were estimated from the MID

operator's narrative notes of gate changes. The total individual discharges were summed and compared to the discharge recorded at the USGS La Grange gage. When adjustments to flow were needed to "true up" to the USGS gage, flow from the MID hillside and/or Portal 1 gate were adjusted first, these being the least reliable flow records. There were no flows over the spillway during the 2014/2015 period. In 2016, spills between 1200 and 1600 cfs occurred on April 16, 2016, April 23, 2016, and April 30, 2016; and a spill of approximately 400 cfs occurred on May 6, 2016. The resulting flow record for the 2014 through 2016 period, based on hourly discharges, is provided in Figures 3.0-2 through 3.0-4. In Figures 3.0-2 through 3.0-4, "USGS Total" refers to flows recorded at the USGS La Grange gage, "Unit 1" refers to flows through La Grange powerhouse Unit 1, "Unit 2" refers to flows through La Grange powerhouse Unit 2, "Sluice A" refers to flows through TID sluice gate 1, "Sluice B" refers to flows through TID sluice gate 2, "MID Total" refers to the sum of flows at the MID hillside discharge and Portal 1, and "Spill" refers to flow over the LGDD spillway. Attachments A, B, and C contain records of discharges by month in years 2014, 2015, and 2016, respectively.

For the period 2005 to 2013, the records available are limited to the TID La Grange powerhouse units, the TID sluice gates, the La Grange headpond water level and the USGS La Grange gage. To estimate flows from the other structures, flows were back-calculated by identifying the difference between the USGS gage flow and the powerhouse plus TID sluice gate flow. If the USGS flow was greater than these combined flows, then flows were assigned as follows: MID hillside gate up to 350 cfs; Portal 1 gate up to 200 cfs; spill at spillway assuming headpond level was greater than 296.5 feet (spillway crest elevation). These estimated flows from 2005 to 2013 are presented in Attachment D for each calendar year.

A flow of 5-10 cfs was estimated to occur at the MID hillside gate at all times as the amount of leakage occurring at the MID Tainter gates. Using a pygmy flow meter, a measurement of flow in the mainstem Tuolumne River parallel to the La Grange powerhouse tailrace channel was made in 2015 when only the leakage was occurring. This flow was measured to be slightly less than 10 cfs. TID currently maintains in an open position an 18-inch pipe that continuously delivers flow from the TID forebay to the channel downstream of the sluice gates. The 18-inch pipe is located in the same area as the TID sluice gate as shown in Figure 2.0-1. This water flows into the tailrace just upstream of the powerhouse. The flow quantity is not measured and is unknown, but is roughly estimated to be about 5 to 10 cfs. This flow is not included in the computations contained in the analyses conducted for this report due to the uncertainty of the quantity of flow discharged and lack of records about its history of operation.

FERC indicated in the SPD that having additional historical flow records below LGDD would help inform an evaluation of Project effects on anadromous fish habitat. These flow records, to the extent able to be estimated, are provided herein.

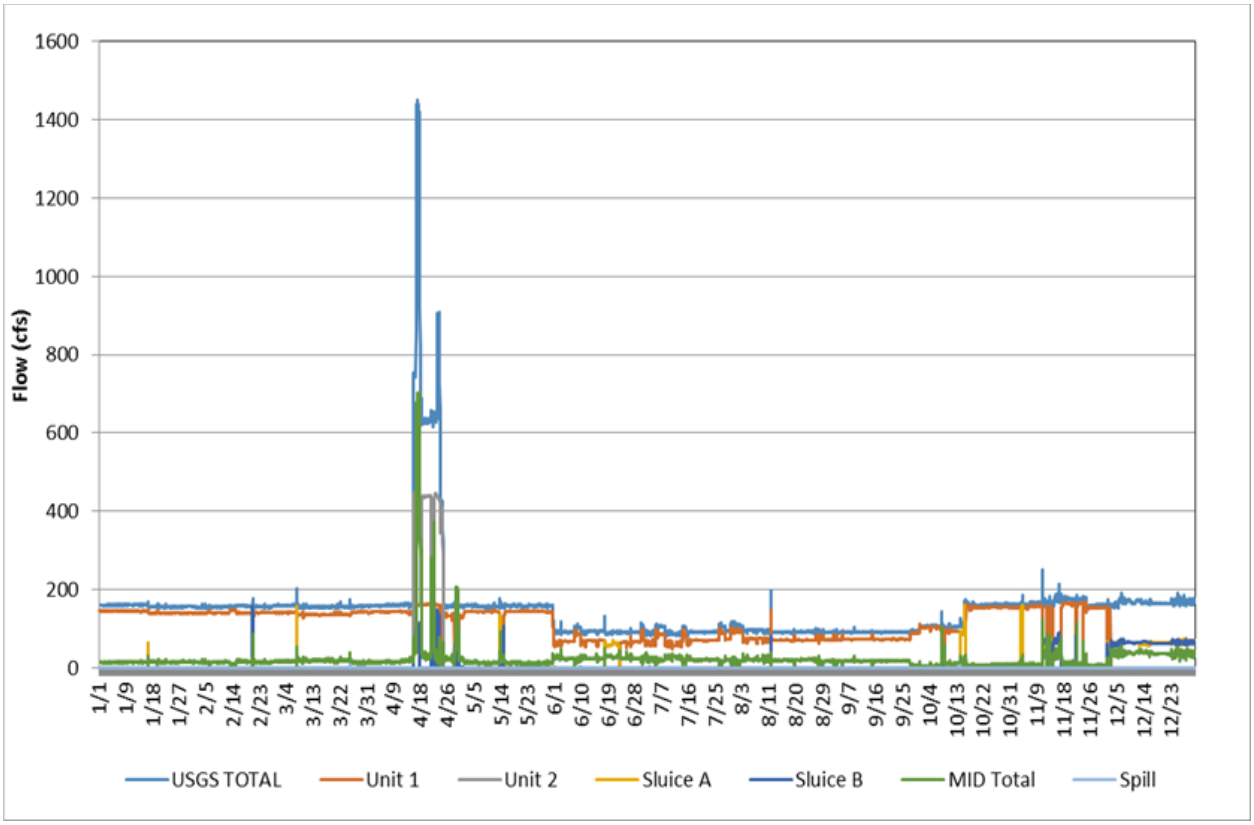

Figure 3.0-2. Flow record for year 2014, based on hourly discharges.

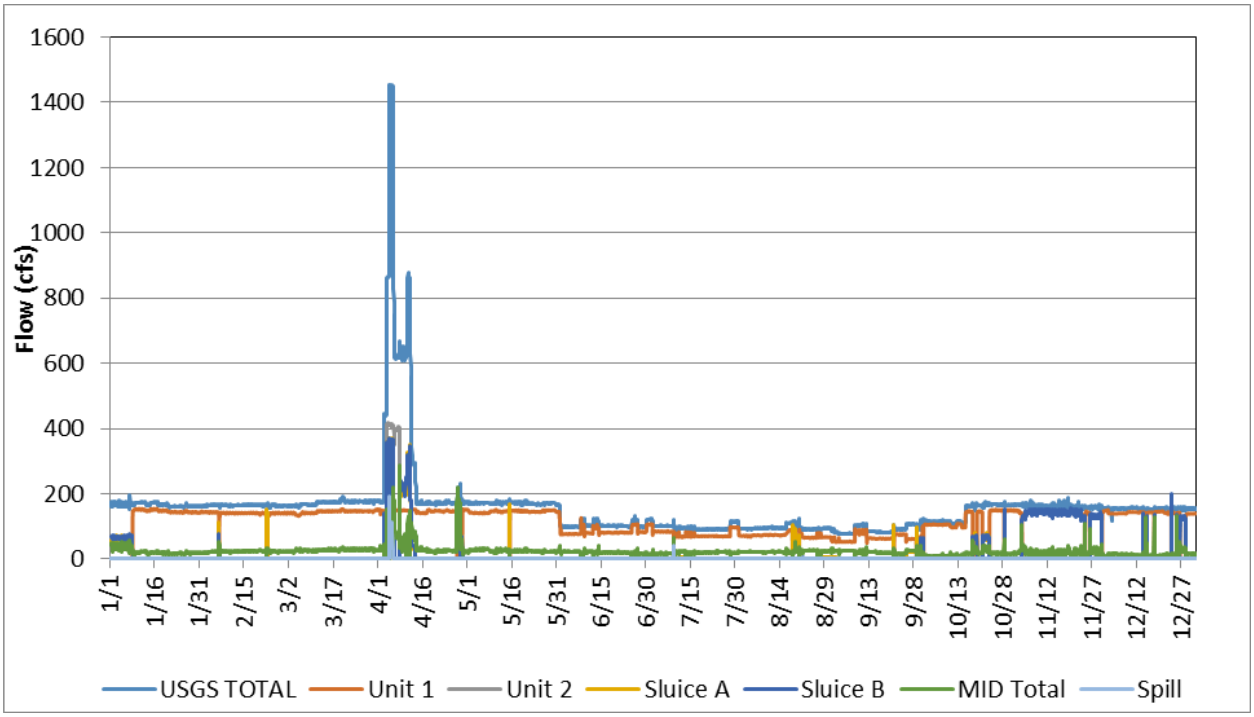

Figure 3.0-3. Flow records for year 2015, based on hourly discharges.

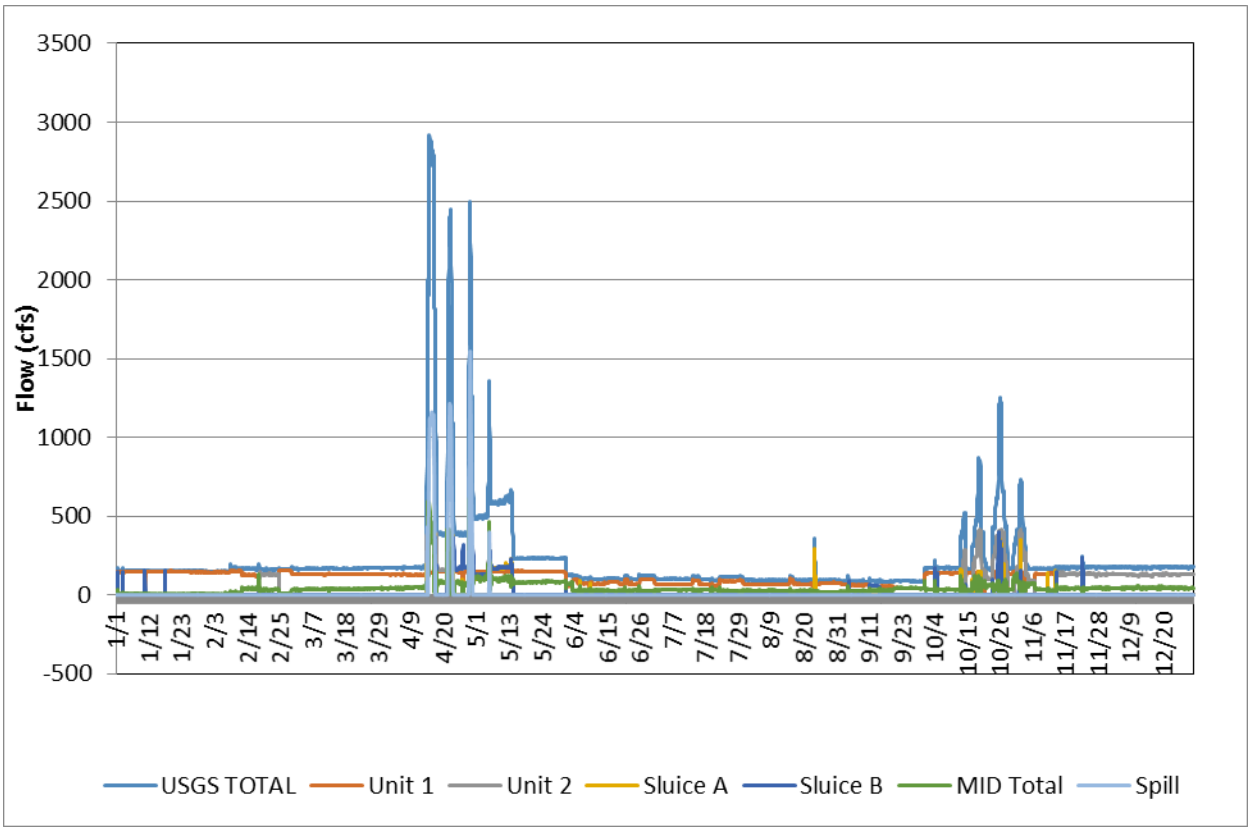

Figure 3.0-4. Flow records for year 2016, based on hourly discharges.

4.0 STUDY VARIANCES AND MODIFICATIONS

This study was conducted consistent with the FERC-approved study plan. No variances or modifications occurred.

5.0 REFERENCES

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013. Don Pedro Hydroelectric Project Initial Study Report. January 2013.

_____. 2014. Don Pedro Hydroelectric Project Updated Study Report, Attachment: *Technical Memorandum: NMFS Information Requests*, pages 1-96. January 2014.

FLOW RECORDS FOR FIVE DISCHARGE STRUCTURES AT THE LA GRANGE PROJECT
TECHNICAL MEMORANDUM

ATTACHMENT A

2014 MONTHLY FLOW RECORDS

Please refer to the legend below for all figures in this attachment:

- USGS Total = Flows recorded by the USGS La Grange gage.
- Unit 1 = Flows through La Grange powerhouse Unit 1.
- Unit 2 = Flows through La Grange powerhouse Unit 2.
- Sluice A = Flows through TID sluice gate 1.
- Sluice B = Flows through TID sluice gate 2.
- MID Total = The sum of flows at the MID hillside discharge and Portal 1.
- Spill = Spill at the LGDD spillway.
- TID currently maintains in an open position an 18-inch pipe that continuously delivers flow from the TID forebay to the channel downstream of the sluice gates. The flow quantity is not measured and is unknown, but is roughly estimated to be about 5 to 10 cfs. This flow is not included in the computations contained in the analyses conducted for this report due to the uncertainty of the quantity of flow discharged and its history of operation.

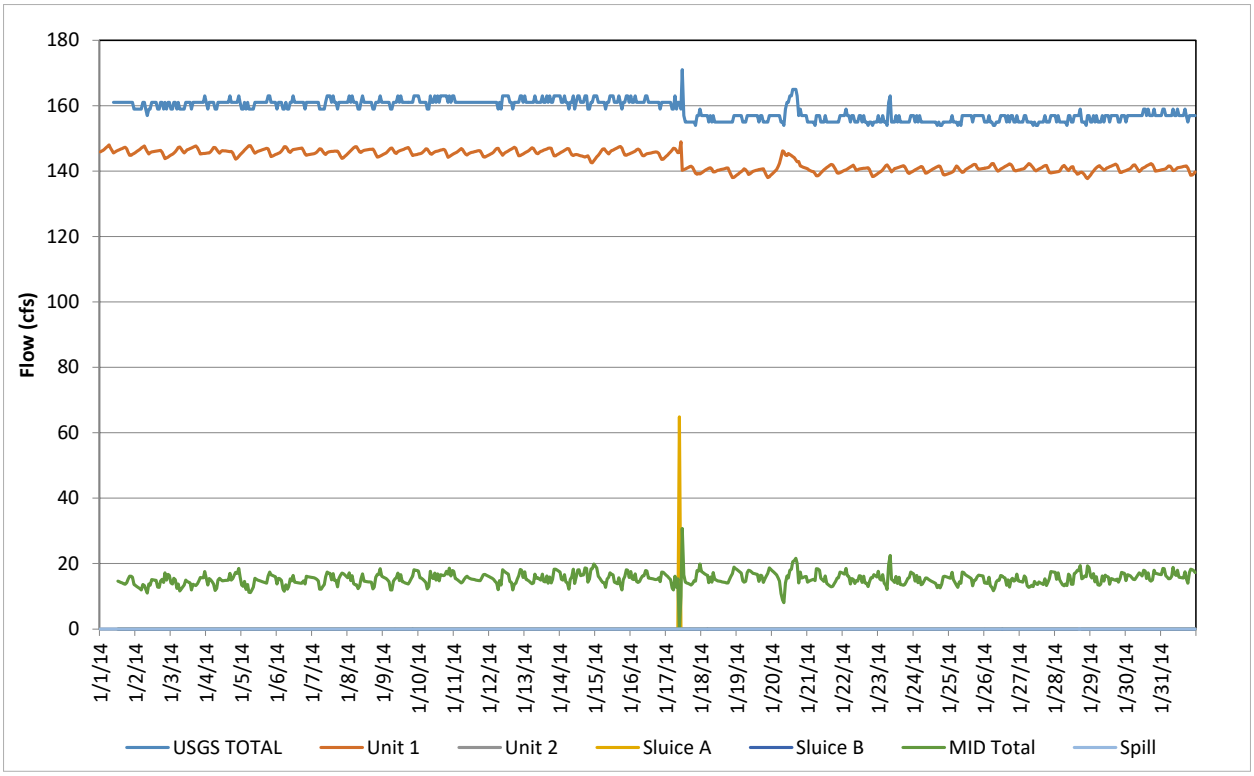

Figure A-1. Flow record in January 2014, based on hourly discharges.

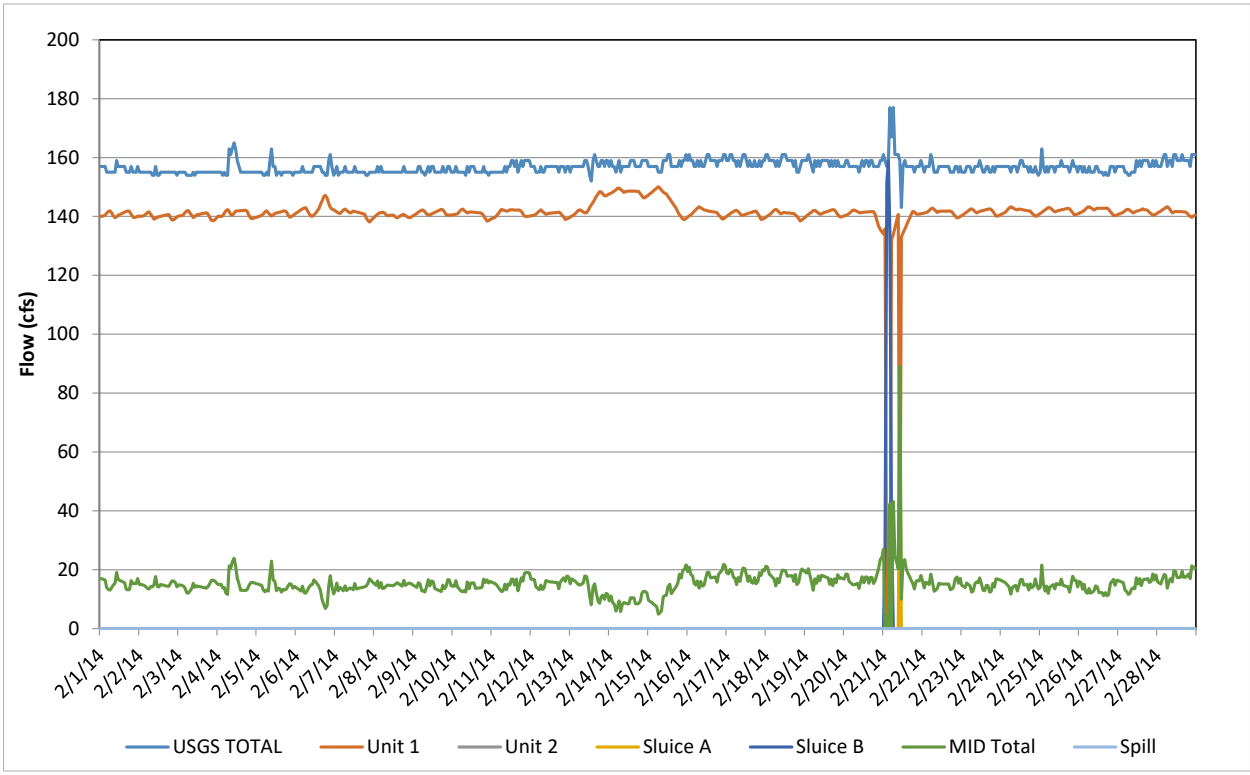

Figure A-2. Flow record in February 2014, based on hourly discharges.

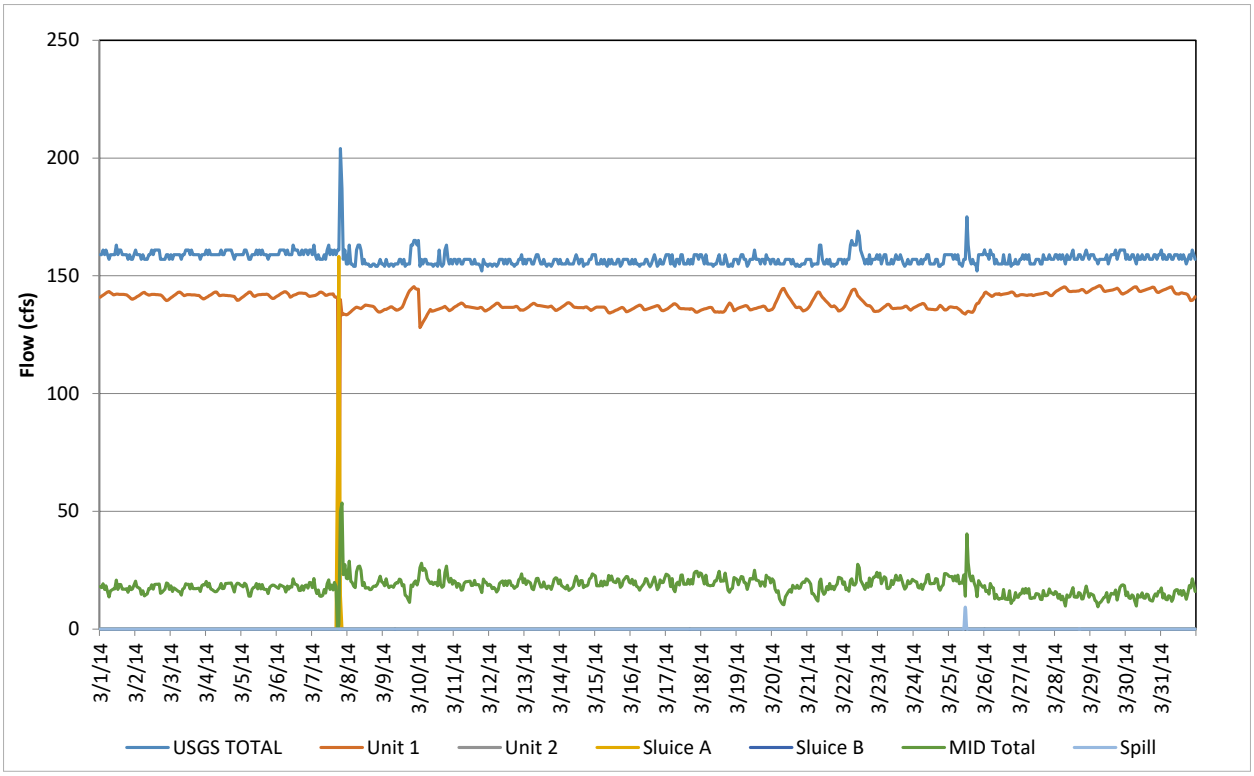

Figure A-3. Flow record in March 2014, based on hourly discharges.

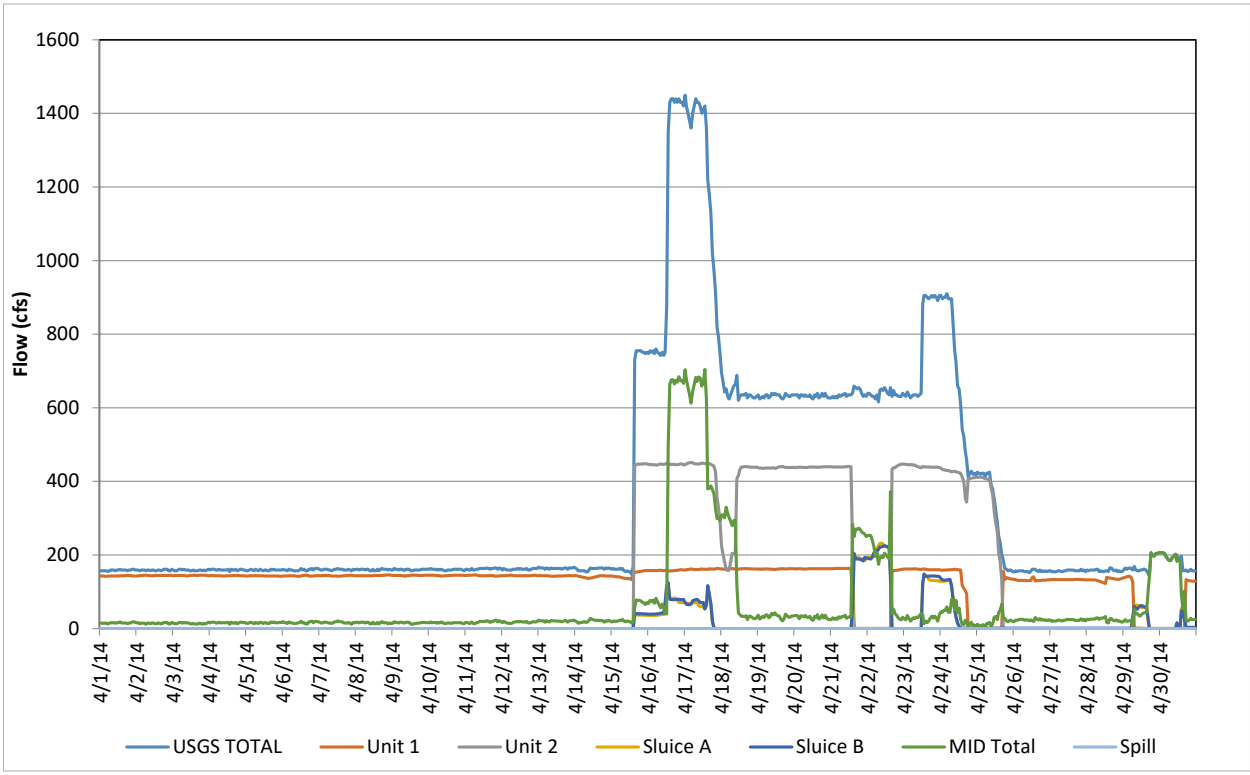

Figure A-4. Flow record in April 2014, based on hourly discharges.

Figure A-5. Flow record in May 2014, based on hourly discharges.

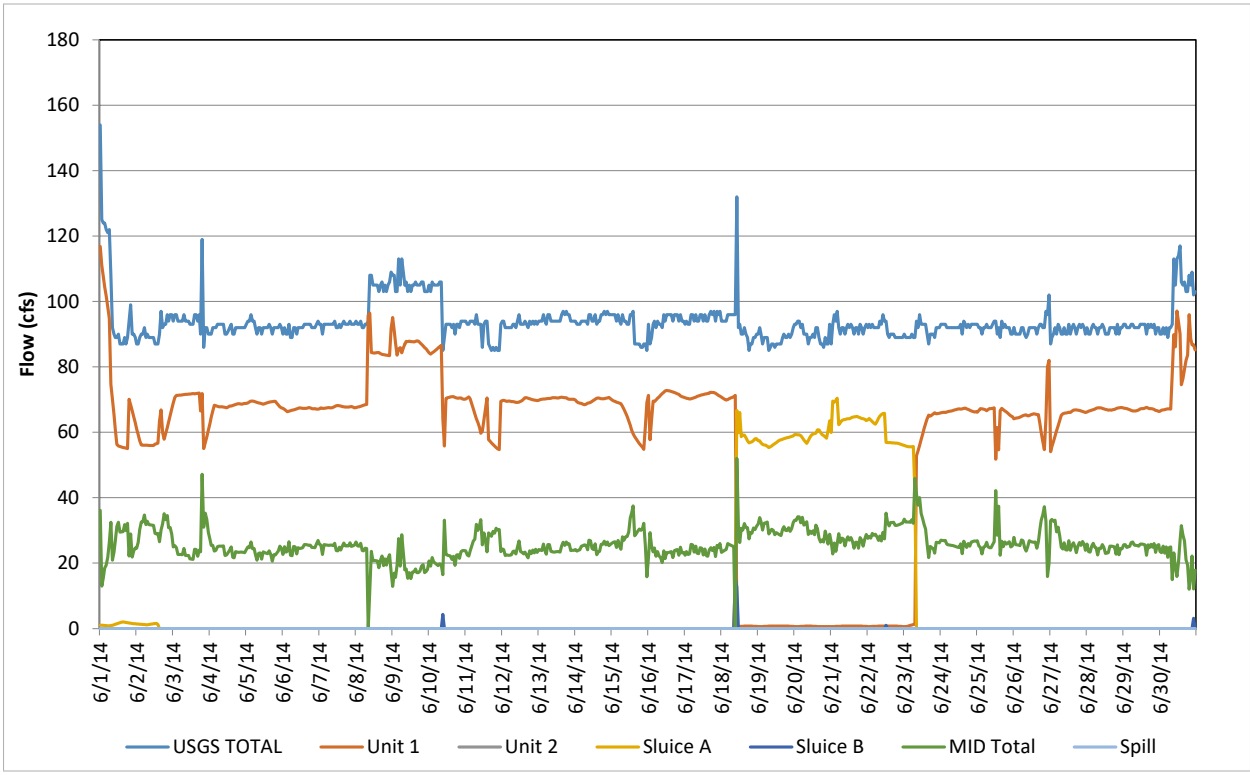

Figure A-6. Flow record in June 2014, based on hourly discharges.

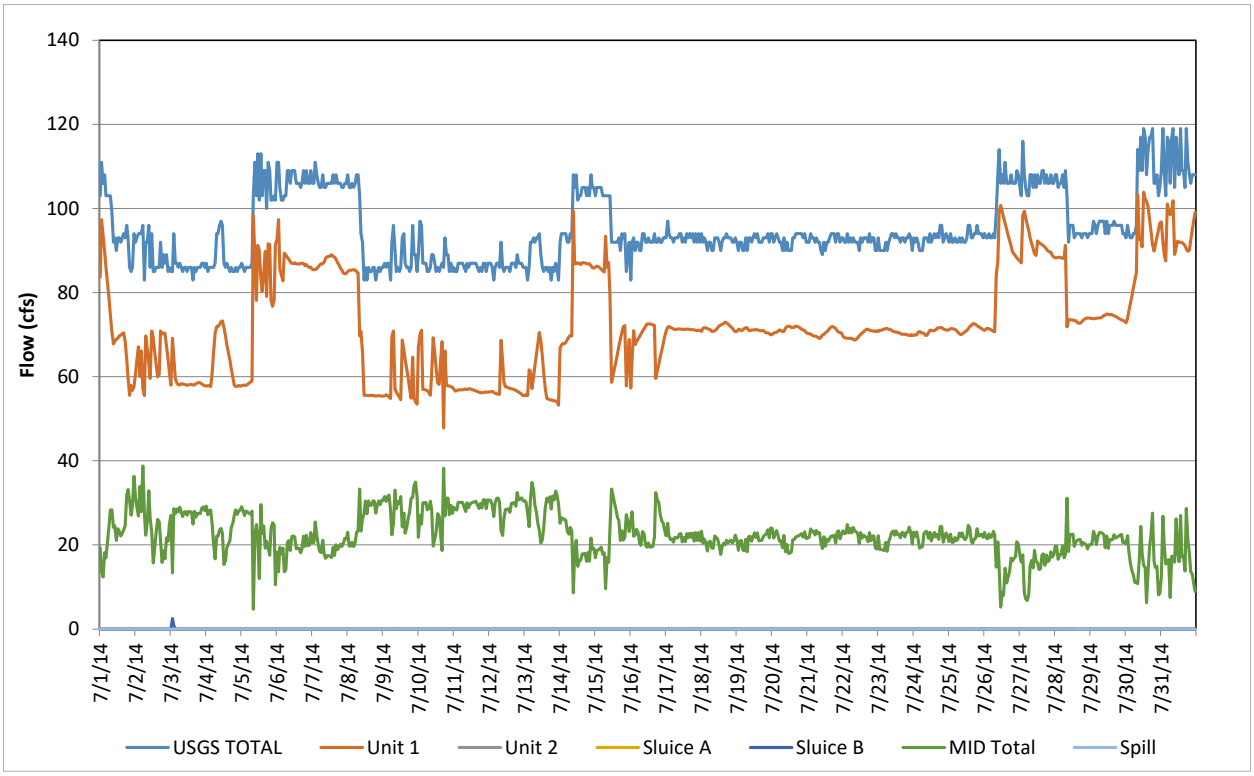

Figure A-7. Flow record in July 2014, based on hourly discharges.

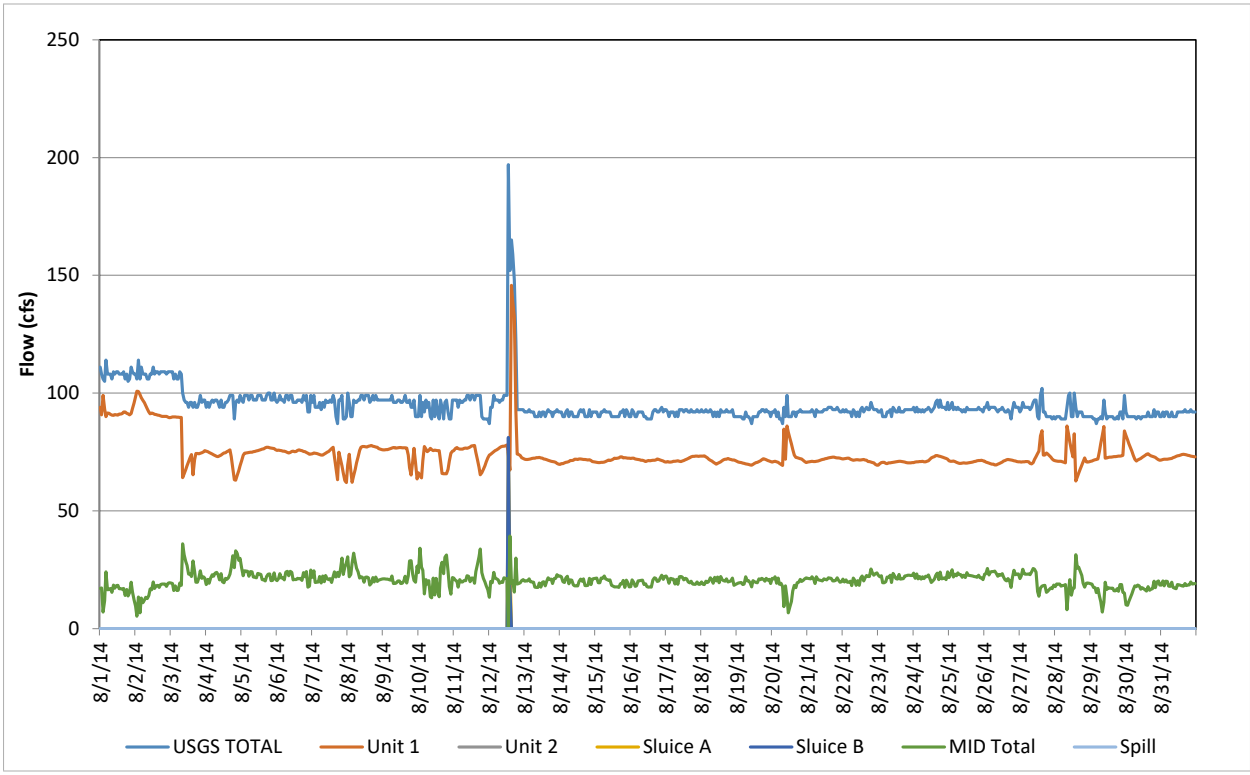

Figure A-8. Flow record in August 2014, based on hourly discharges.

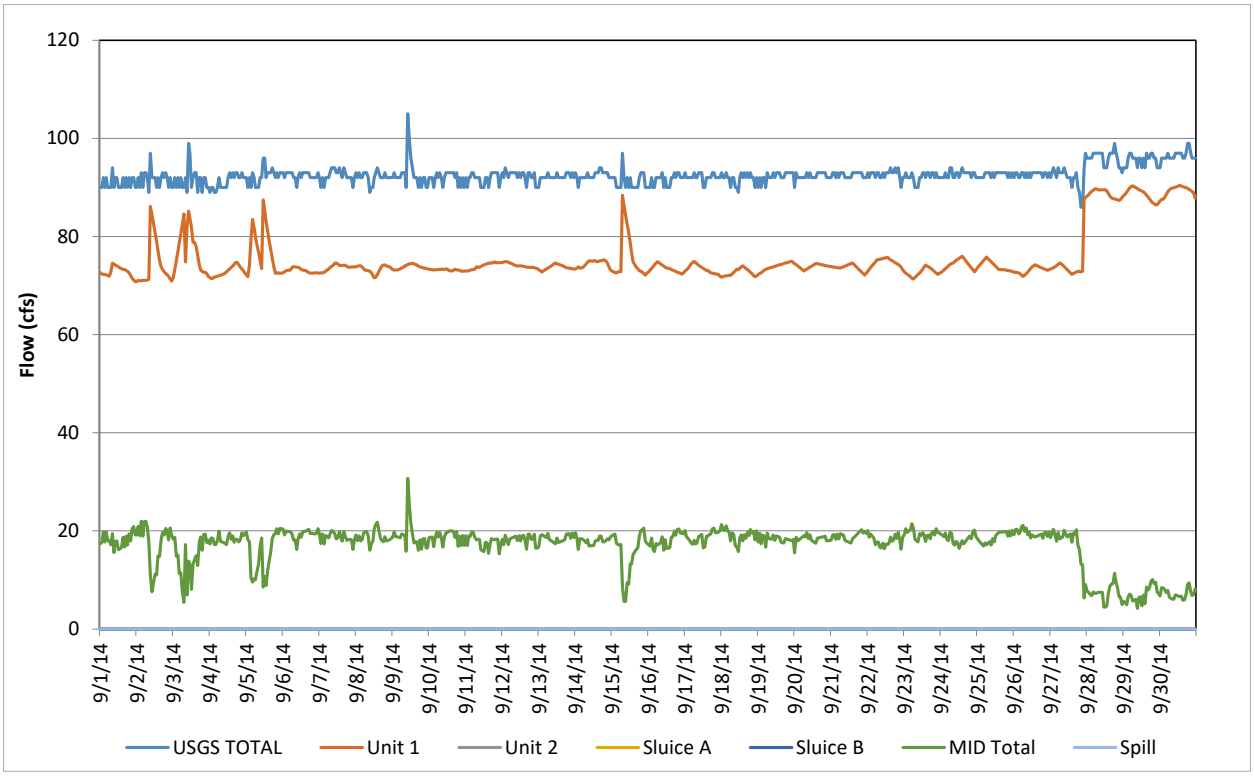

Figure A-9. Flow record in September 2014, based on hourly discharges.

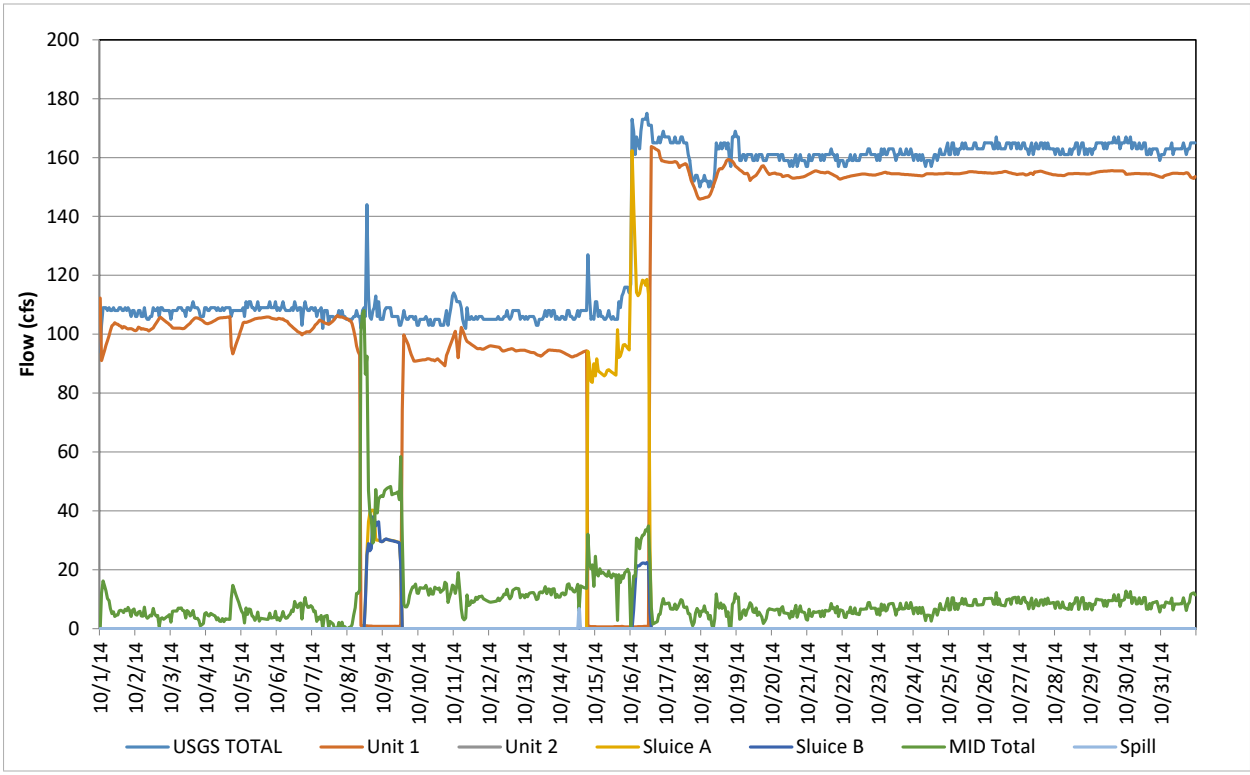

Figure A-10. Flow record in October 2014, based on hourly discharges.

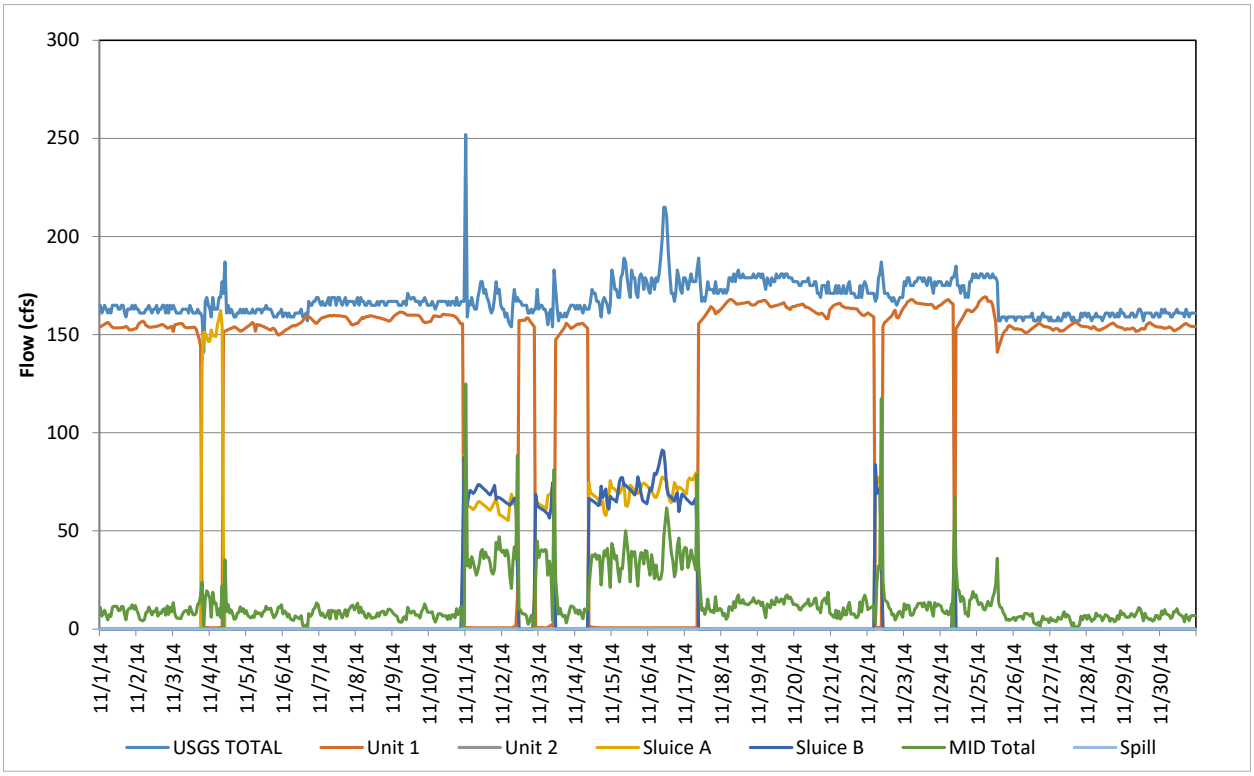

Figure A-11. Flow record in November 2014, based on hourly discharges.

Figure A-12. Flow record in December 2014, based on hourly discharges.

FLOW RECORDS FOR FIVE DISCHARGE STRUCTURES AT THE LA GRANGE PROJECT

ATTACHMENT B

2015 MONTHLY FLOW RECORDS

Please refer to the legend below for all figures in this attachment:

- USGS Total = Flows recorded by the USGS La Grange gage.
- Unit 1 = Flows through La Grange powerhouse Unit 1.
- Unit 2 = Flows through La Grange powerhouse Unit 2.
- Sluice A = Flows through TID sluice gate 1.
- Sluice B = Flows through TID sluice gate 2.
- MID Total = The sum of flows at the MID hillside discharge and Portal 1.
- Spill = Spill at the LGDD spillway.
- TID currently maintains in an open position an 18-inch pipe that continuously delivers flow from the TID forebay to the channel downstream of the sluice gates. The flow quantity is not measured and is unknown, but is roughly estimated to be about 5 to 10 cfs. This flow is not included in the computations contained in the analyses conducted for this report due to the uncertainty of the quantity of flow discharged and its history of operation.

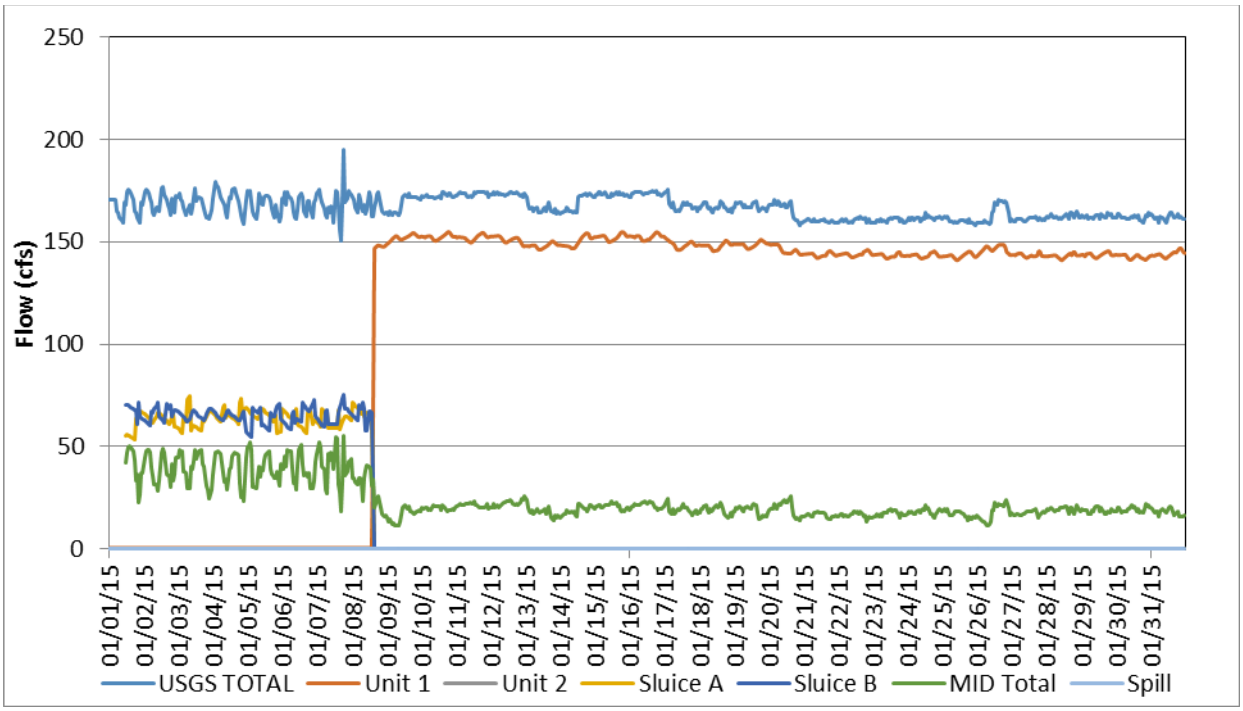

Figure B-1. Flow record in January 2015, based on hourly discharges.

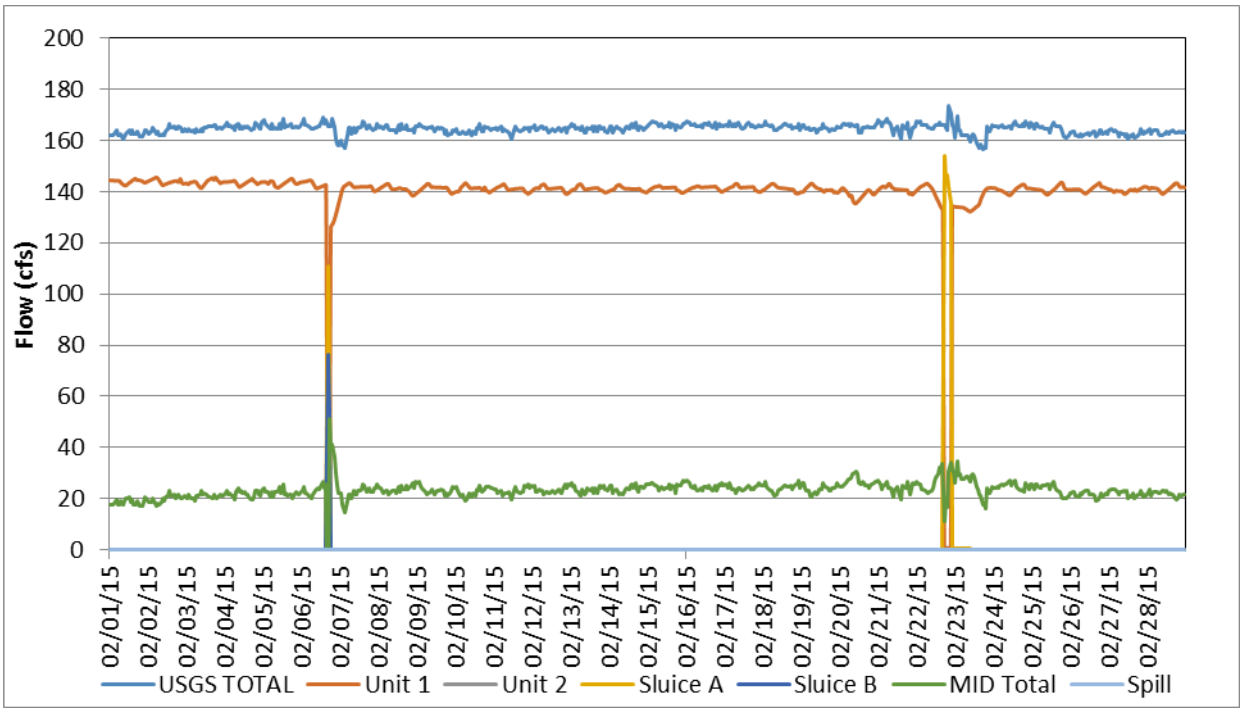

Figure B-2. Flow record in February 2015, based on hourly discharges.

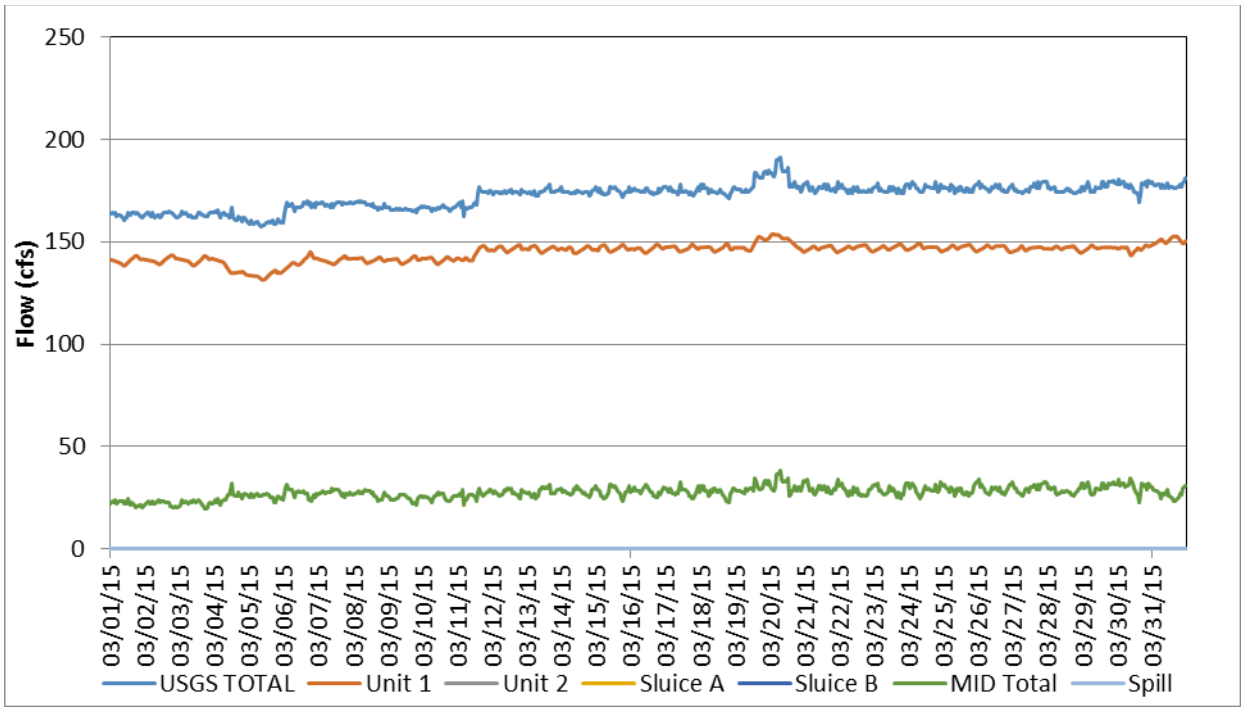

Figure B-3. Flow record in March 2015, based on hourly discharges.

