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Relicensing Study 3.1.3

NORTHFIELD MOUNTAIN PROJECT SEDIMENT MANAGEMENT PLAN

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers

SEPTEMBER 2014

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1.1 Study Summary

The purpose of Study 3.1.3 is to better understand sediment transport and dynamics between the Connecticut River and the Upper Reservoir of the Northfield Mountain Pumped Storage Project. By letter dated January 20, 2011 the Federal Energy Regulatory Commission (FERC) requested a plan to avoid or minimize the entrainment of sediment into the Project works during reservoir maintenance drawdowns. In response to this request FirstLight developed its Sediment Management Plan in consultation with the United States Environmental Protection Agency (USEPA) and Massachusetts Department of Environmental Protection (MADEP). FirstLight filed the Sediment Management Plan with FERC and the agencies on July 15, 2011. As part of the Integrated Licensing Process study scoping process USEPA requested that FirstLight incorporate the Sediment Management Plan into its relicensing studies.

Suspended sediment concentration (SSC) and particle size distribution (PSD) are monitored continuously at the Route 10 Bridge in Northfield, MA and in the Northfield Mountain tailrace. One LISST-StreamSide continuous sediment monitor was installed on April 2, 2014 at the Route 10 Bridge to monitor SSC and PSD in the Turners Falls Impoundment (Impoundment).[1] Two LISST-HYDROs (North and South) were installed in the Northfield Mountain tailrace on March 27, 2014 (North) and April 4, 2014 (South) to monitor SSC and PSD during Northfield Mountain pumping and generating cycles.[2] The LISST-StreamSide and HYDROs will remain in place until early November 2014 or the onset of freezing temperatures, whichever is earlier. Water samples have also been collected from the drain hose of the instruments over a range of flow conditions. Samples are submitted to a laboratory for analysis of SSC and TSS.

In addition, cross-section SSC and PSD data were collected in 2013 across the span of the Route 10 Bridge and across the span of the Northfield Mountain tailrace boat barrier as a means of comparing the representativeness of the LISST-StreamSide and HYDRO data with cross-section measurements. LISST-100X measurements were collected over a range of flows and operating conditions in the spring and fall 2013.

1.2 Study Progress Summary

<u>Task 1. Continuous Monitoring of Suspended Sediments</u>

Continuous sediment monitoring instruments were installed at the Route 10 Bridge and Northfield Mountain tailrace prior to the spring freshet. The instruments continue to collect data and will remain in operation until late November 2014 or at the onset of freezing temperatures. The data is downloaded, the instruments are serviced, and the clean water tanks are refilled weekly.

<u>Task 2. Laboratory Samples</u>

Water samples continue to be collected at the instruments over a range of flow conditions. All samples are submitted to a laboratory for analysis of SSC and TSS. Grab samples will continue to be periodically collected until the LISST equipment has been removed for the season.

<u>Task 3. Reporting</u>

In accordance with FERC's Order Approving Sediment Management Plan (March 28, 2012), FirstLight is required to file an annual report with the USEPA, MADEP, and the FERC no later than December 1 of

[1] The LISST-StreamSide was also installed during the 2012 and 2013 field seasons.
[2] The LISST-HYDROs were also installed during the 2012 and 2013 field seasons.

each sampling year. The next report is due December 1, 2014. In FirstLight's December 2, 2013 (after the August 14, 2013 RSP filing) annual report to USEPA, MADEP and FERC, it states "*In light of the equipment issues encountered in 2012 and 2013, FirstLight will expand field data collection activities through the 2015 field season*".

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the RSP, other than expanding the sediment data collection to include 2015.

Continuous suspended sediment sampling will continue through 2015. FirstLight anticipates filing the final study report with FERC by December 1, 2015.

1.4 Remaining Activities

- Data review, QA/QC, and analyses
- 2014 Annual Report
- 2015