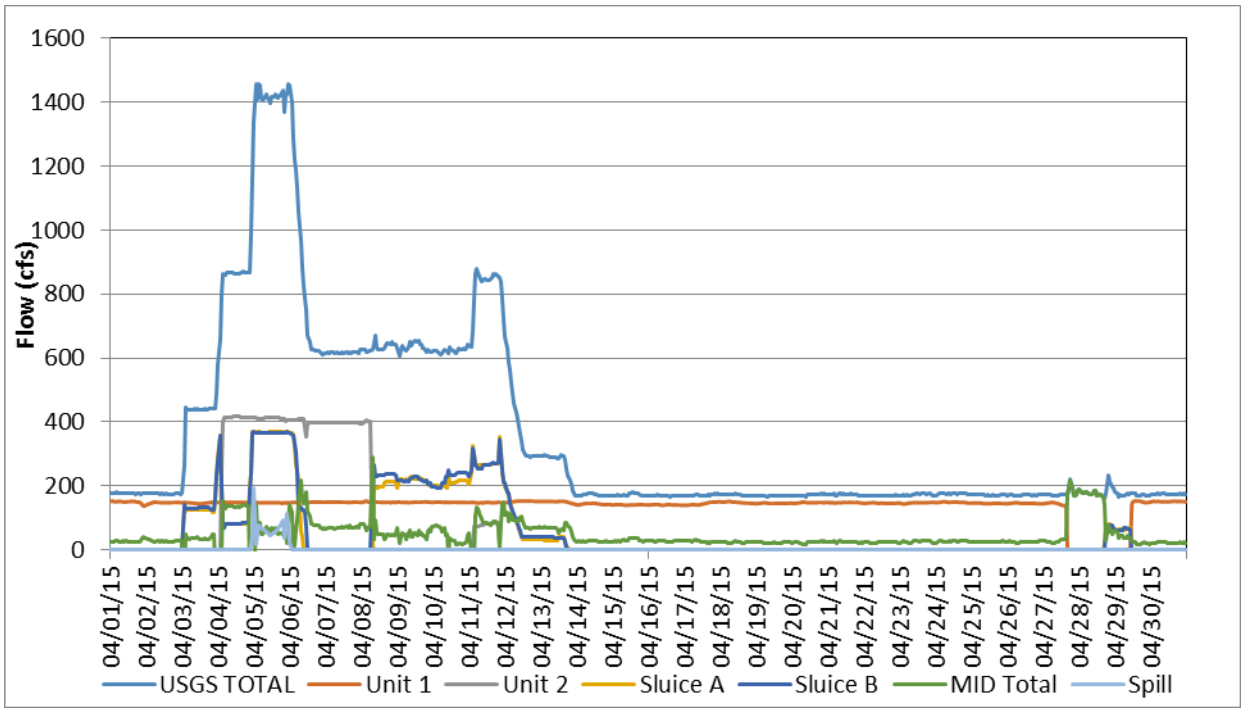

Figure B-4. Flow record in April 2015, based on hourly discharges.

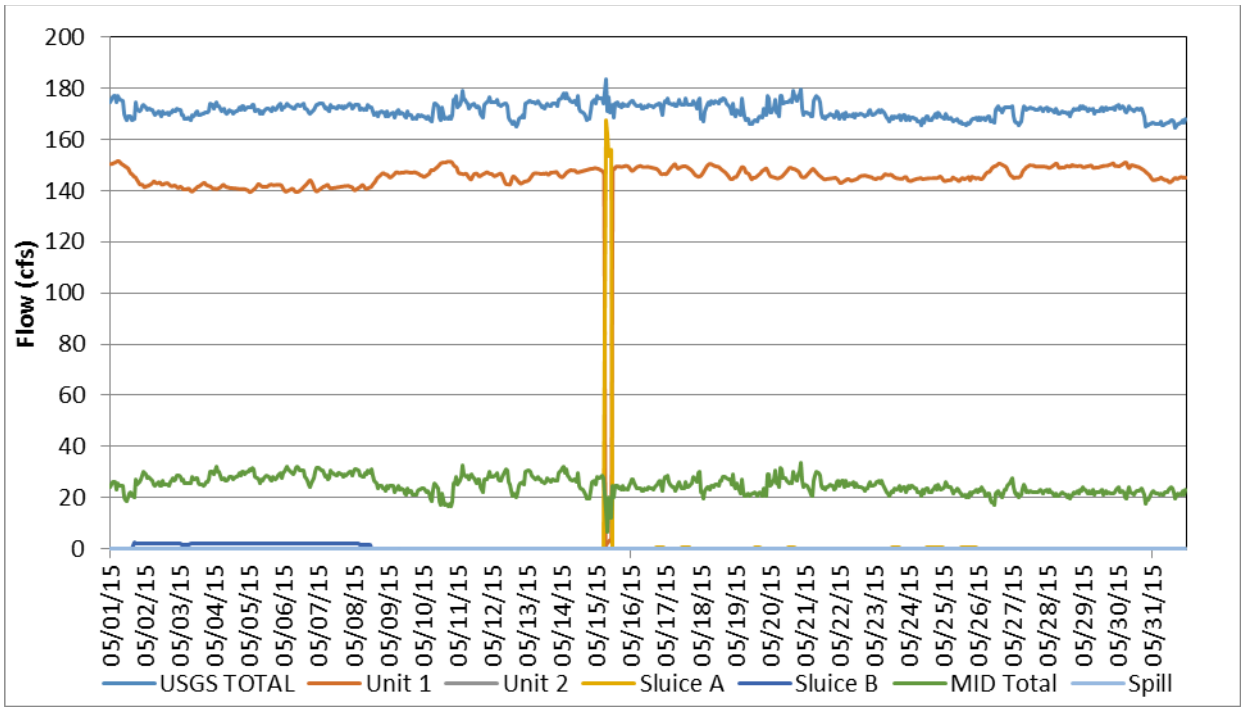

Figure B-5. Flow record in May 2015, based on hourly discharges.

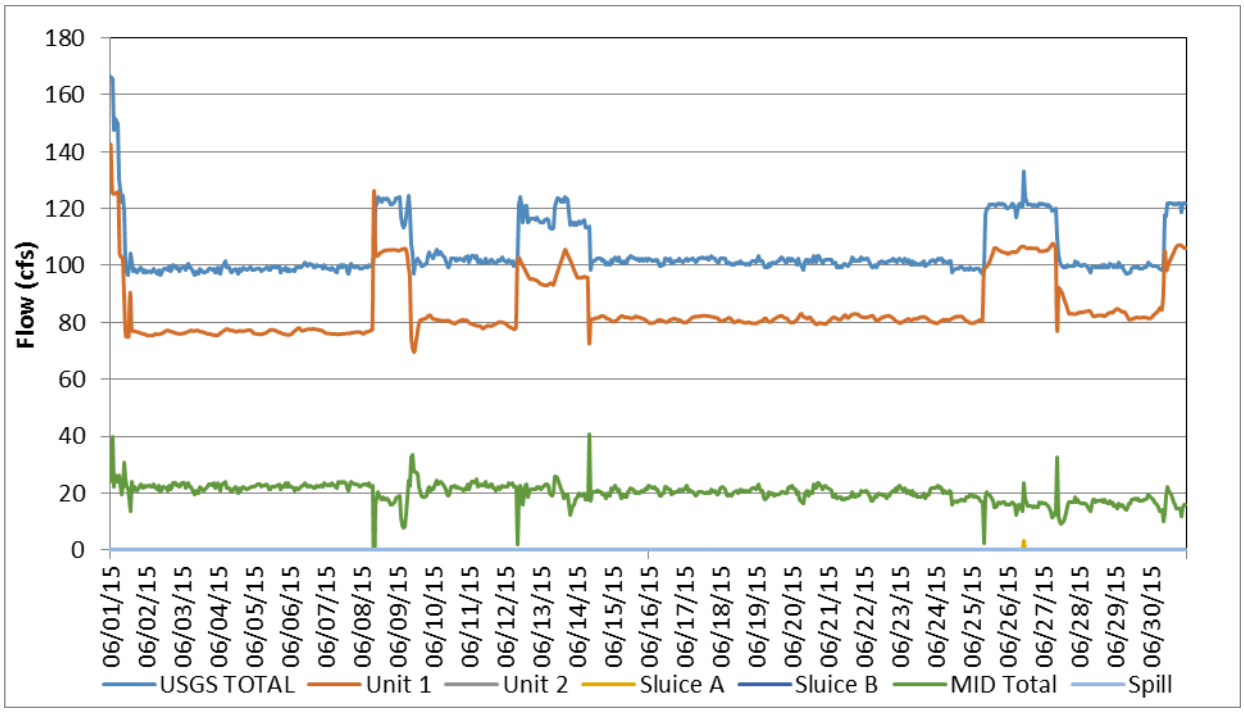

Figure B-6. Flow record in June 2015, based on hourly discharges.

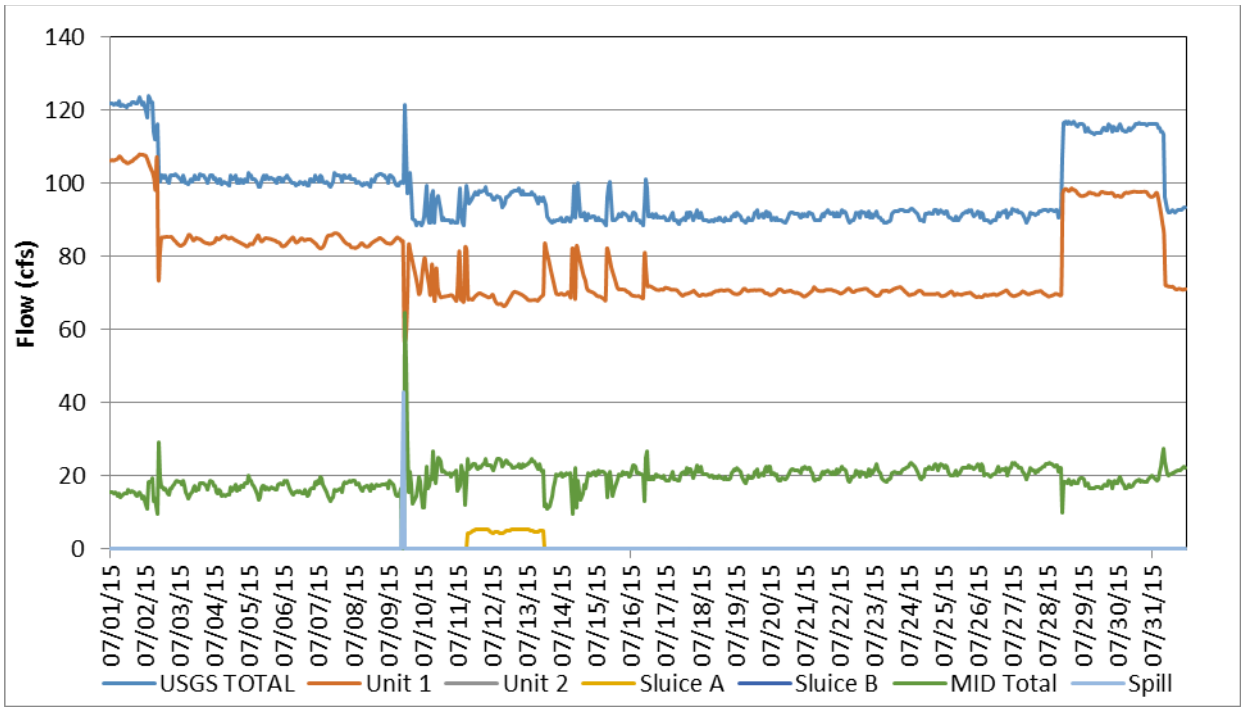

Figure B-7. Flow record in July 2015, based on hourly discharges.

Figure B-8. Flow record in August 2015, based on hourly discharges.

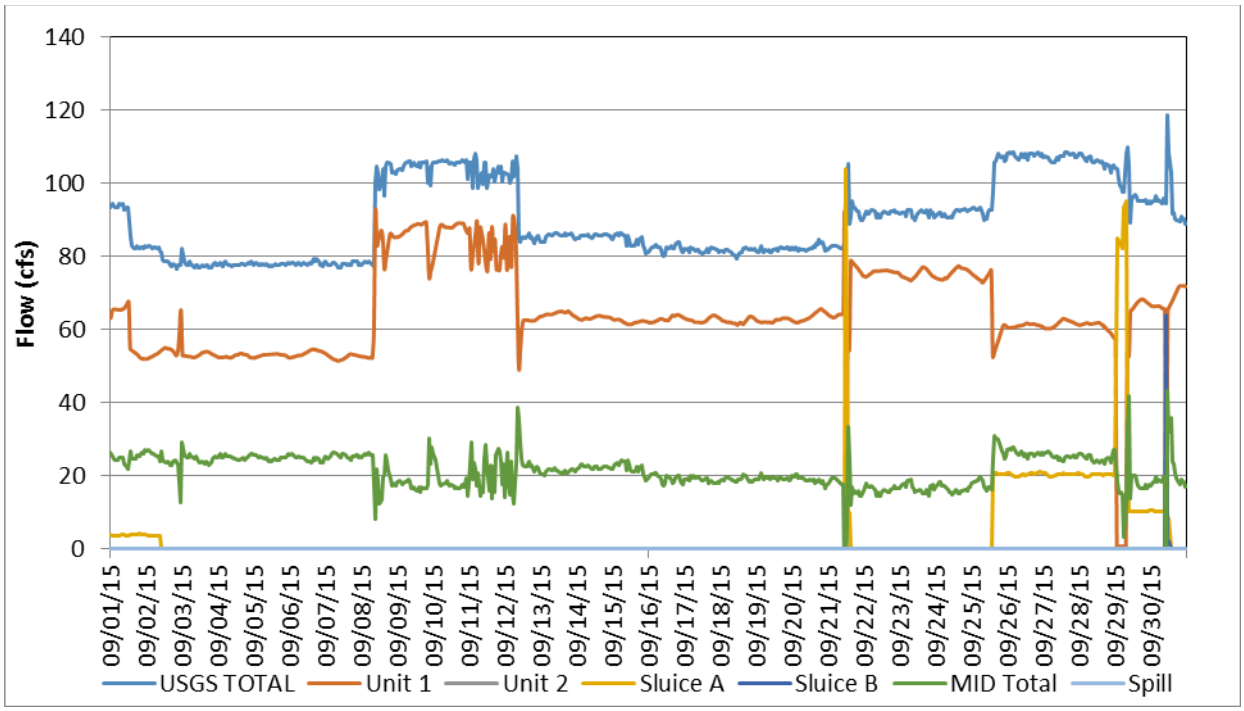

Figure B-9. Flow record in September 2015, based on hourly discharges.

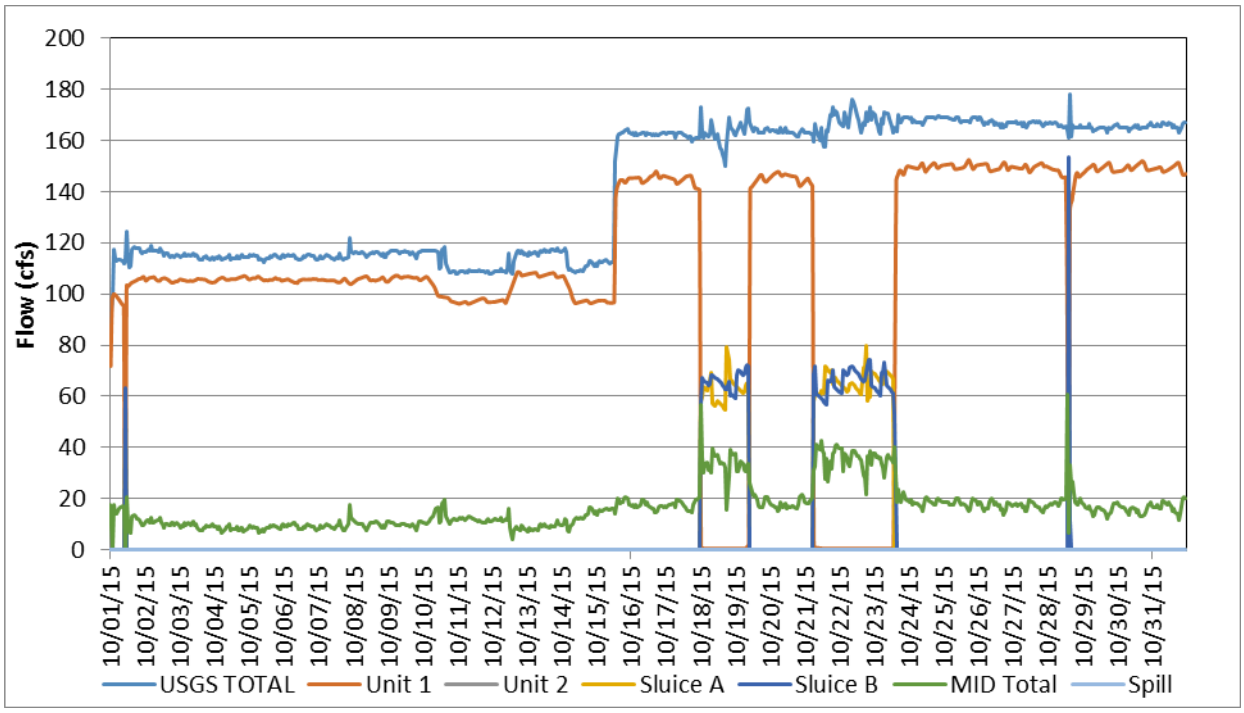

Figure B-10. Flow record in October 2015, based on hourly discharges.

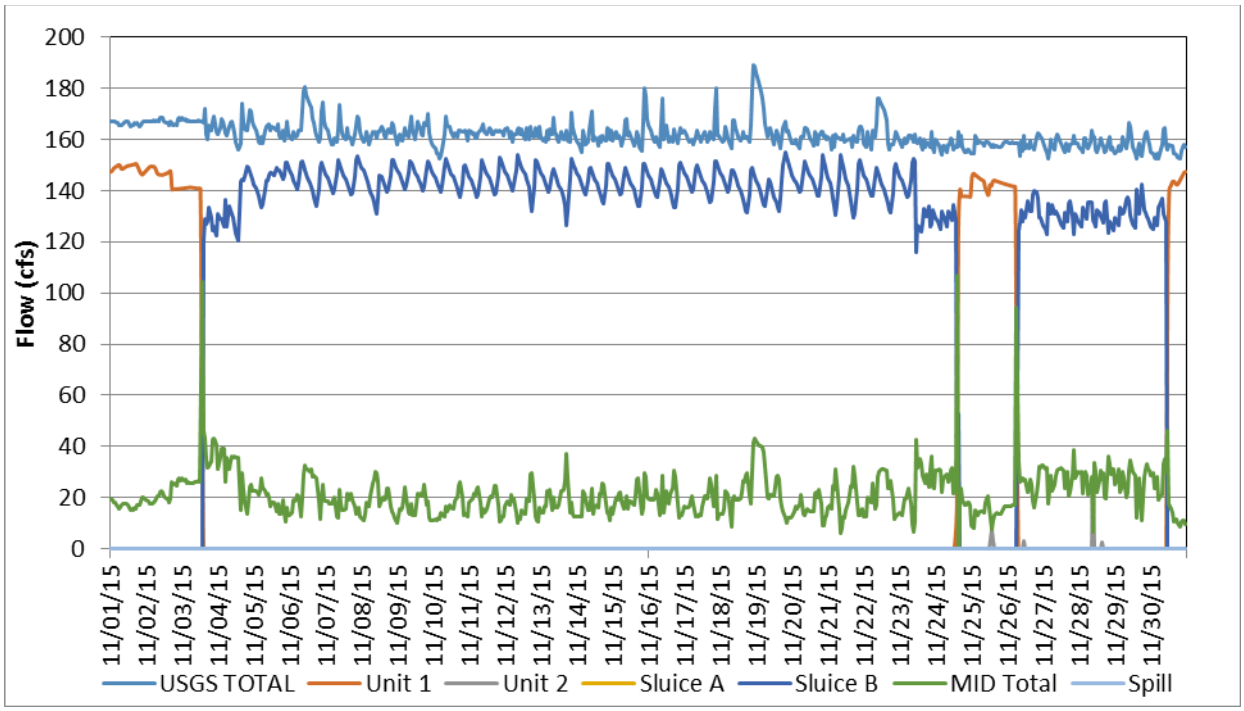

Figure B-11. Flow record in November 2015, based on hourly discharges.

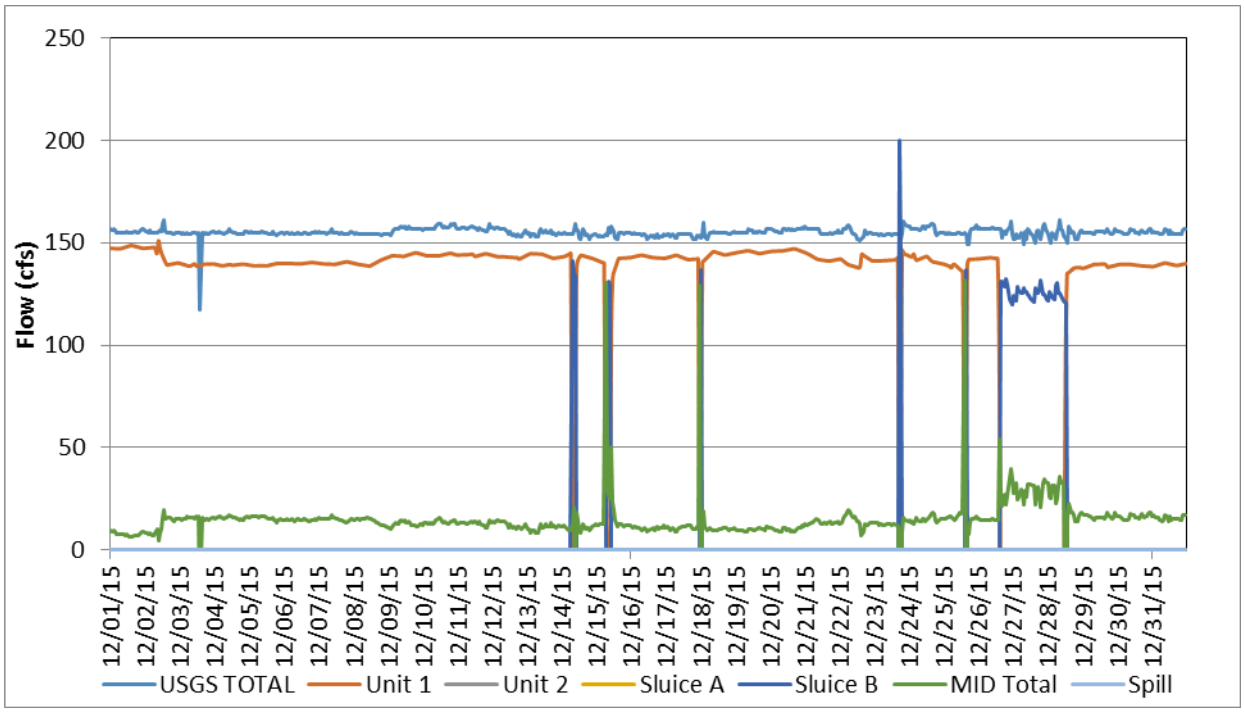

Figure B-12. Flow record in December 2015, based on hourly discharges.

FLOW RECORDS FOR FIVE DISCHARGE STRUCTURES AT THE LA GRANGE PROJECT

ATTACHMENT C

2016 MONTHLY FLOW RECORDS

Please refer to the legend below for all figures in this attachment:

- USGS Total = Flows recorded by the USGS La Grange gage.
- Unit 1 = Flows through La Grange powerhouse Unit 1.
- Unit 2 = Flows through La Grange powerhouse Unit 2.
- Sluice A = Flows through TID sluice gate 1.
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- MID Total = The sum of flows at the MID hillside discharge and Portal 1.
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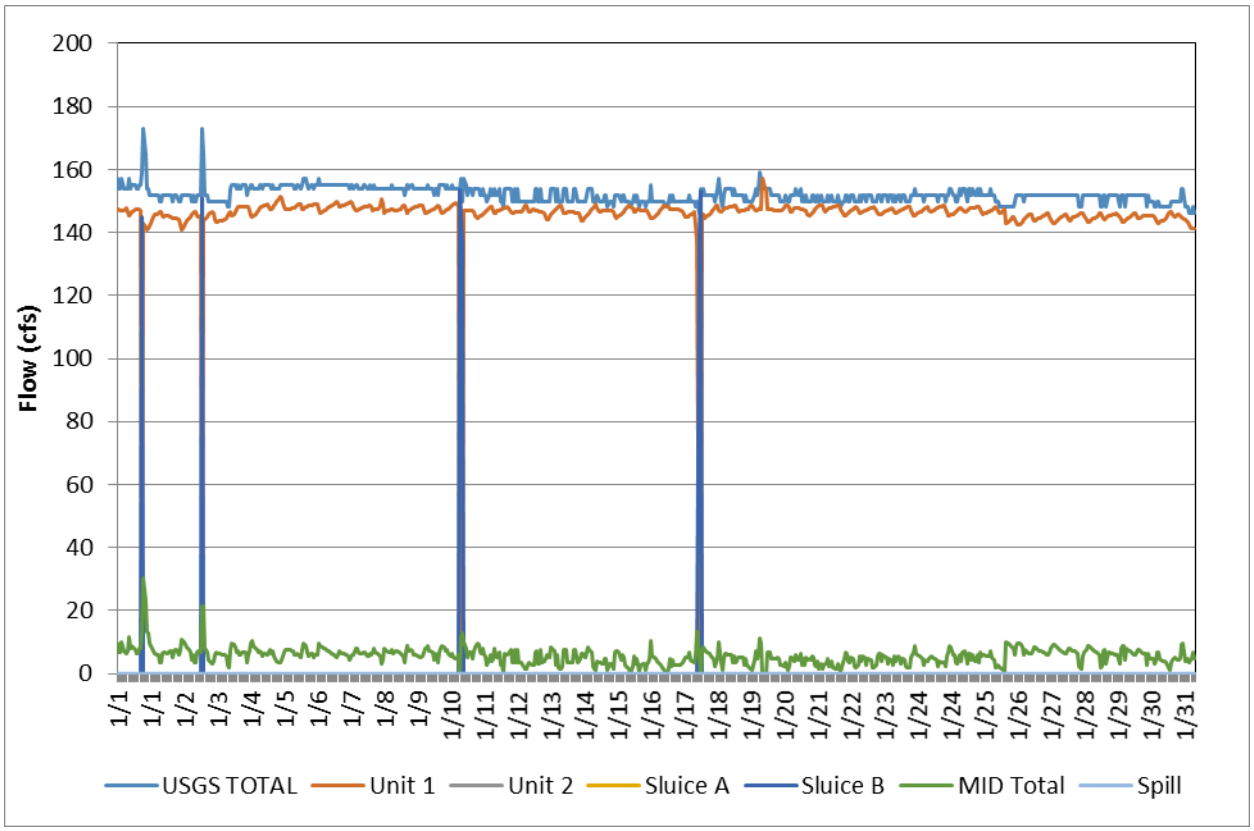

Figure C-1. Flow record in January 2016, based on hourly discharges.

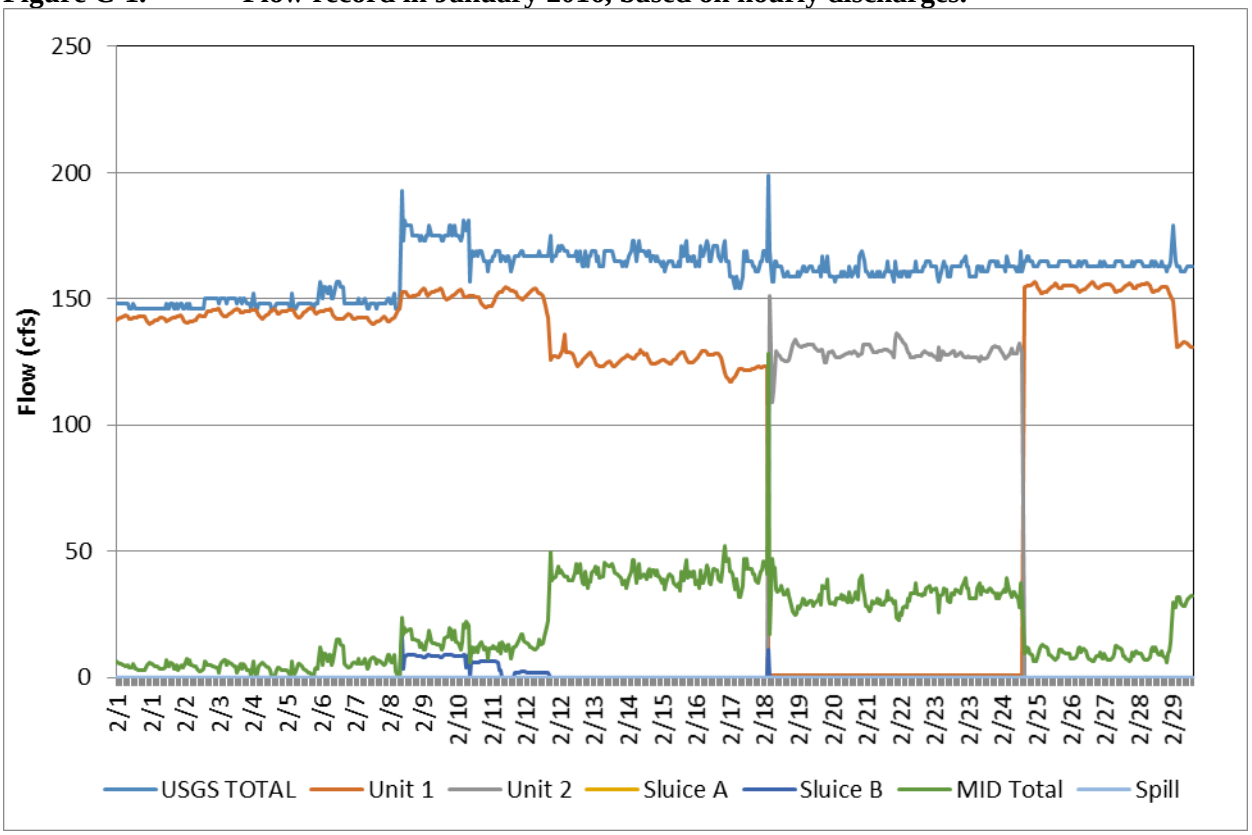

Figure C-2. Flow record in February 2016, based on hourly discharges.

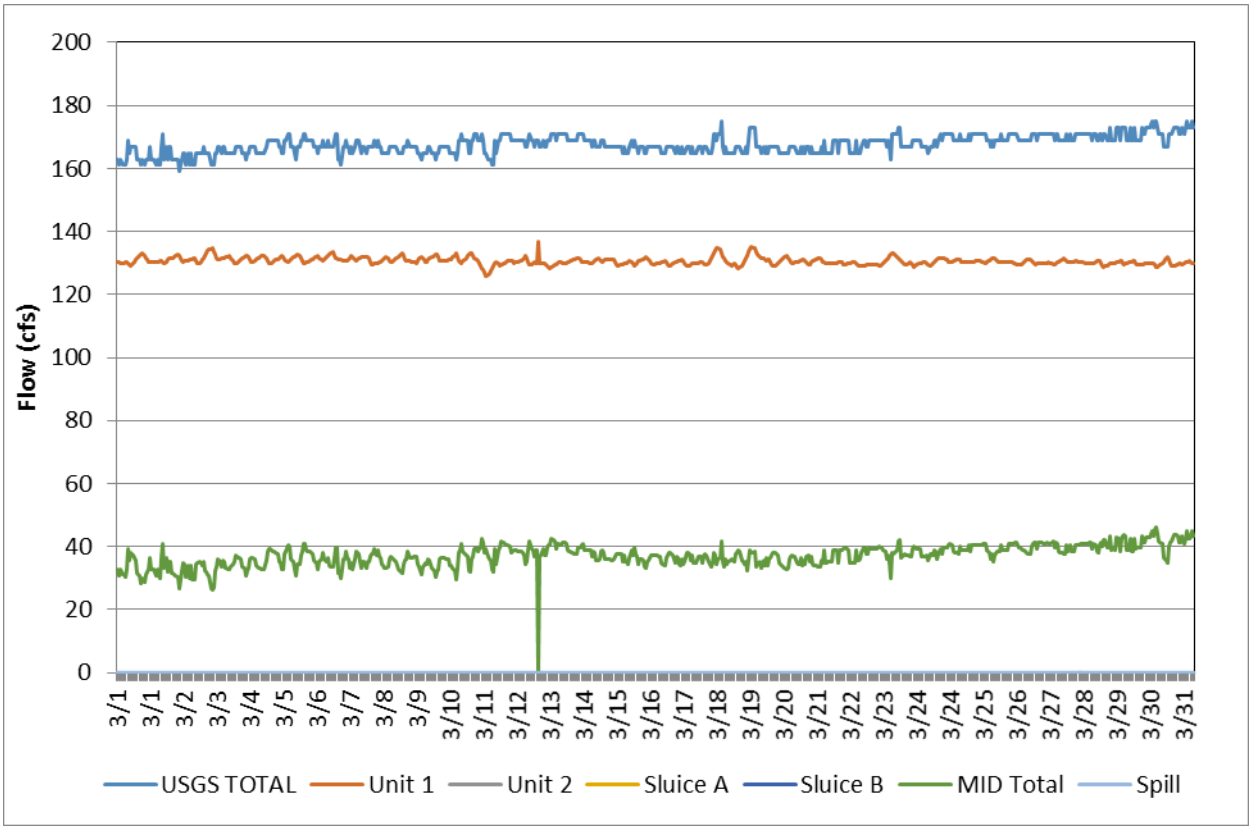

Figure C-3. Flow record in March 2016, based on hourly discharges.

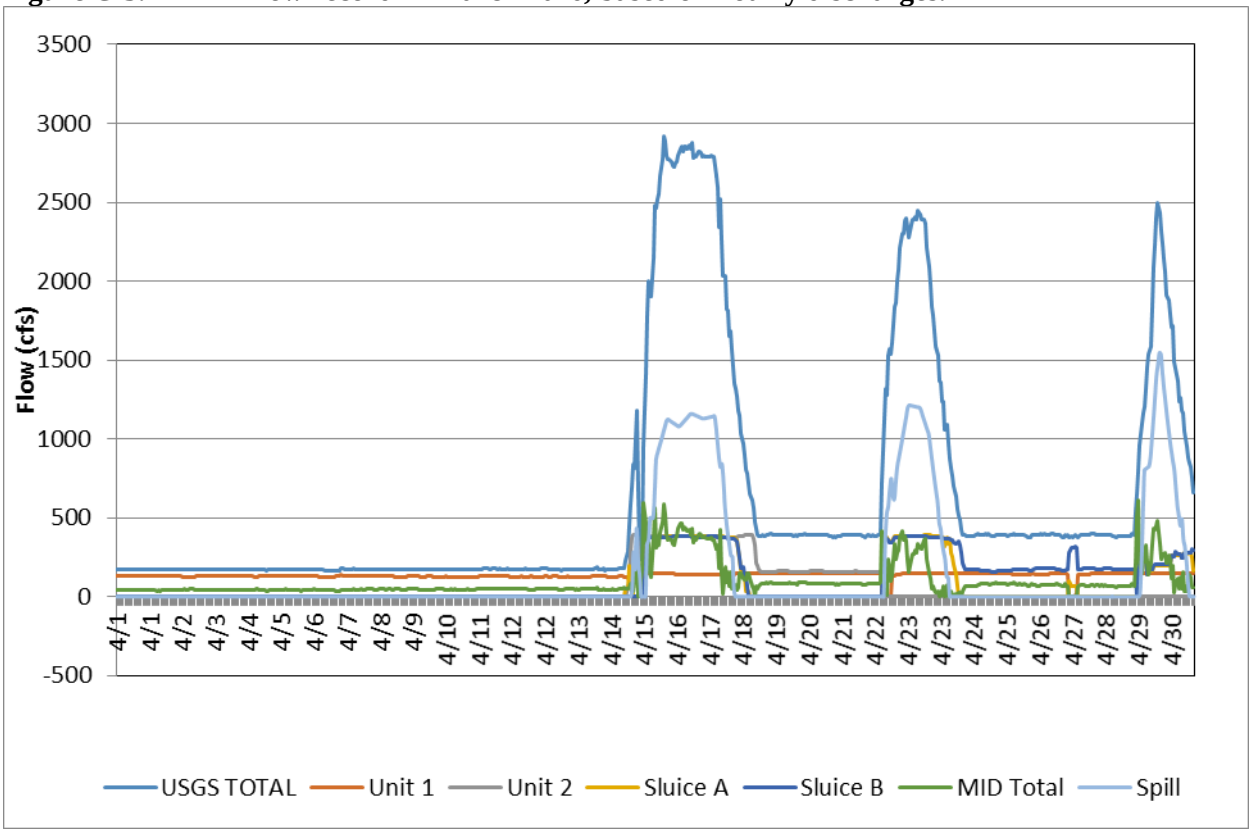

Figure C-4. Flow record in April 2016, based on hourly discharges.

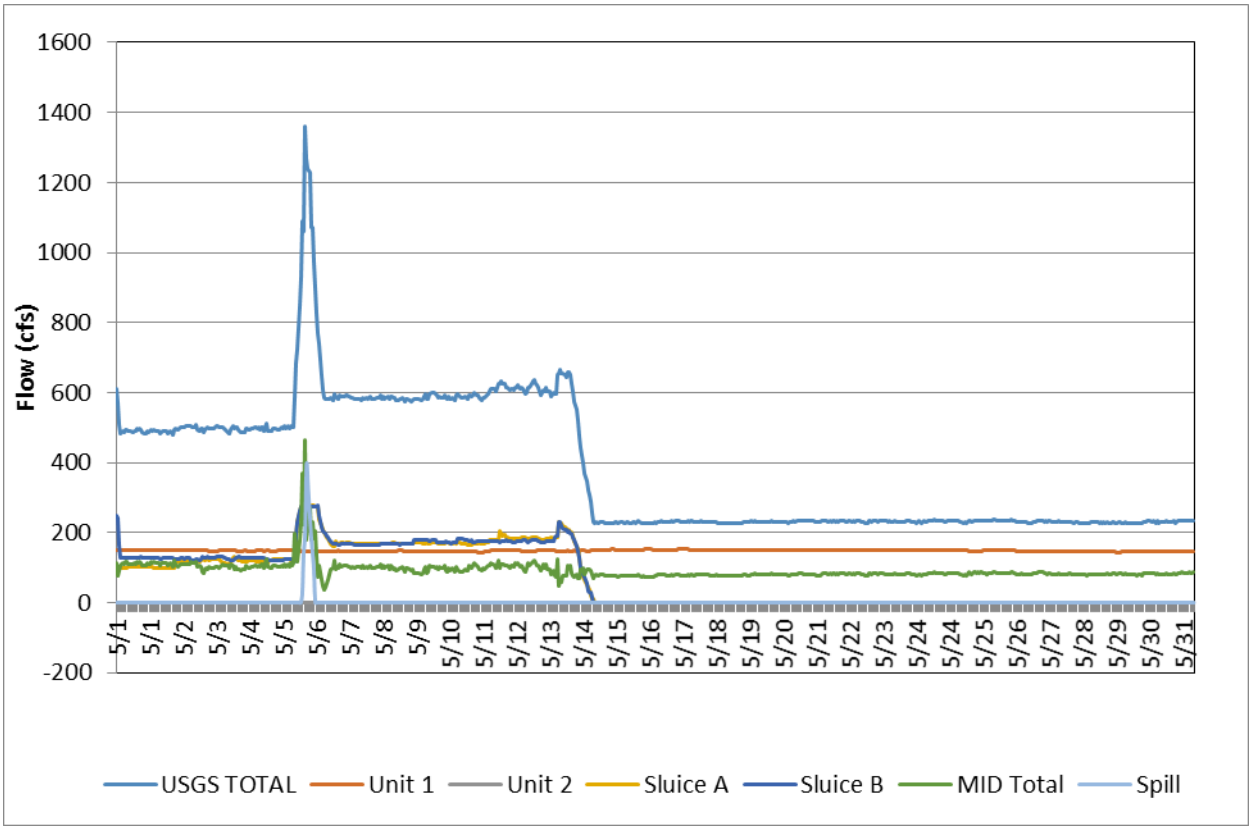

Figure C-5. Flow record in May 2016, based on hourly discharges.

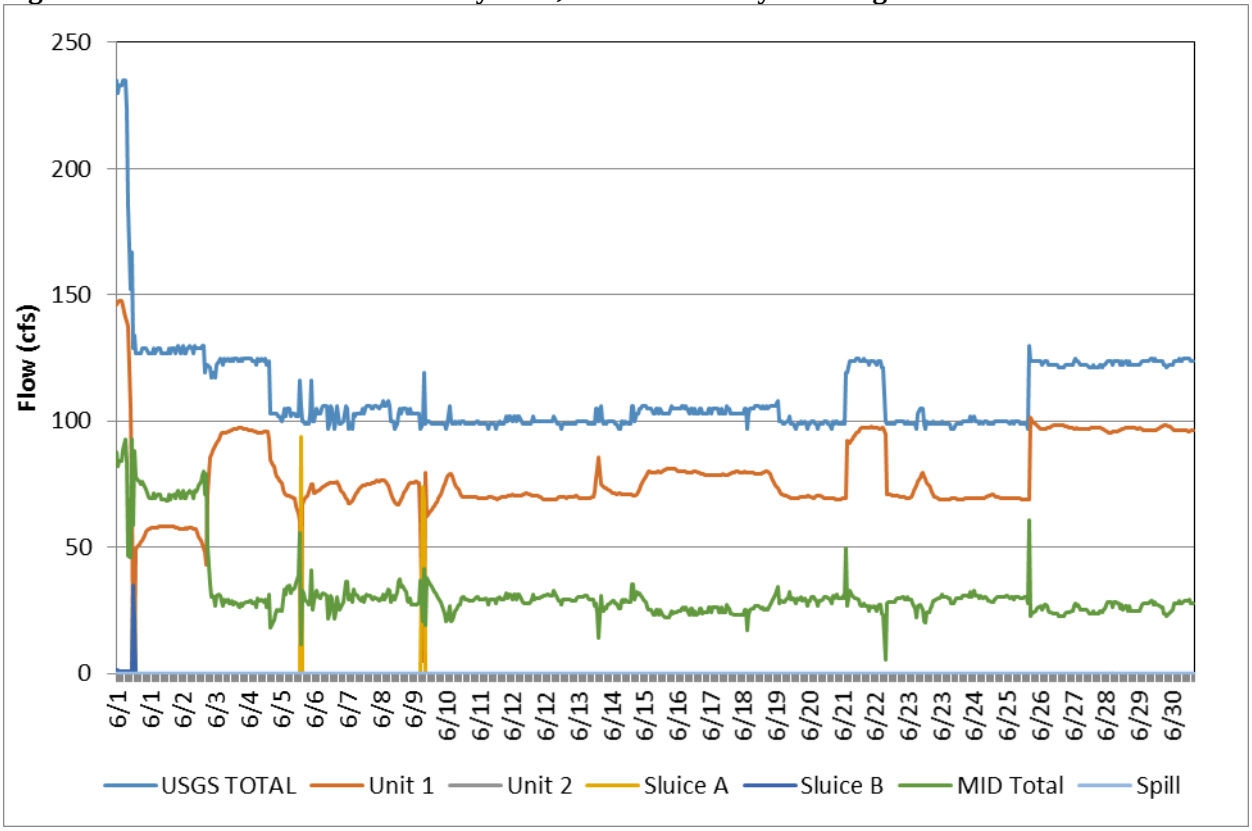

Figure C-6. Flow record in June 2016, based on hourly discharges.

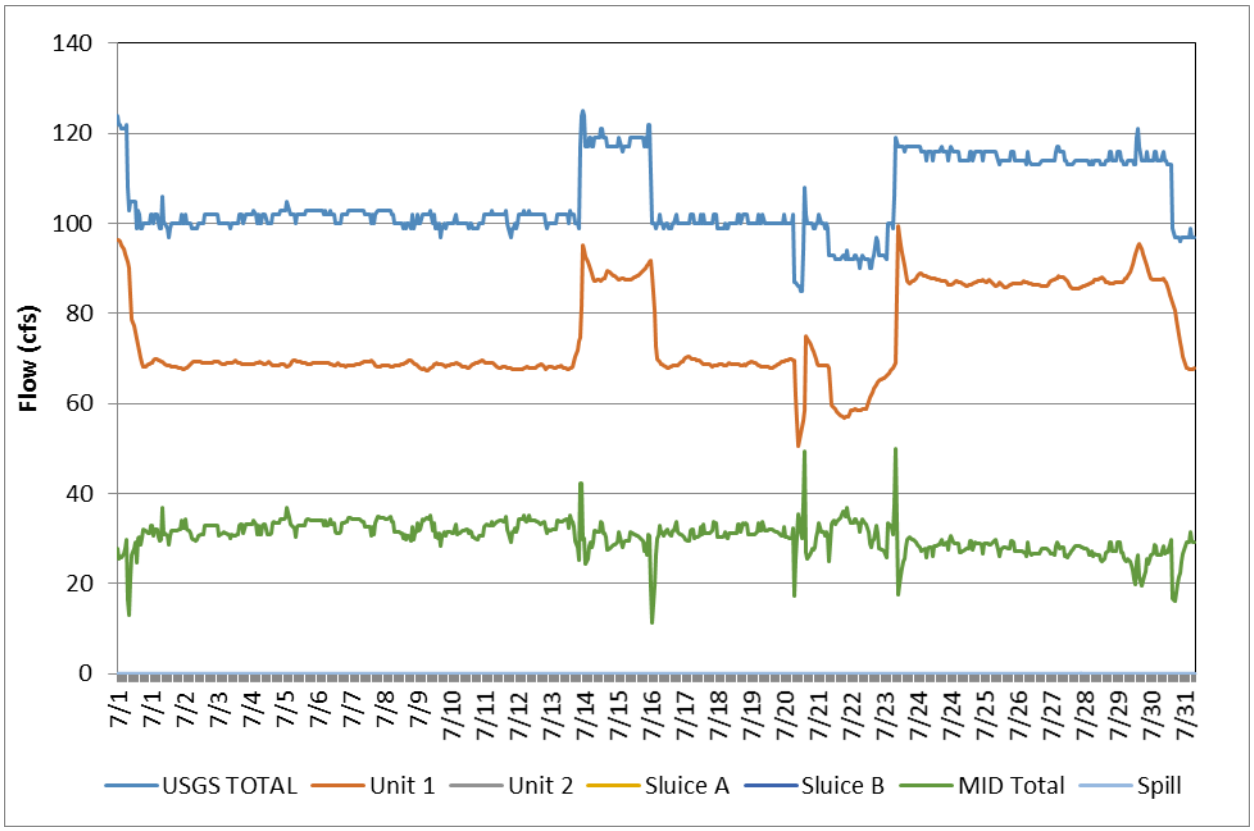

Figure C-7. Flow record in July 2016, based on hourly discharges.

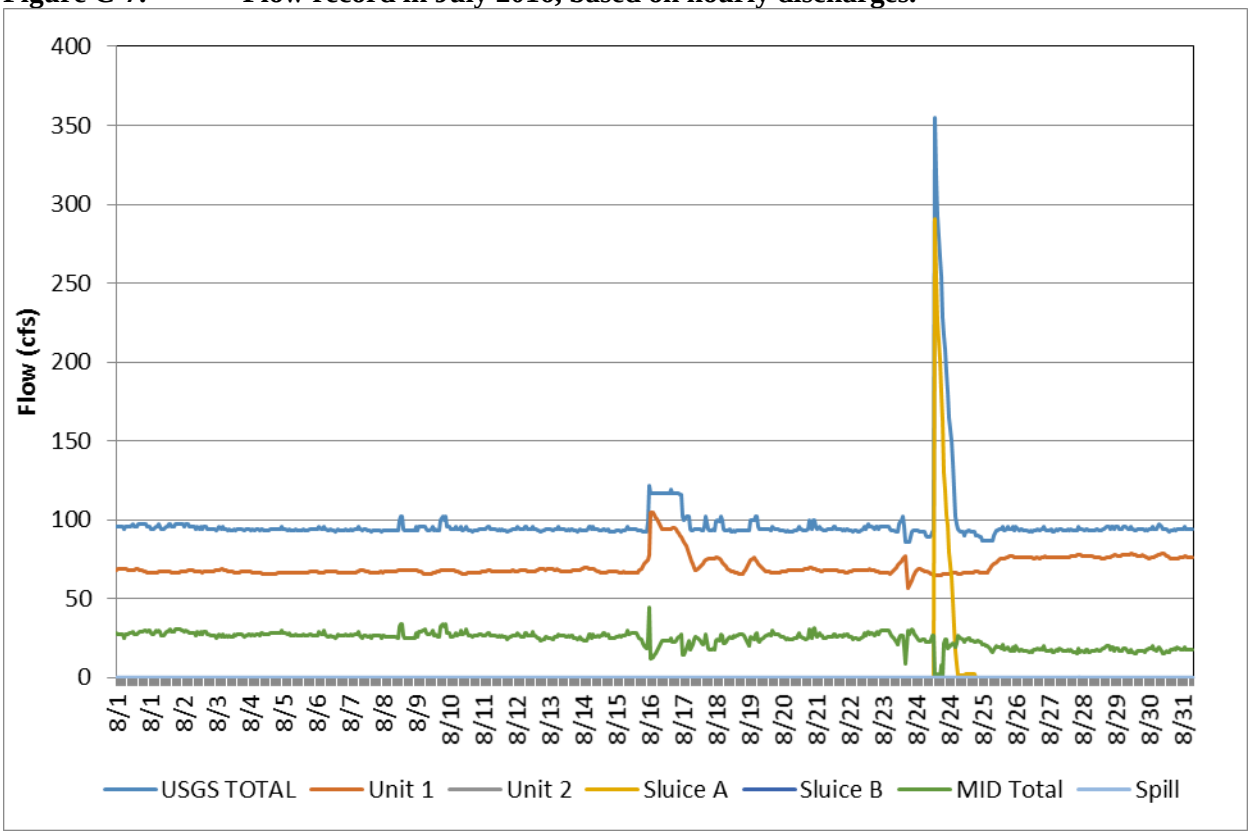

Figure C-8. Flow record in August 2016, based on hourly discharges.

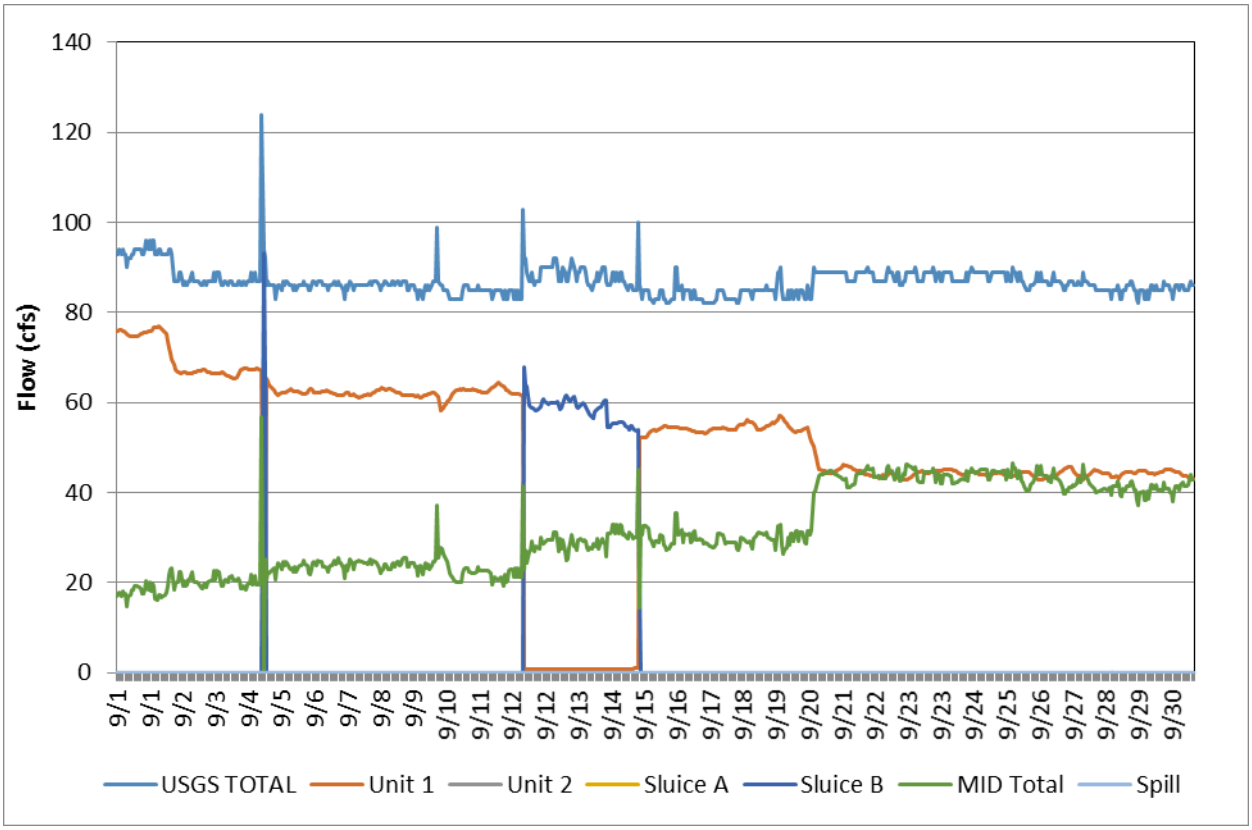

Figure C-9. Flow record in September 2016, based on hourly discharges.

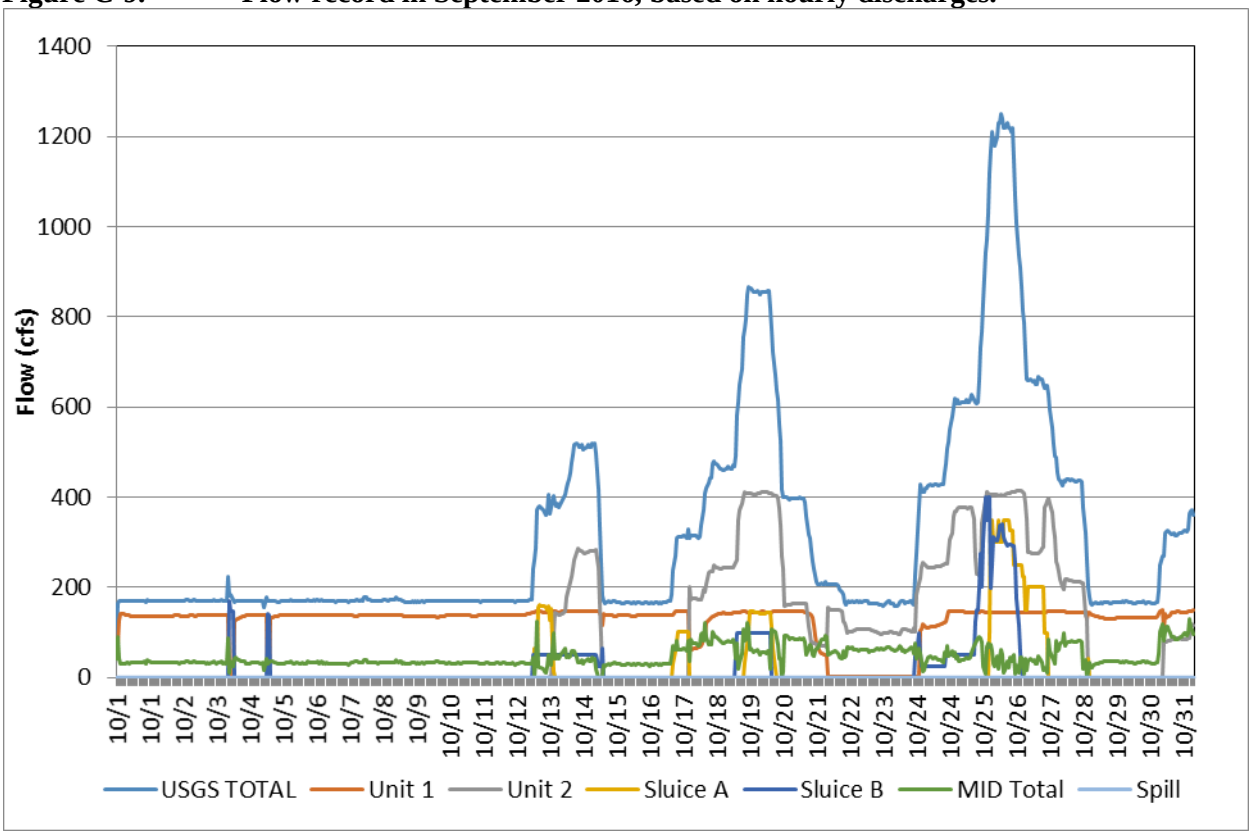

Figure C-10. Flow record in October 2016, based on hourly discharges.

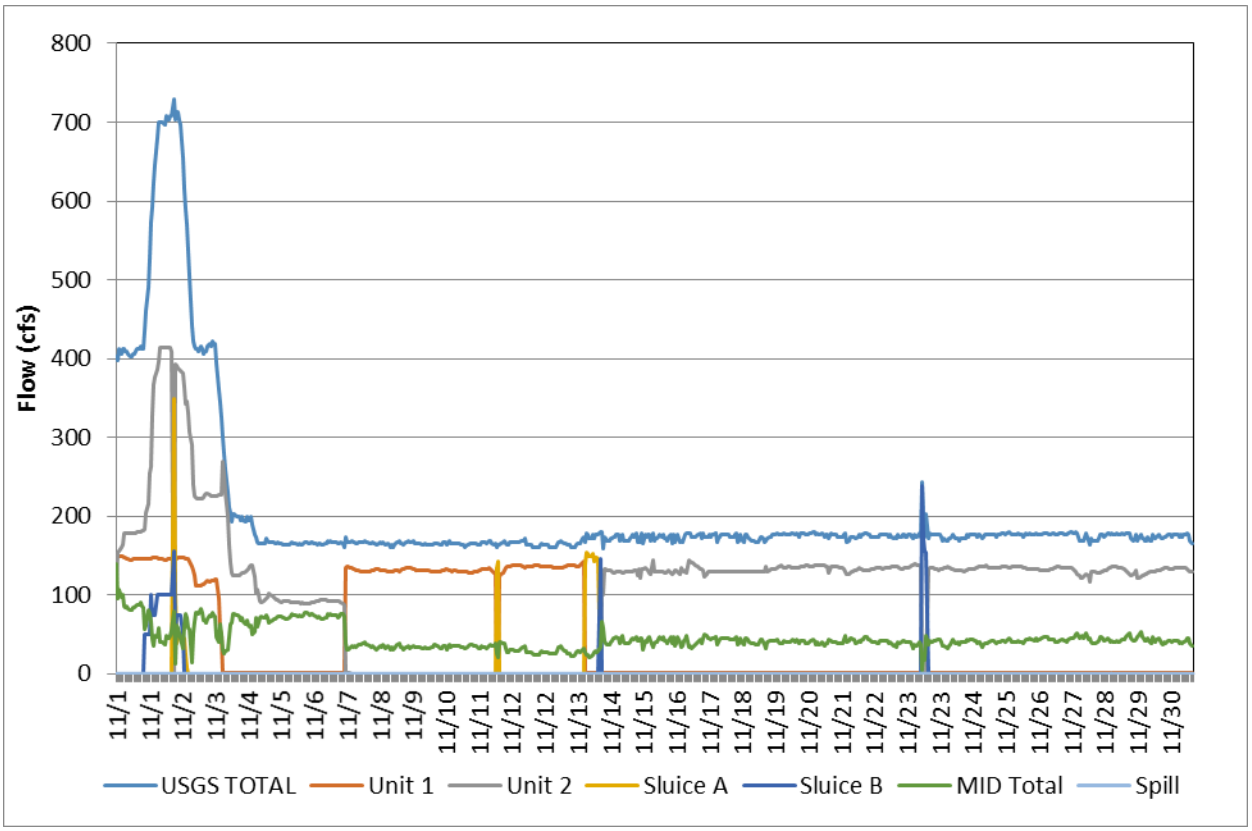

Figure C-11. Flow record in November 2016, based on hourly discharges.

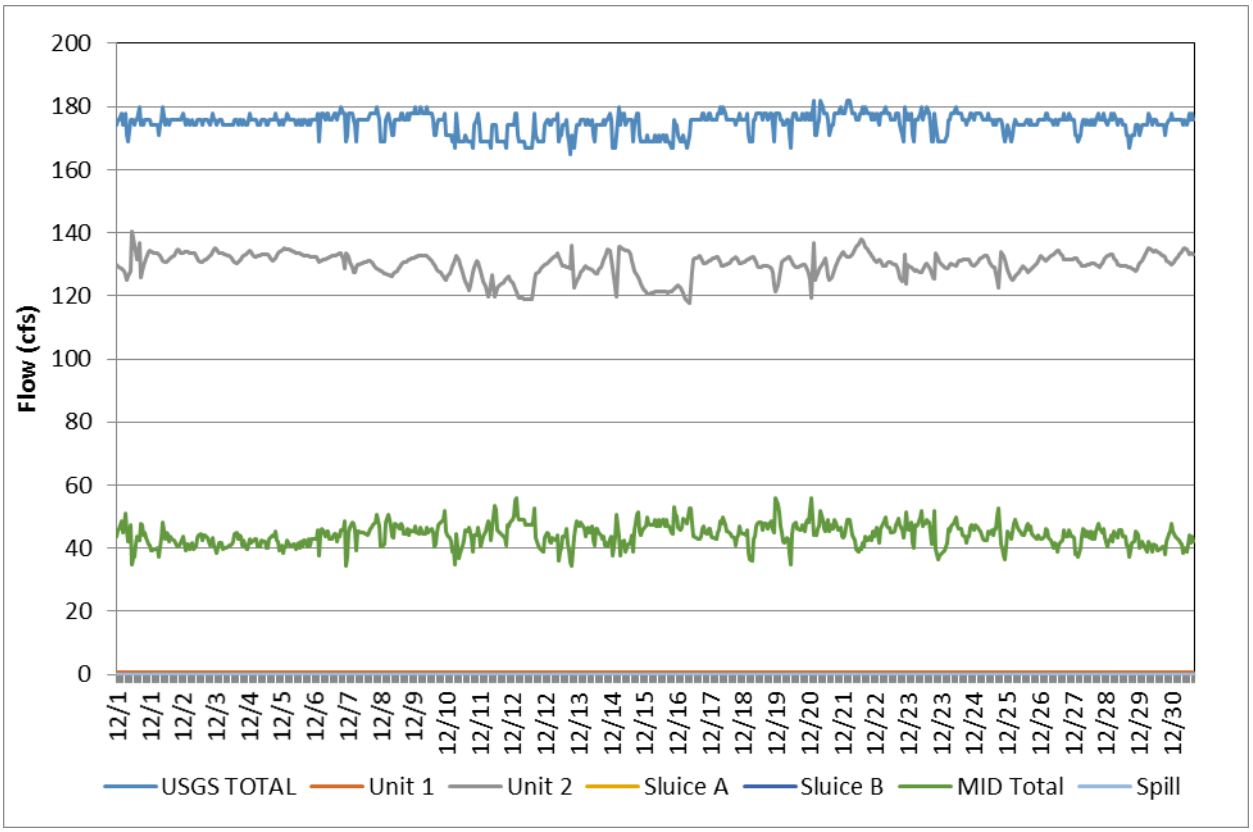

Figure C-12. Flow record in December 2016, based on hourly discharges.

FLOW RECORDS FOR FIVE DISCHARGE STRUCTURES AT THE LA GRANGE PROJECT

ATTACHMENT D

2005 – 2013 FLOW RECORDS

Please refer to the legend below for all figures in this attachment:

- USGS Total = Flows recorded by the USGS La Grange gage.
- Unit 1 = Flows through La Grange powerhouse Unit 1.
- Unit 2 = Flows through La Grange powerhouse Unit 2.
- Sluice A = Flows through TID sluice gate 1.
- Sluice B = Flows through TID sluice gate 2.
- MID Total = The sum of flows at the MID hillside discharge and Portal 1.
- Spill = Spill at the LGDD spillway.
- TID currently maintains in an open position an 18-inch pipe that continuously delivers flow from the TID forebay to the channel downstream of the sluice gates. The flow quantity is not measured and is unknown, but is roughly estimated to be about 5 to 10 cfs. This flow is not included in the computations contained in the analyses conducted for this report due to the uncertainty of the quantity of flow discharged and its history of operation.

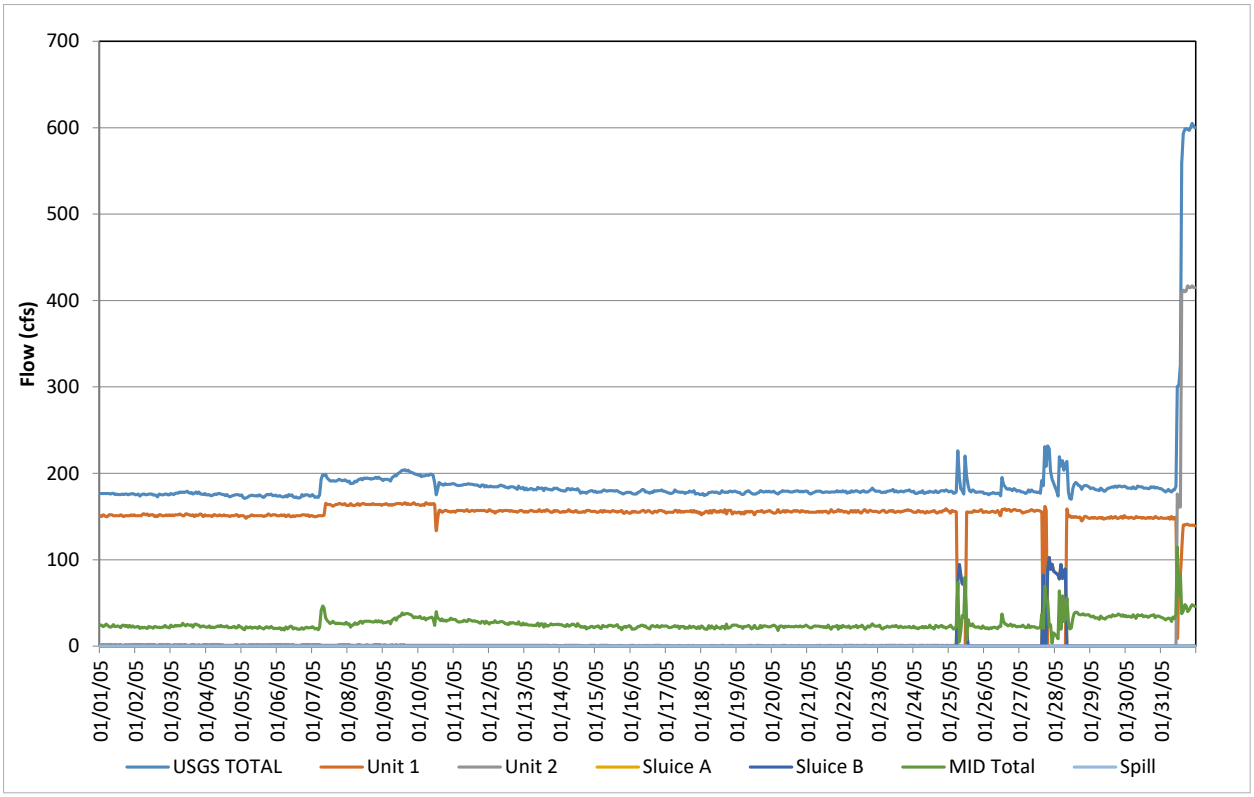

Figure D-1. Flow record in January 2005, based on hourly discharges.

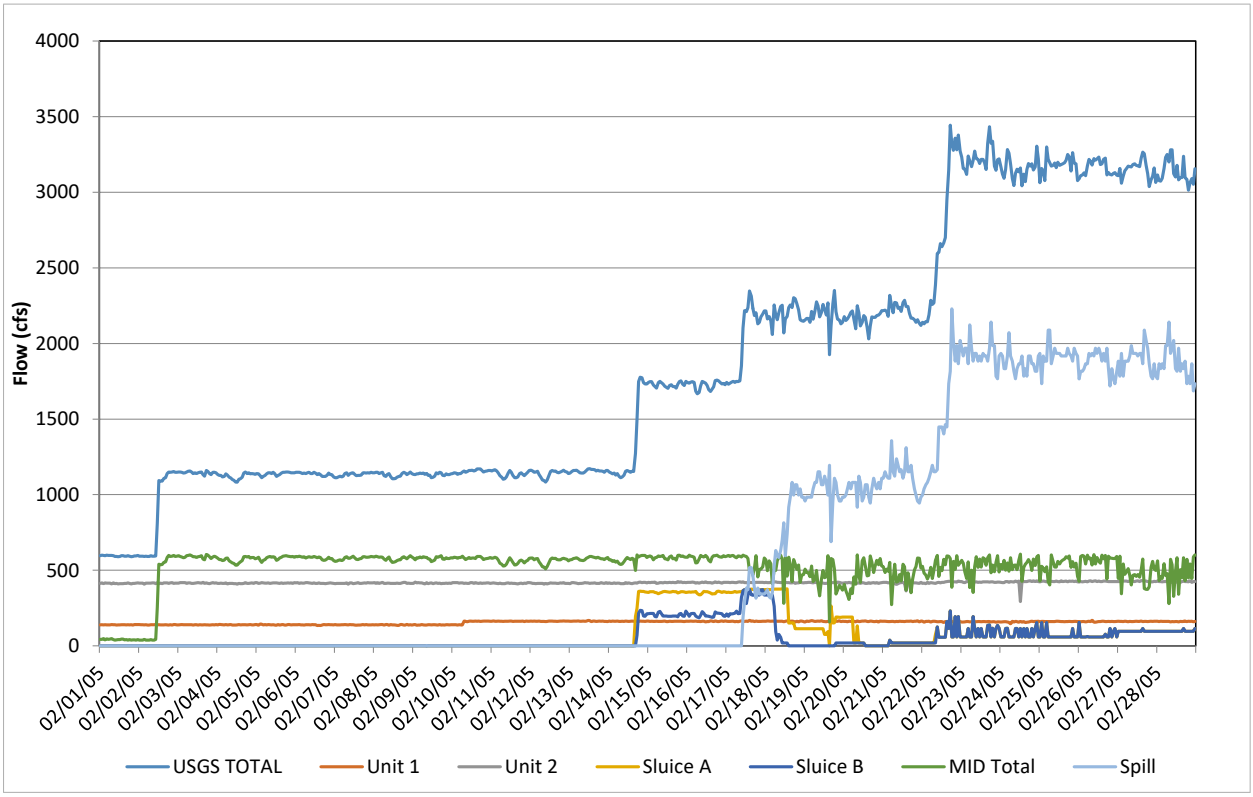

Figure D-2. Flow record in February 2005, based on hourly discharges.

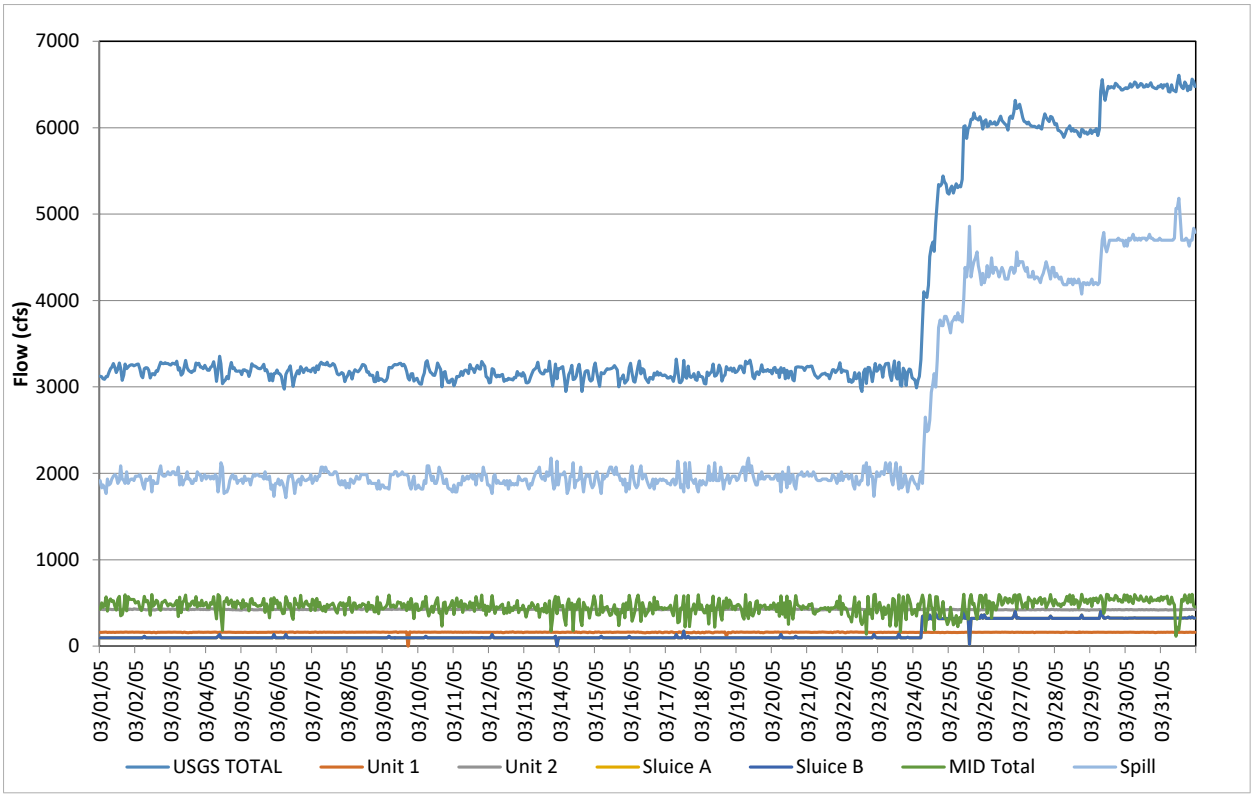

Figure D-3. Flow record in March 2005, based on hourly discharges.

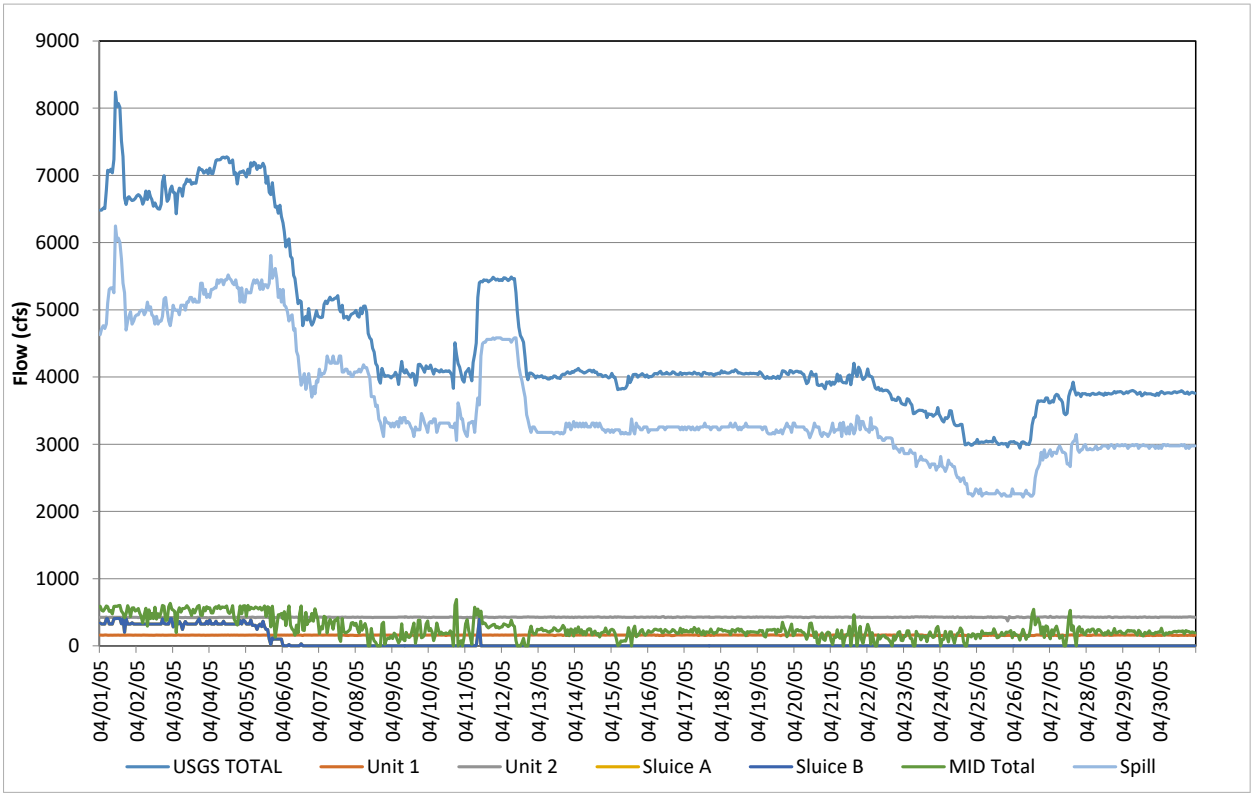

Figure D-4. Flow record in April 2005, based on hourly discharges.

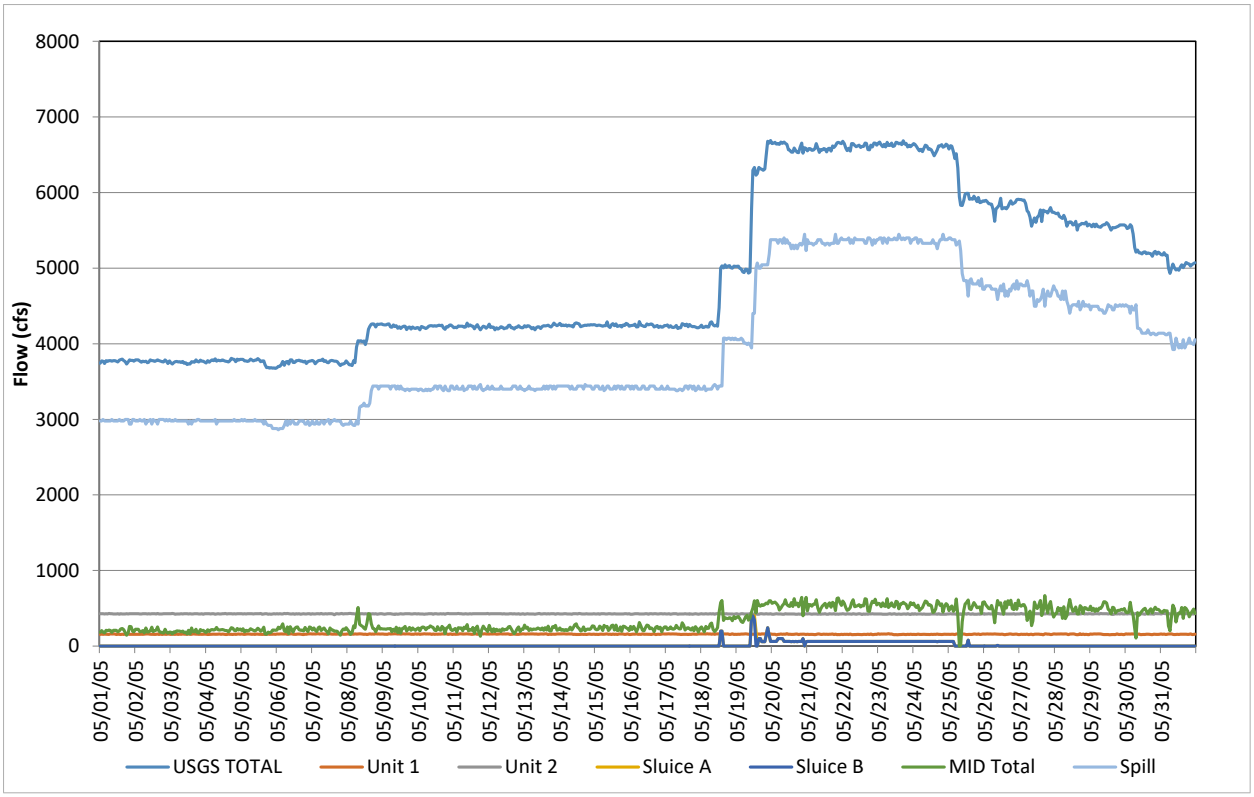

Figure D-5. Flow record in May 2005, based on hourly discharges.

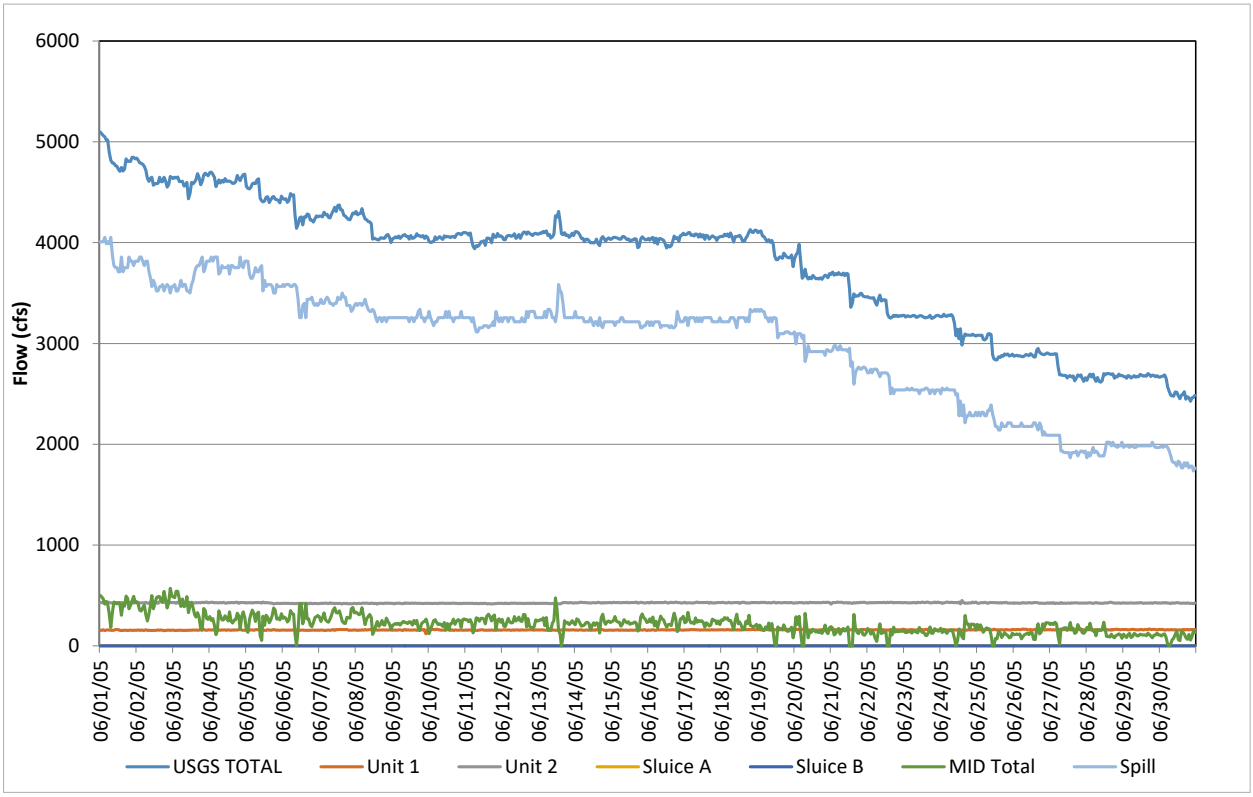

Figure D-6. Flow record in June 2005, based on hourly discharges.

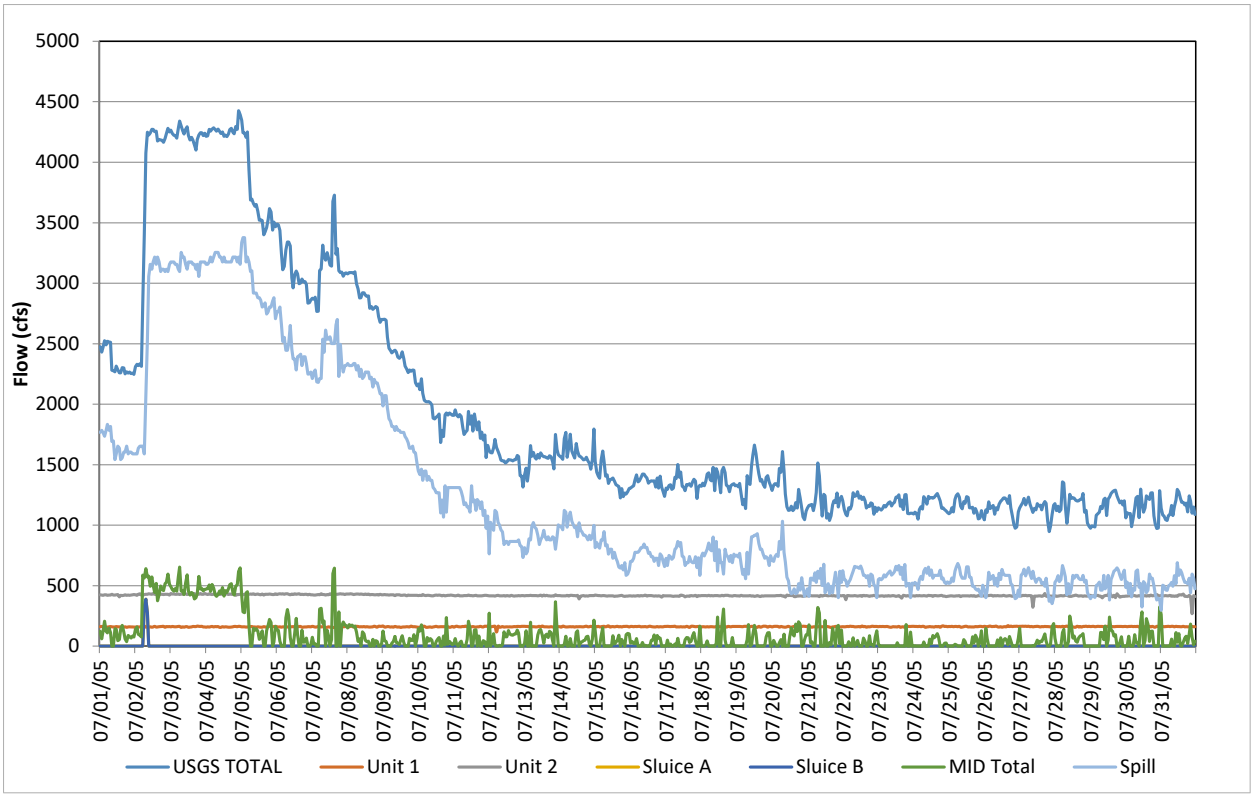

Figure D-7. Flow record in July 2005, based on hourly discharges.

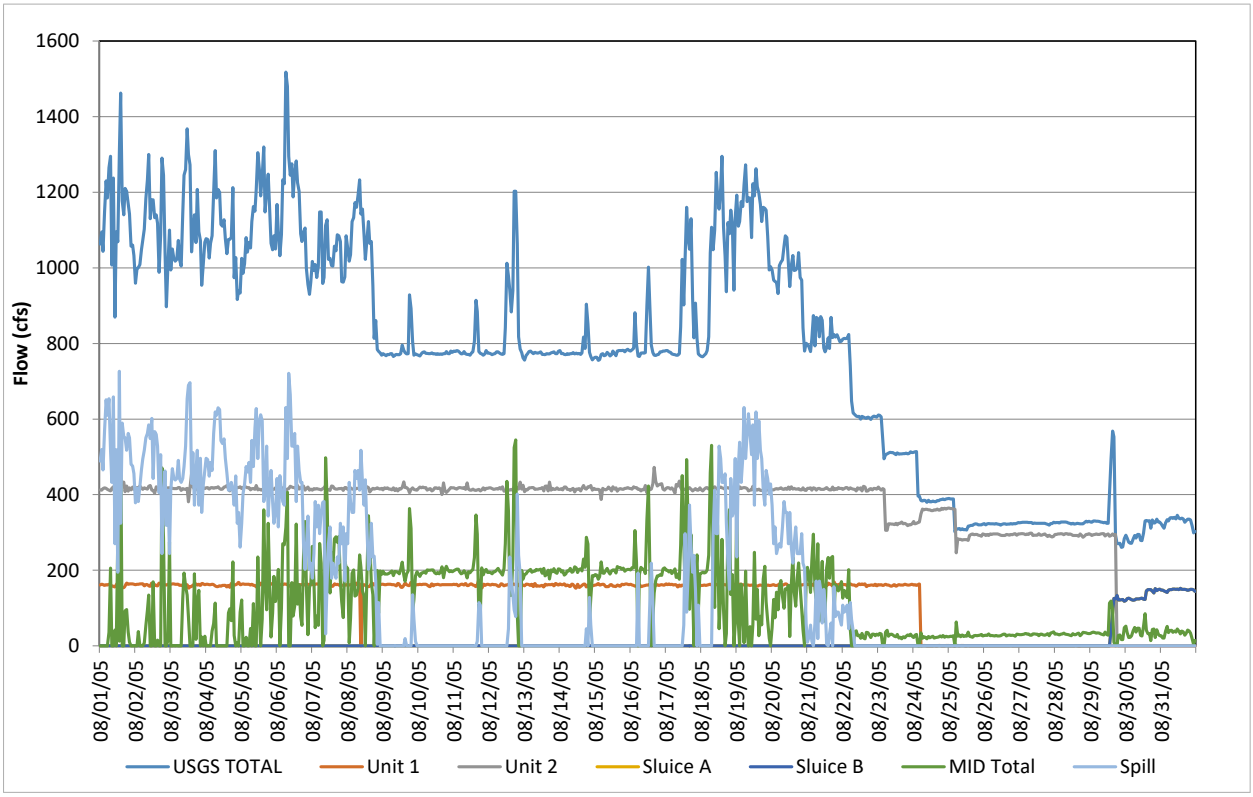

Figure D-8. Flow record in August 2005, based on hourly discharges.

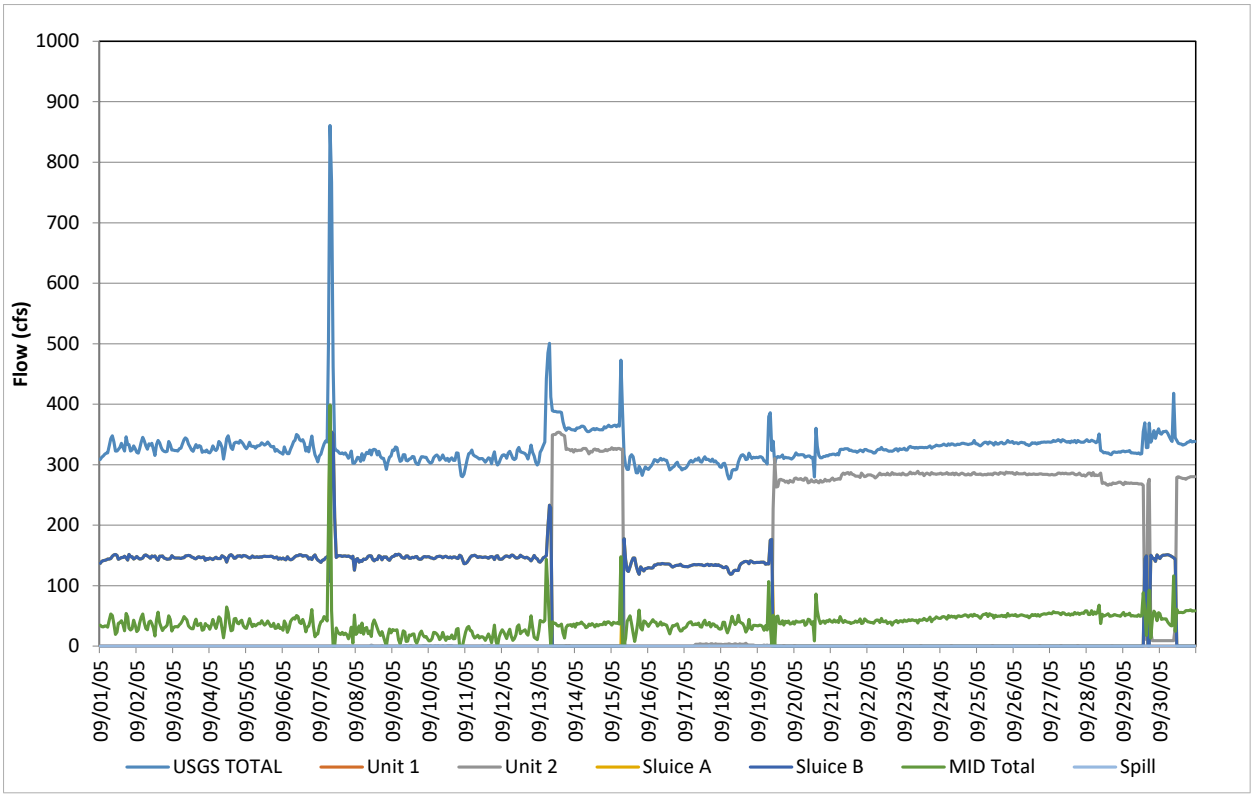

Figure D-9. Flow record in September 2005, based on hourly discharges.

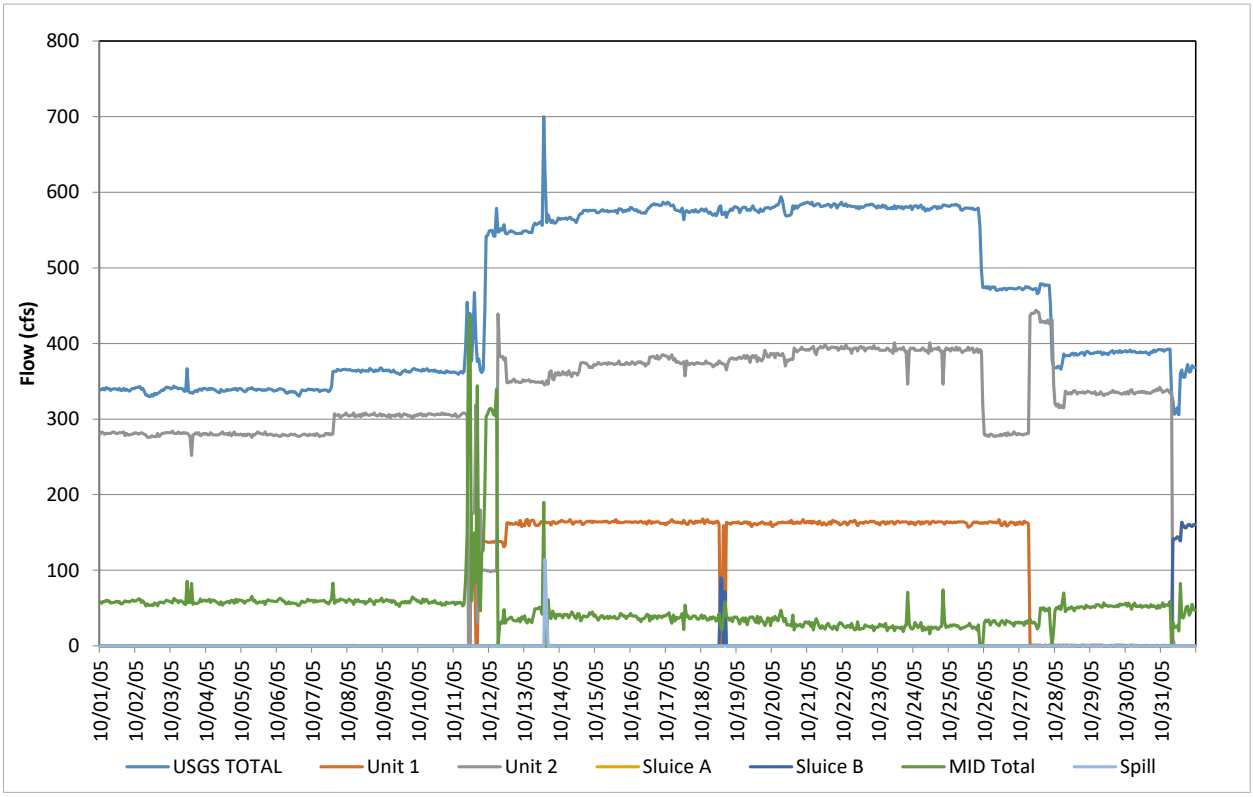

Figure D-10. Flow record in October 2005, based on hourly discharges.

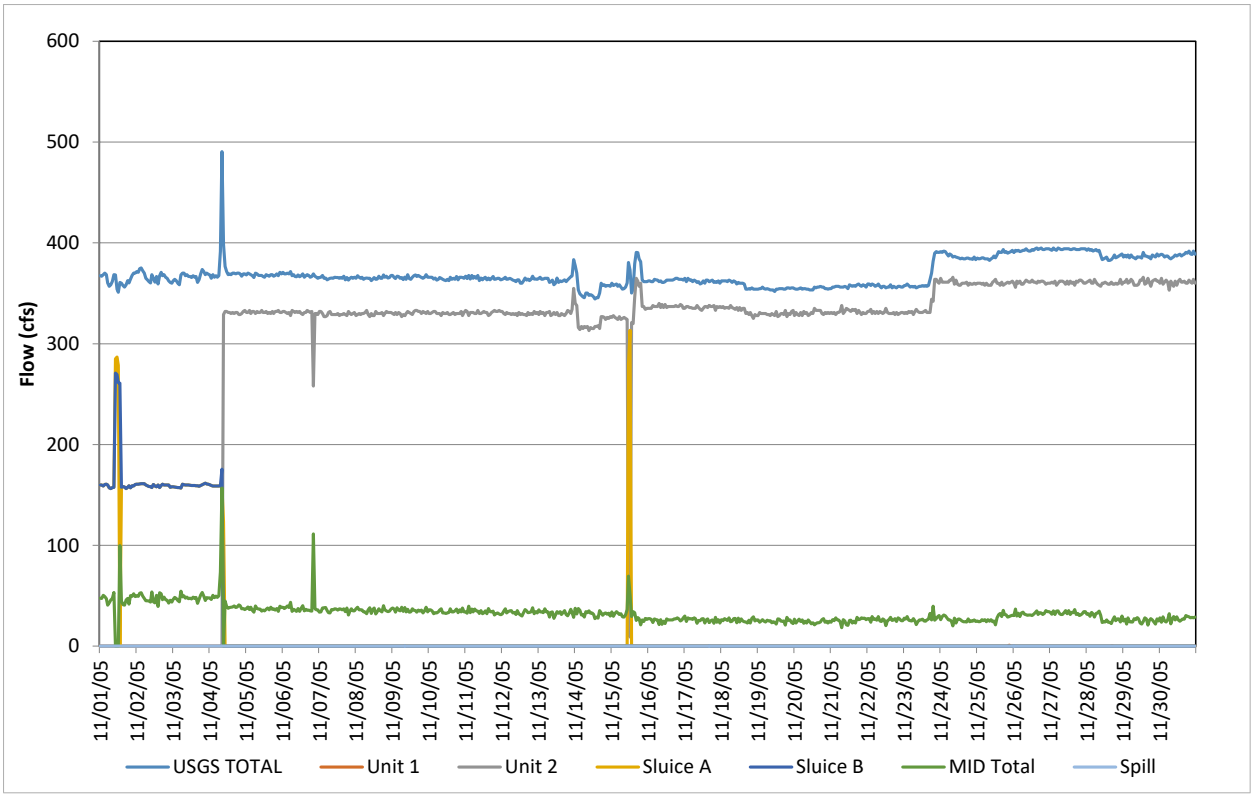

Figure D-11. Flow record in November 2005, based on hourly discharges.

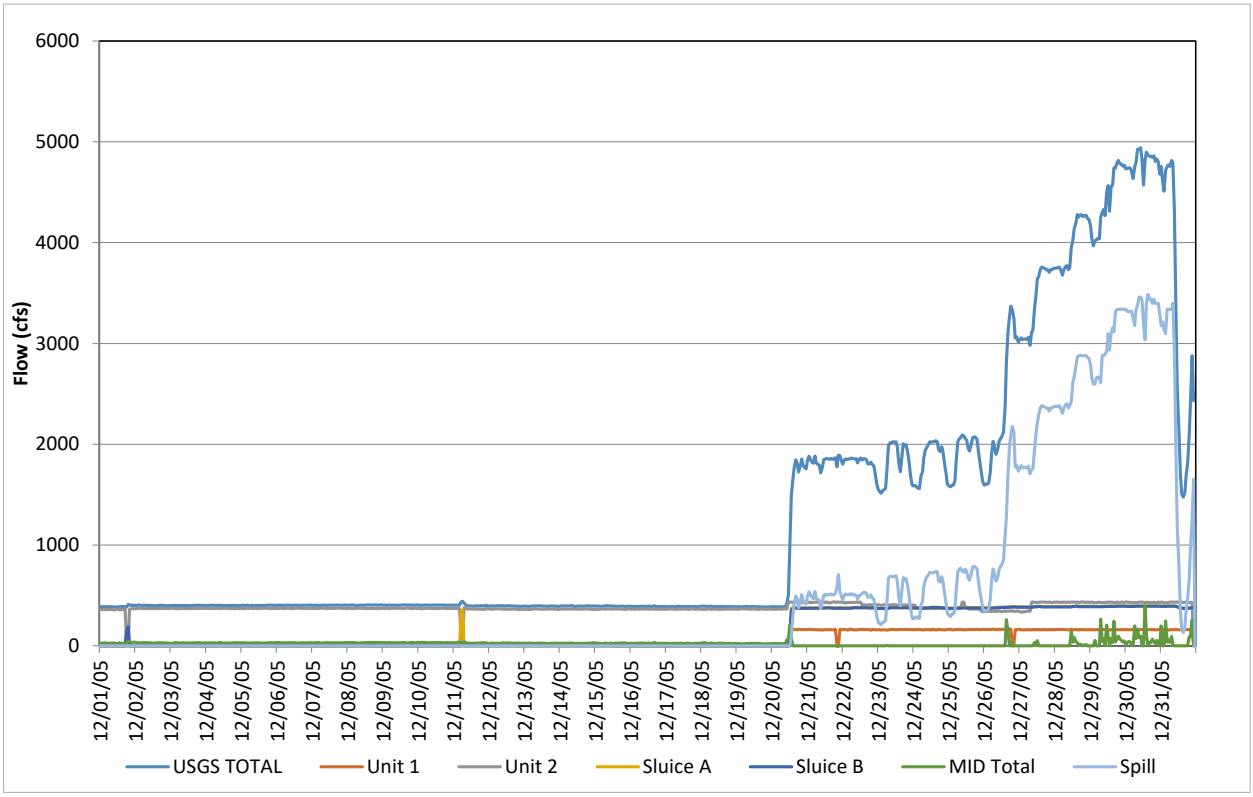

Figure D-12. Flow record in December 2005, based on hourly discharges.

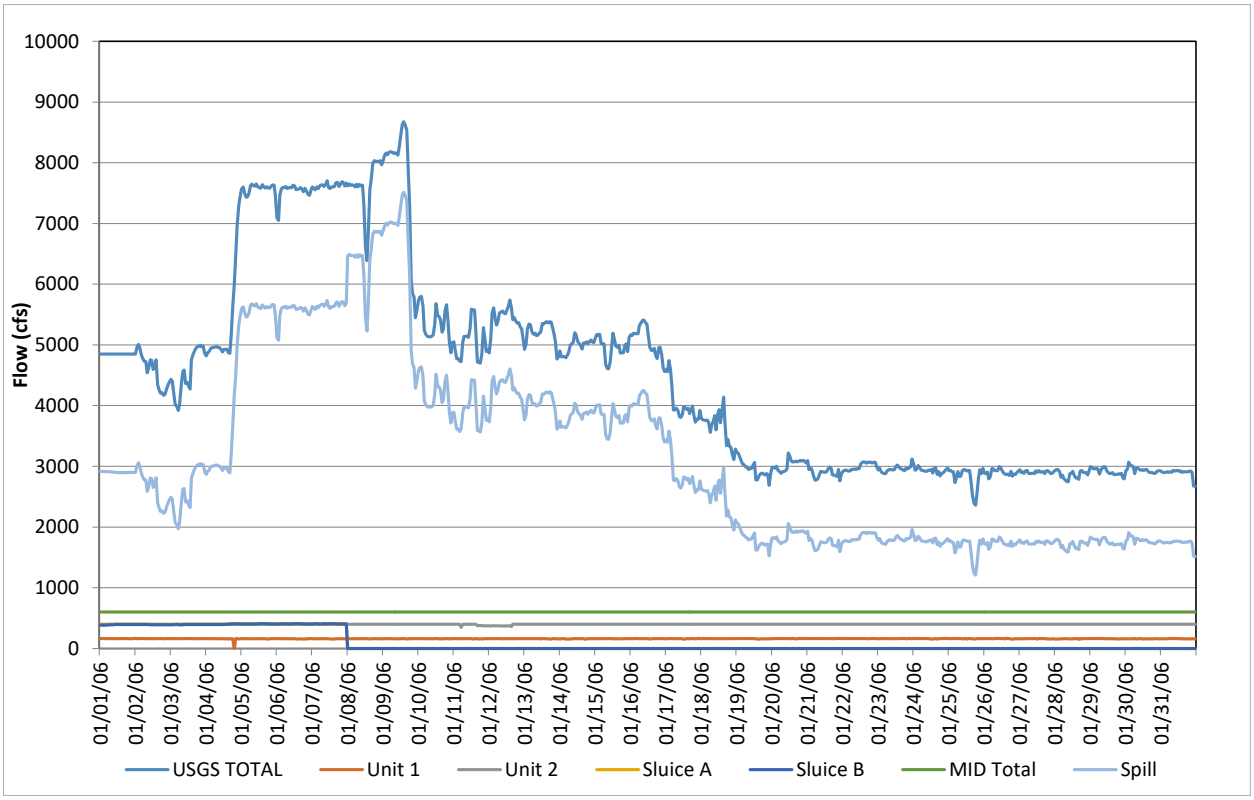

Figure D-13. Flow record in January 2006, based on hourly discharges.

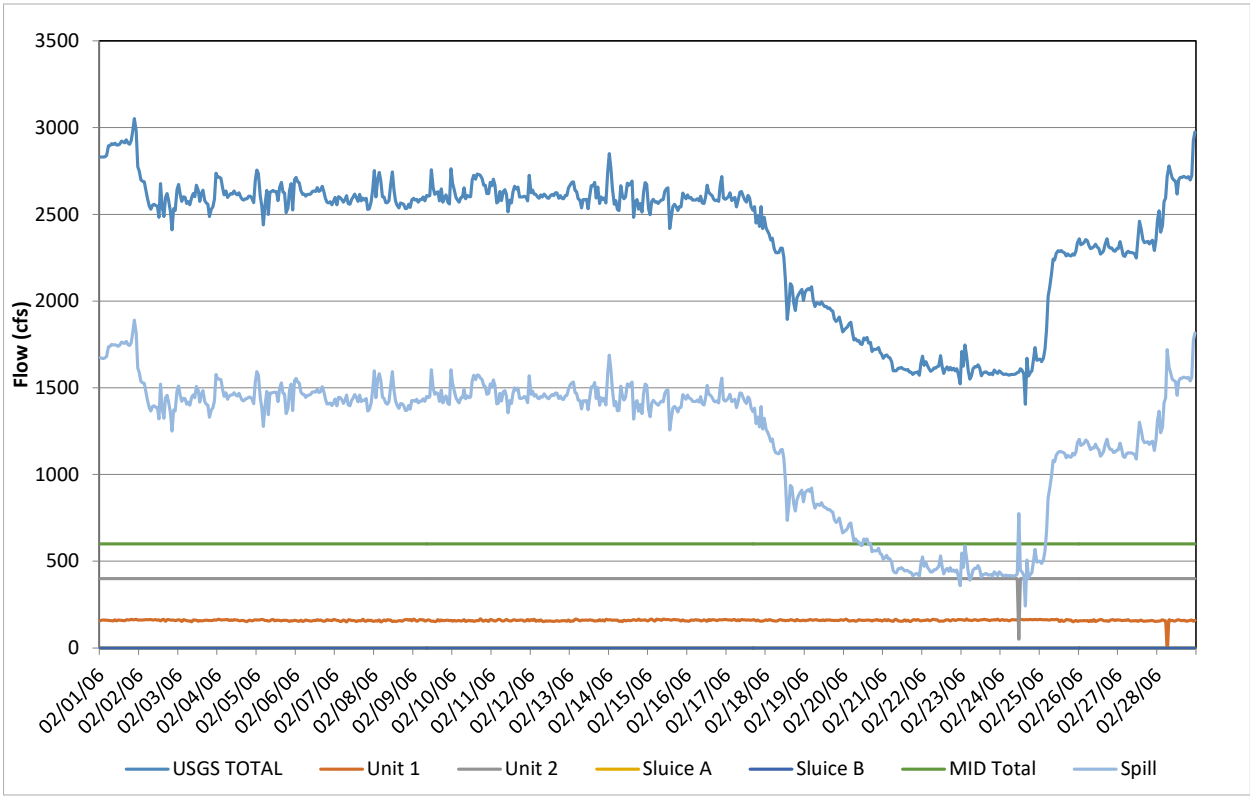

Figure D-14. Flow record in February 2006, based on hourly discharges.

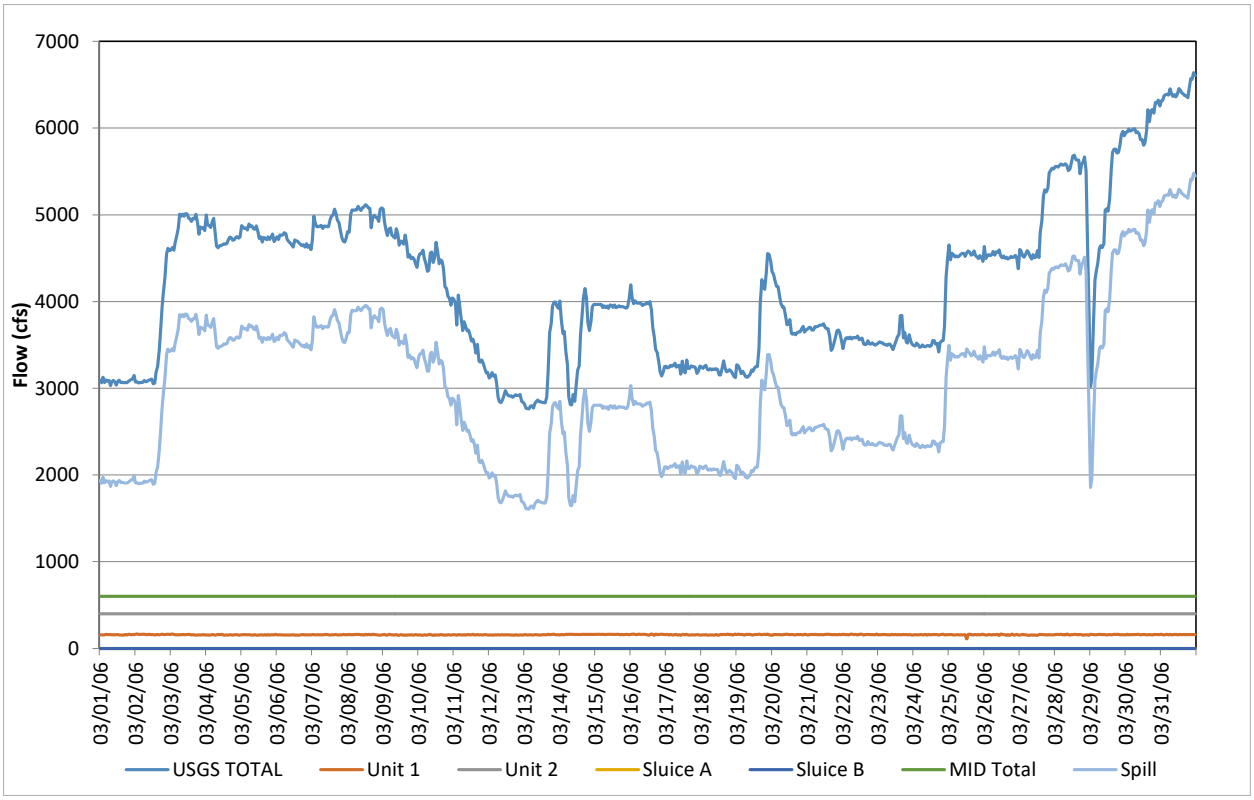

Figure D-15. Flow record in March 2006, based on hourly discharges.

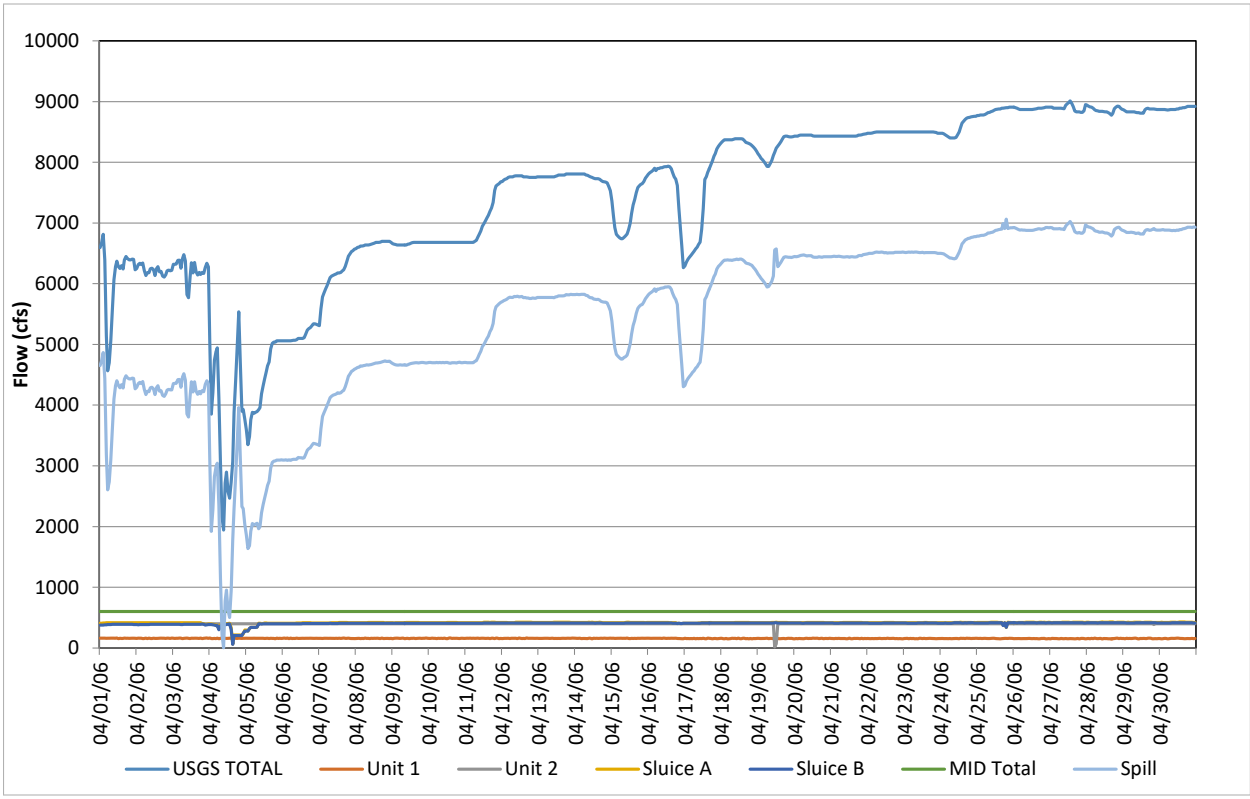

Figure D-16. Flow record in April 2006, based on hourly discharges.

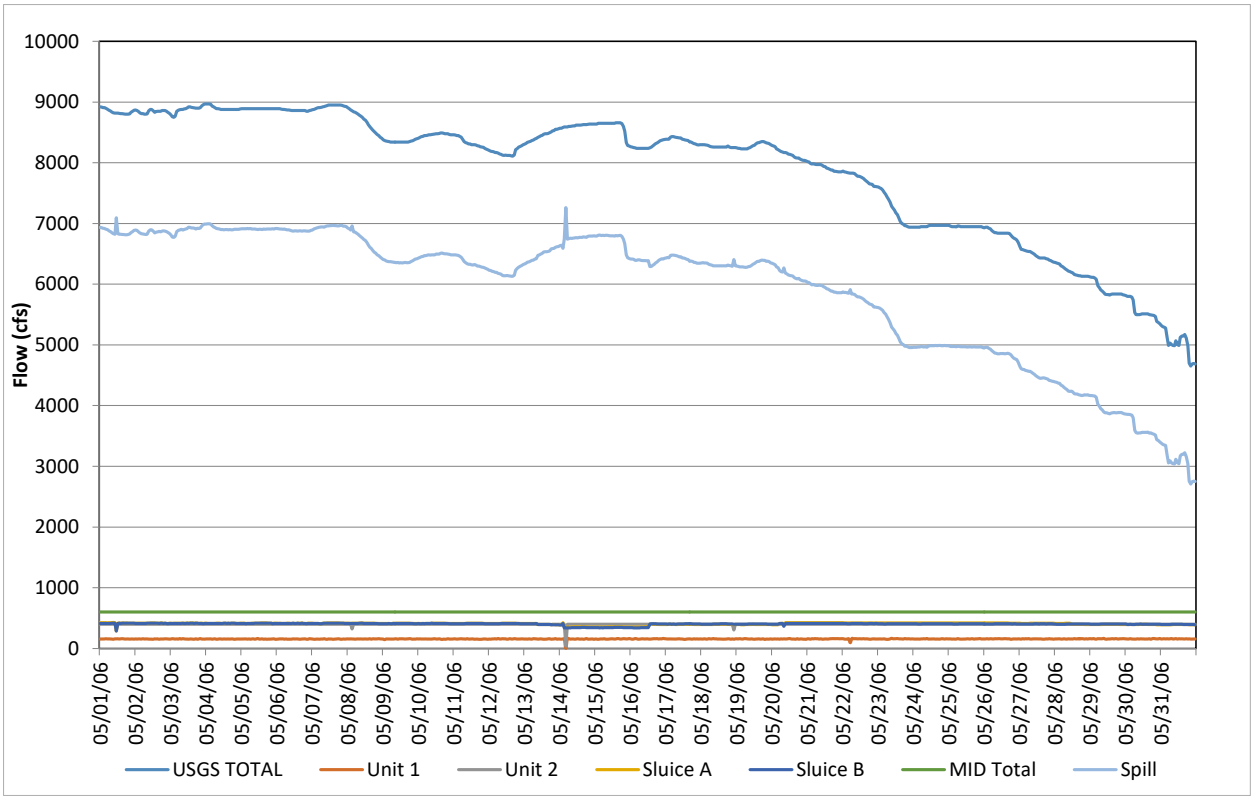

Figure D-17. Flow record in May 2006, based on hourly discharges.

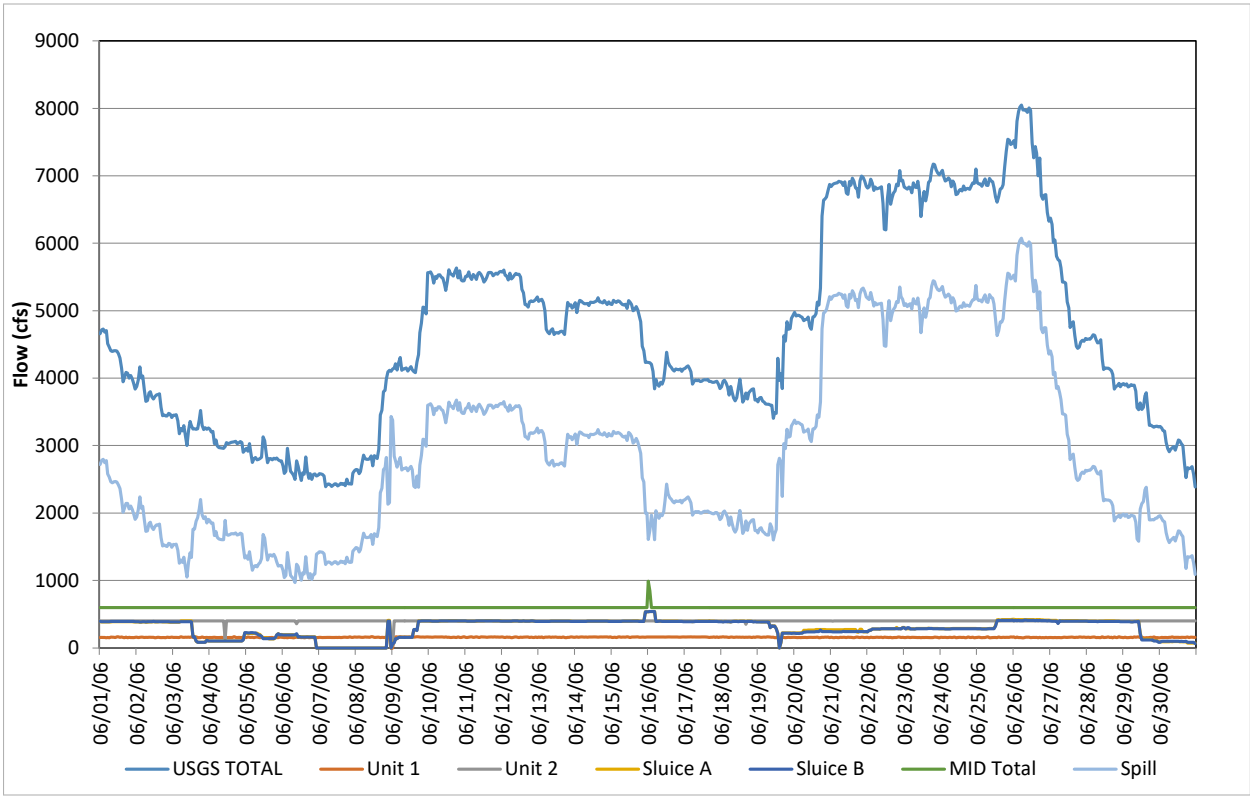

Figure D-18. Flow record in June 2006, based on hourly discharges.

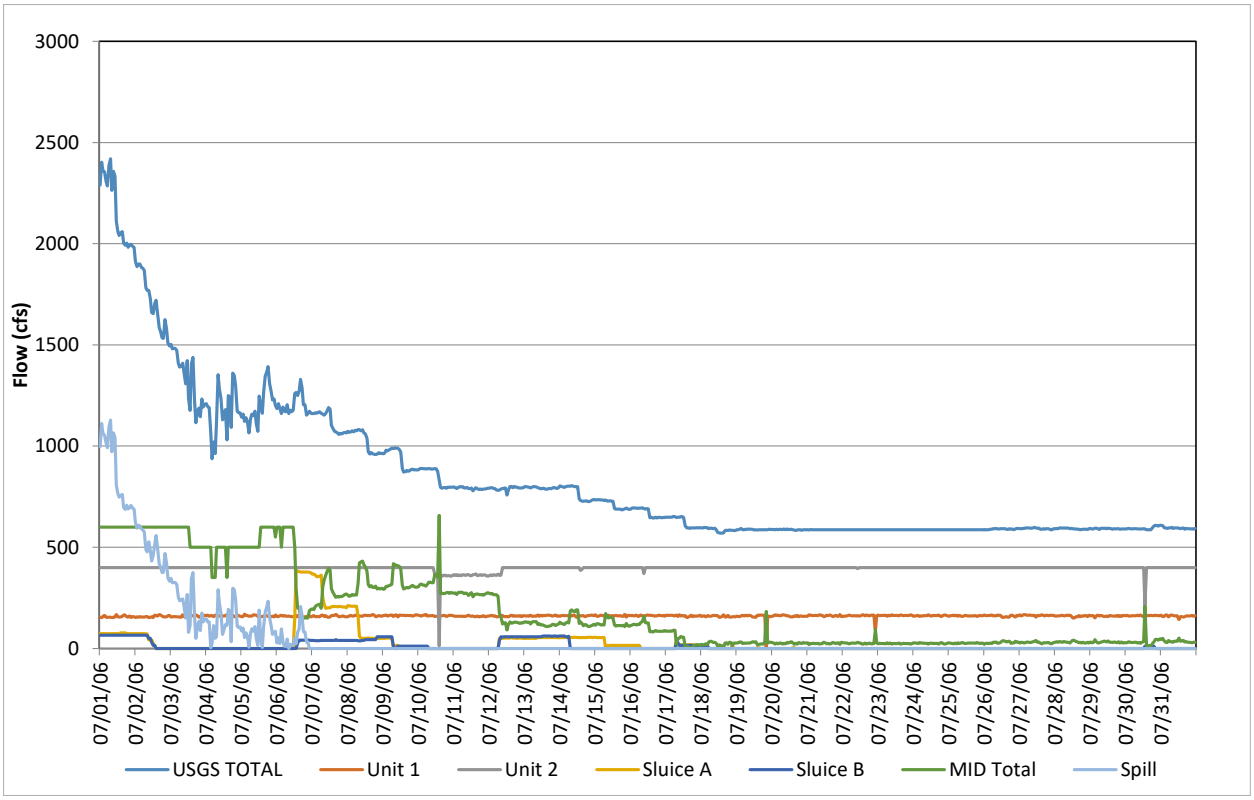

Figure D-19. Flow record in July 2006, based on hourly discharges.

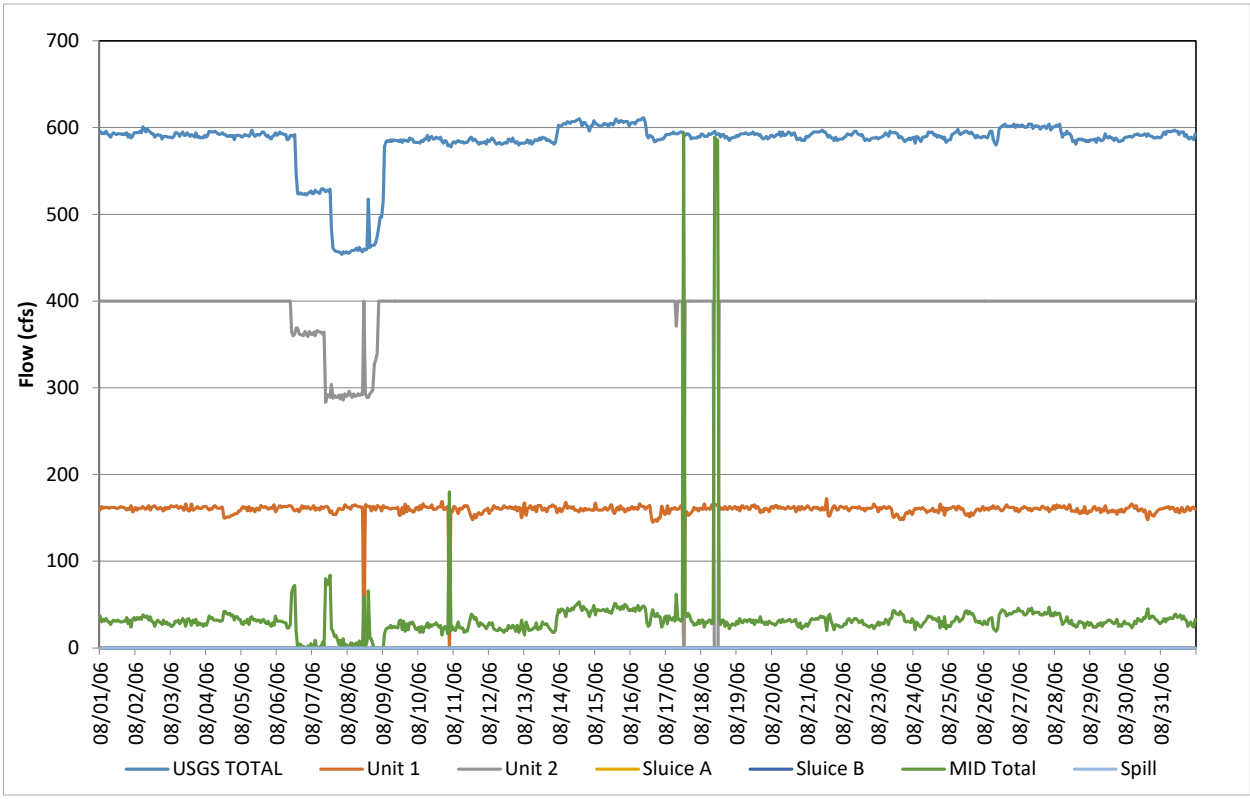

Figure D-20. Flow record in August 2006, based on hourly discharges.

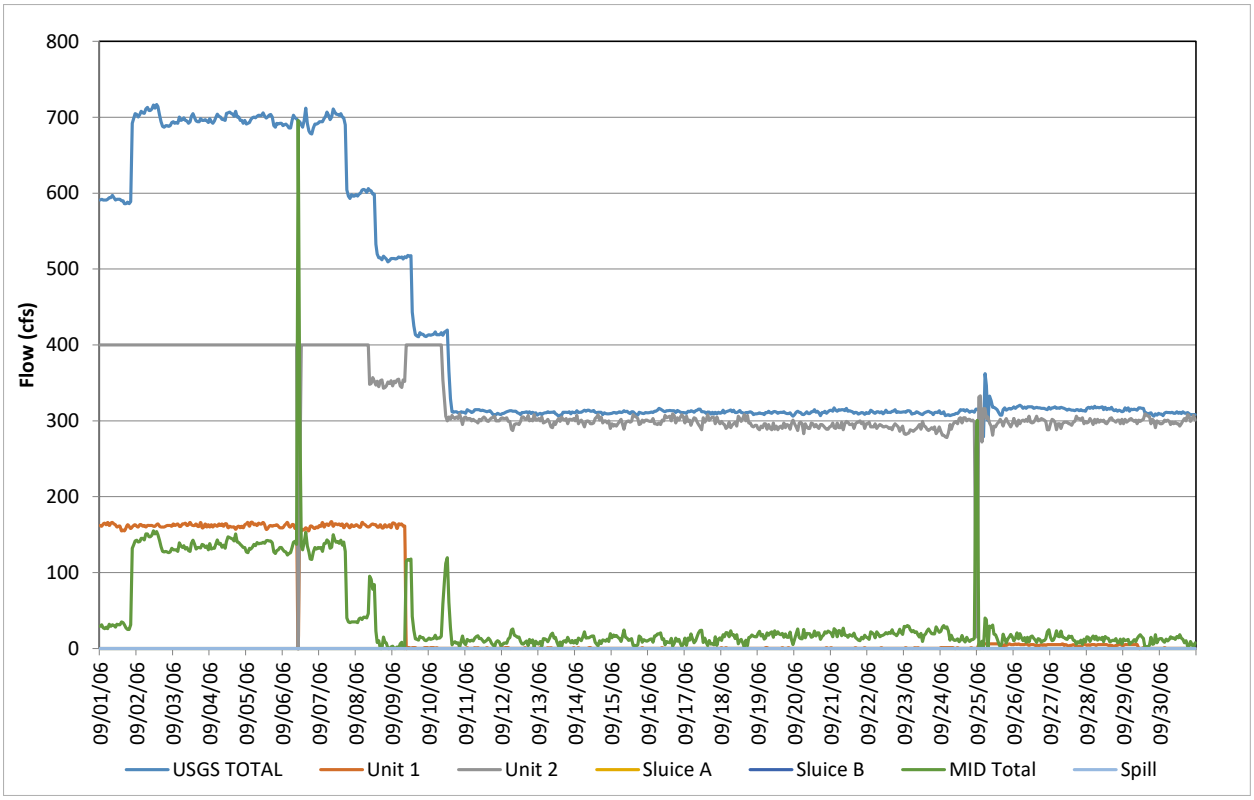

Figure D-21. Flow record in September 2006, based on hourly discharges.

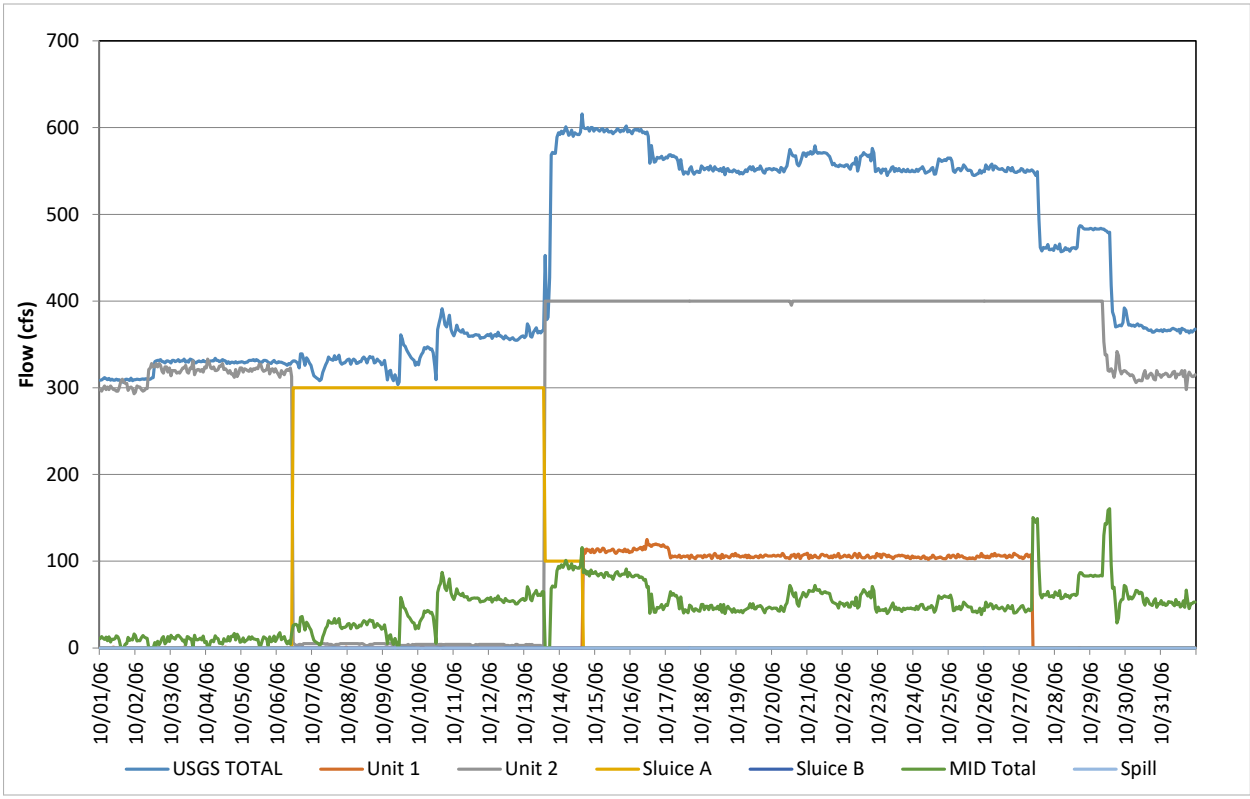

Figure D-22. Flow record in October 2006, based on hourly discharges.

Figure D-23. Flow record in November 2006, based on hourly discharges.

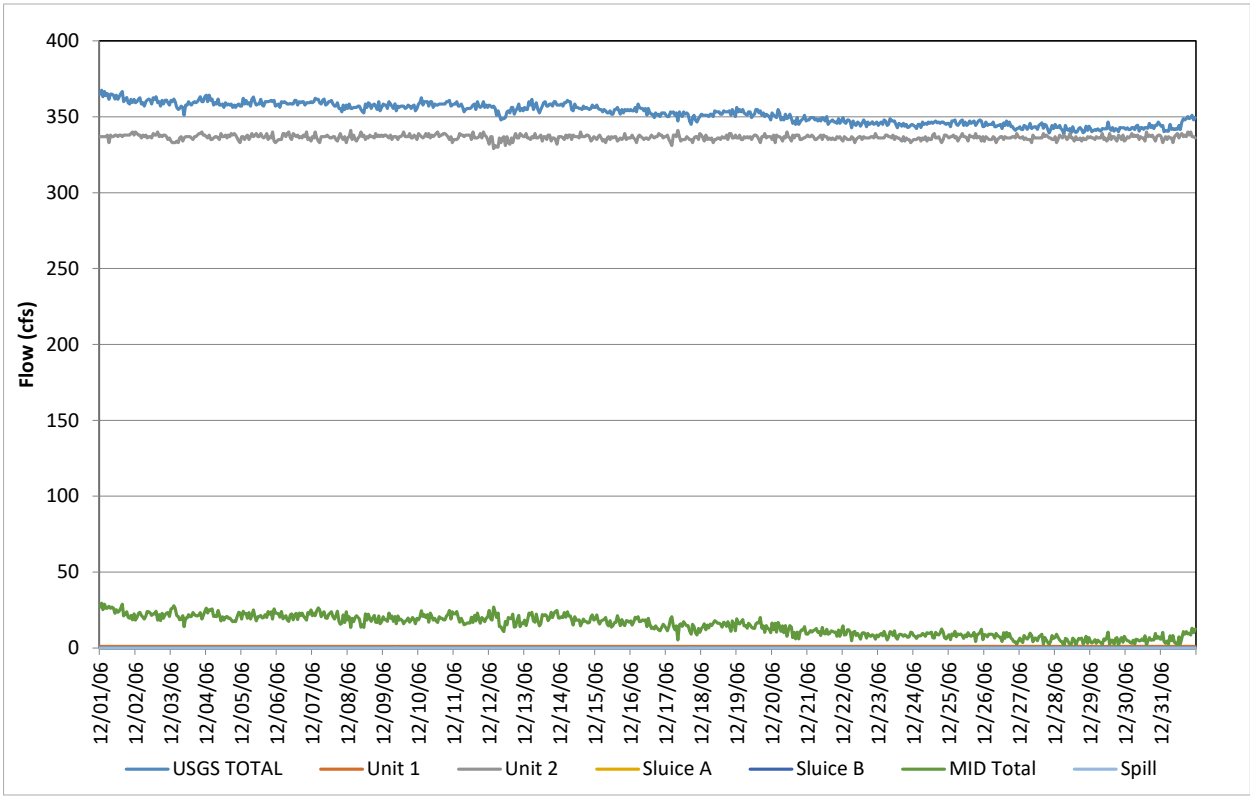

Figure D-24 Flow record in December 2006, based on hourly discharges.

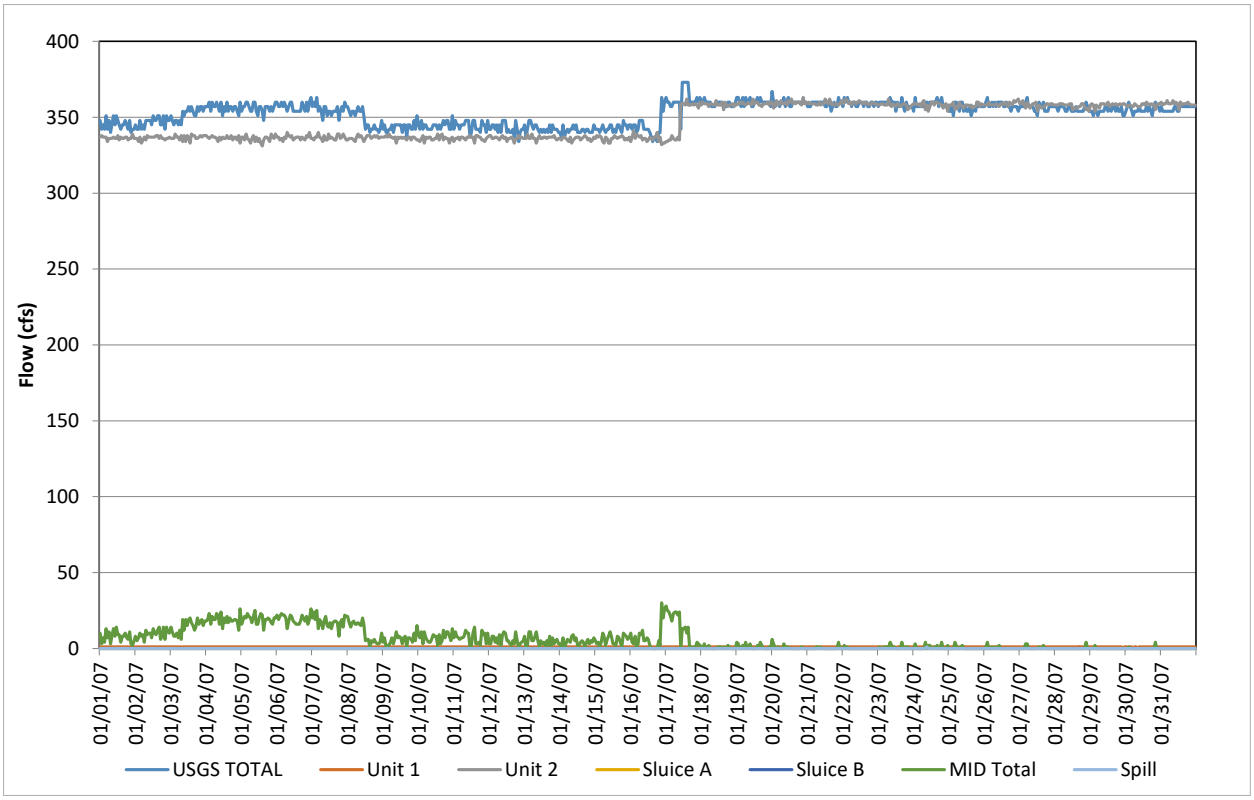

Figure D-25. Flow record in January 2007, based on hourly discharges.

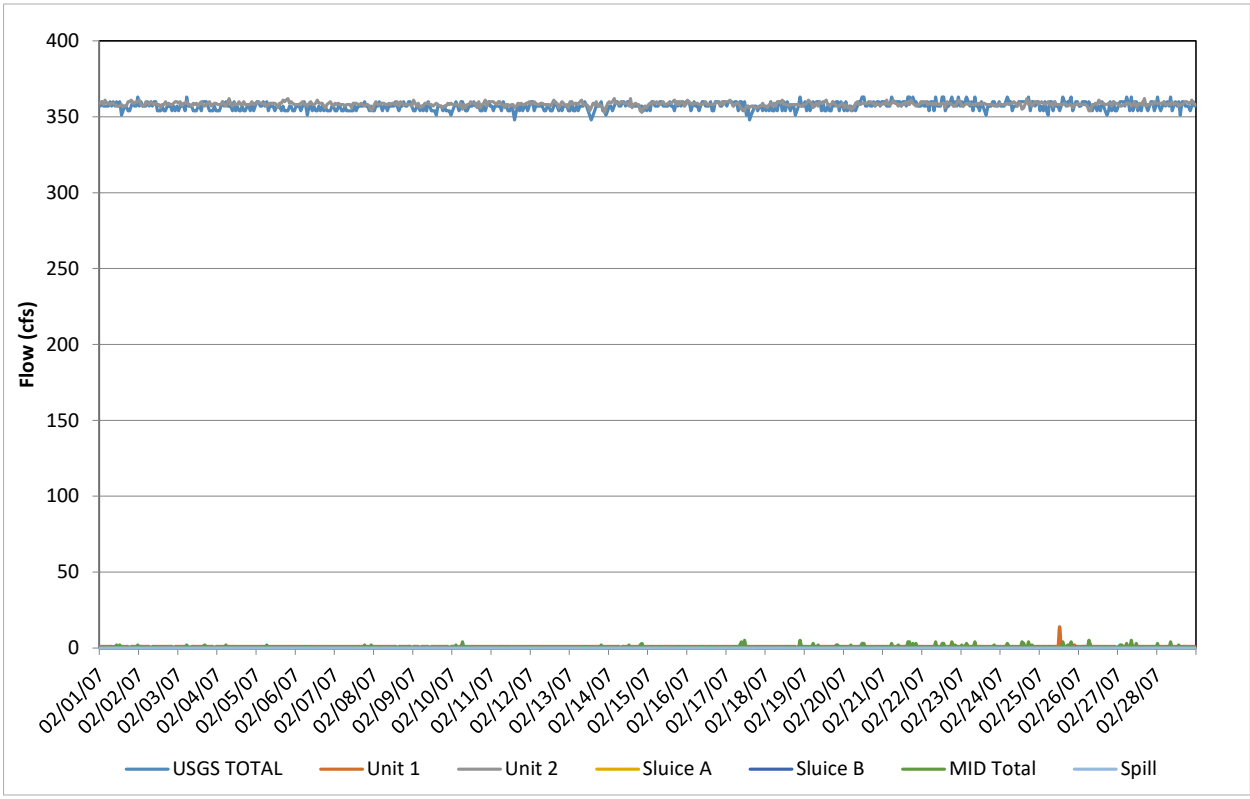

Figure D-26. Flow record in February 2007, based on hourly discharges.

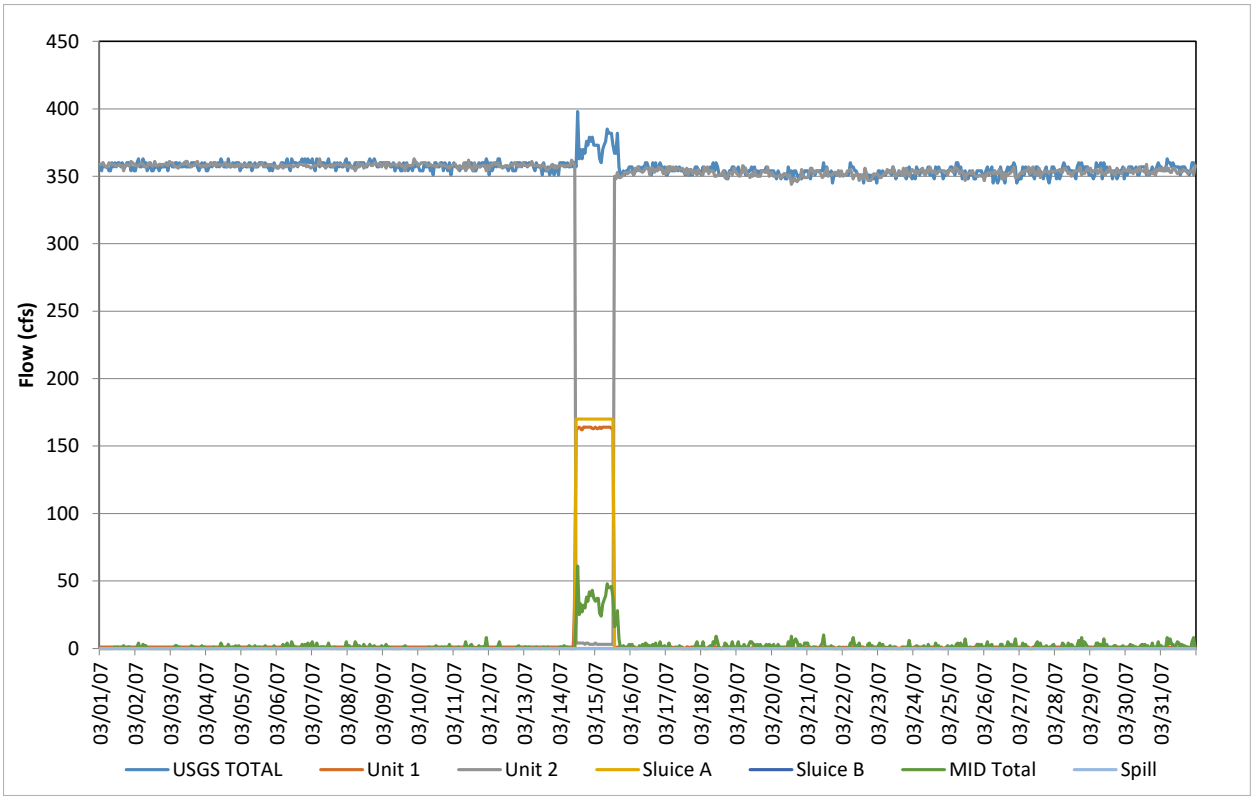

Figure D-27. Flow record in March 2007, based on hourly discharges.

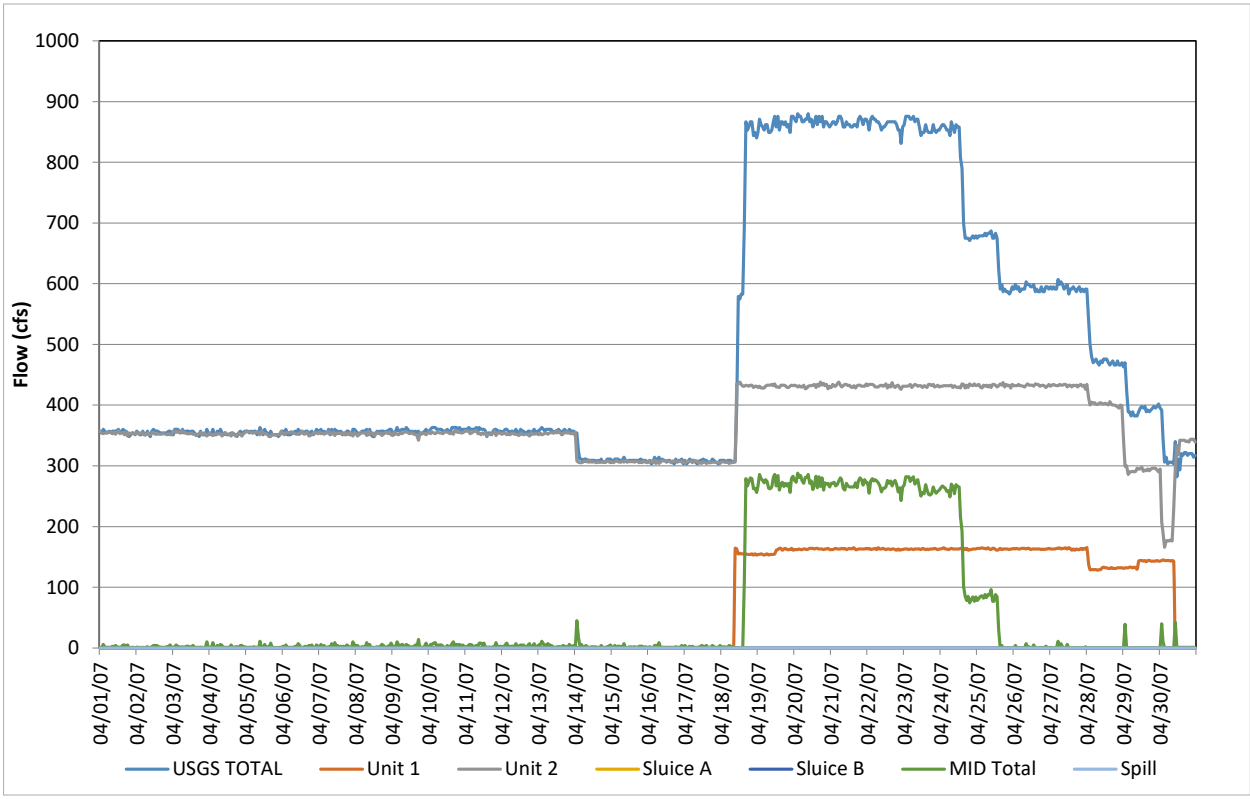

Figure D-28. Flow record in April 2007, based on hourly discharges.

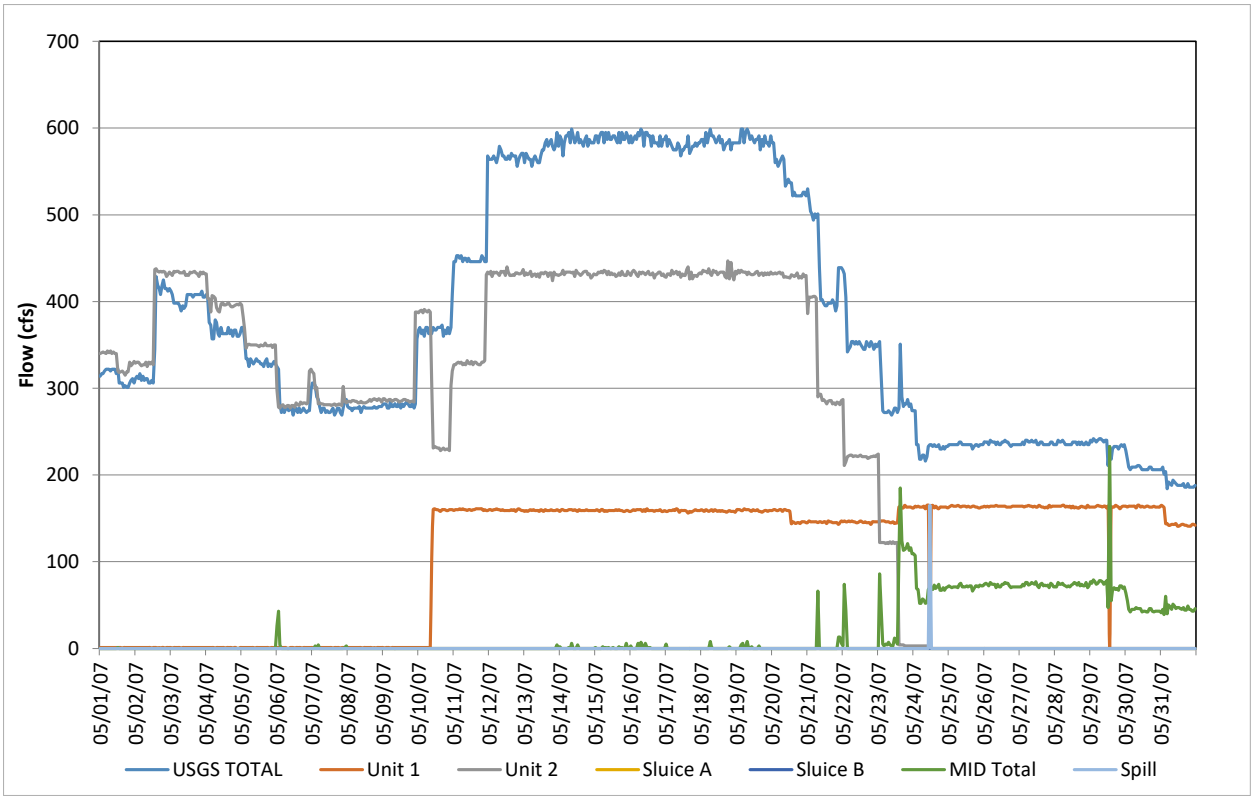

Figure D-29. Flow record in May 2007, based on hourly discharges.

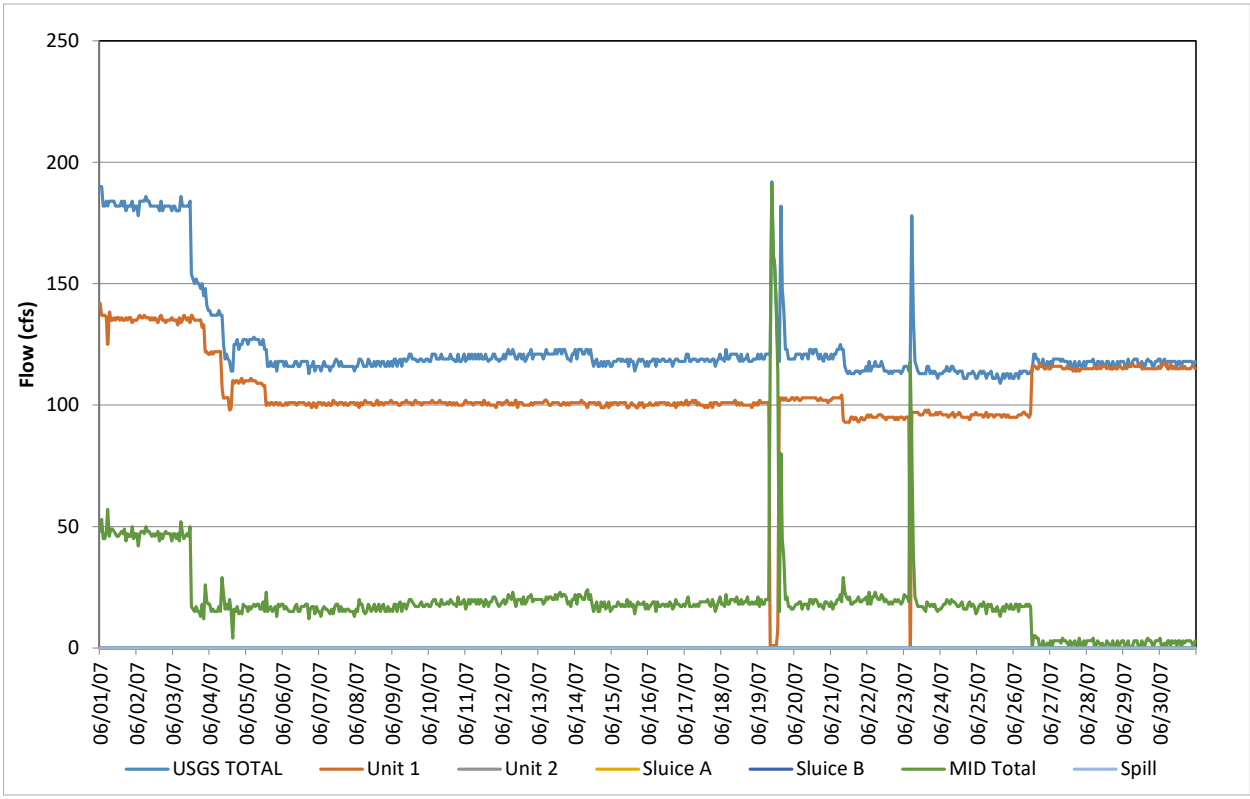

Figure D-30. Flow record in June 2007, based on hourly discharges.

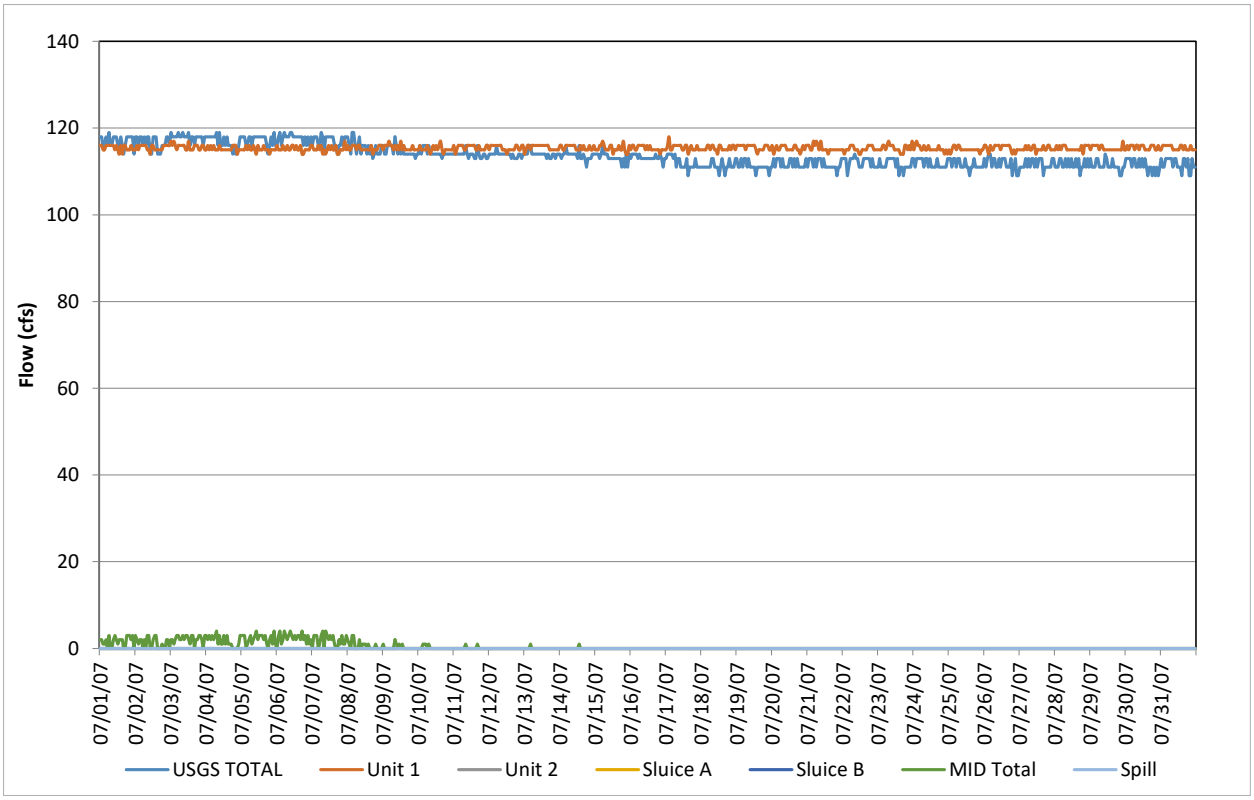

Figure D-31. Flow record in July 2007, based on hourly discharges.

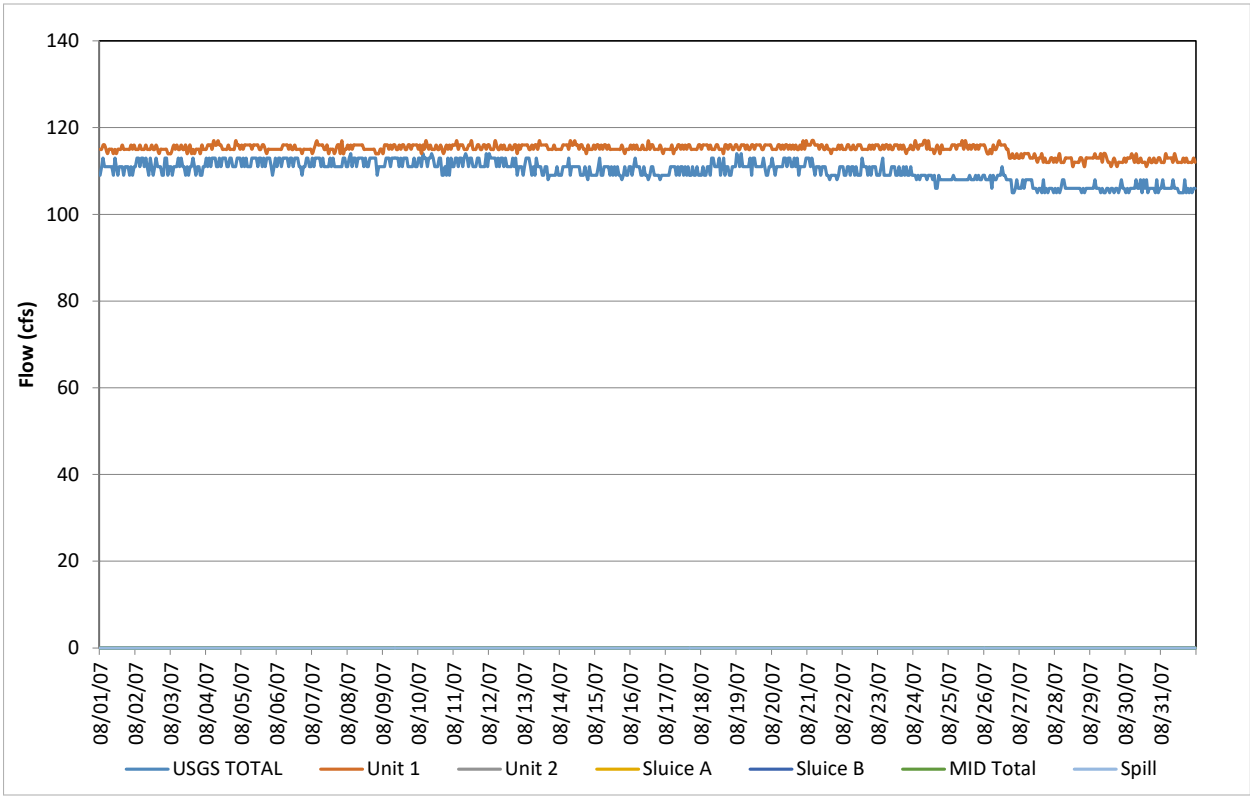

Figure D-32. Flow record in August 2007, based on hourly discharges.

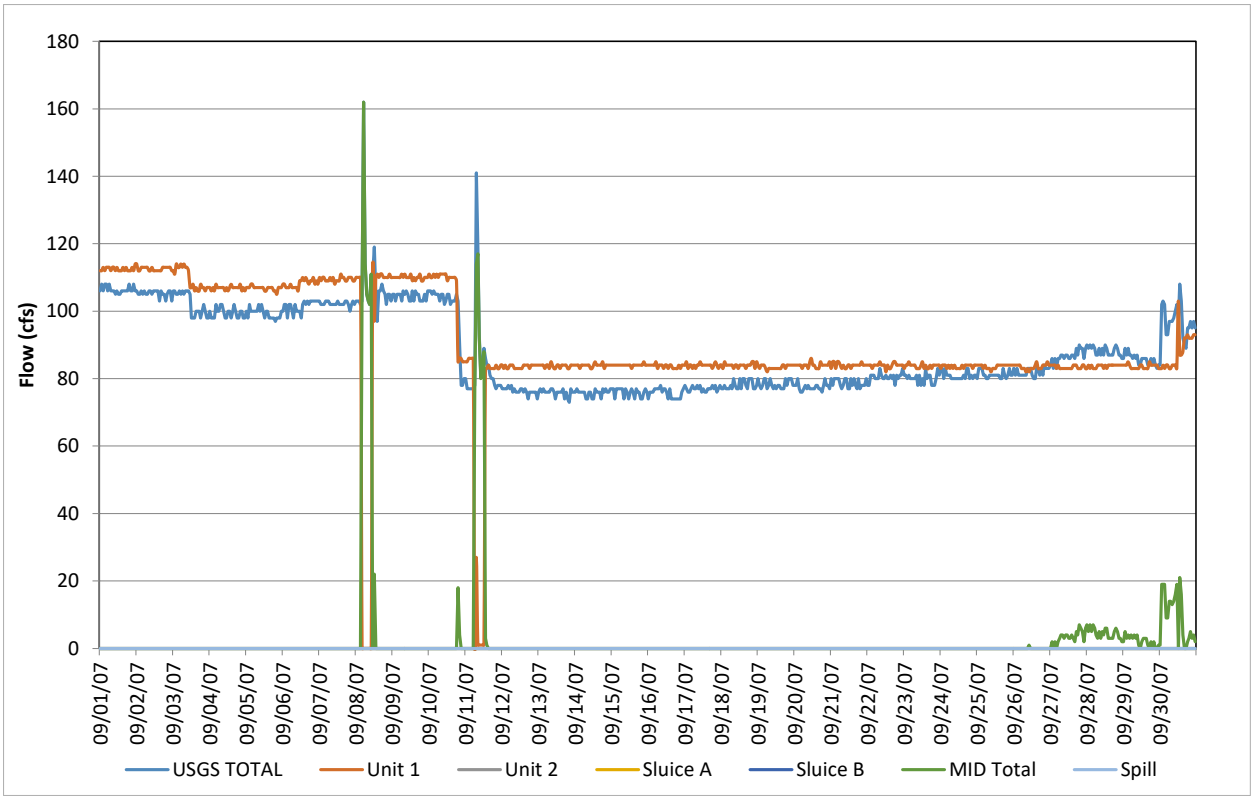

Figure D-33. Flow record in September 2007, based on hourly discharges.

Figure D-34. Flow record in October 2007, based on hourly discharges.

Figure D-35. Flow record in November 2007, based on hourly discharges.

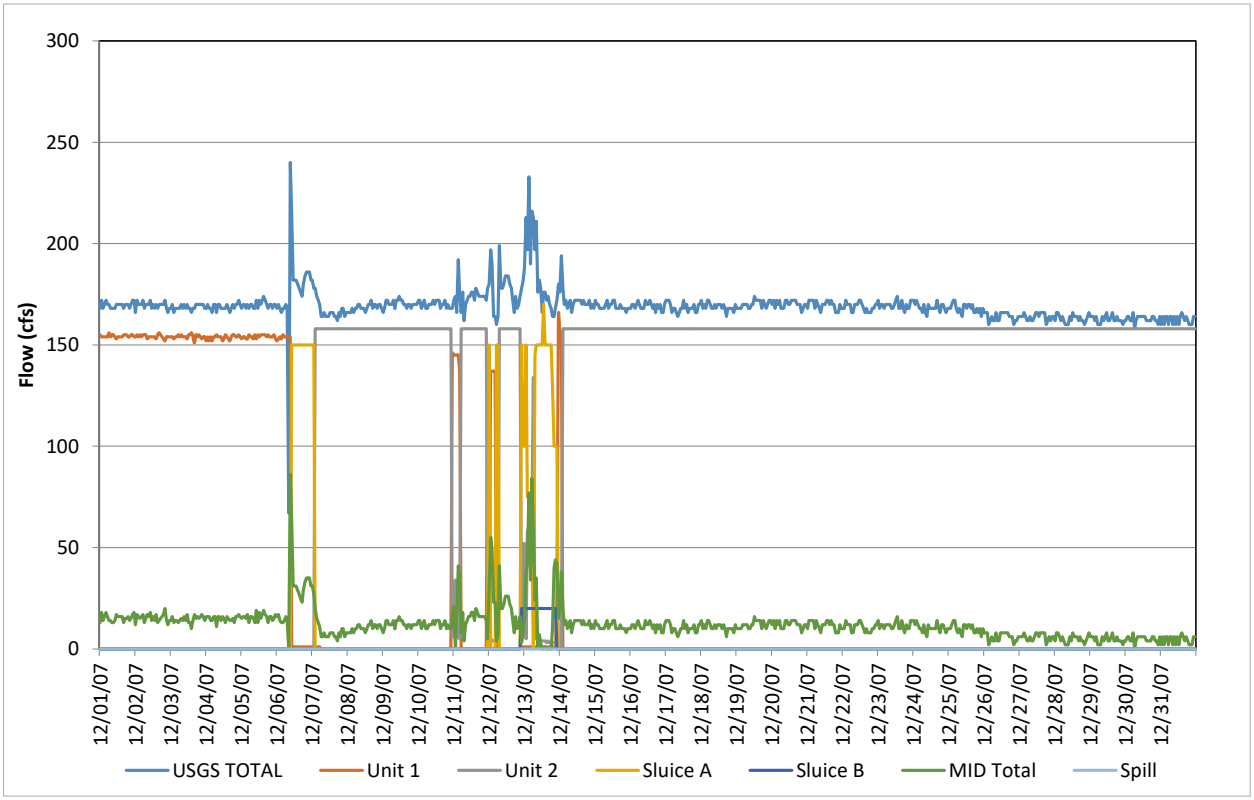

Figure D-36. Flow record in December 2007, based on hourly discharges.

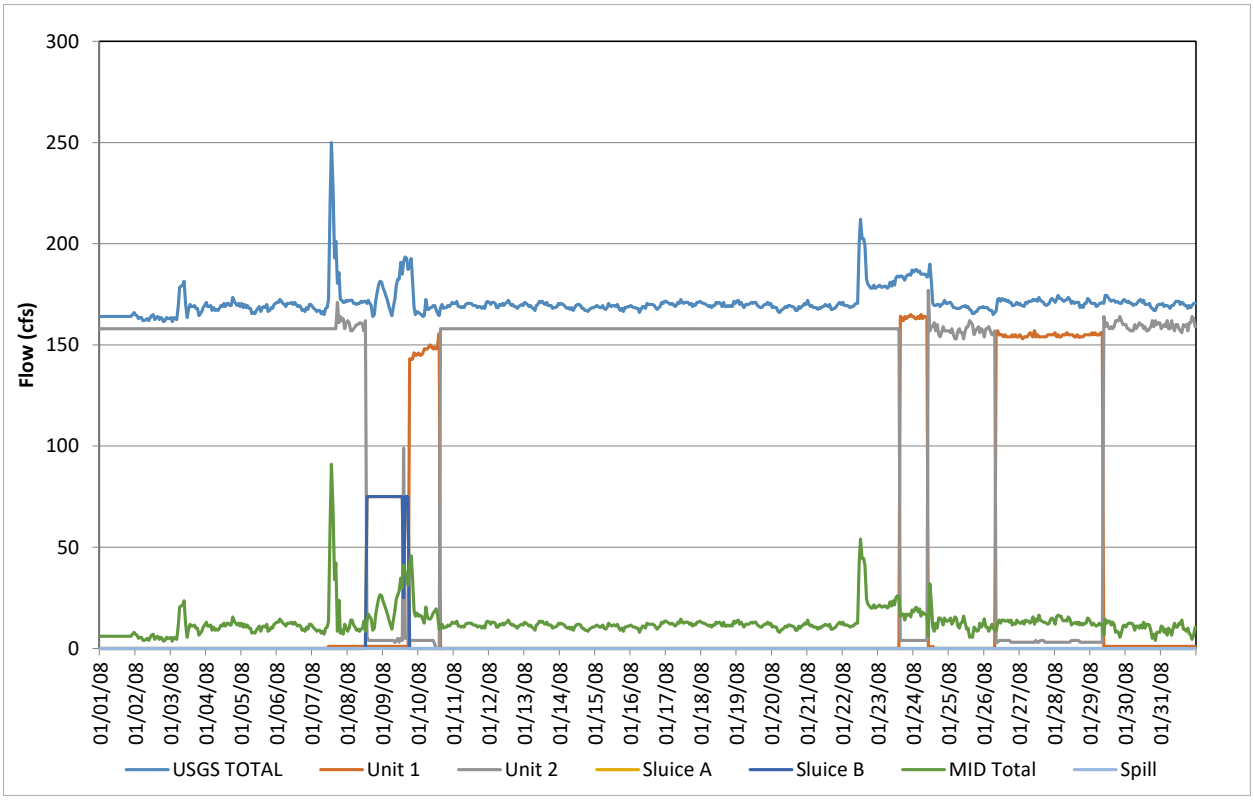

Figure D-37. Flow record in January 2008, based on hourly discharges.

Figure D-38. Flow record in February 2008, based on hourly discharges.

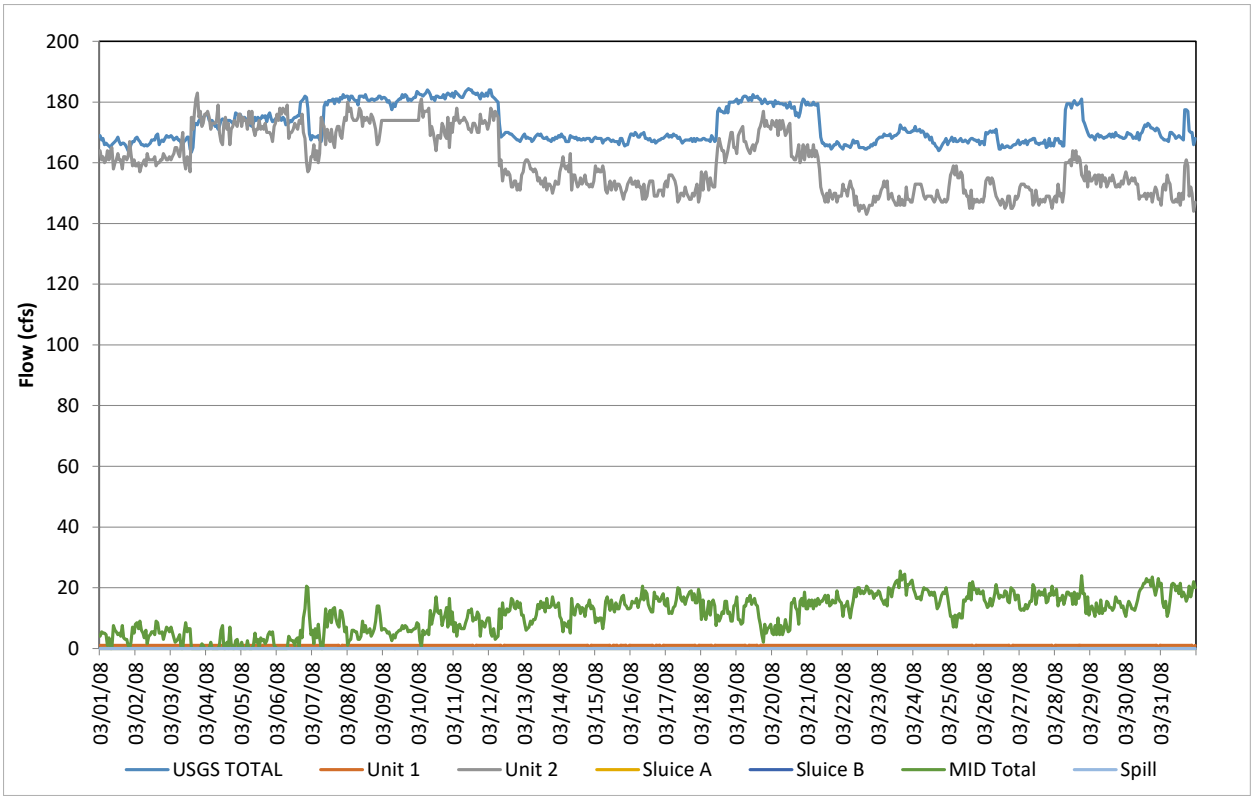

Figure D-39. Flow record in March 2008, based on hourly discharges.

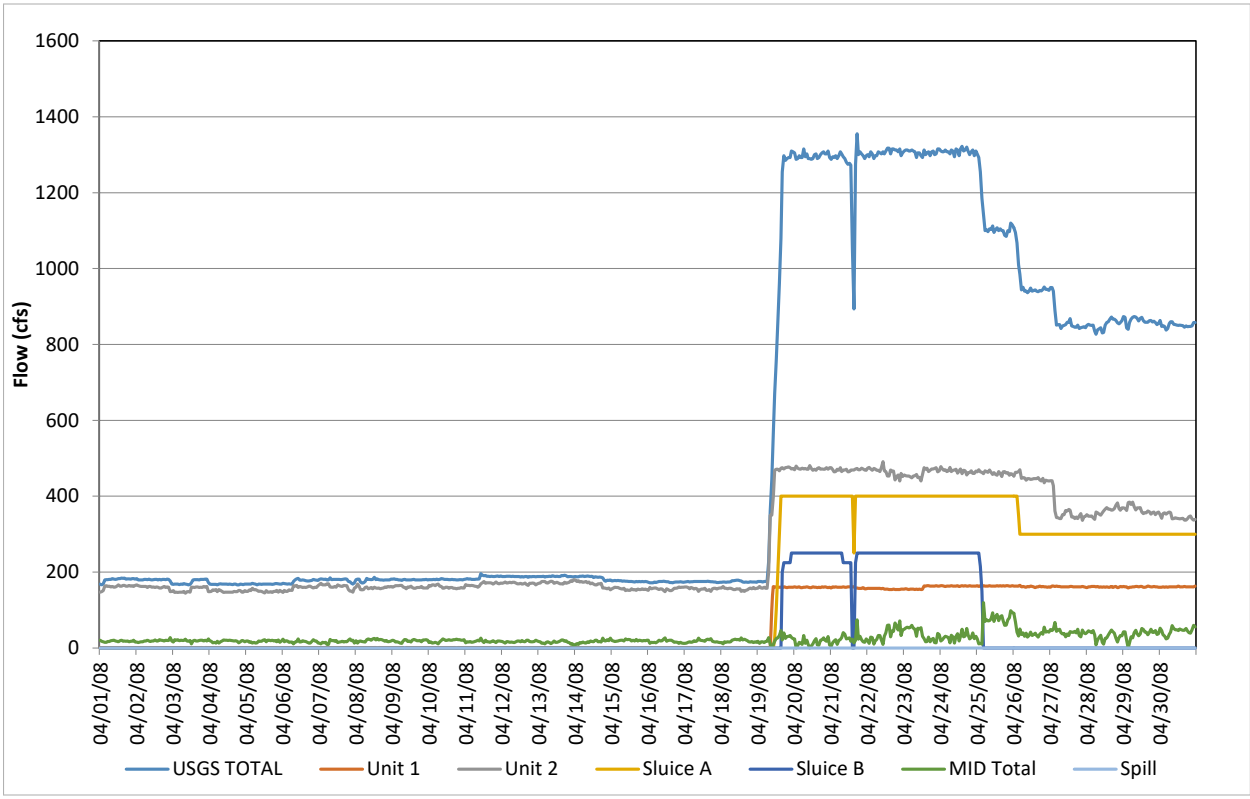

Figure D-40. Flow record in April 2008, based on hourly discharges.

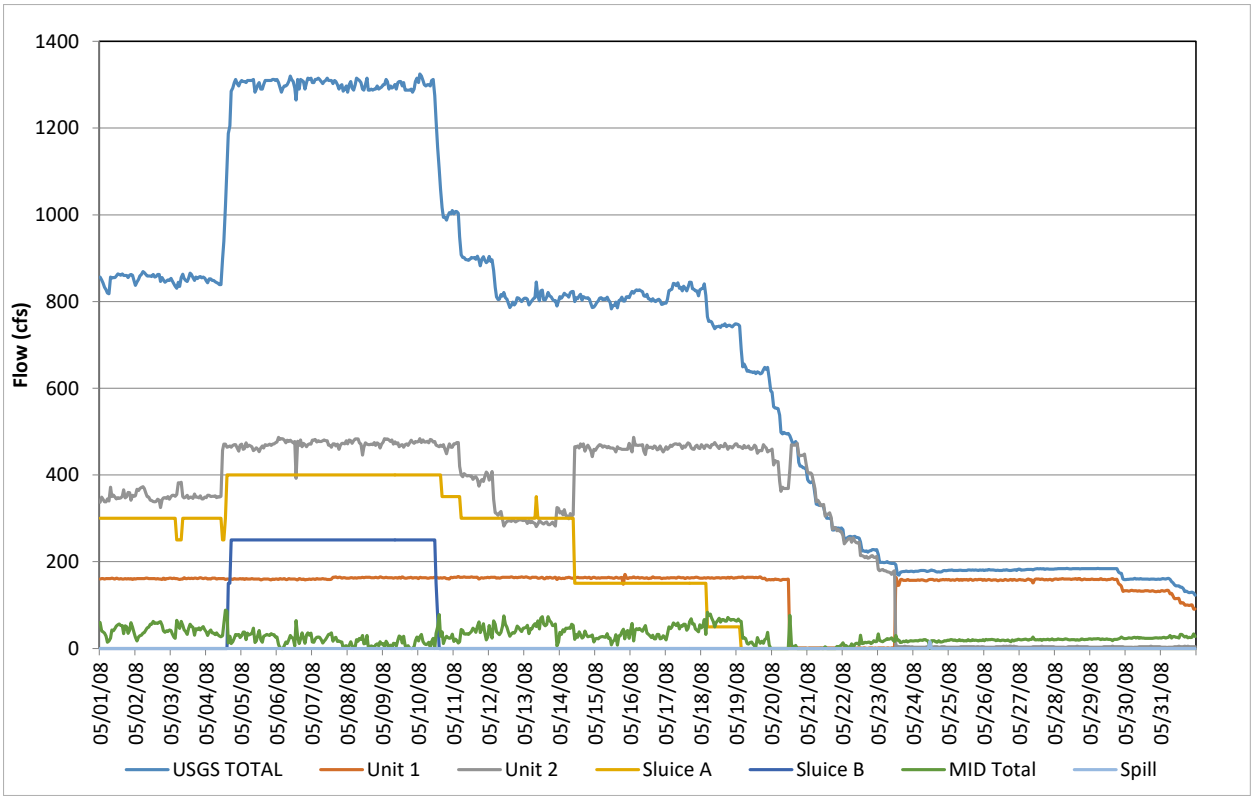

Figure D-41. Flow record in May 2008, based on hourly discharges.

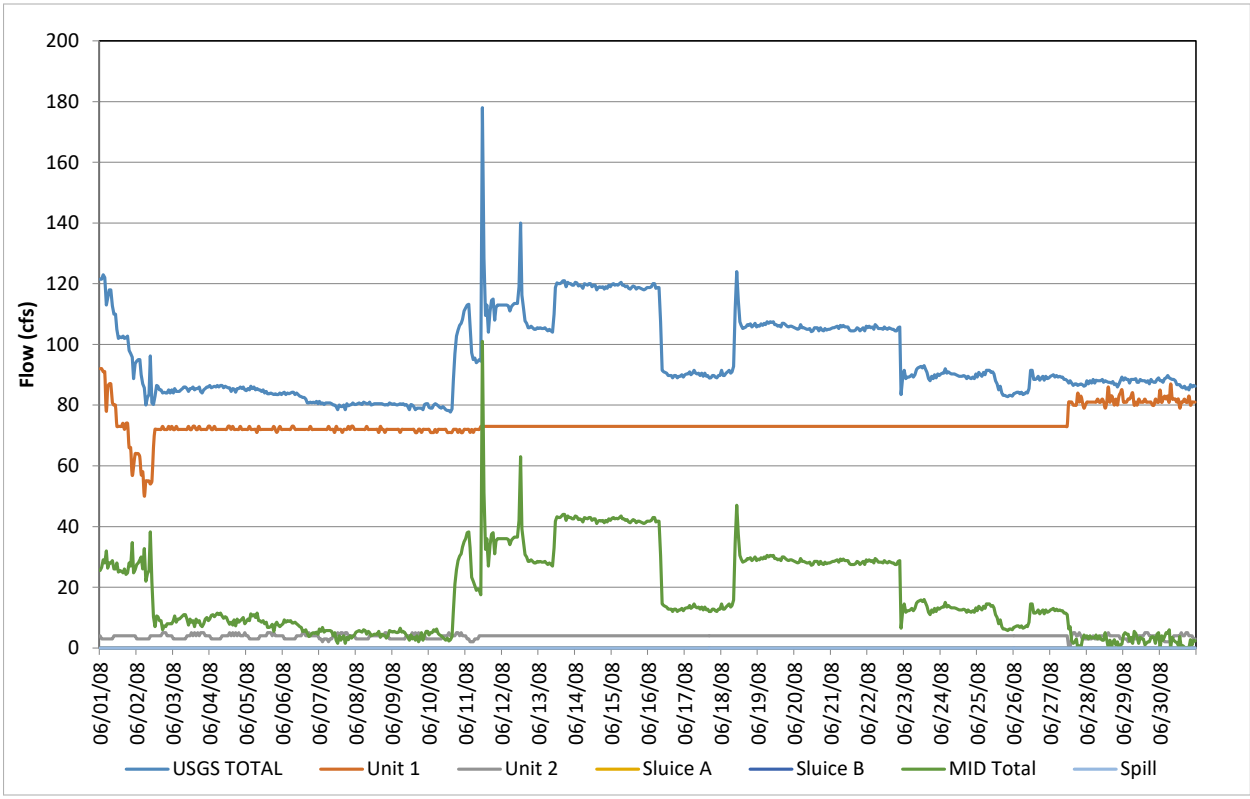

Figure D-42. Flow record in June 2008, based on hourly discharges.

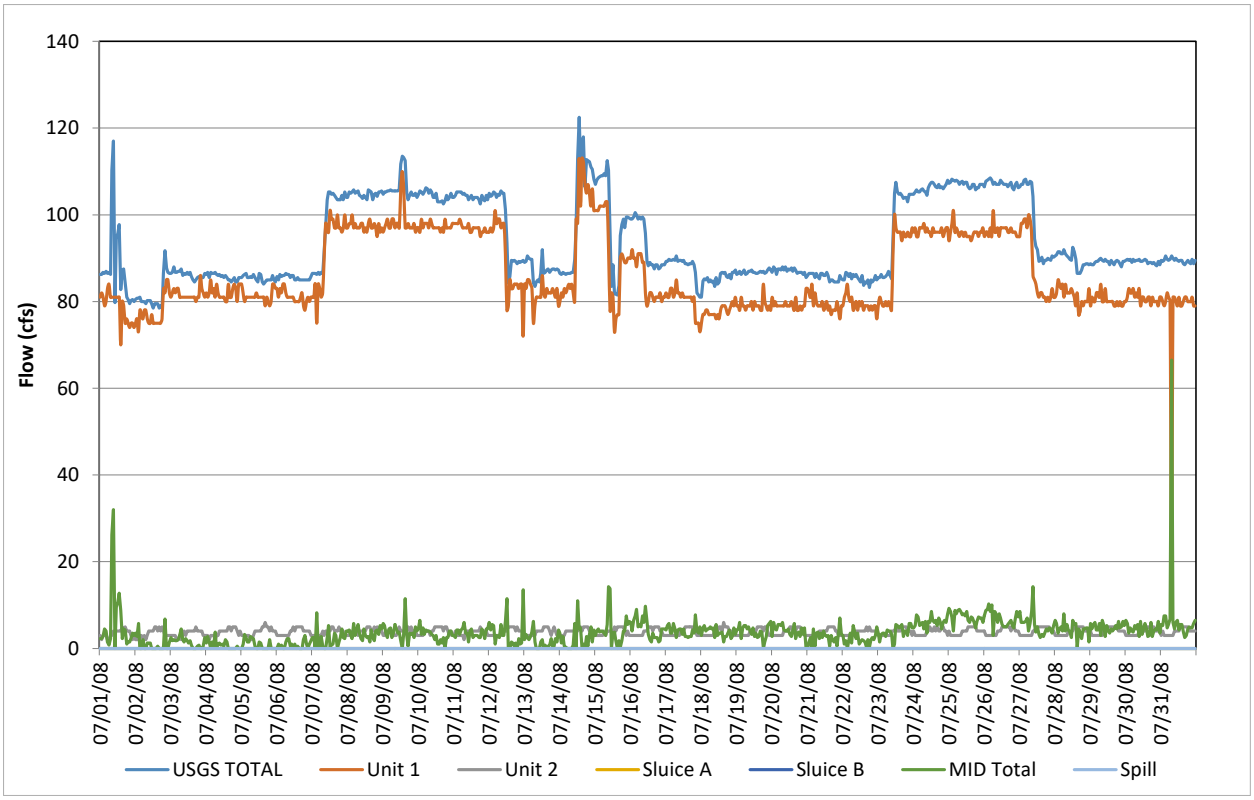

Figure D-43. Flow record in July 2008, based on hourly discharges.

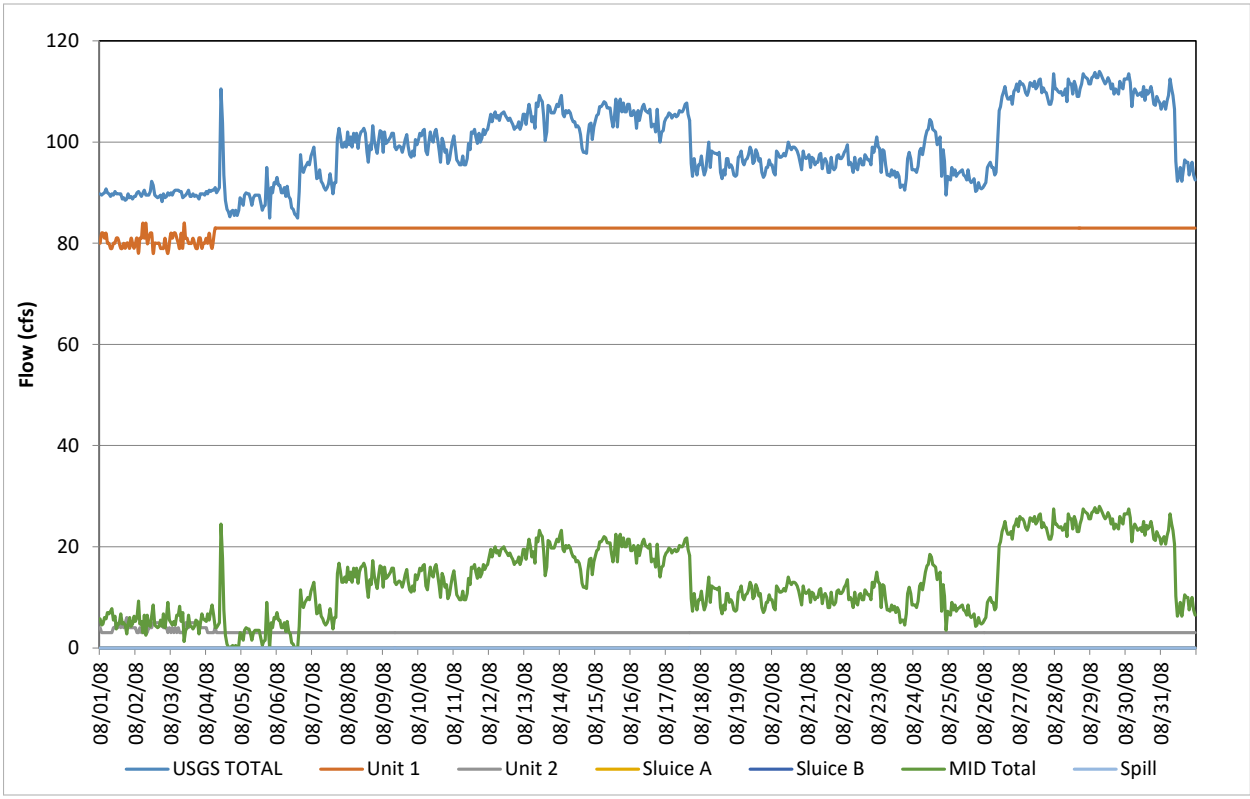

Figure D-44. Flow record in August 2008, based on hourly discharges.

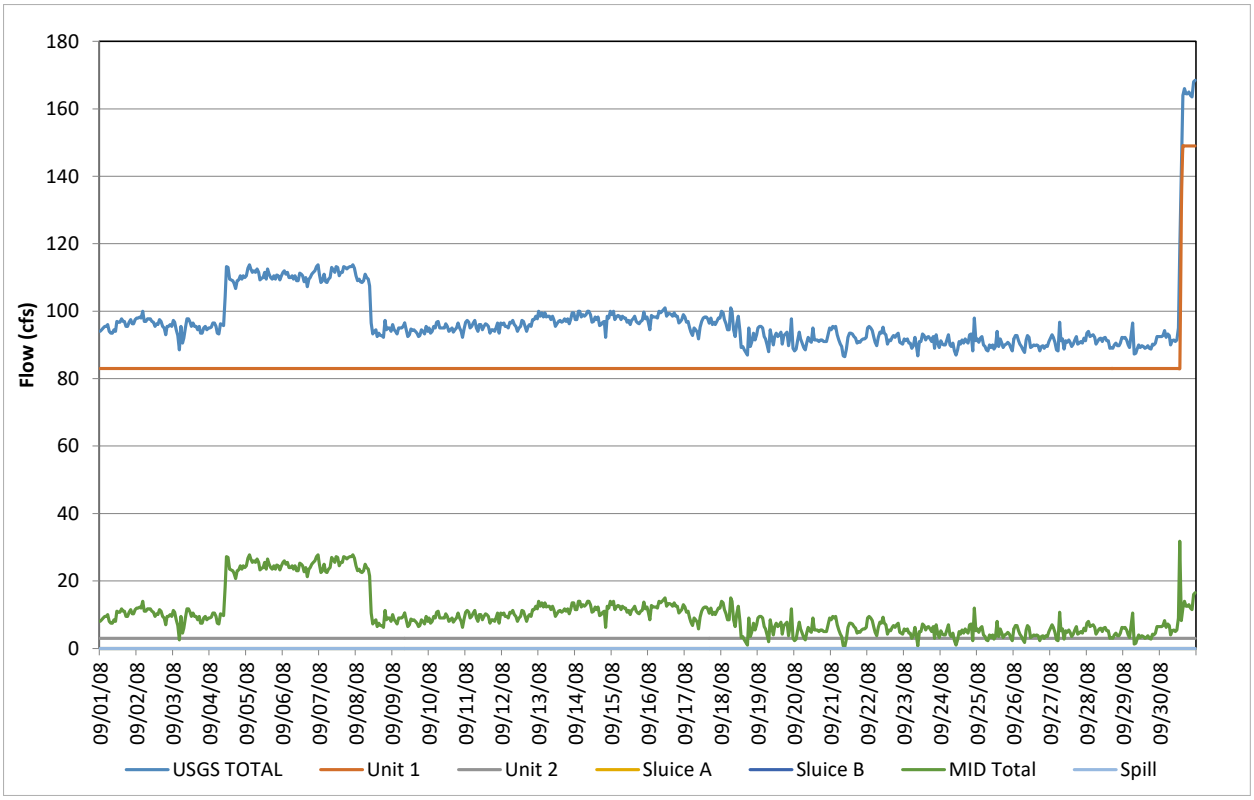

Figure D-45. Flow record in September 2008, based on hourly discharges.

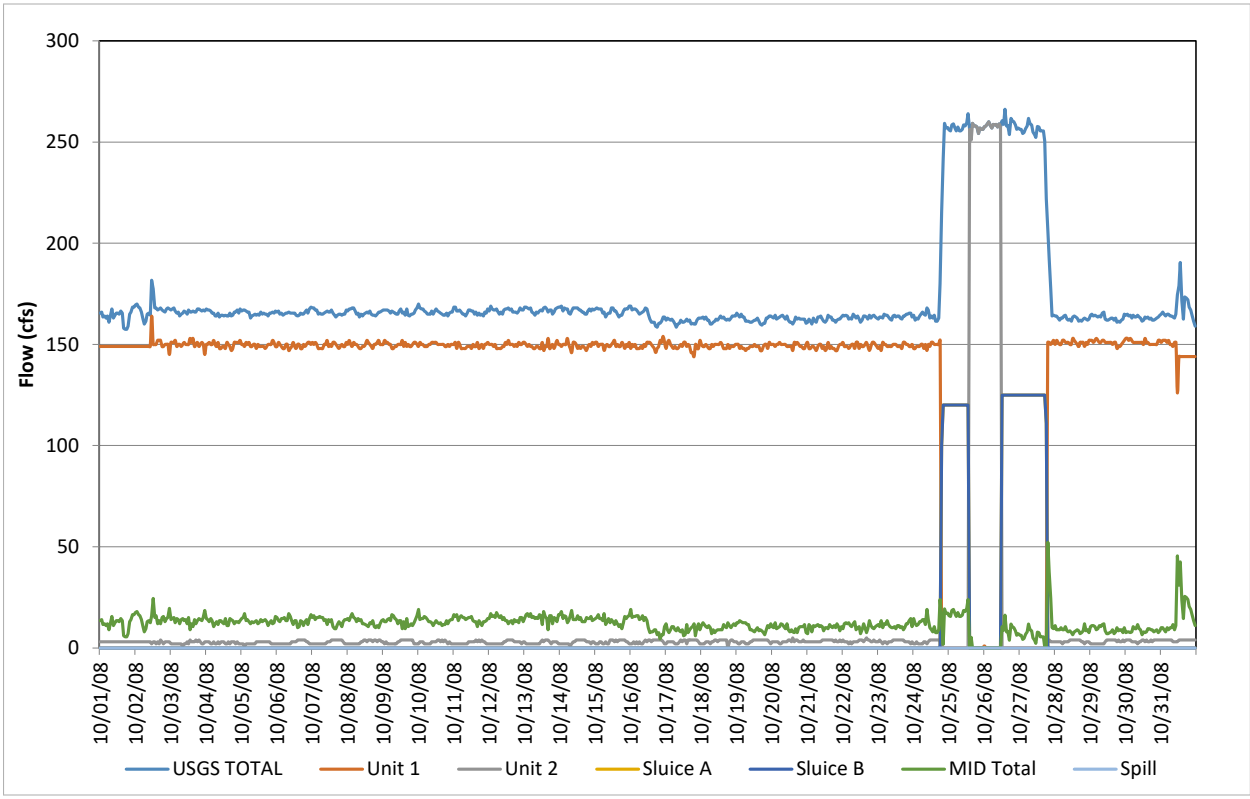

Figure D-46. Flow record in October 2008, based on hourly discharges.

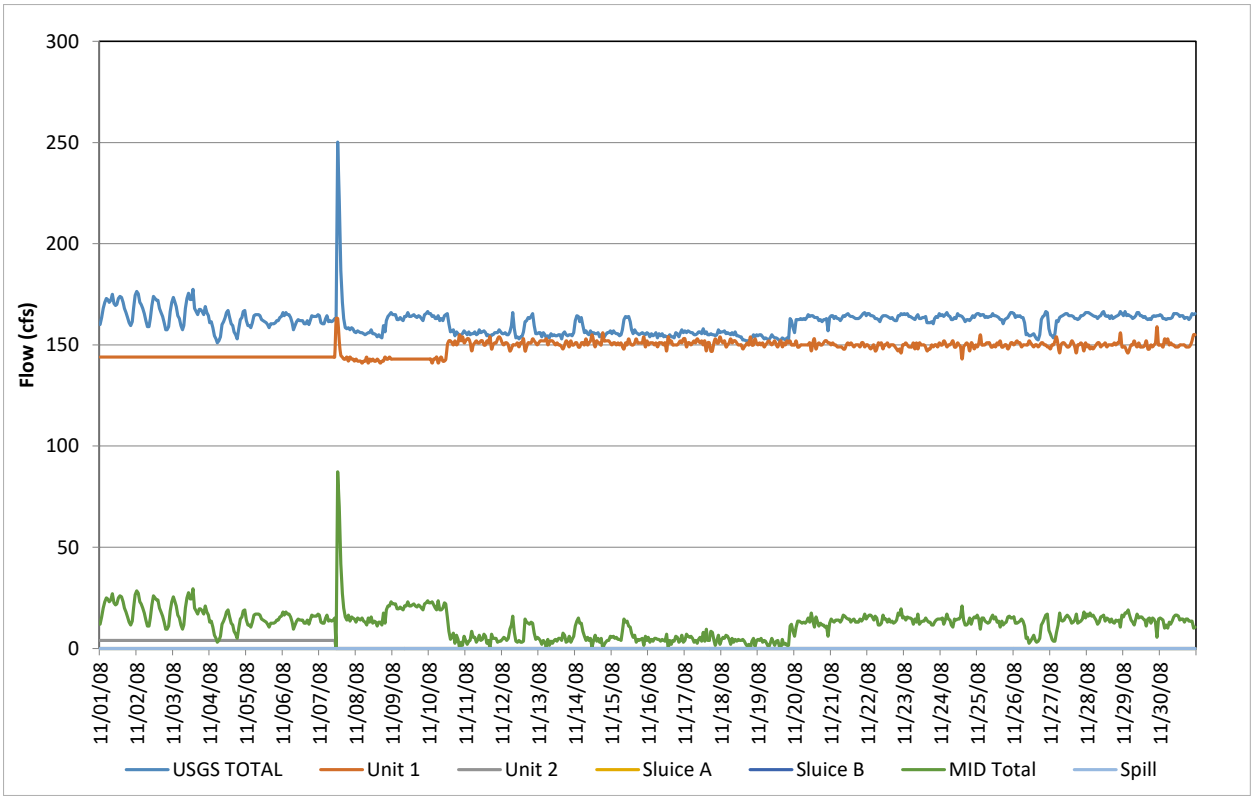

Figure D-47. Flow record in November 2008, based on hourly discharges.

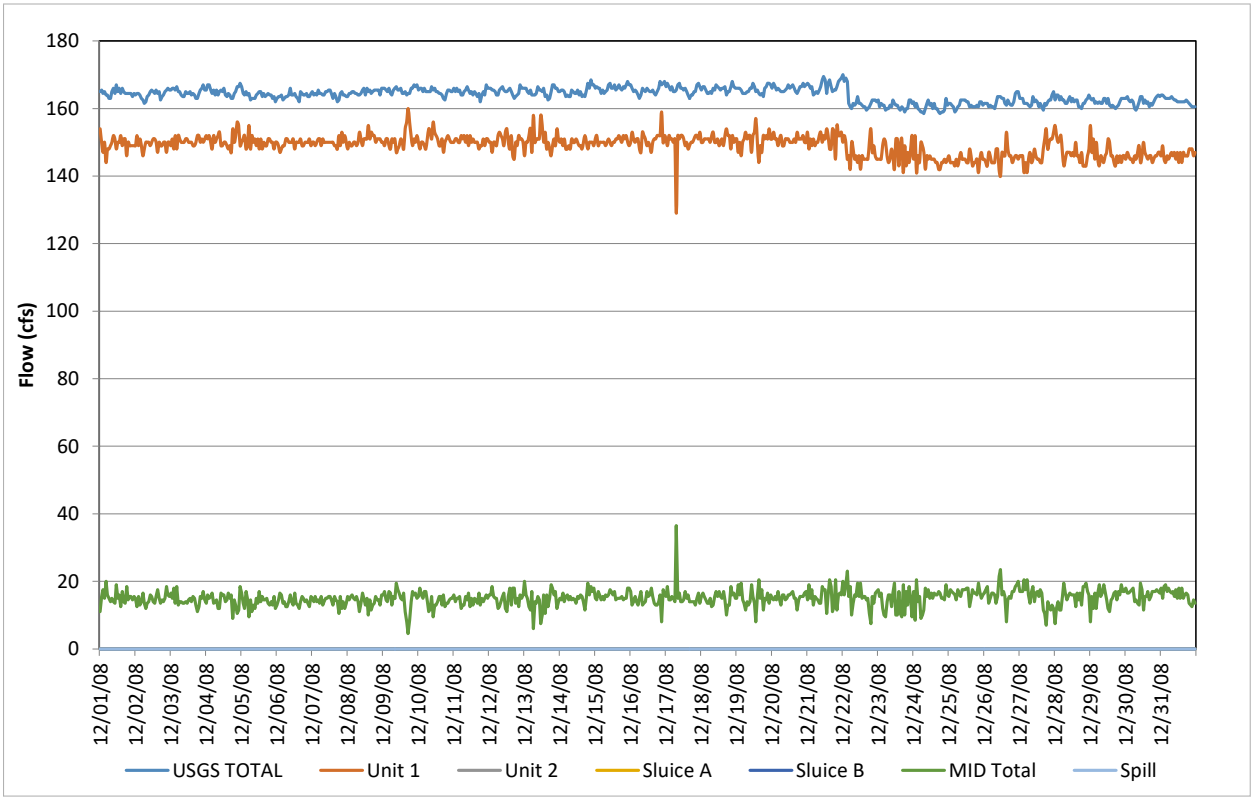

Figure D-48. Flow record in December 2008, based on hourly discharges.

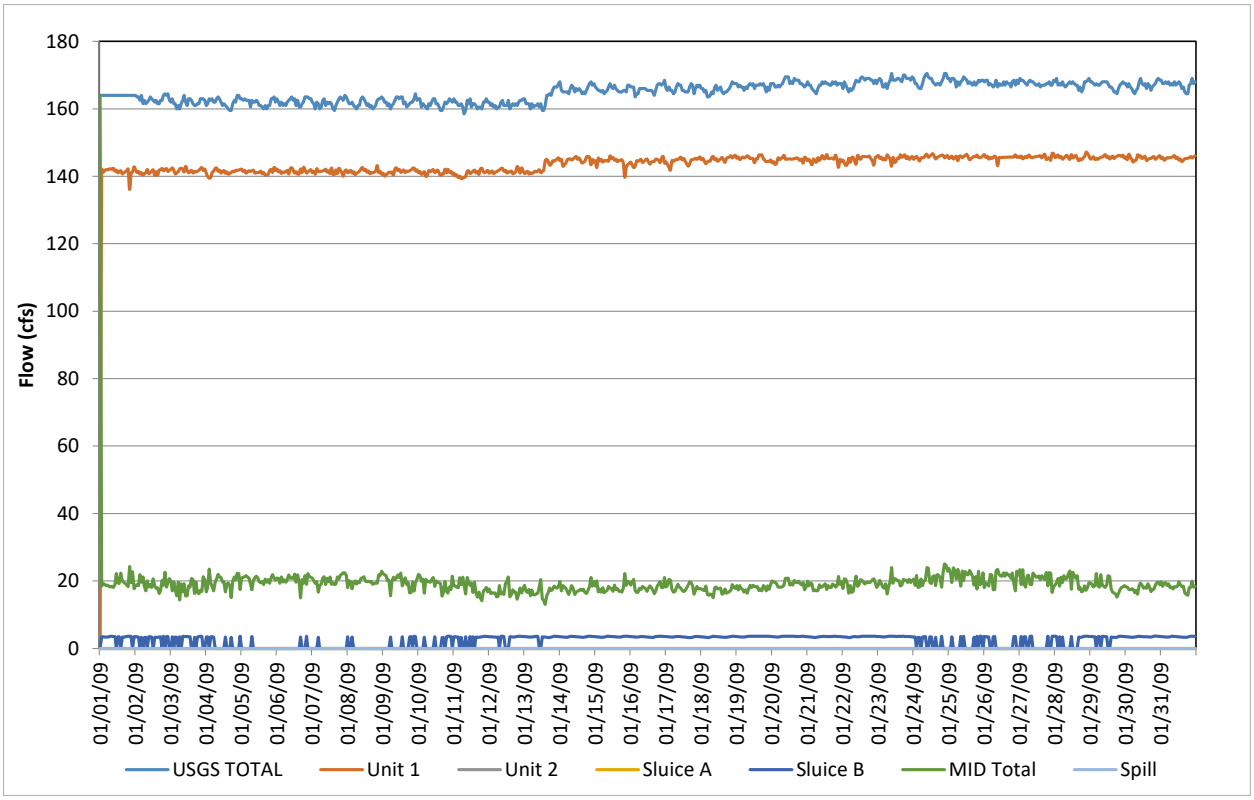

Figure D-49. Flow record in January 2009, based on hourly discharges.

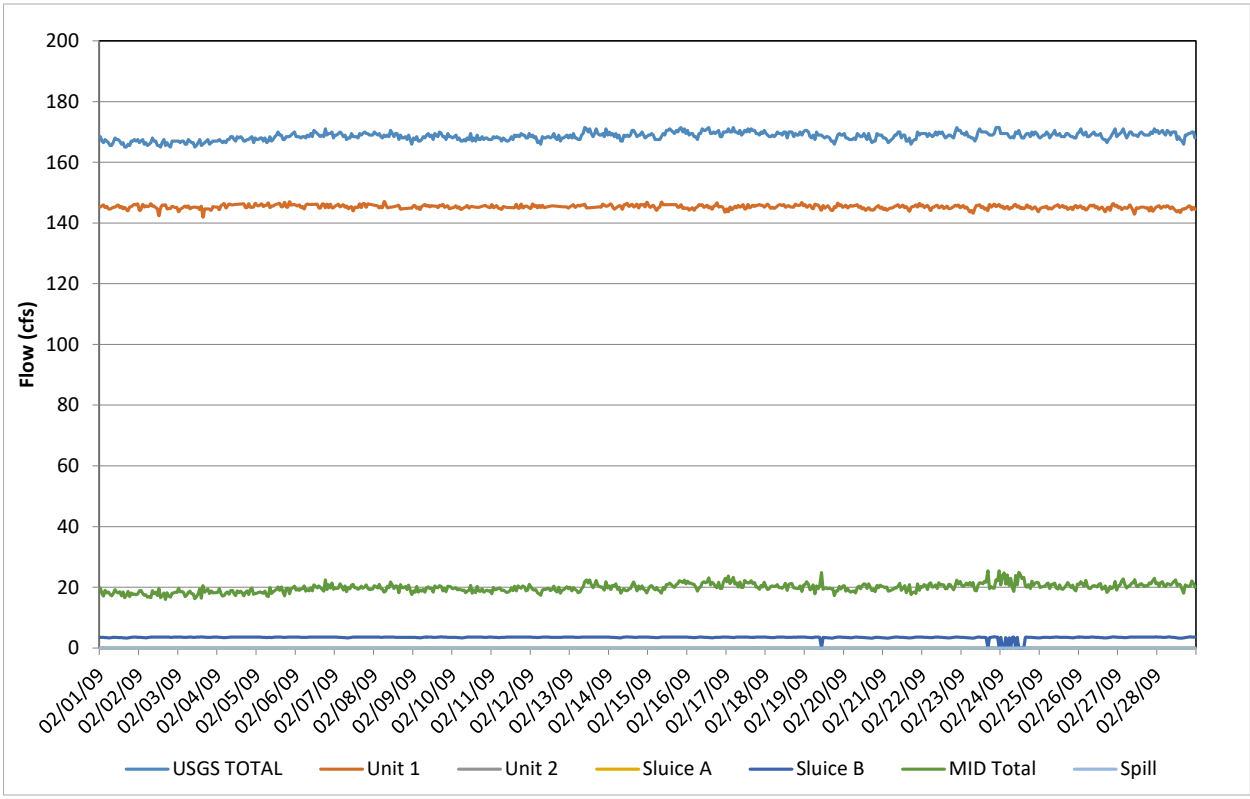

Figure D-50. Flow record in February 2009, based on hourly discharges.

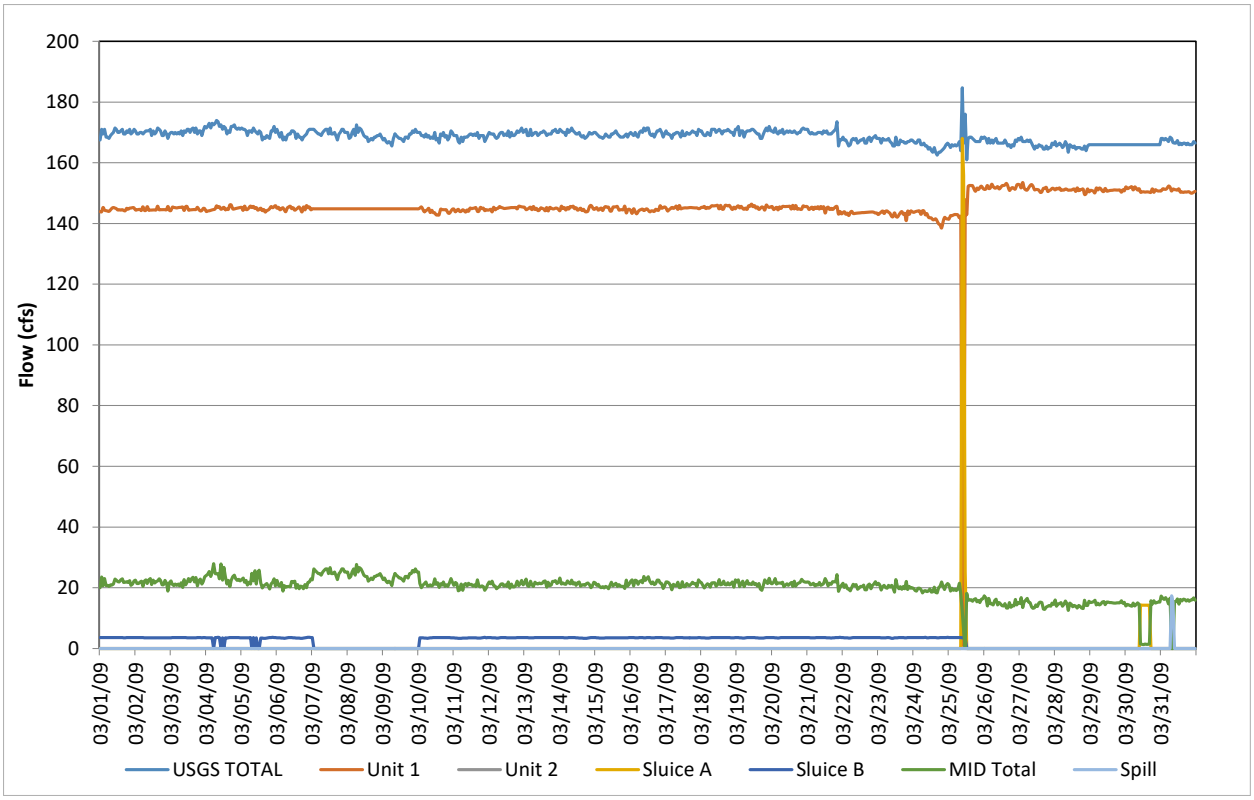

Figure D-51. Flow record in March 2009, based on hourly discharges.

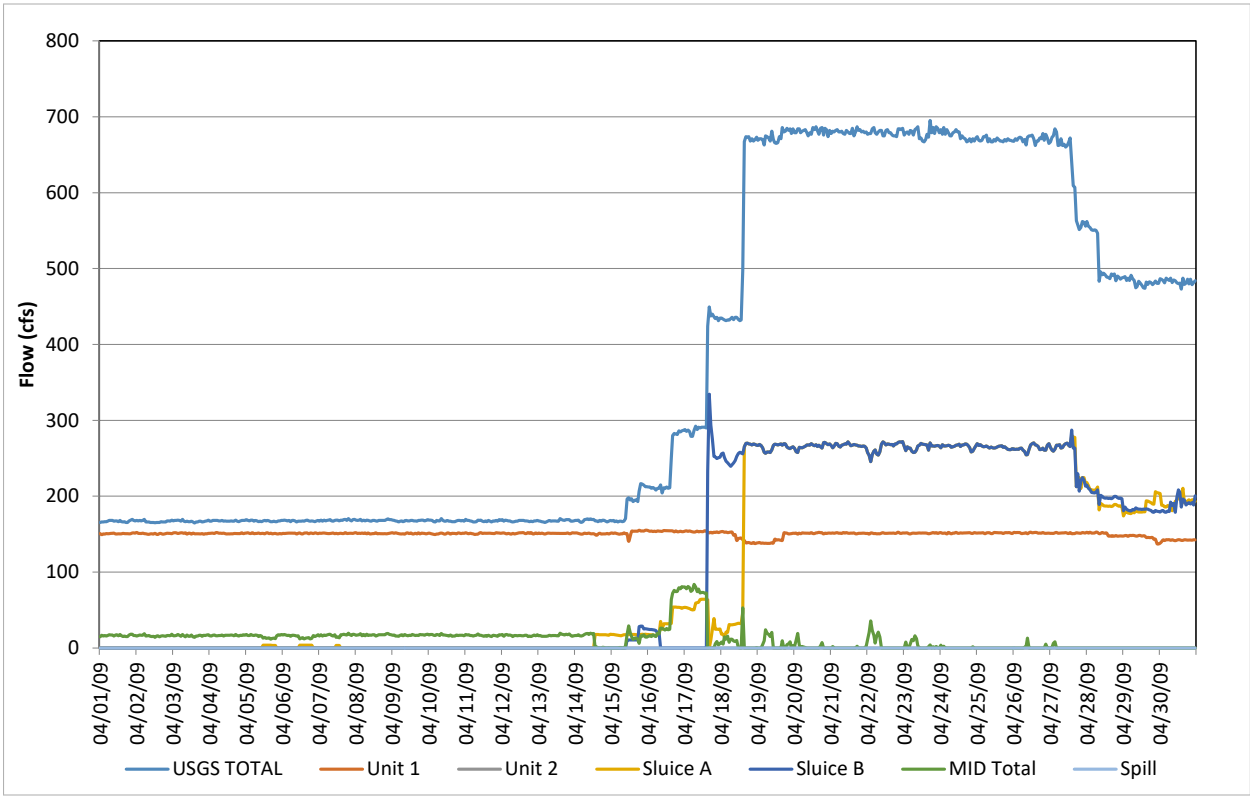

Figure D-52. Flow record in April 2009, based on hourly discharges.

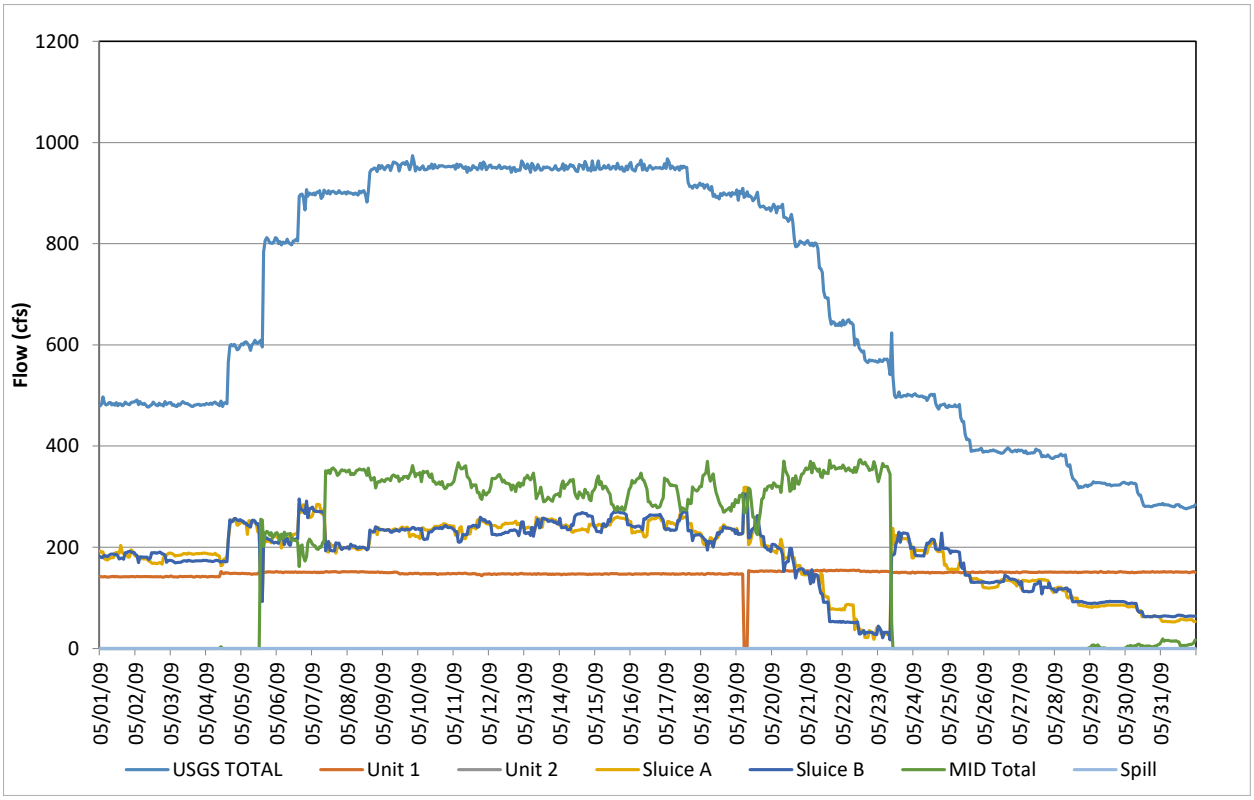

Figure D-53. Flow record in May 2009, based on hourly discharges.

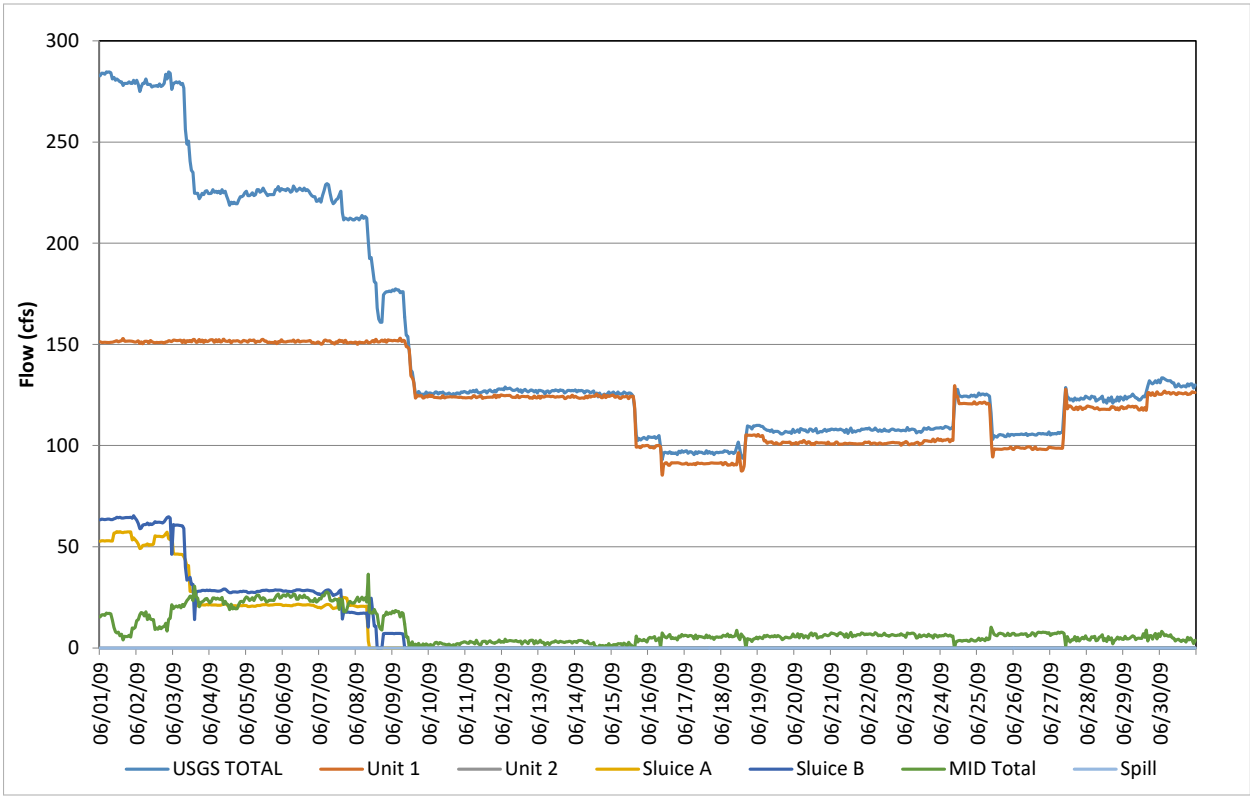

Figure D-54. Flow record in June 2009, based on hourly discharges.

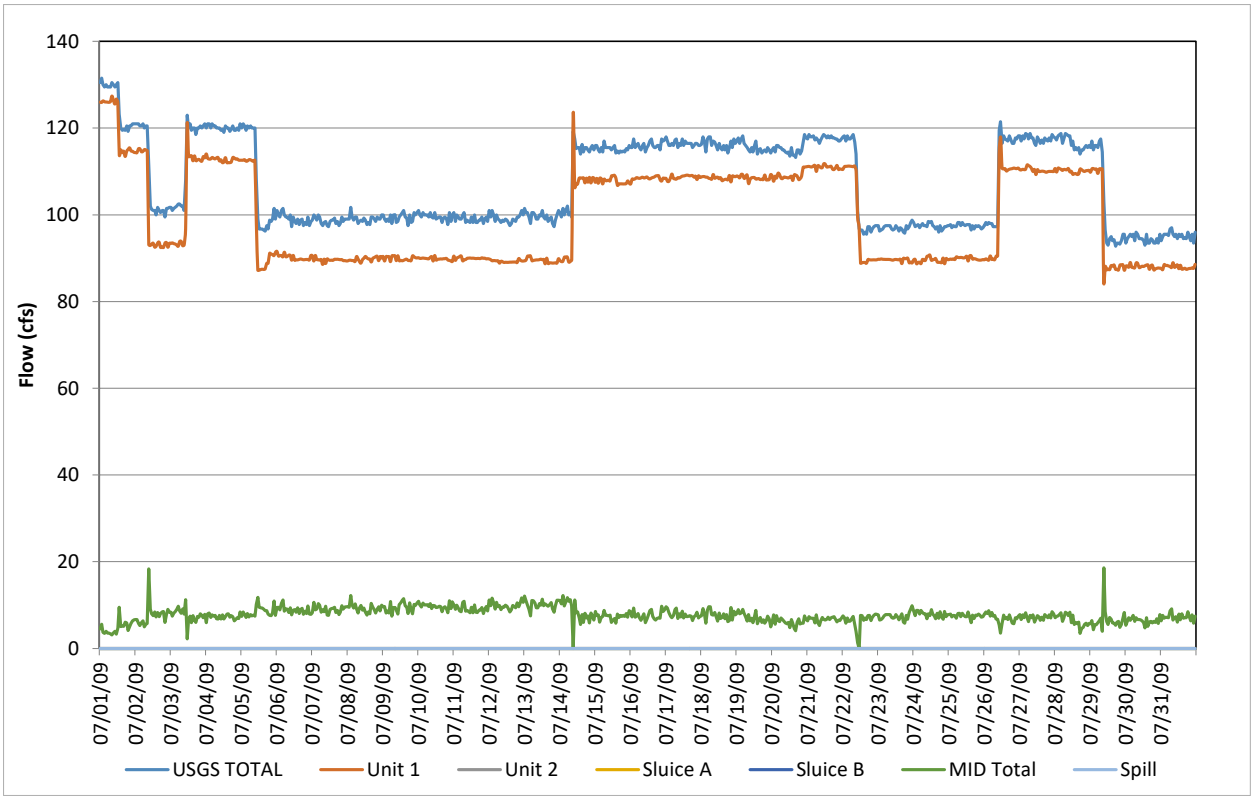

Figure D-55. Flow record in July 2009, based on hourly discharges.

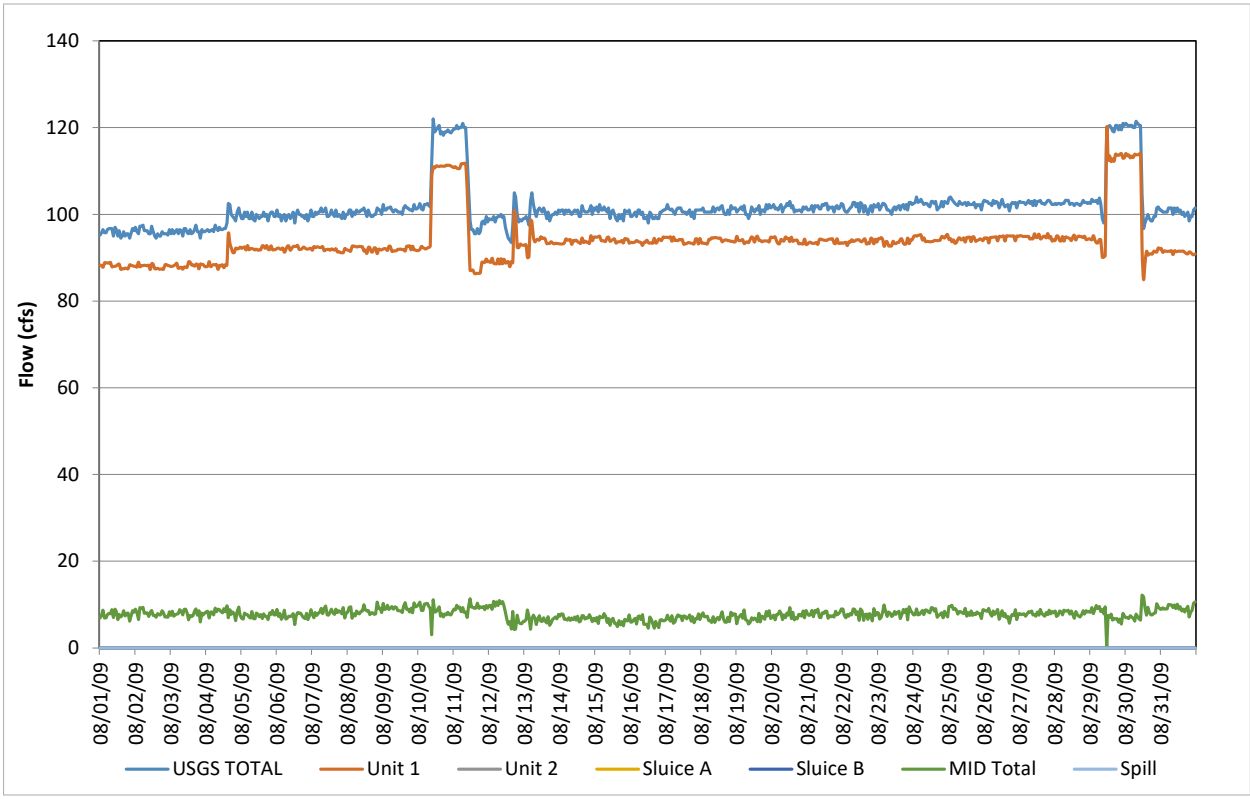

Figure D-56. Flow record in August 2009, based on hourly discharges.

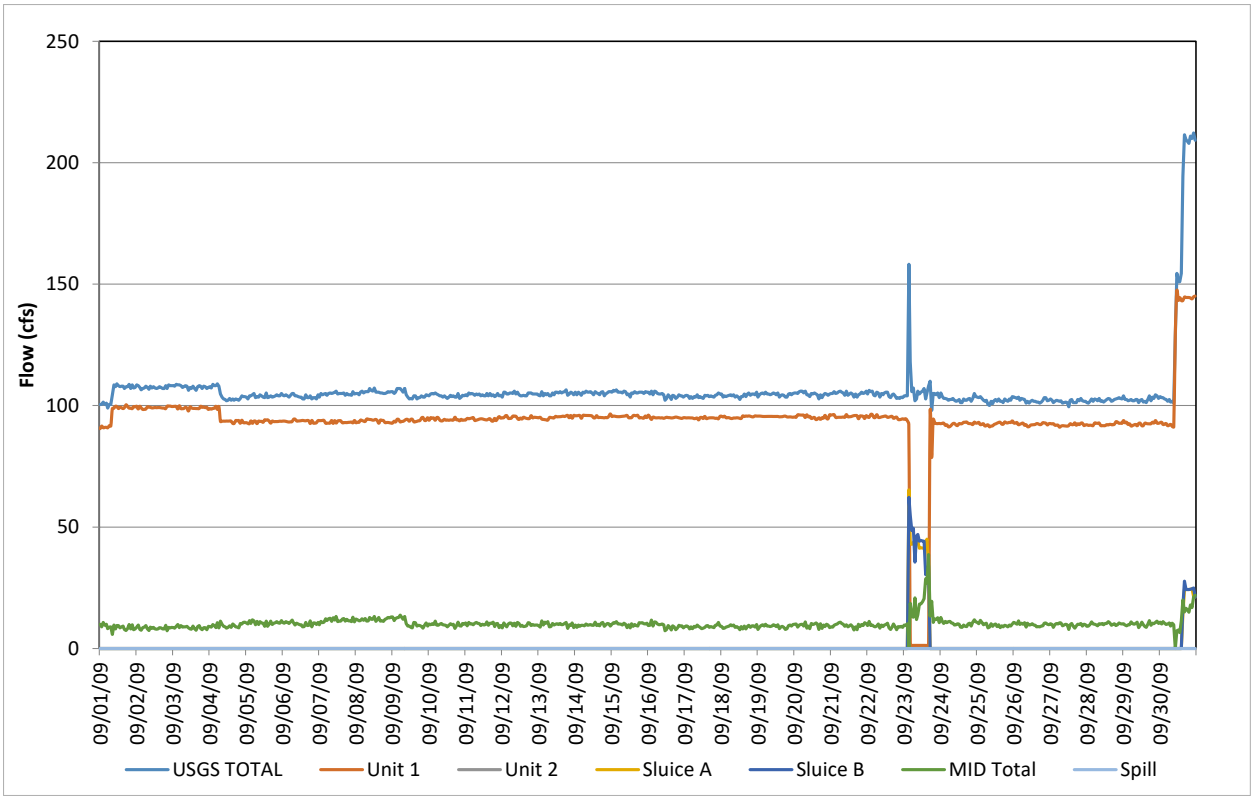

Figure D-57. Flow record in September 2009, based on hourly discharges.

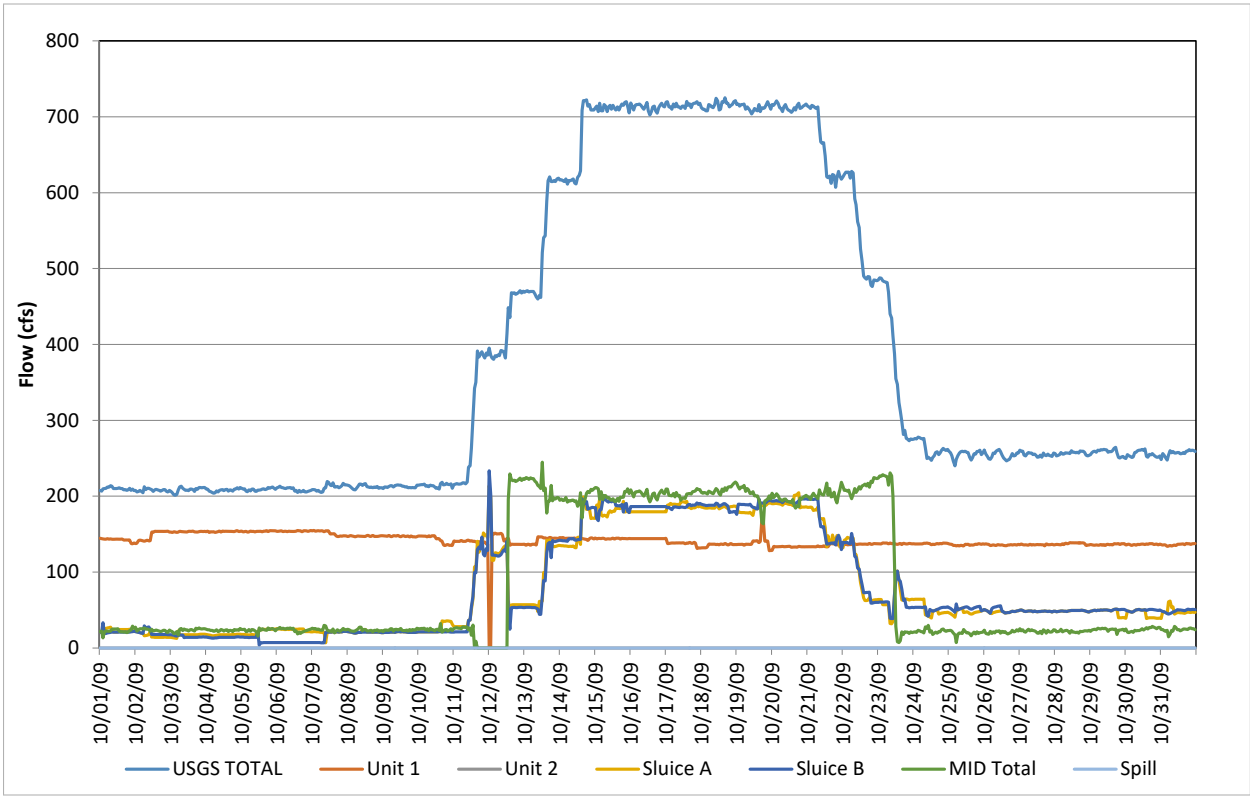

Figure D-58. Flow record in October 2009, based on hourly discharges.

Figure D-59. Flow record in November 2009, based on hourly discharges.

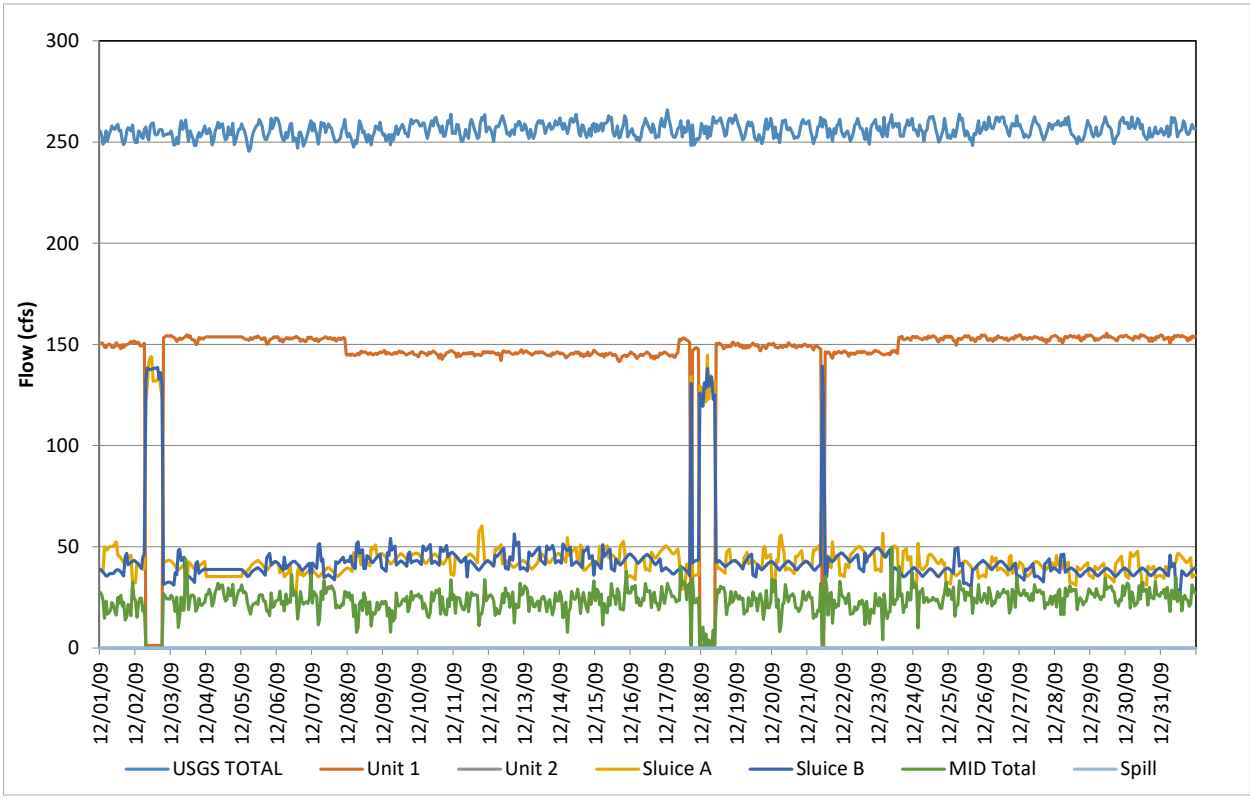

Figure D-60. Flow record in December 2009, based on hourly discharges.

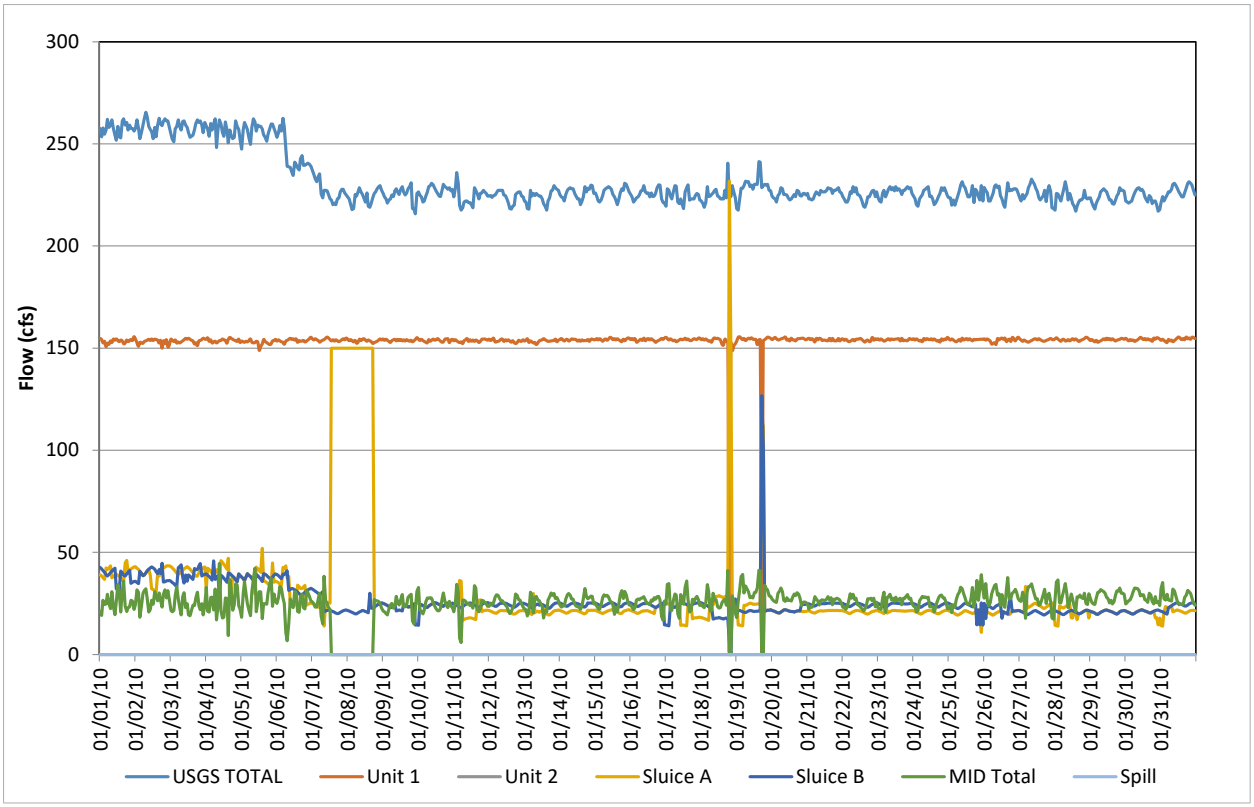

Figure D-61. Flow record in January 2010, based on hourly discharges.

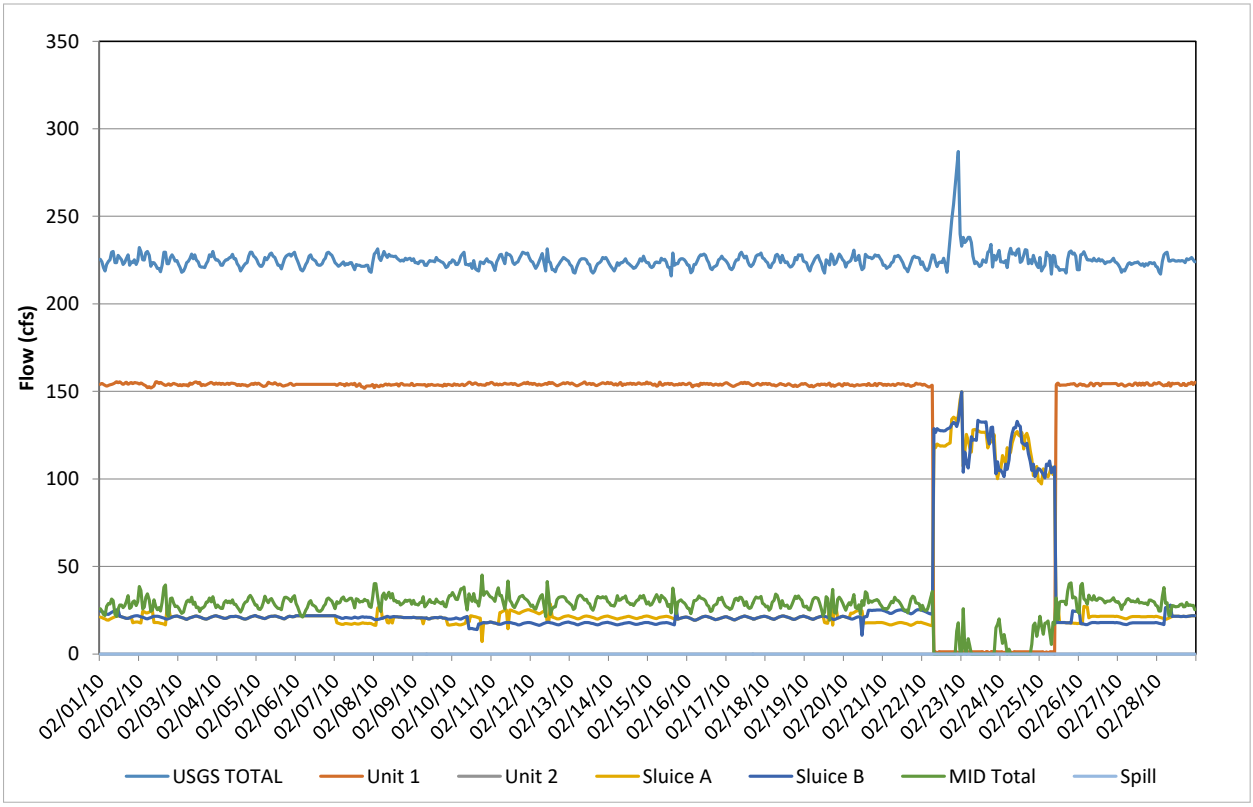

Figure D-62. Flow record in February 2010, based on hourly discharges.

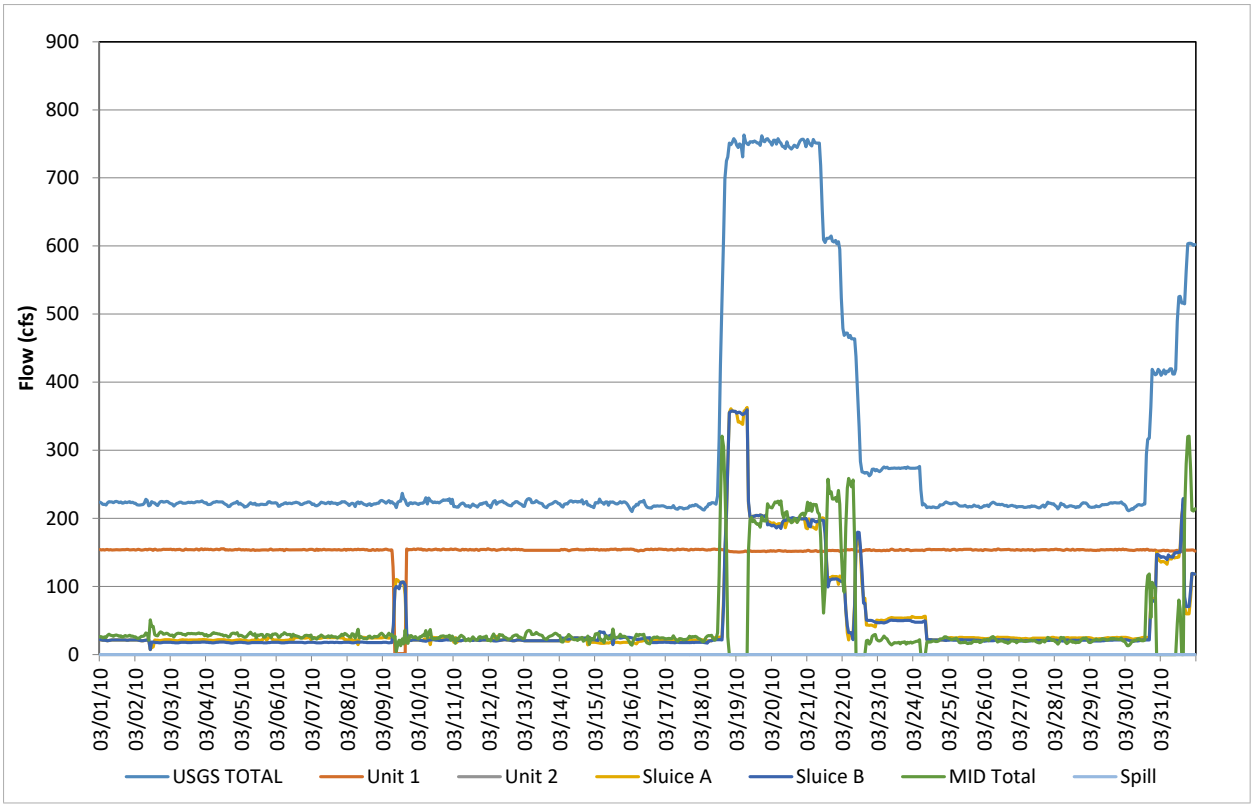

Figure D-63. Flow record in March 2010, based on hourly discharges.

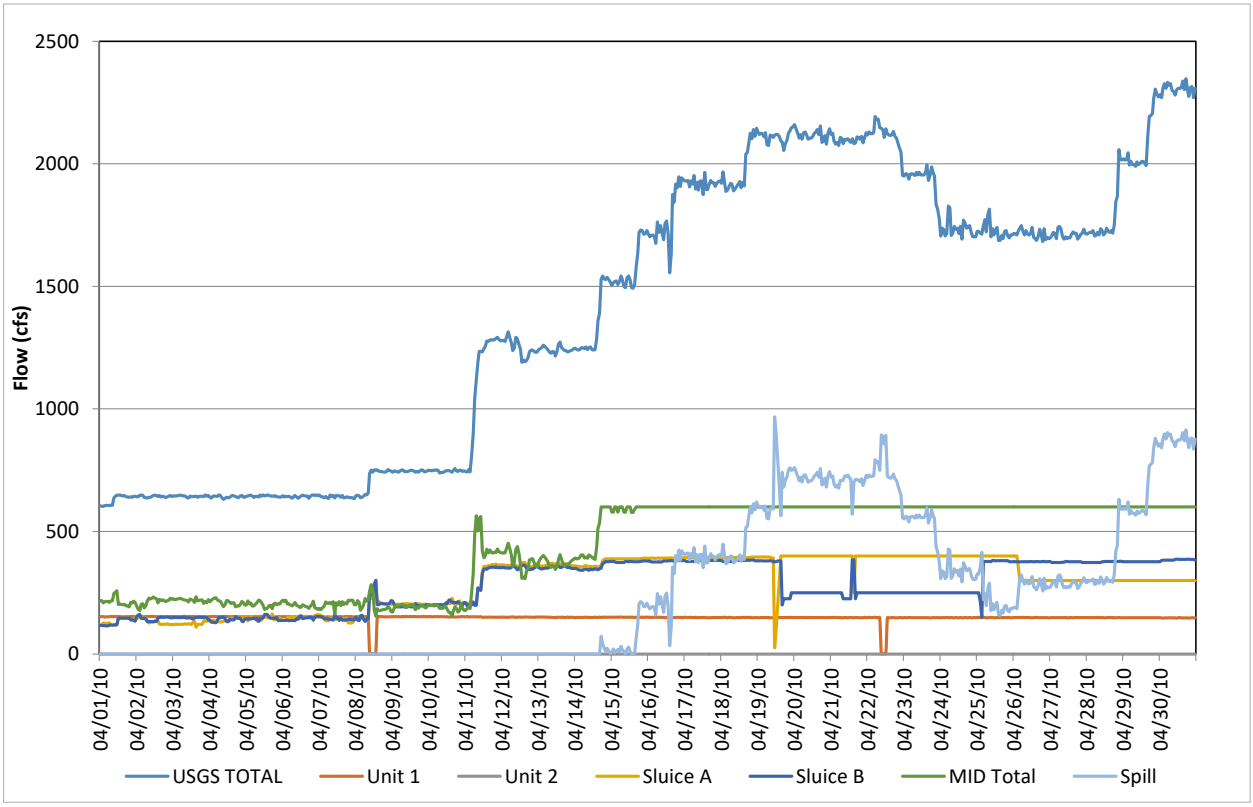

Figure D-64. Flow record in April 2010, based on hourly discharges.

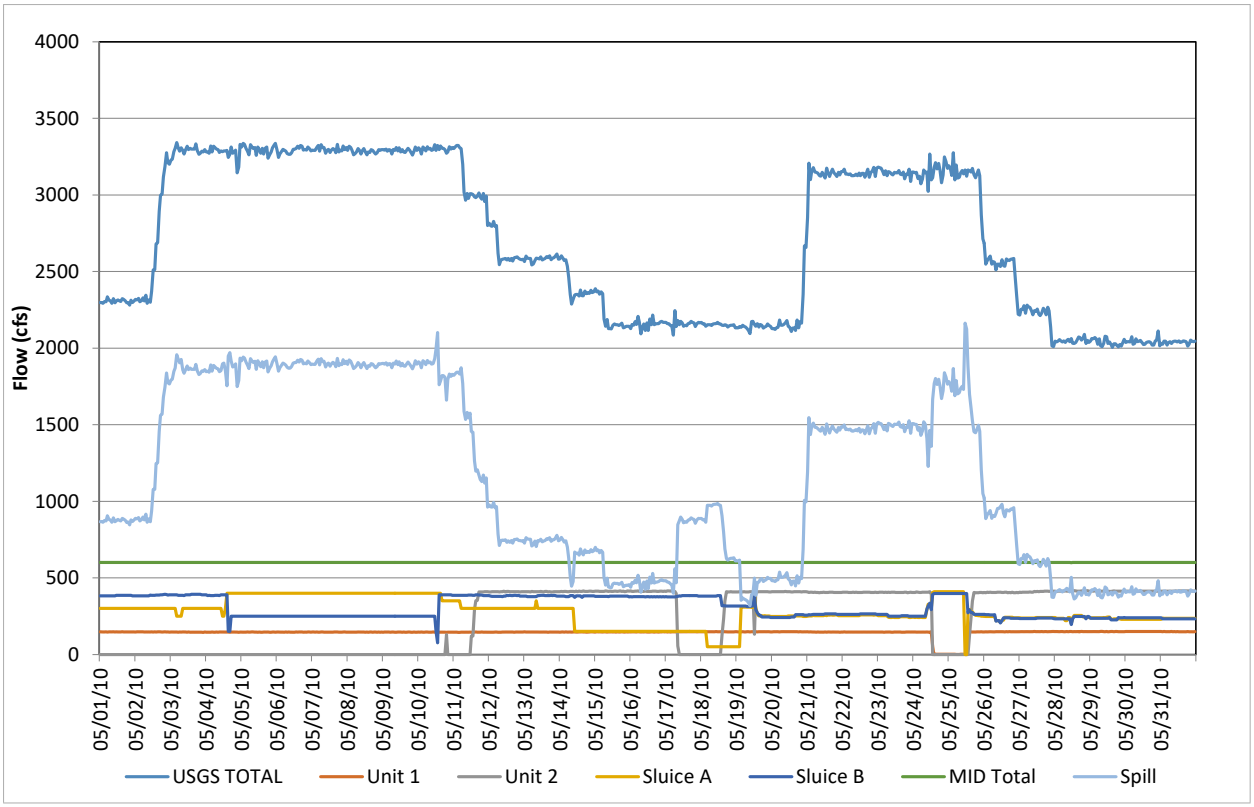

Figure D-65. Flow record in May 2010, based on hourly discharges.

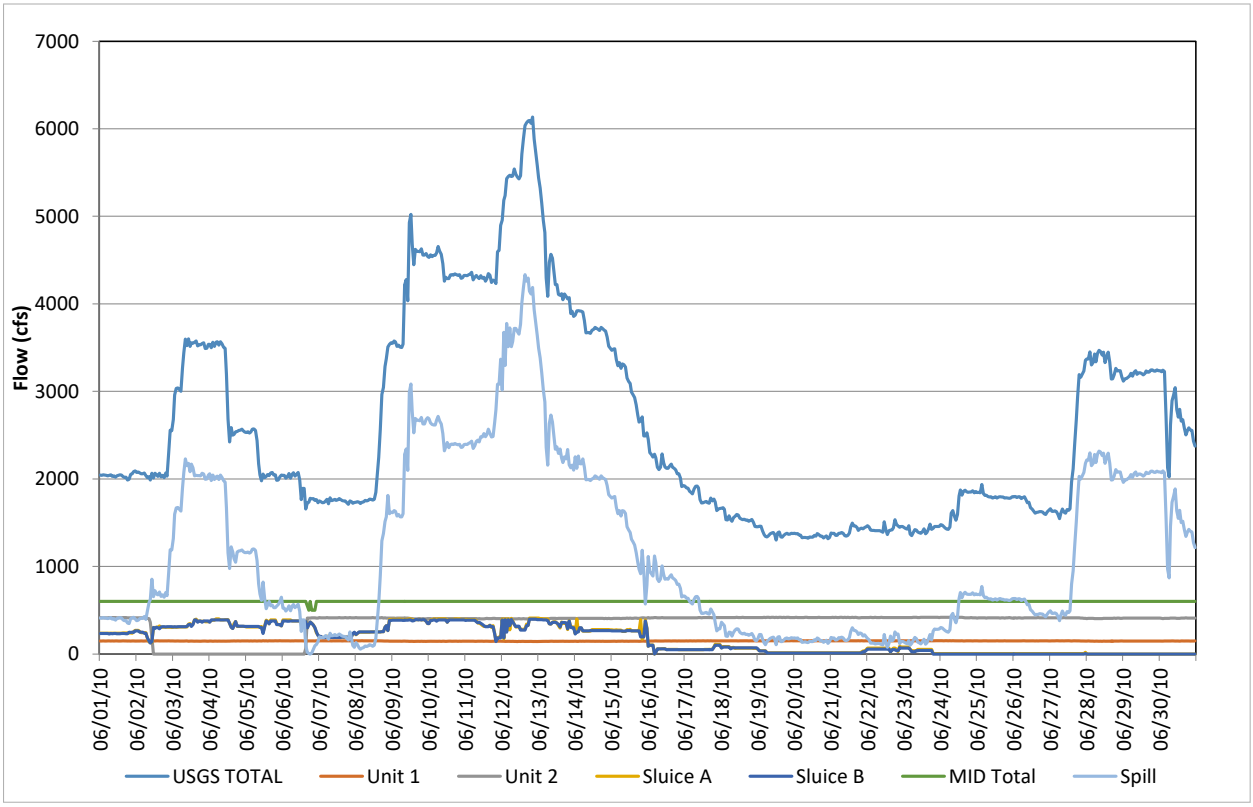

Figure D-66. Flow record in June 2010, based on hourly discharges.

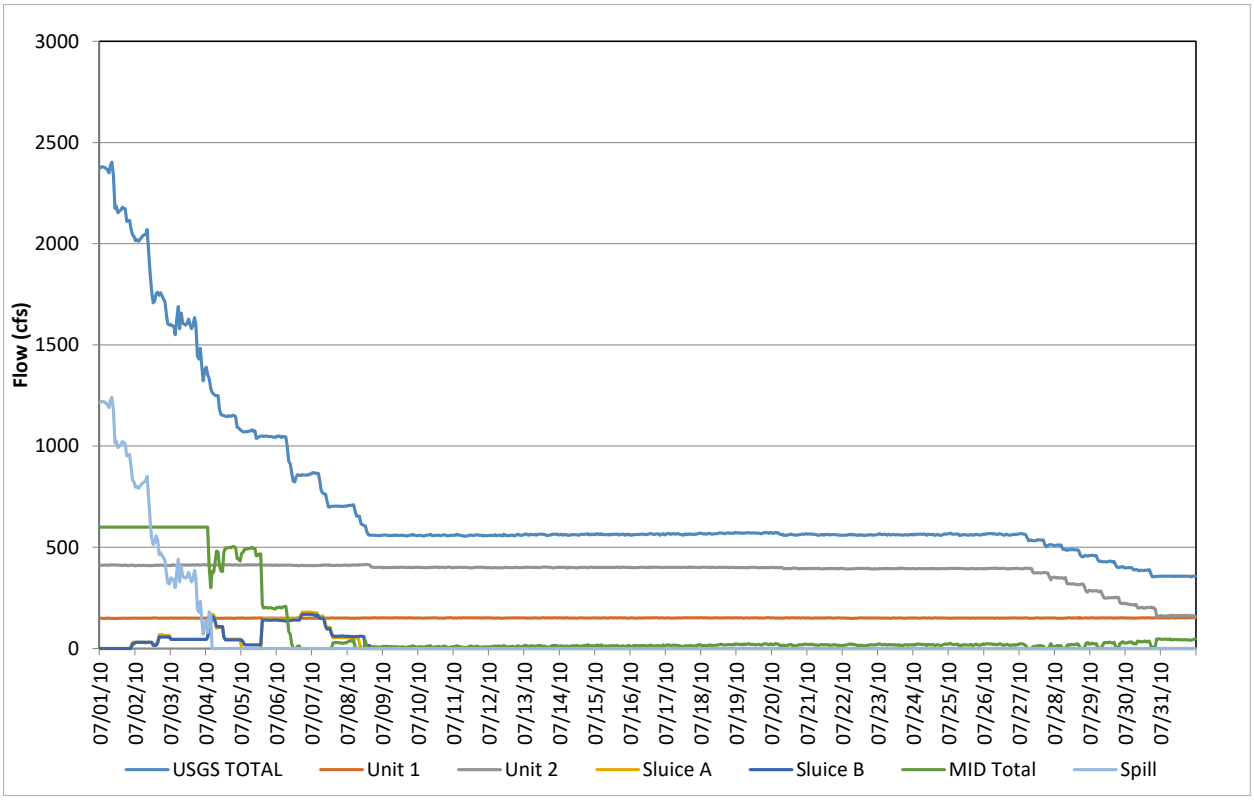

Figure D-67. Flow record in July 2010, based on hourly discharges.

Figure D-68. Flow record in August 2010, based on hourly discharges.

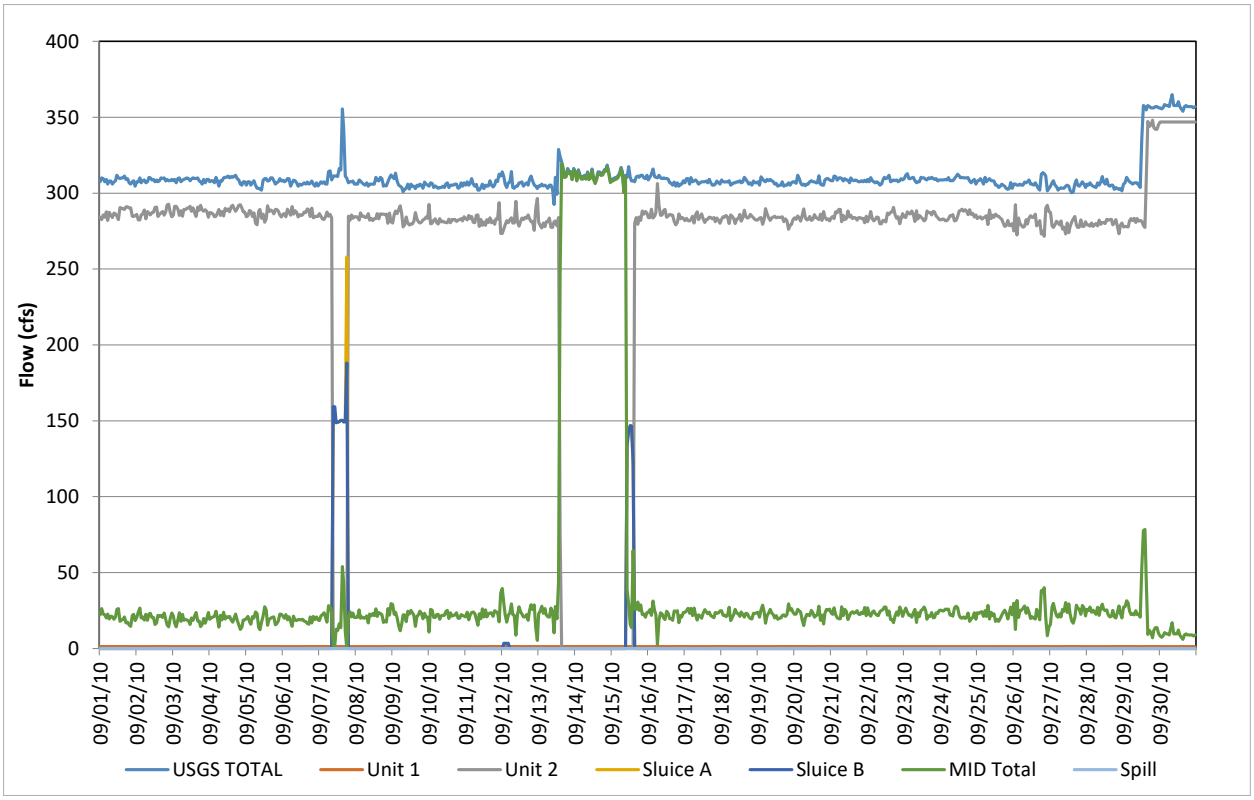

Figure D-69. Flow record in September 2010, based on hourly discharges.

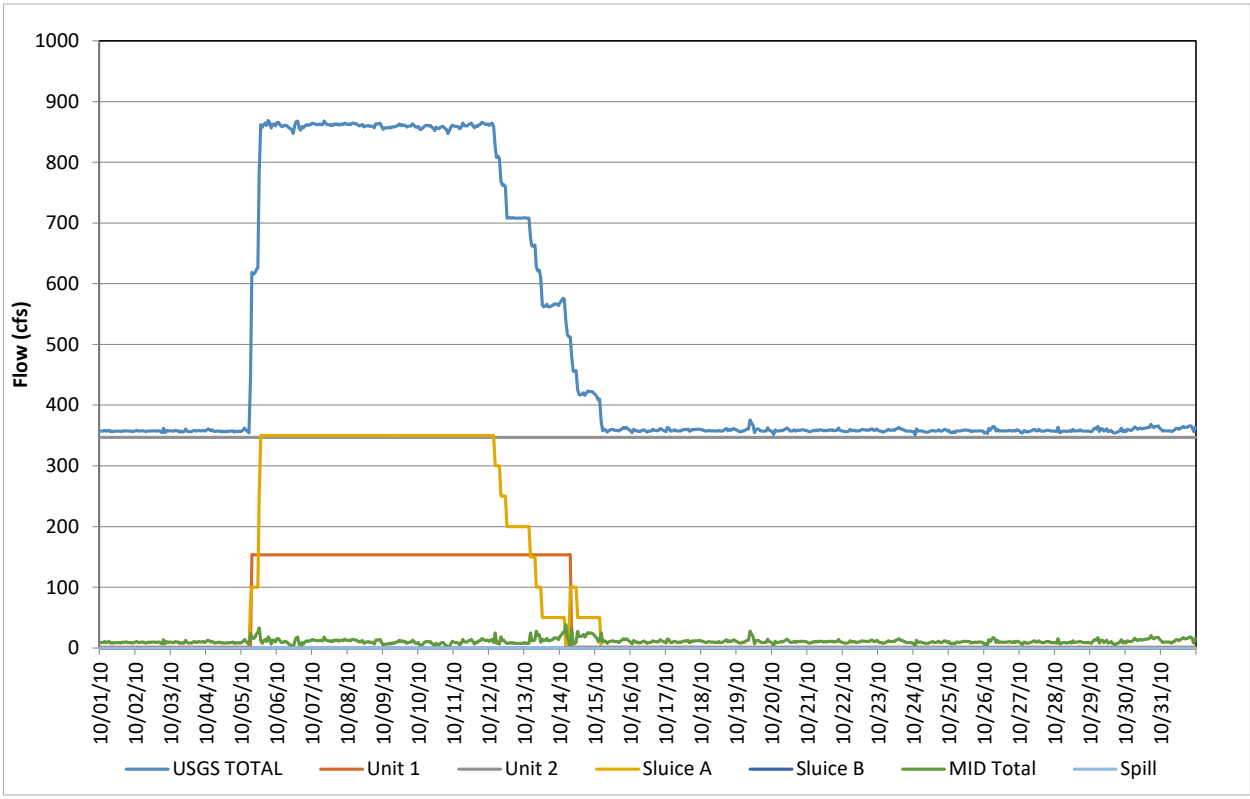

Figure D-70. Flow record in October 2010, based on hourly discharges.

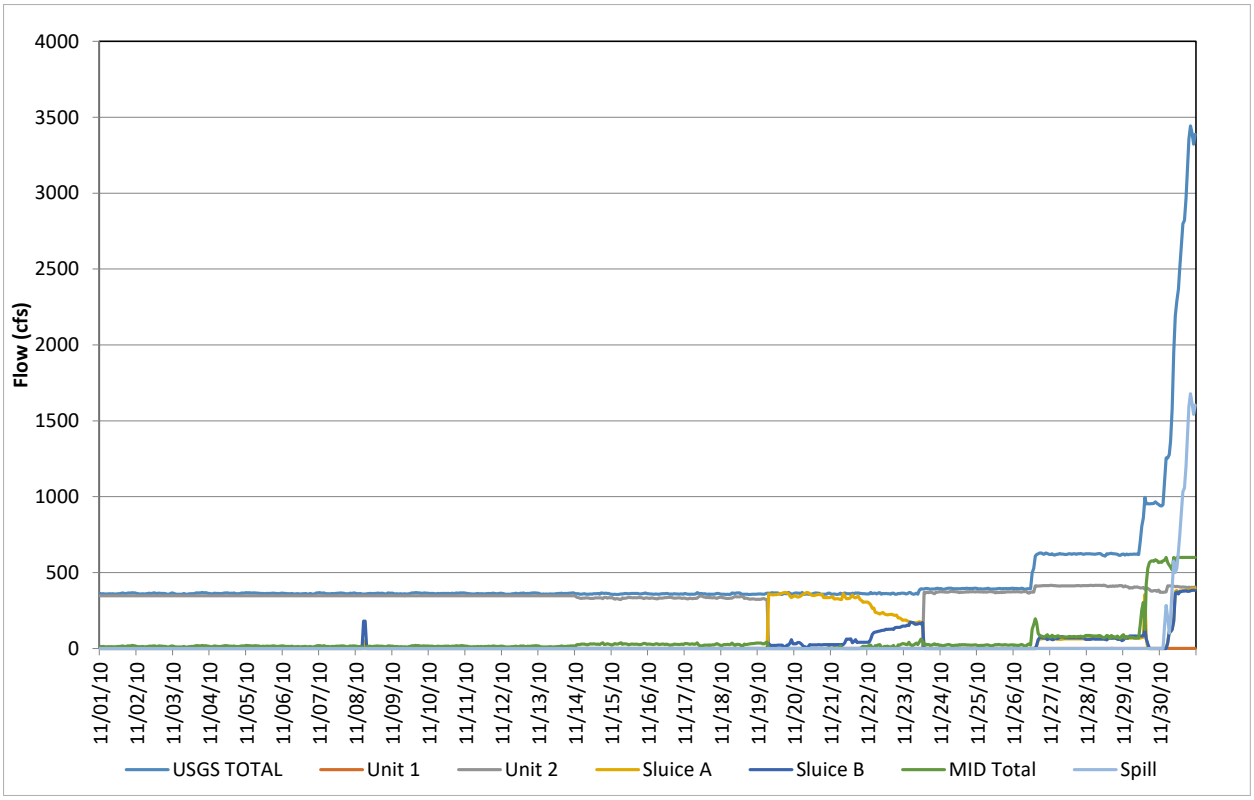

Figure D-71. Flow record in November 2010, based on hourly discharges.

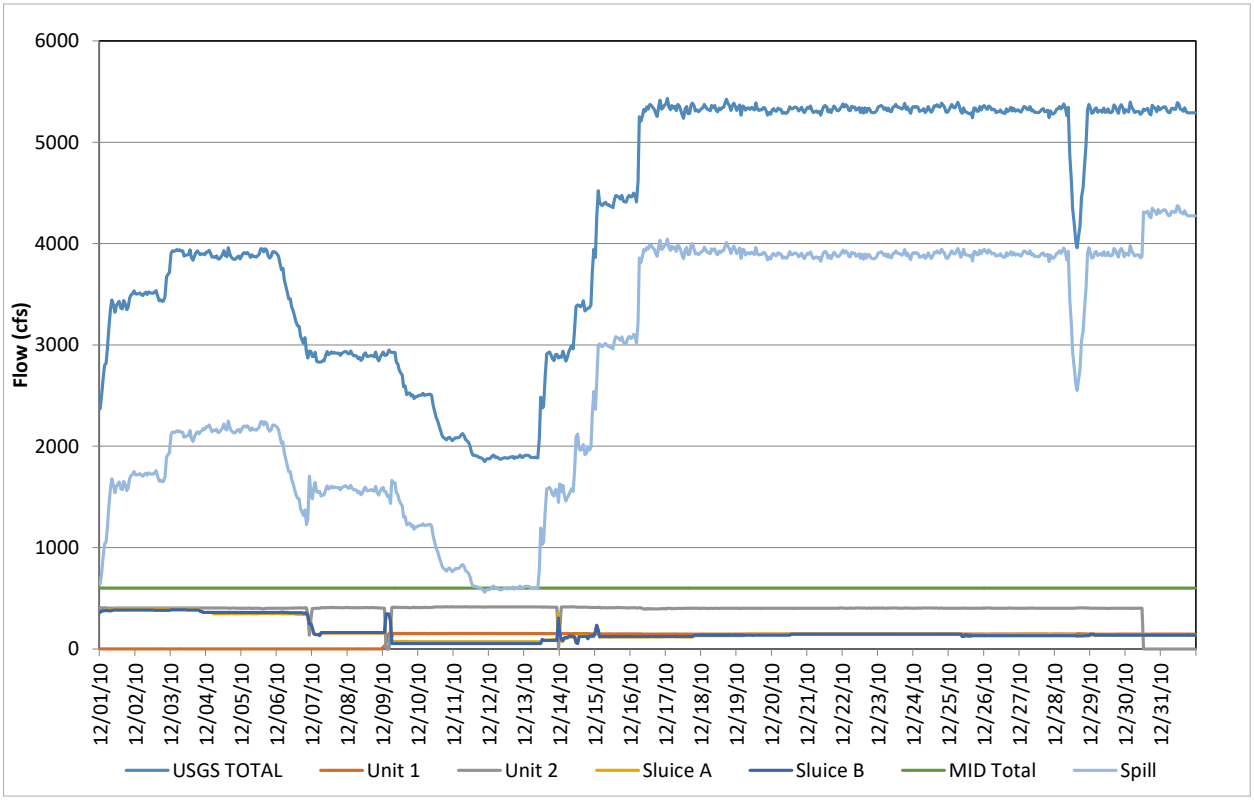

Figure D-72. Flow record in December 2010, based on hourly discharges.

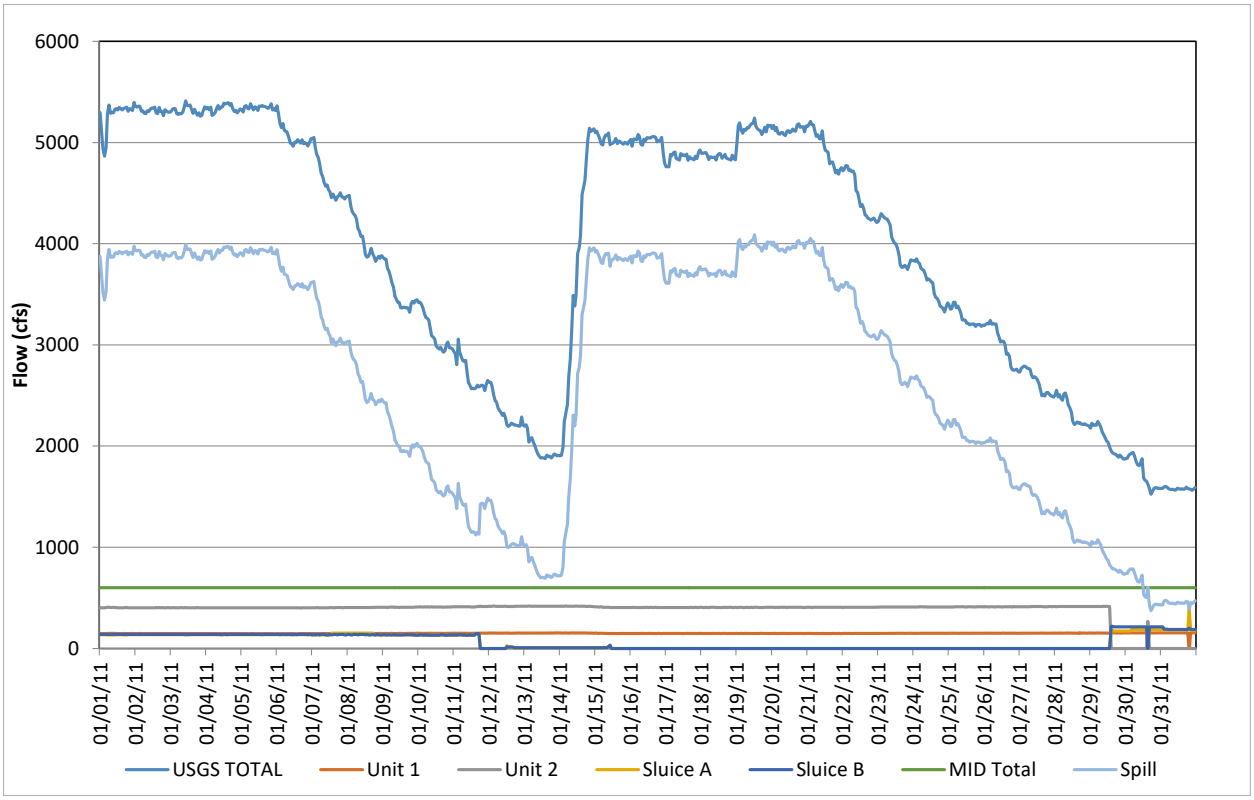

Figure D-73. Flow record in January 2011, based on hourly discharges.

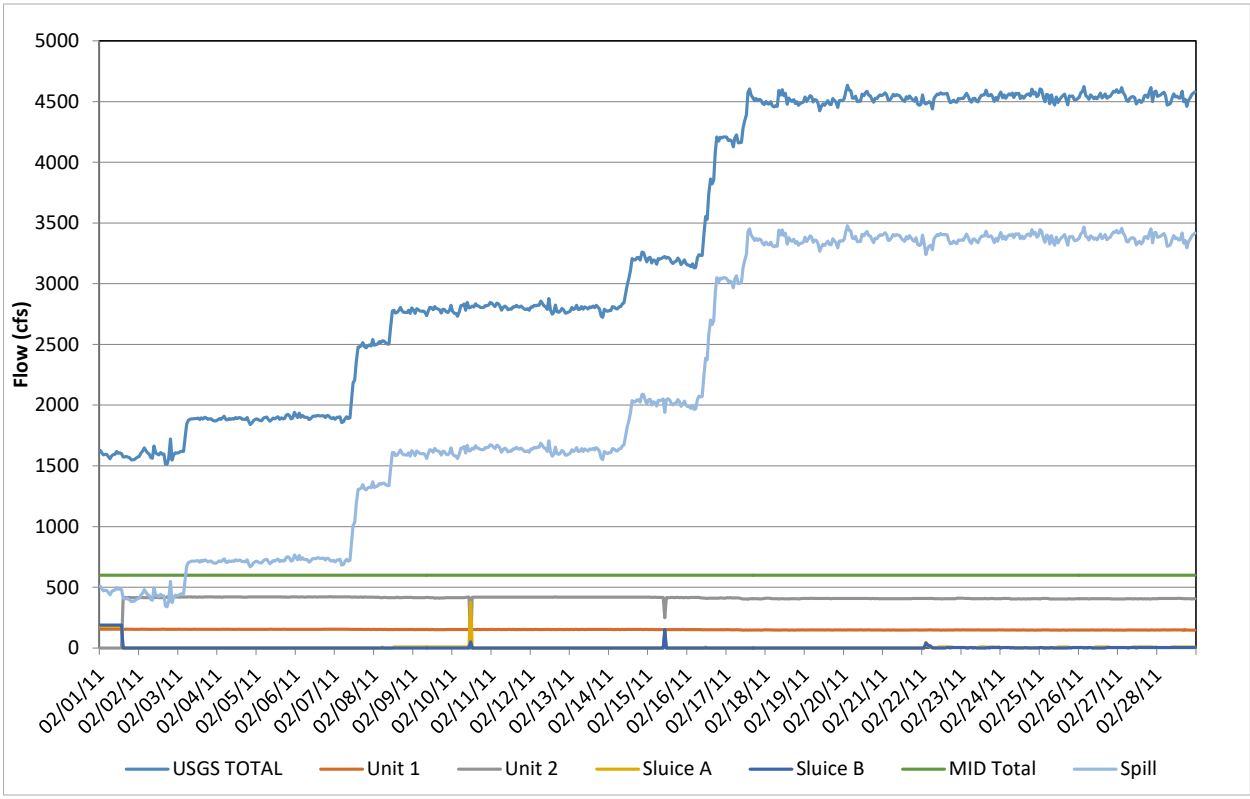

Figure D-74. Flow record in February 2011, based on hourly discharges.

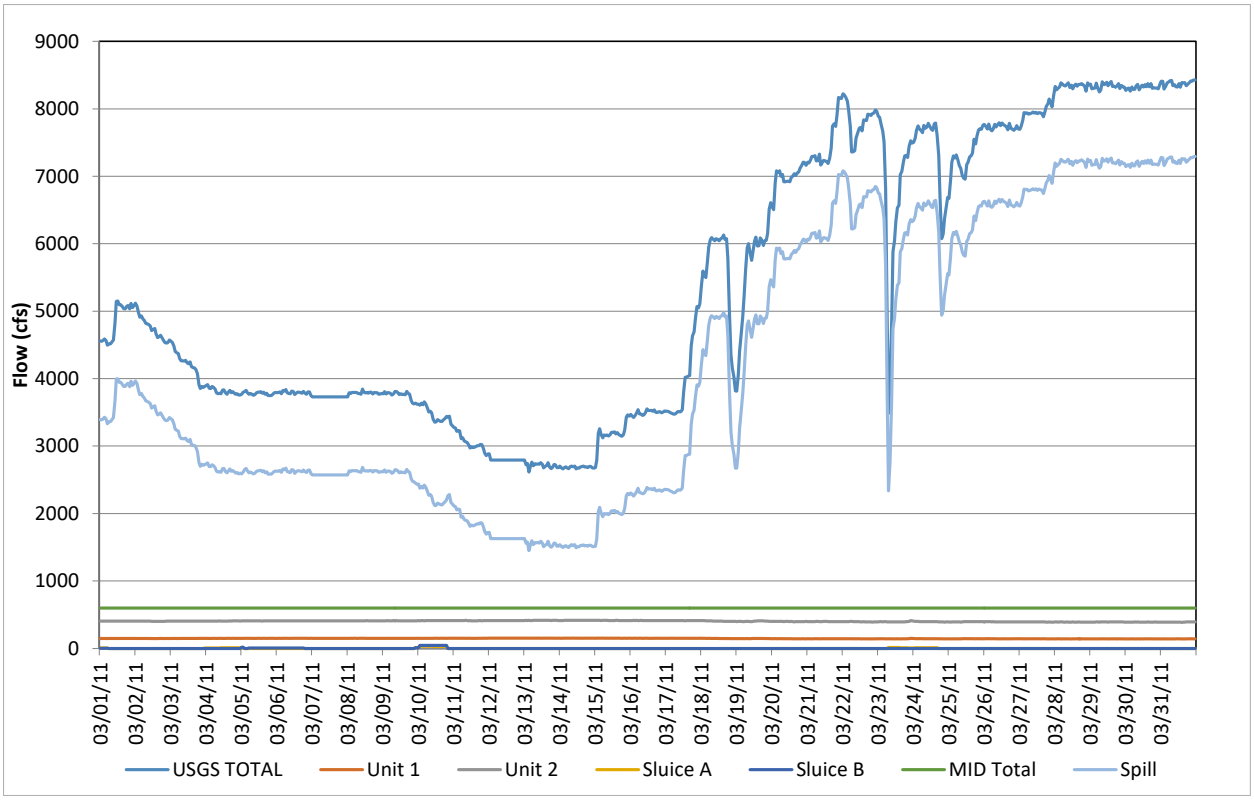

Figure D-75. Flow record in March 2011, based on hourly discharges.

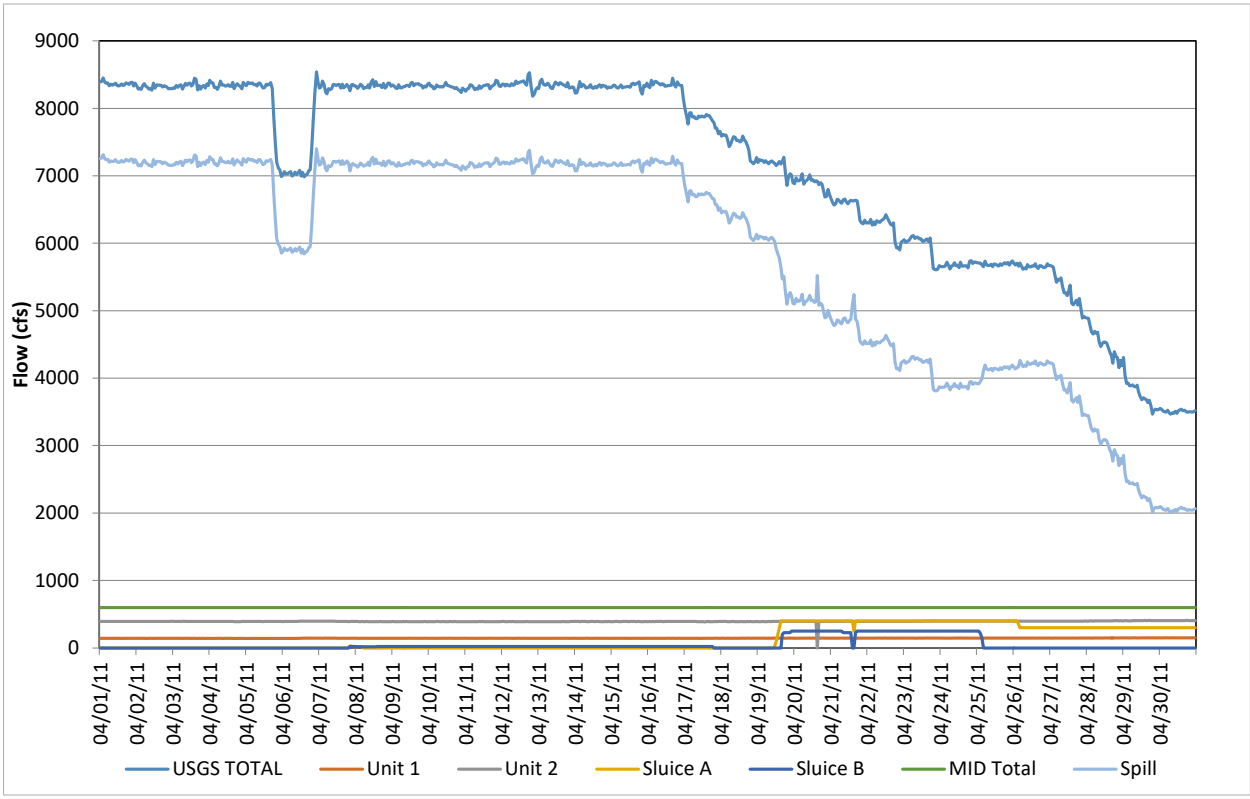

Figure D-76. Flow record in April 2011, based on hourly discharges.

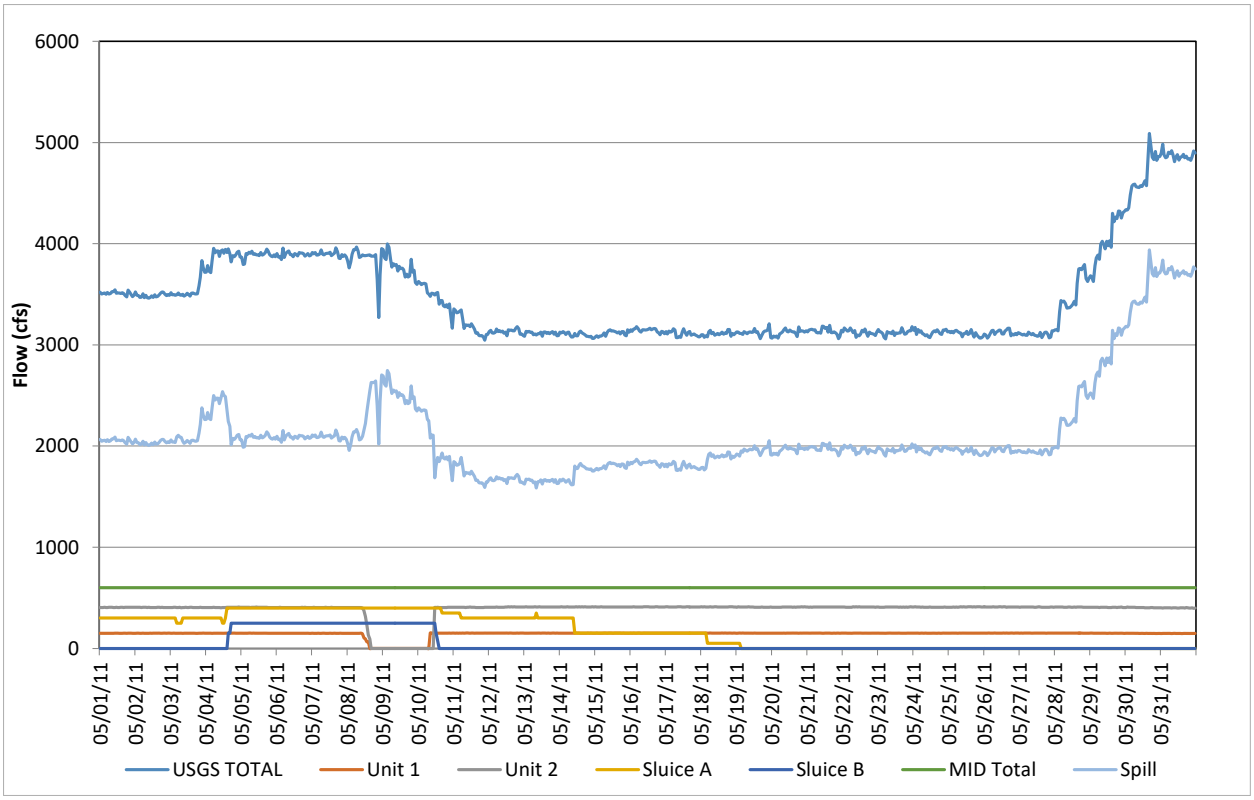

Figure D-77. Flow record in May 2011, based on hourly discharges.

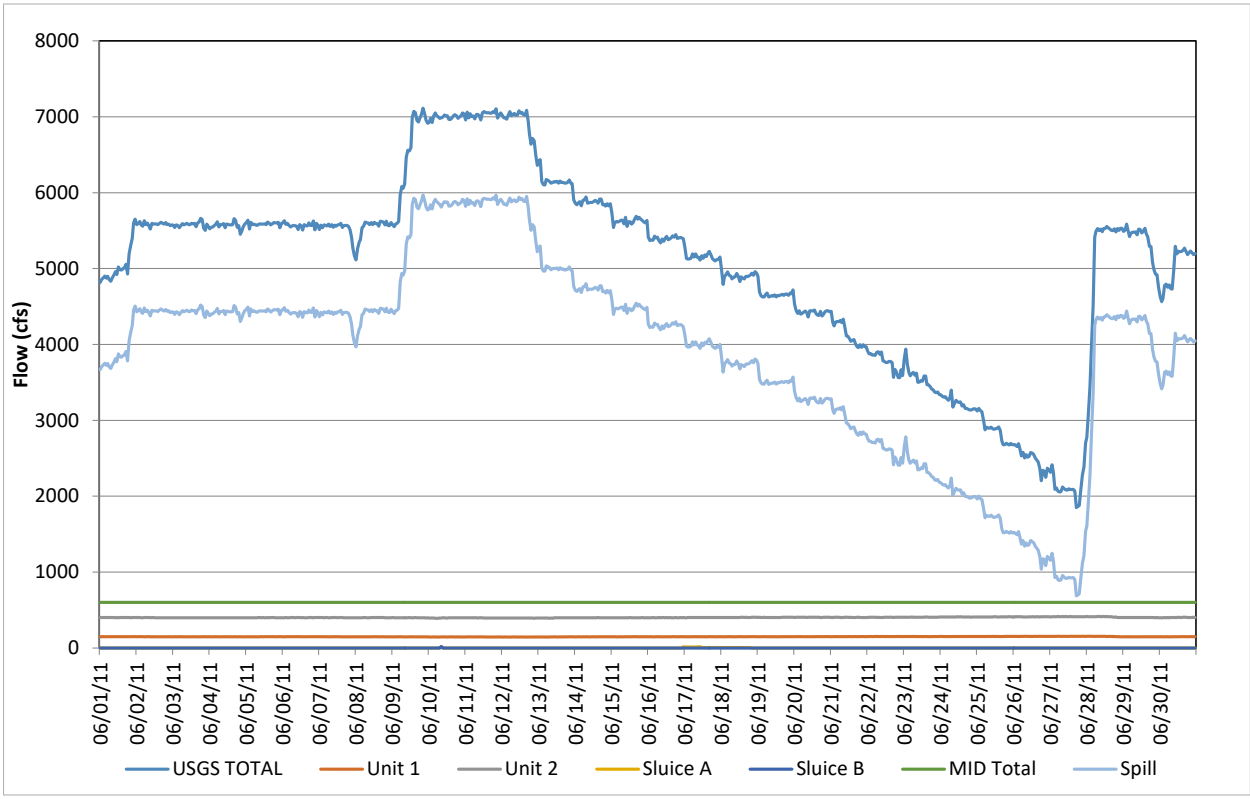

Figure D-78. Flow record in June 2011, based on hourly discharges.

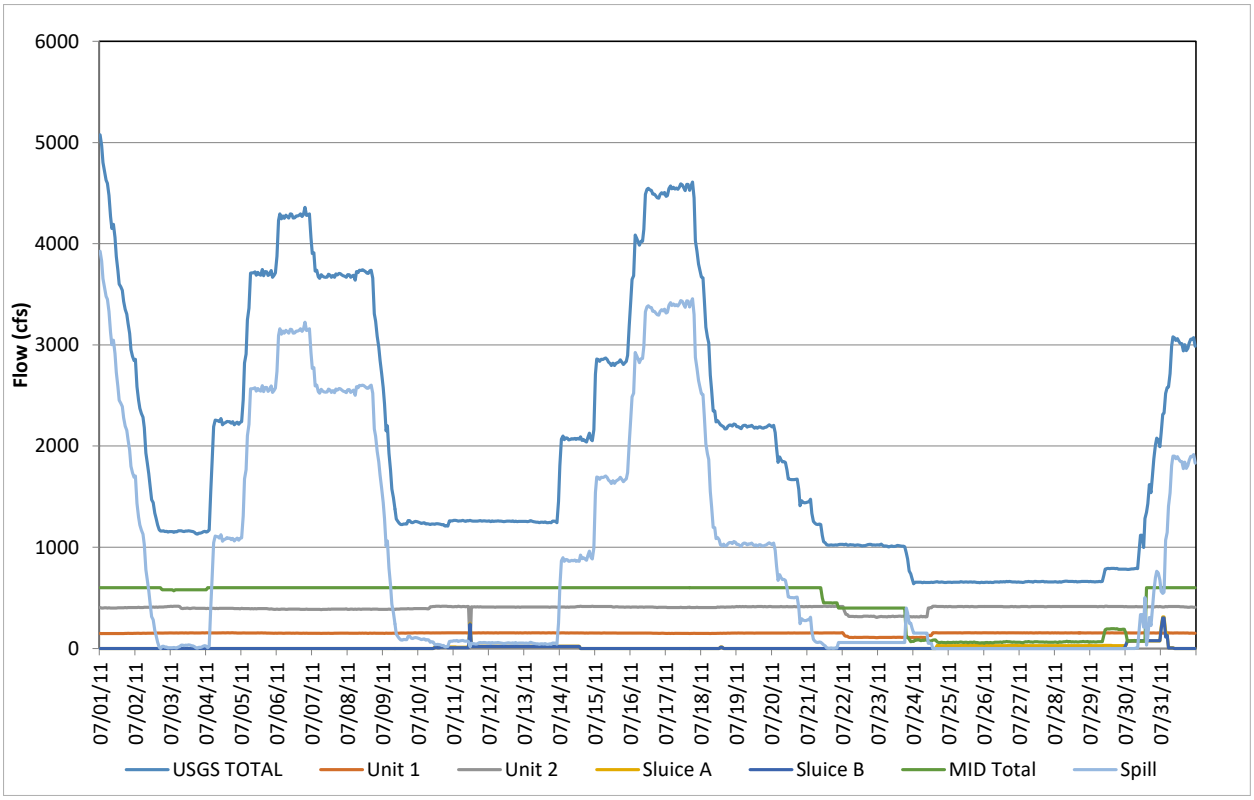

Figure D-79. Flow record in July 2011, based on hourly discharges.

Figure D-80. Flow record in August 2011, based on hourly discharges.

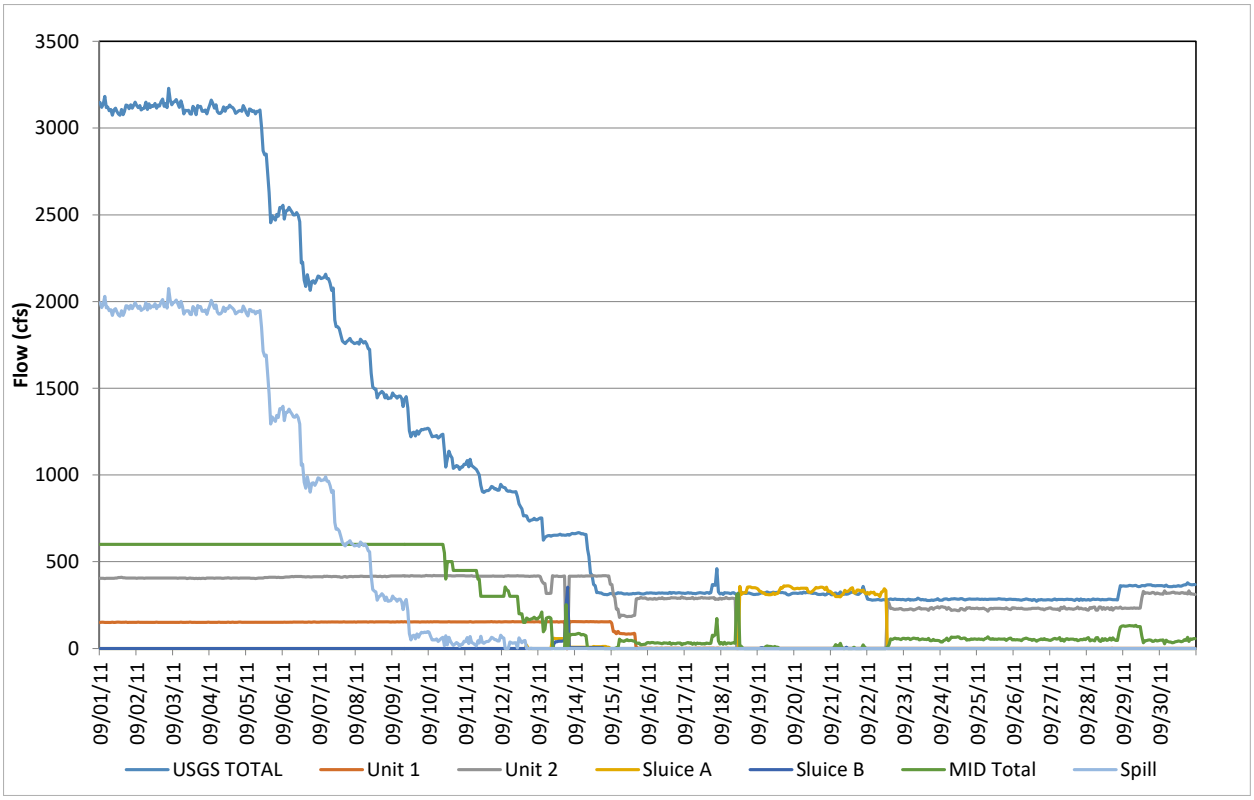

Figure D-81. Flow record in September 2011, based on hourly discharges.

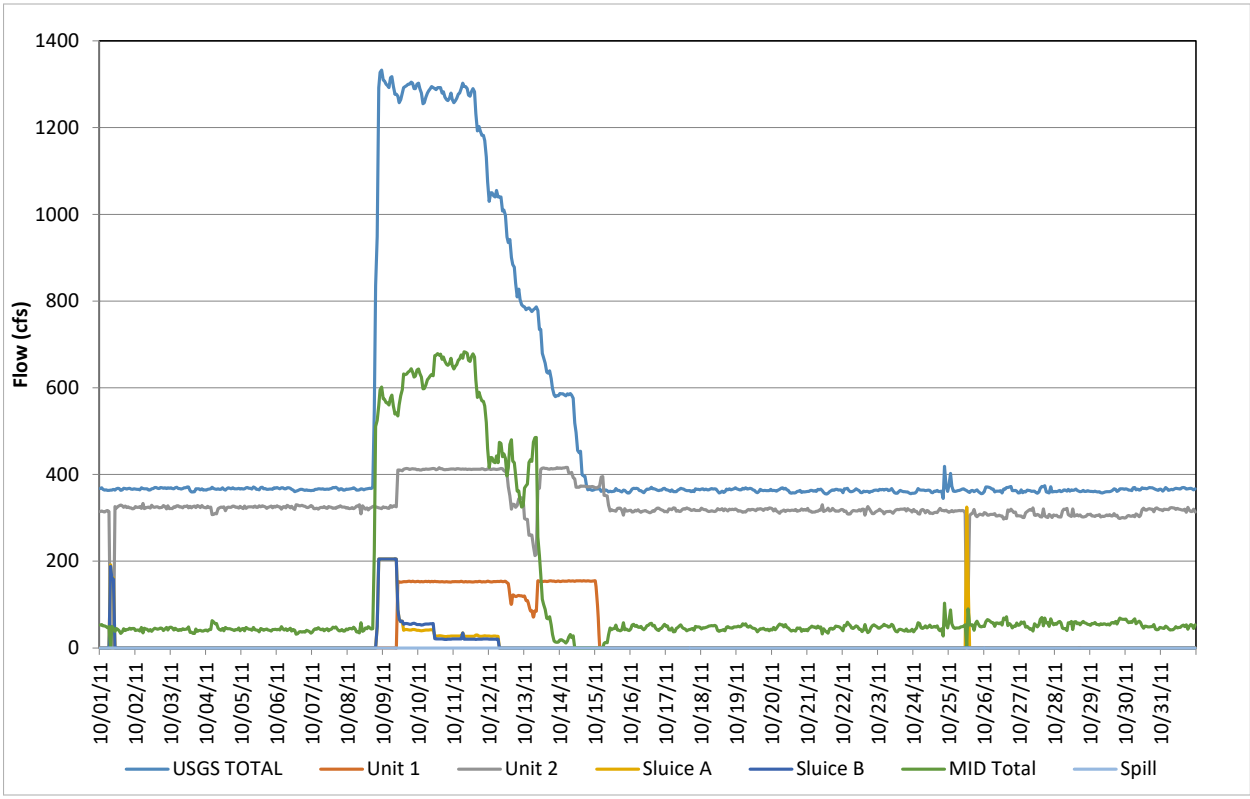

Figure D-82. Flow record in October 2011, based on hourly discharges.

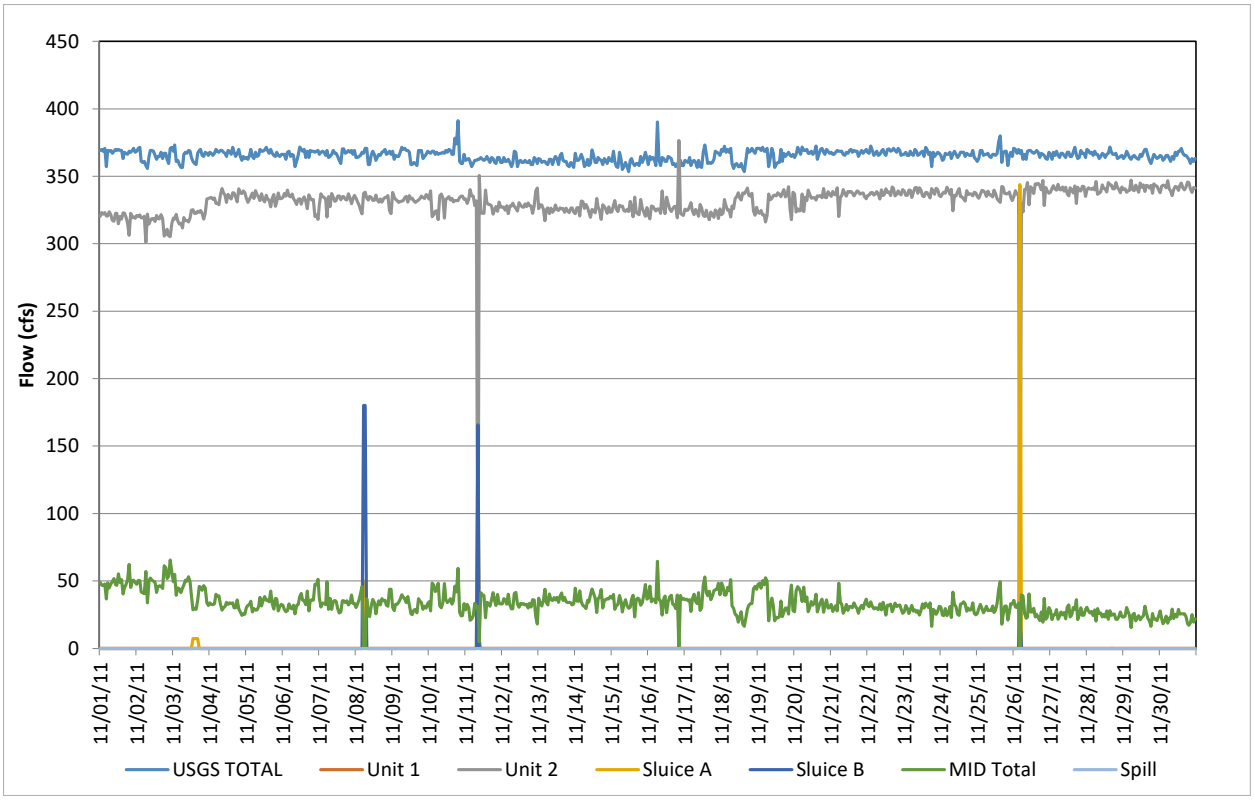

Figure D-83. Flow record in November 2011, based on hourly discharges.

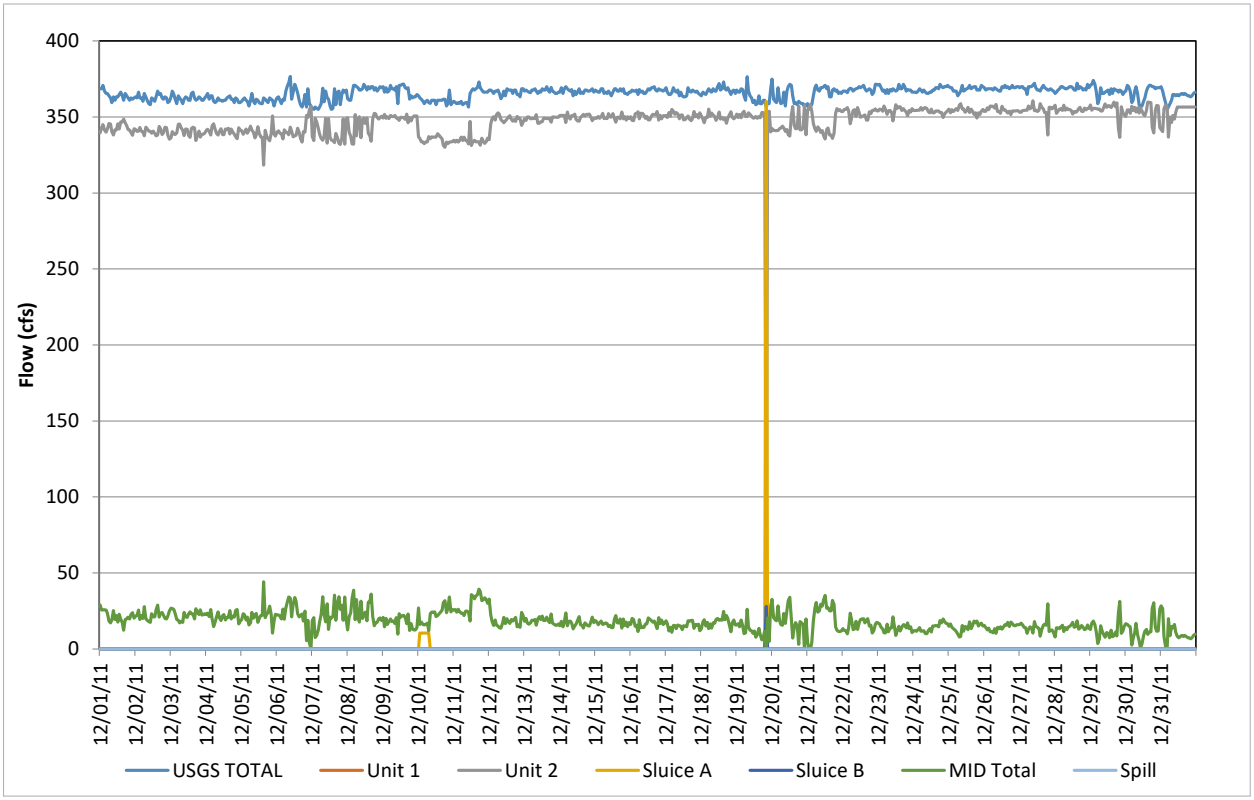

Figure D-84 Flow record in December 2011, based on hourly discharges.

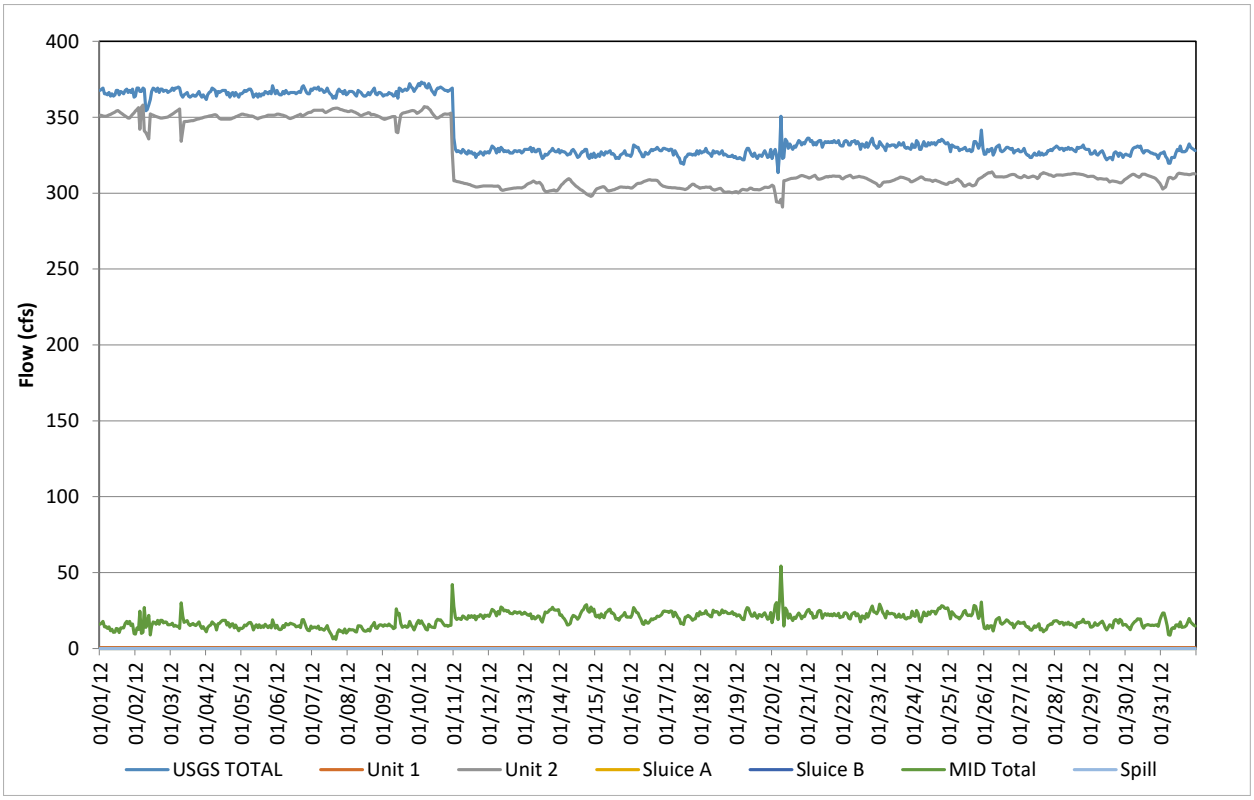

Figure D-85. Flow record in January 2012, based on hourly discharges.

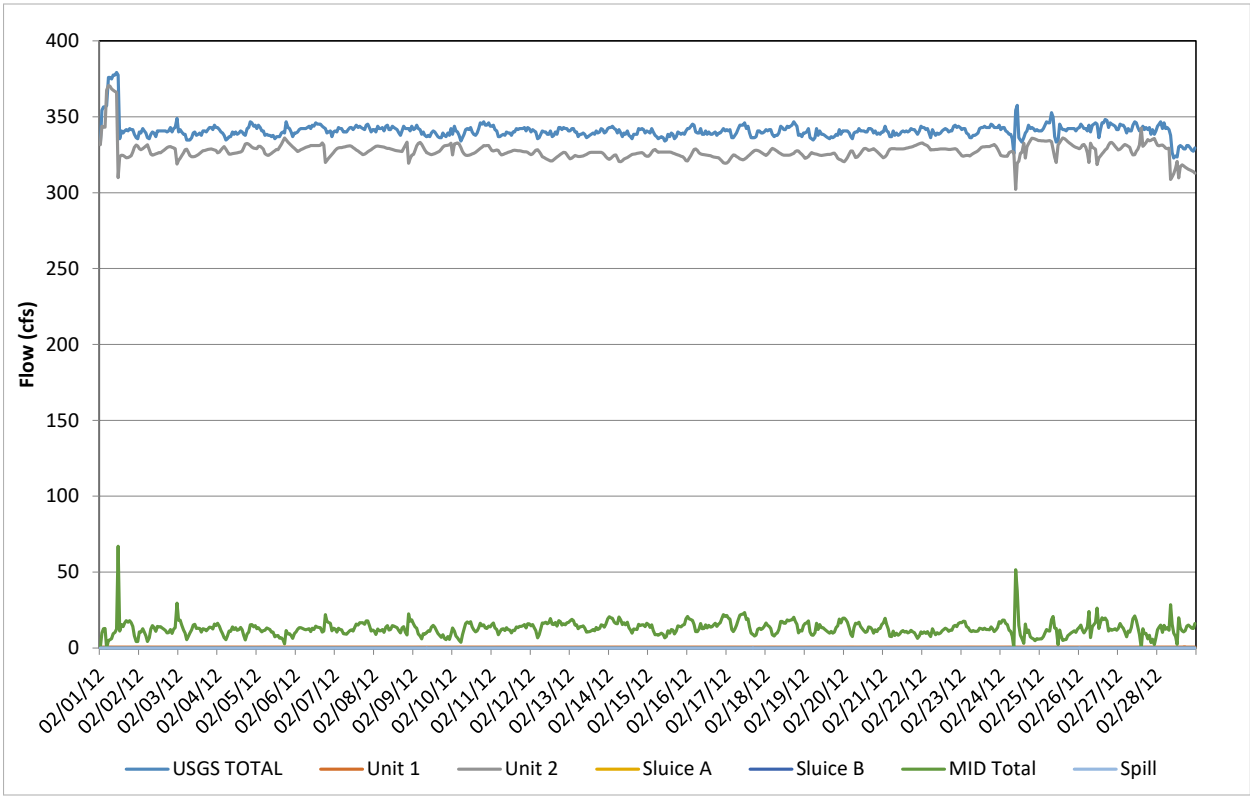

Figure D-86. Flow record in February 2012, based on hourly discharges.

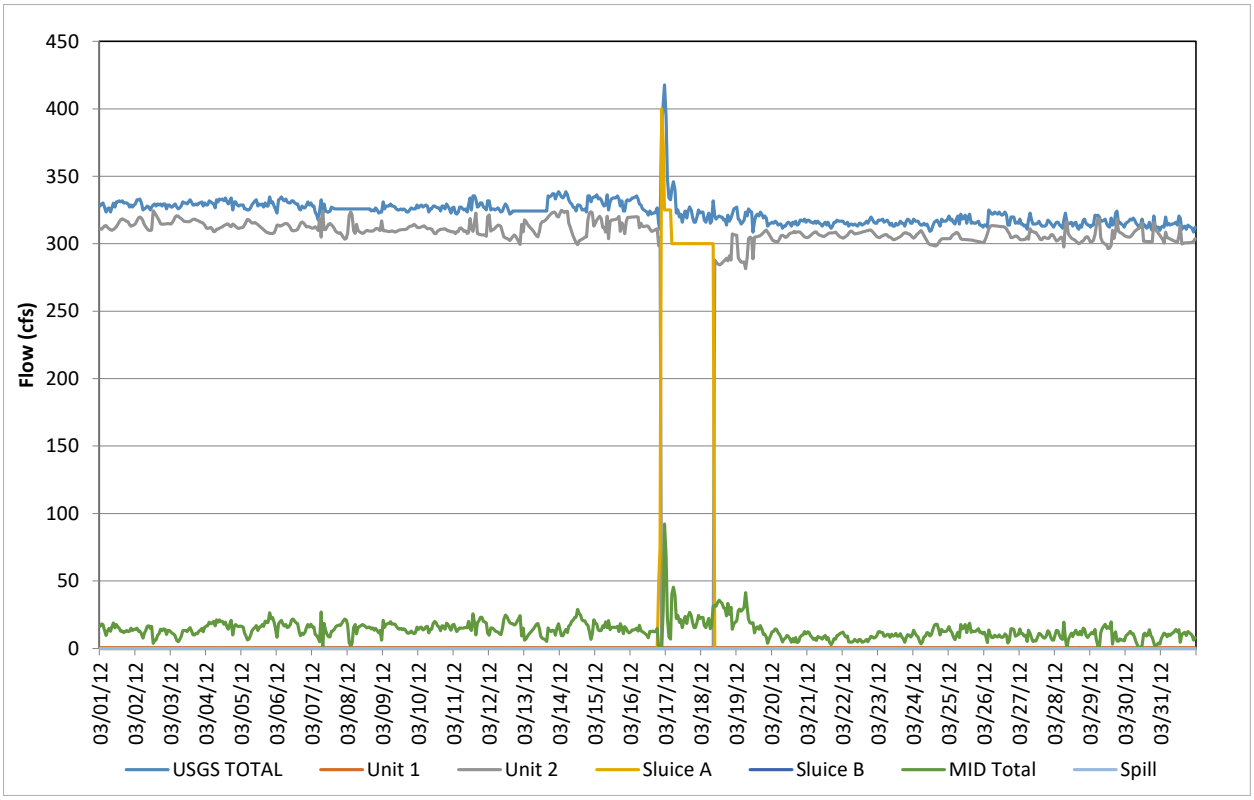

Figure D-87. Flow record in March 2012, based on hourly discharges.

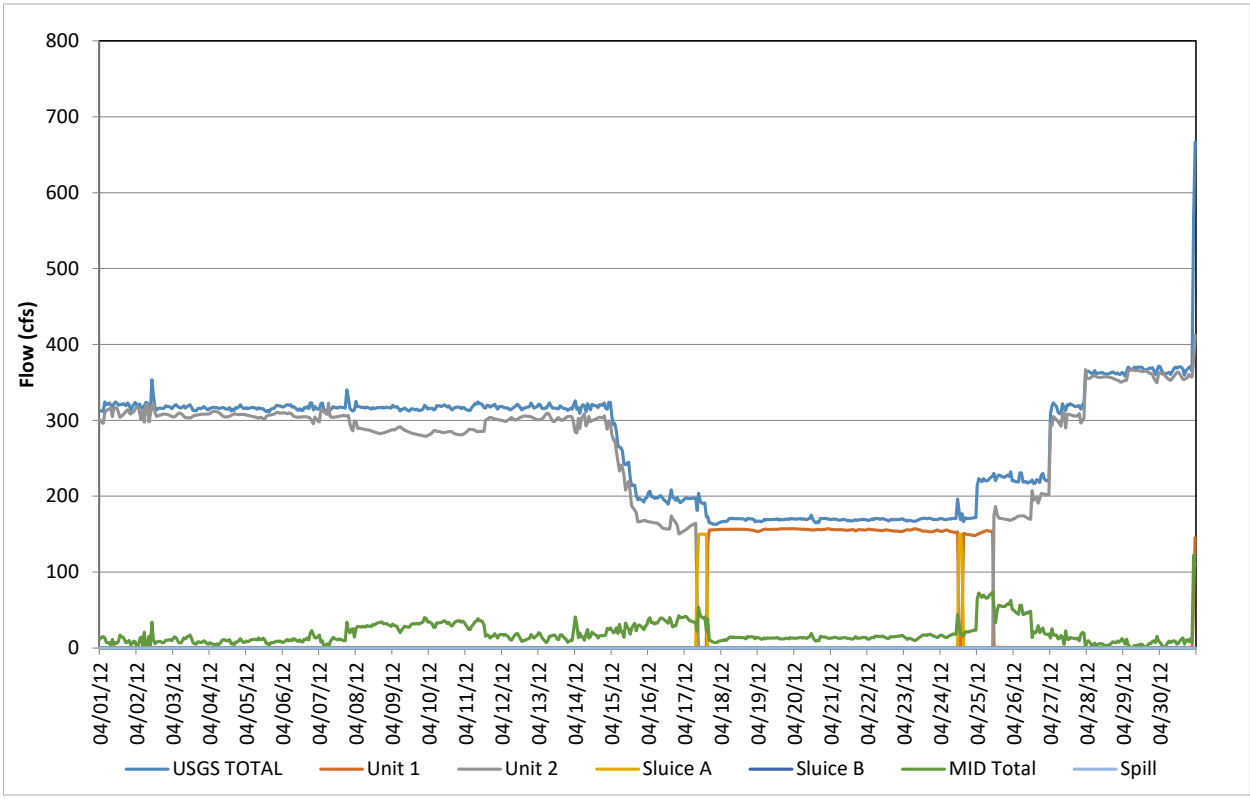

Figure D-88. Flow record in April 2012, based on hourly discharges.

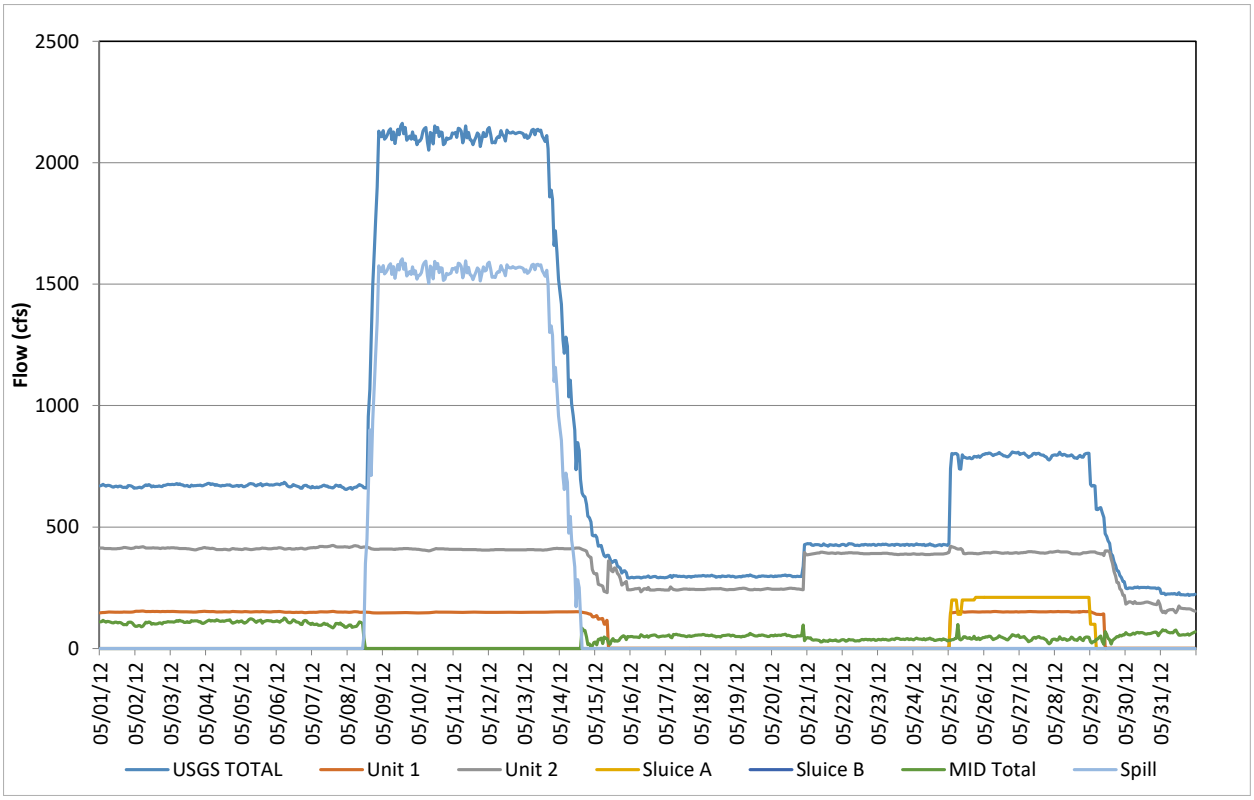

Figure D-89. Flow record in May 2012, based on hourly discharges.

Figure D-90. Flow record in June 2012, based on hourly discharges.

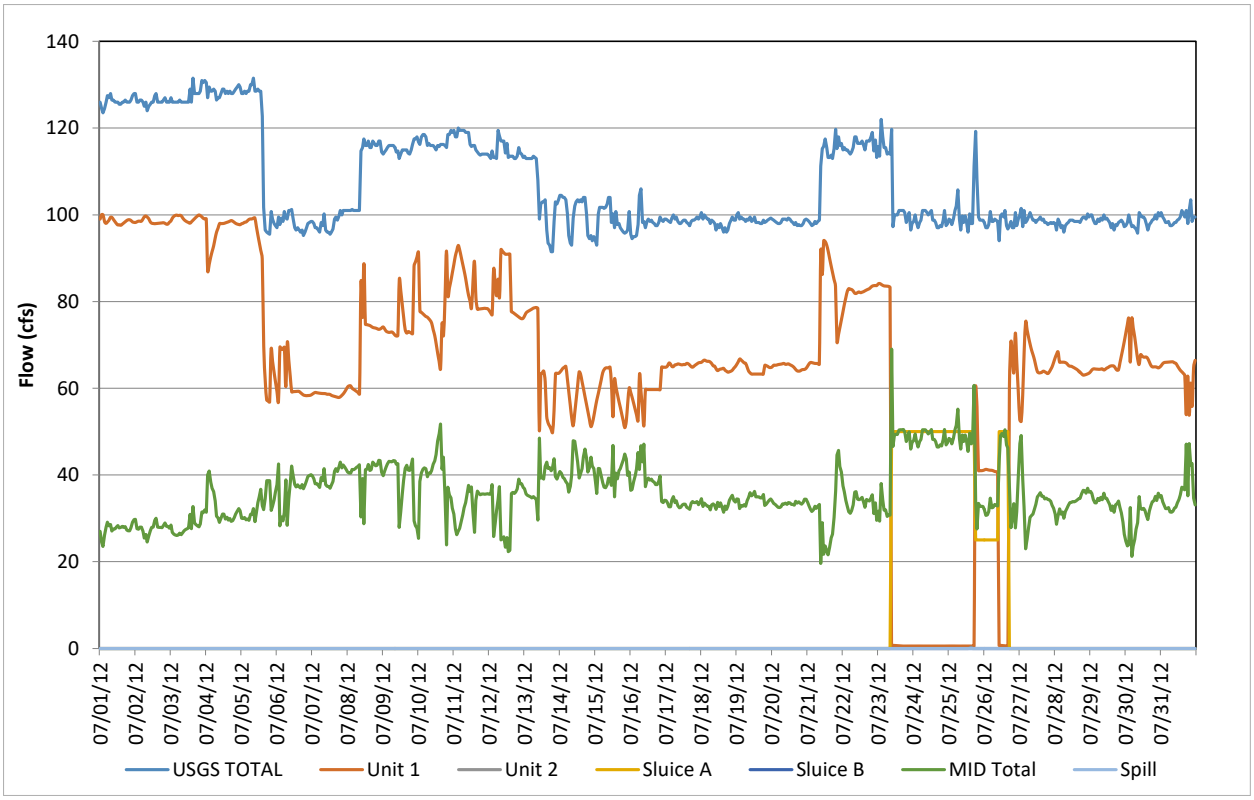

Figure D-91. Flow record in July 2012, based on hourly discharges.

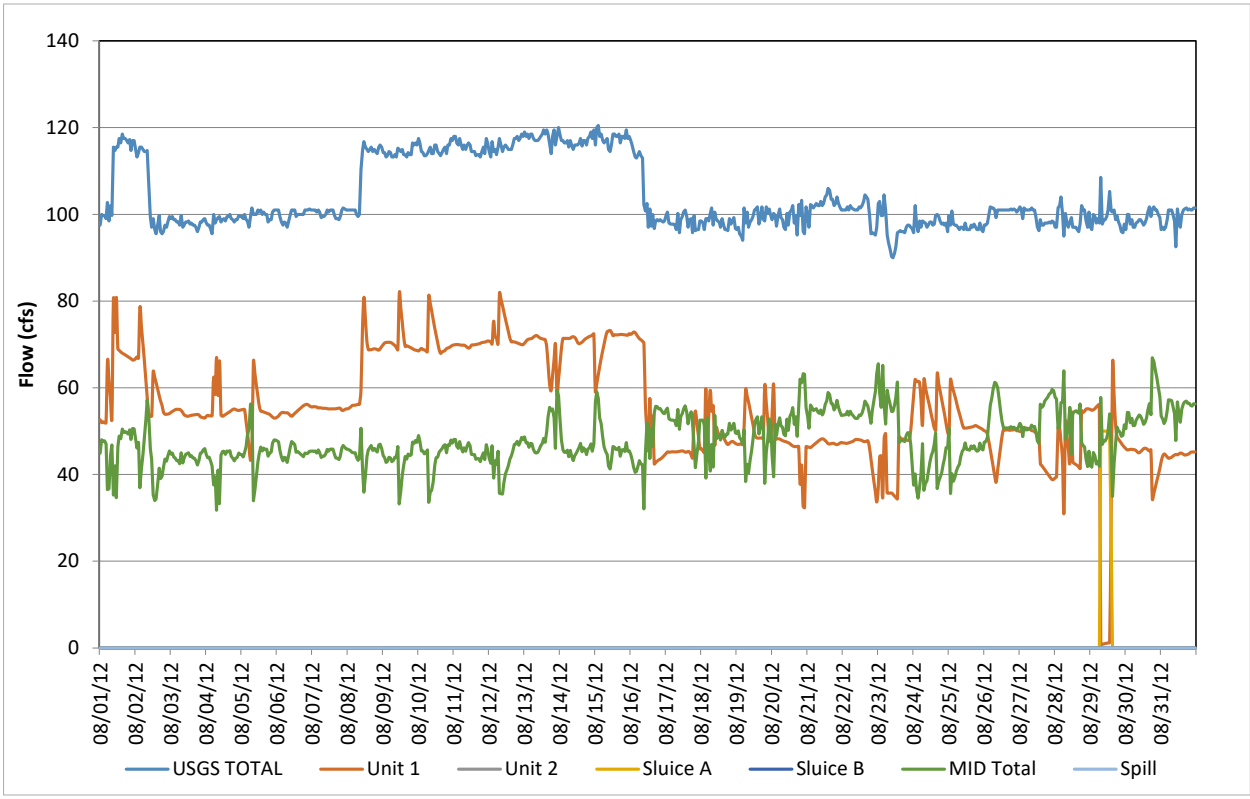

Figure D-92. Flow record in August 2012, based on hourly discharges.

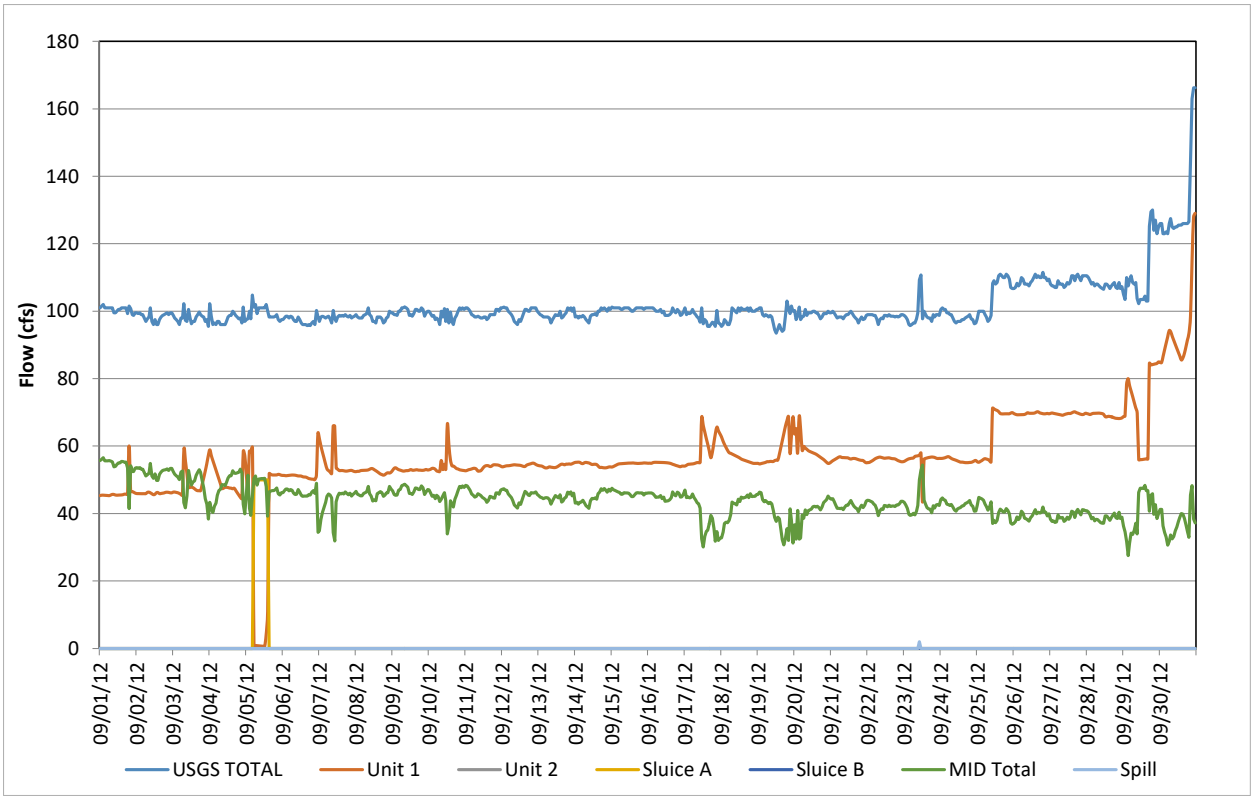

Figure D-93. Flow record in September 2012, based on hourly discharges.

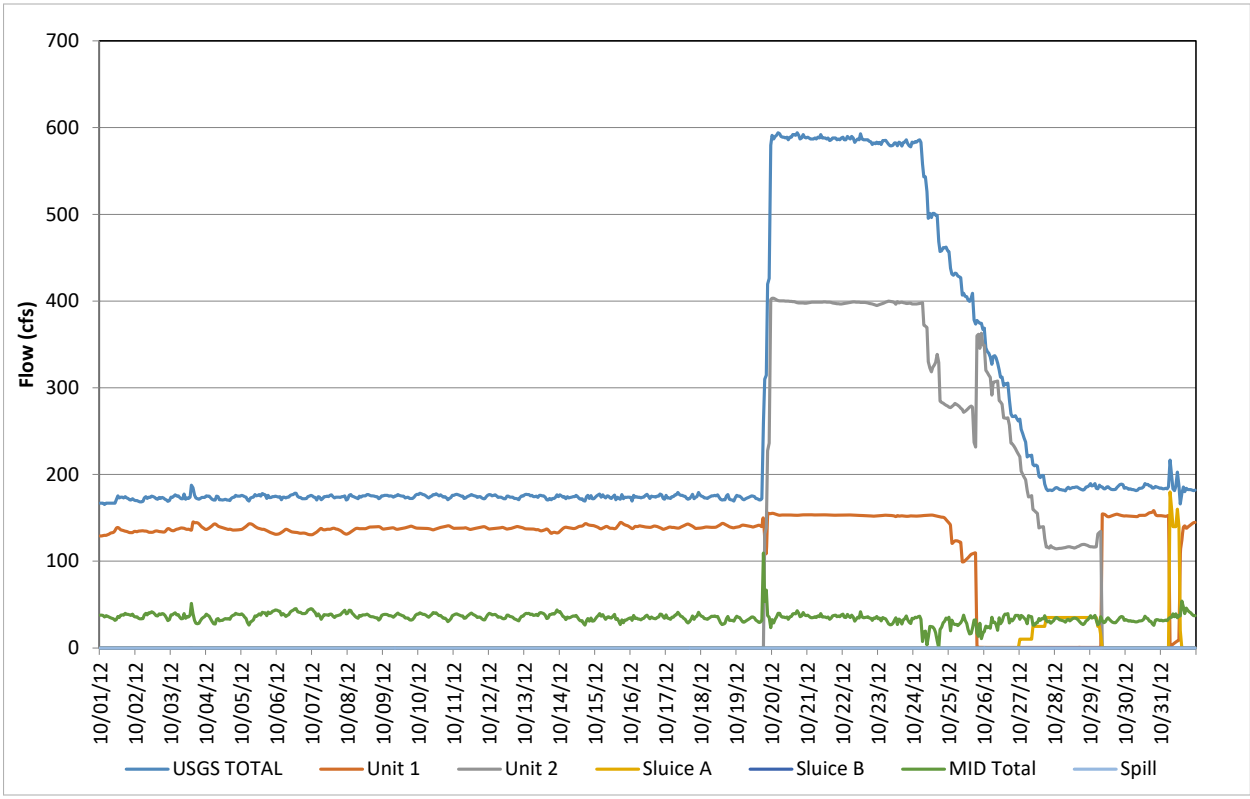

Figure D-94. Flow record in October 2012, based on hourly discharges.

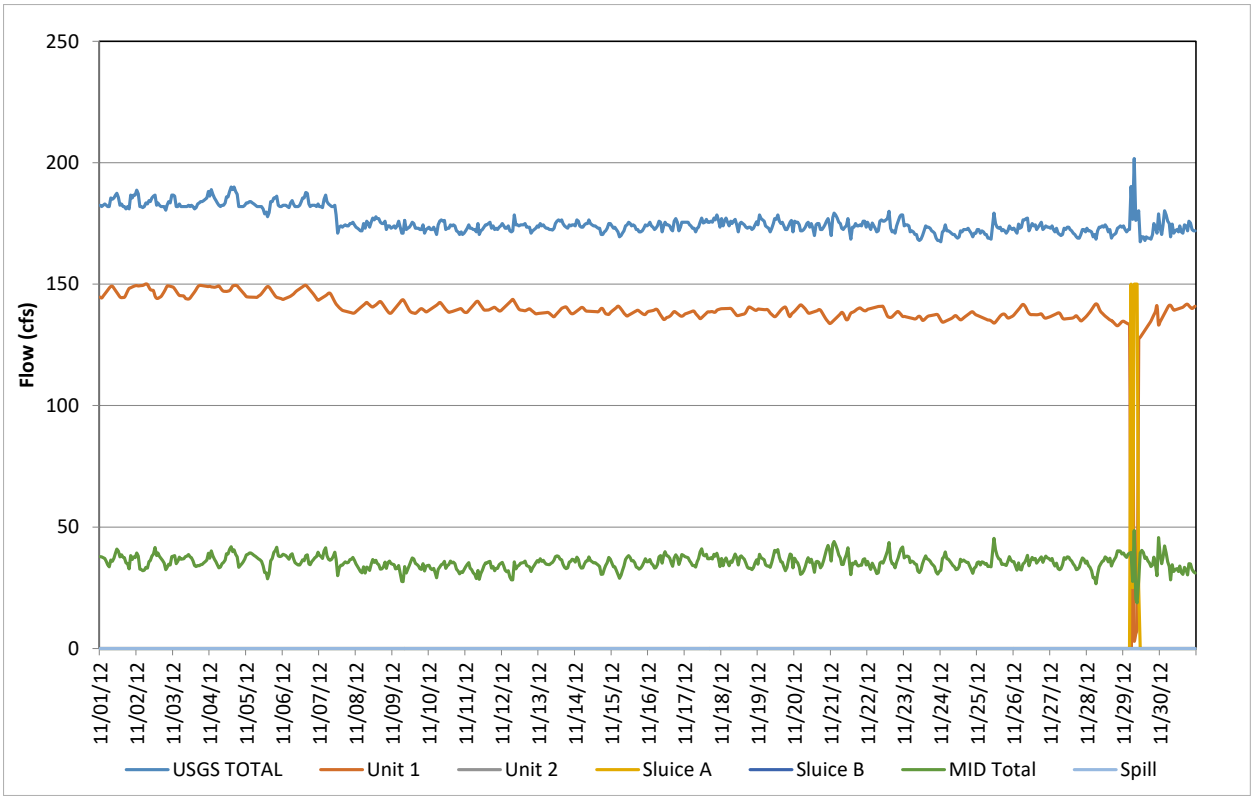

Figure D-95. Flow record in November 2012, based on hourly discharges.

Figure D-96. Flow record in December 2012, based on hourly discharges.

Figure D-97. Flow record in January 2013, based on hourly discharges.

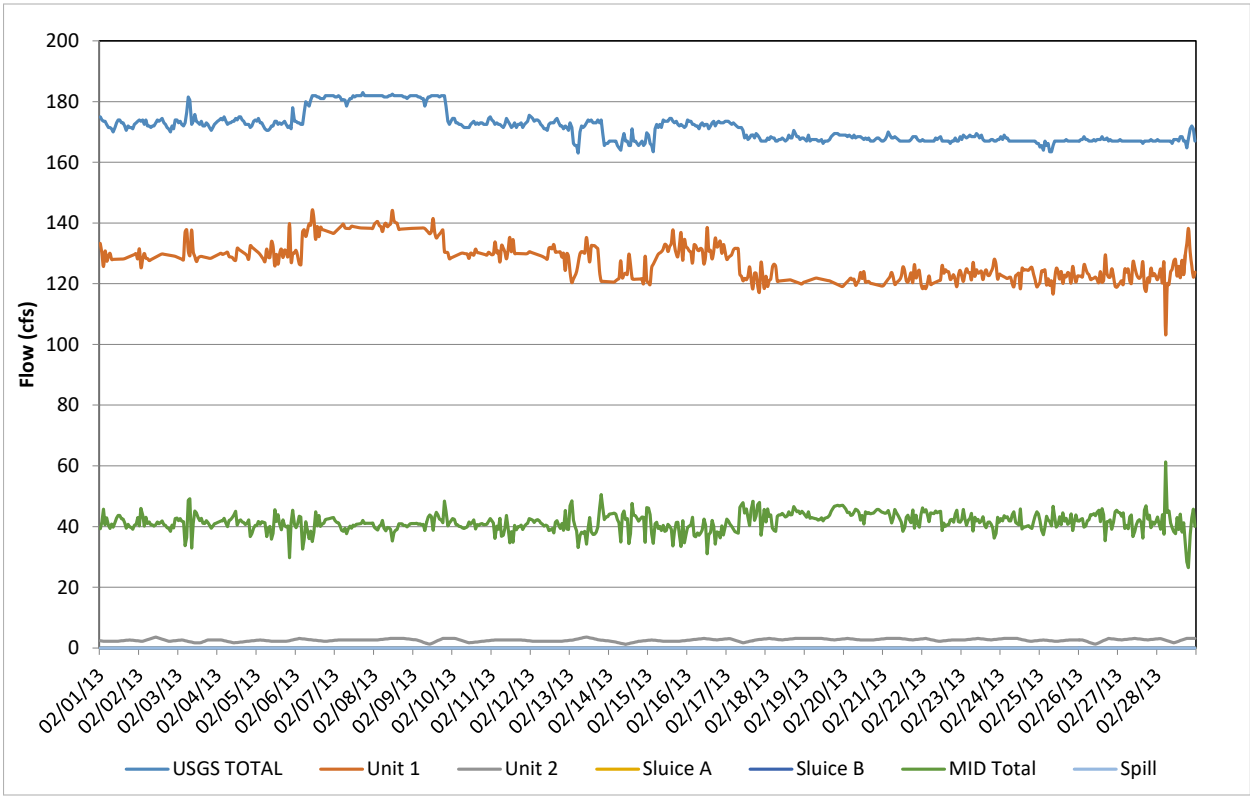

Figure D-98. Flow record in February 2013, based on hourly discharges.

Figure D-99. Flow record in March 2013, based on hourly discharges.

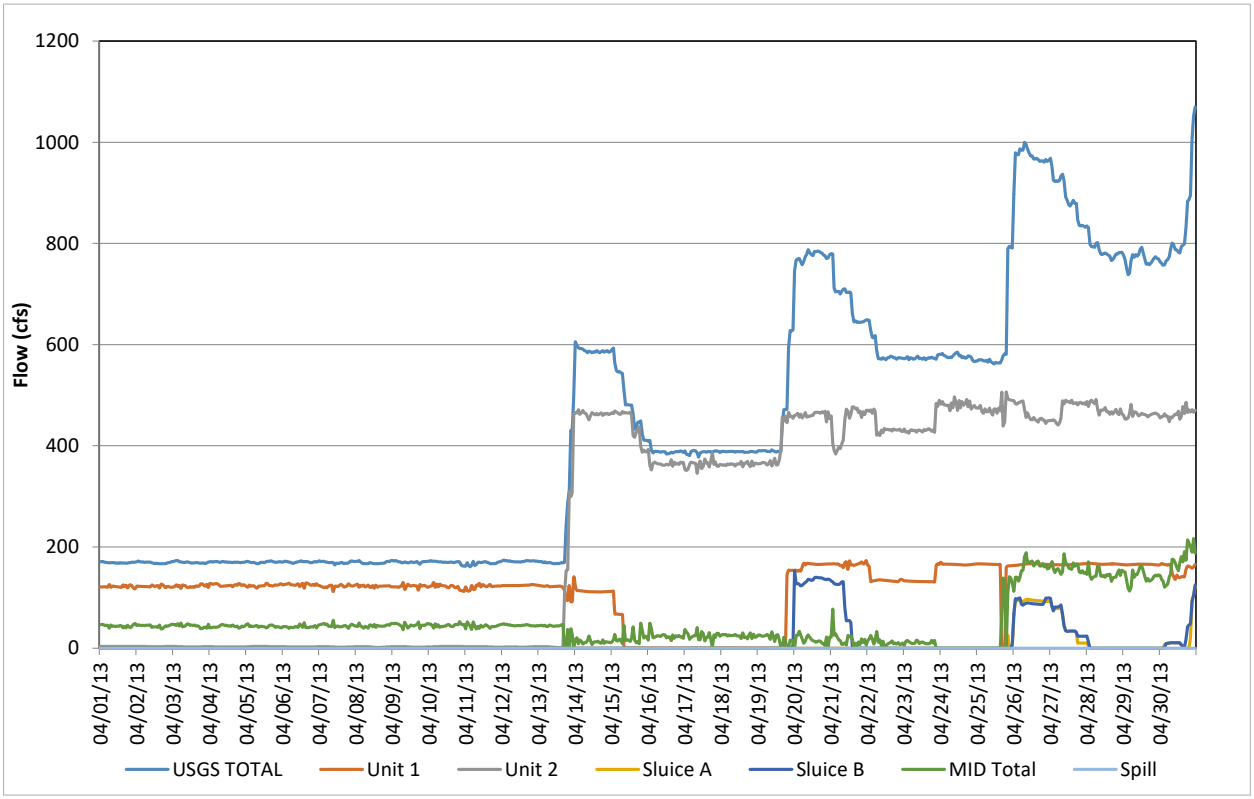

Figure D-100. Flow record in April 2013, based on hourly discharges.

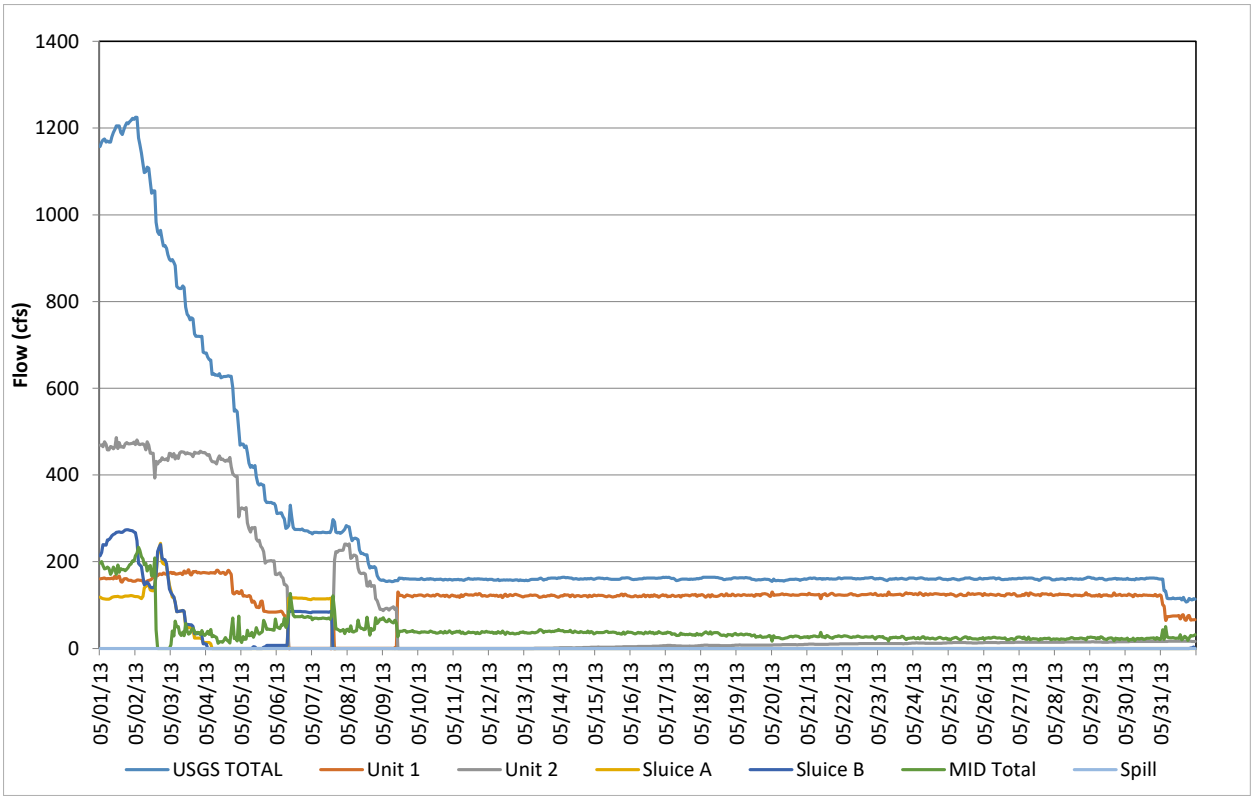

Figure D-101. Flow record in May 2013, based on hourly discharges.

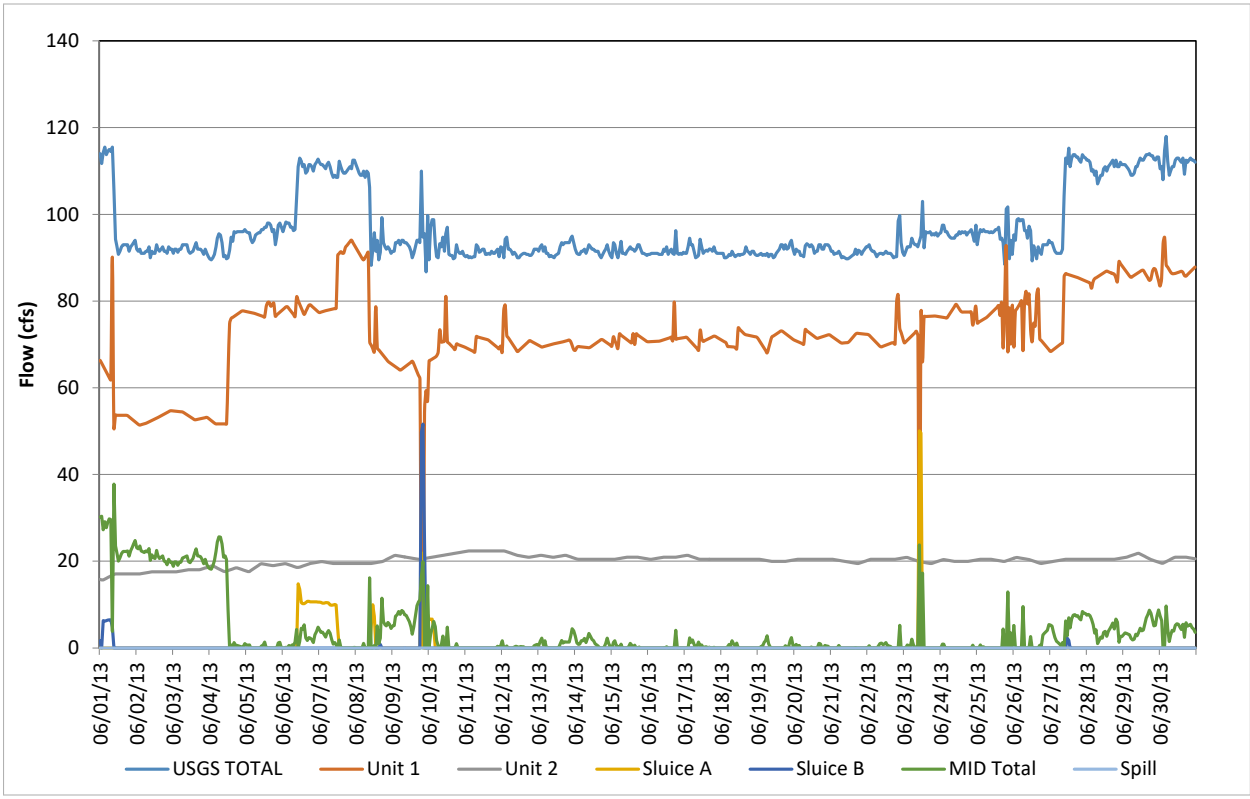

Figure D-102. Flow record in June 2013, based on hourly discharges.

Figure D-103. Flow record in July 2013, based on hourly discharges.

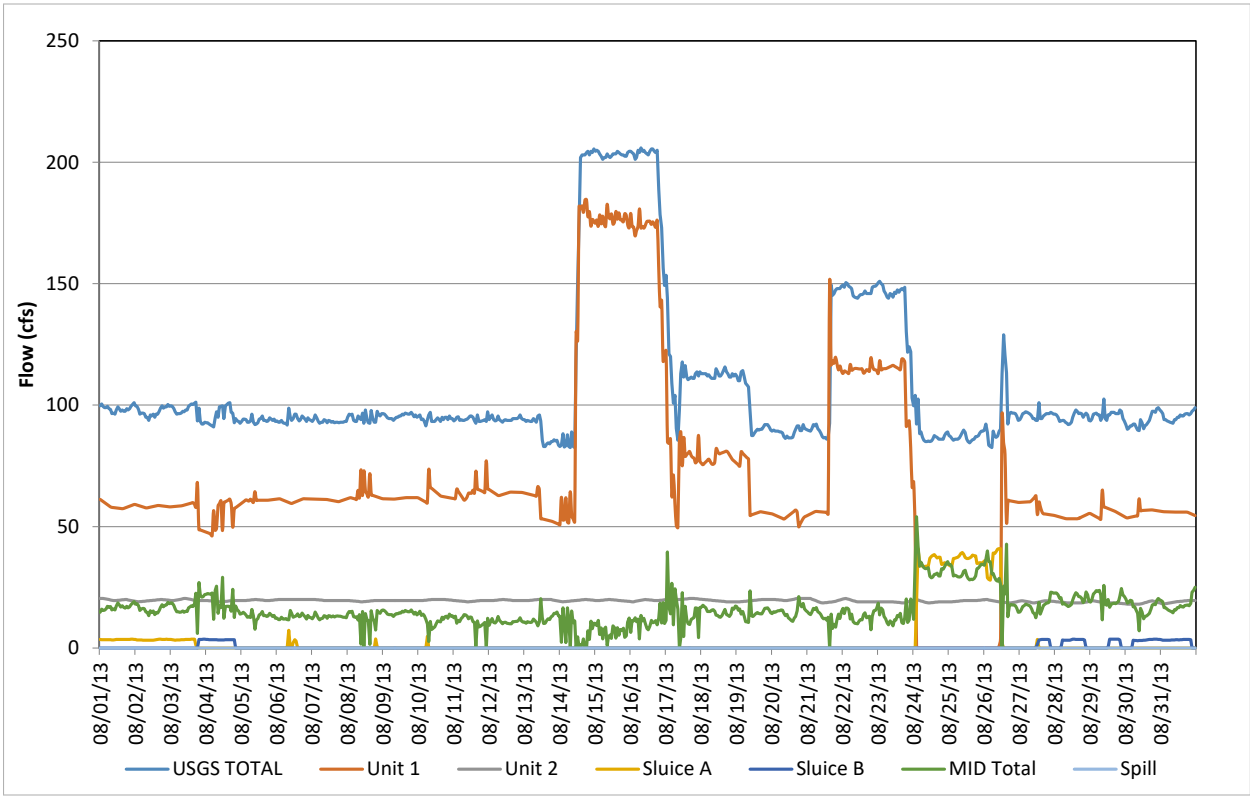

Figure D-104. Flow record in August 2013, based on hourly discharges.

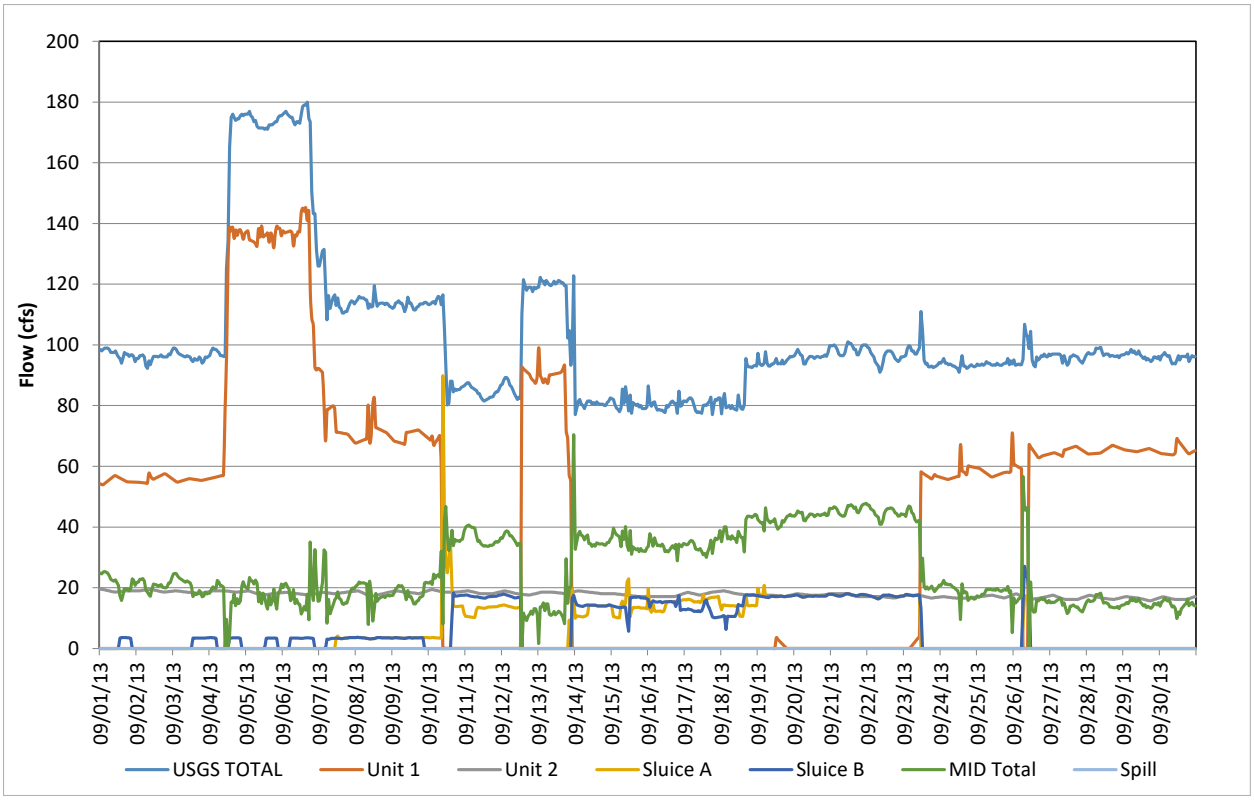

Figure D-105. Flow record in September 2013, based on hourly discharges.

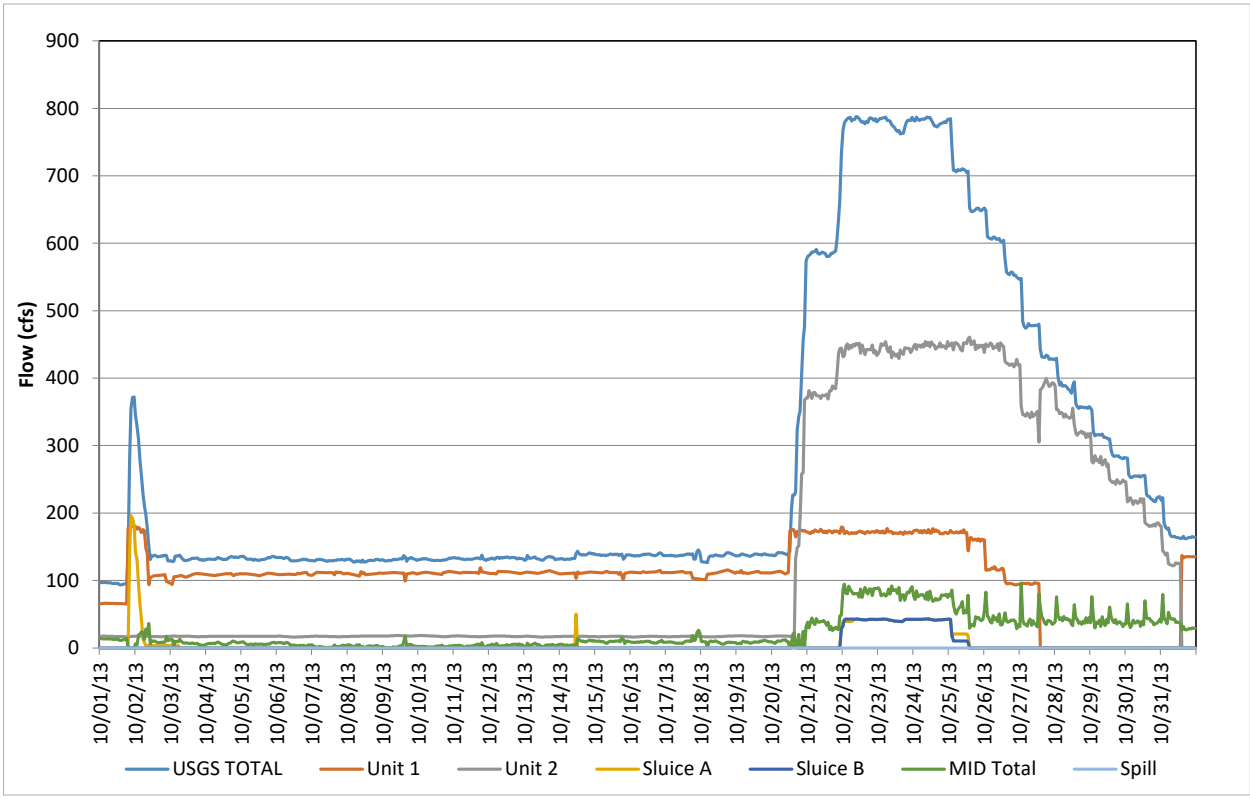

Figure D-106. Flow record in October 2013, based on hourly discharges.

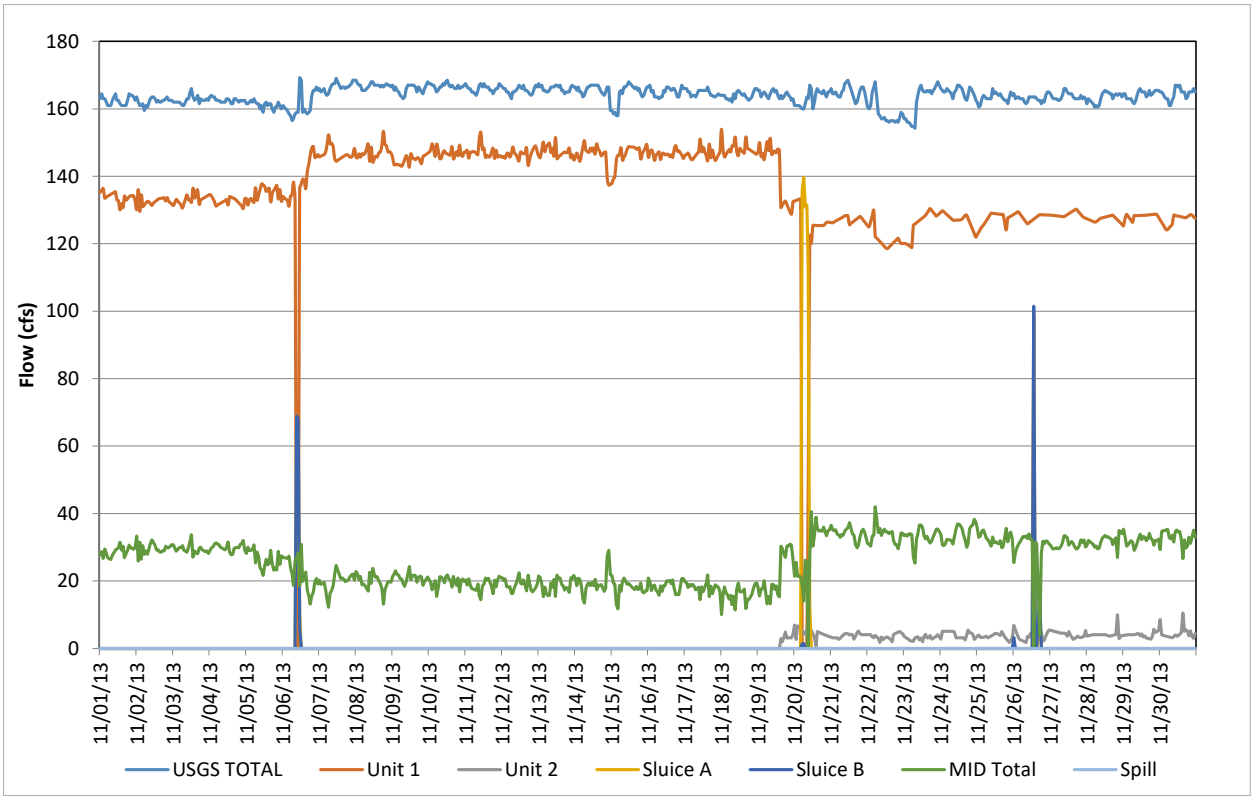

Figure D-107. Flow record in November 2013, based on hourly discharges.

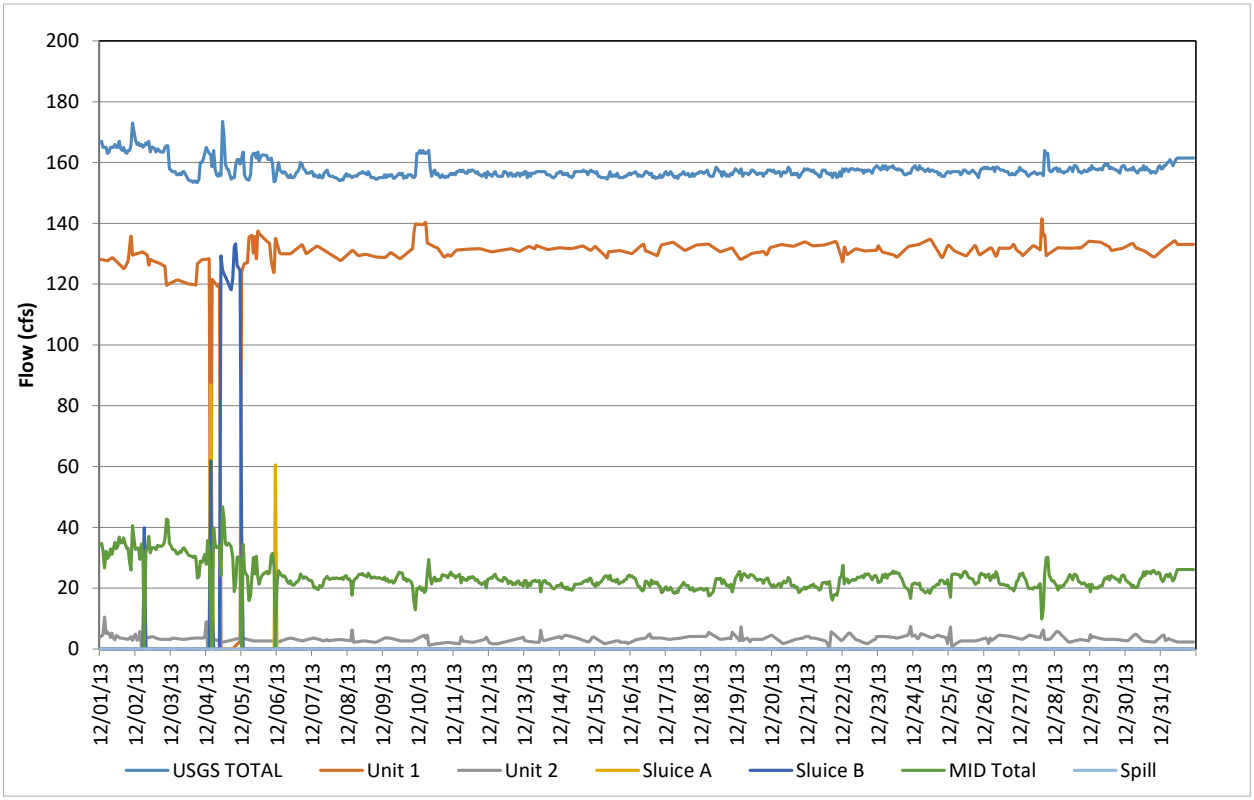

Figure D-108. Flow record in December 2013, based on hourly discharges.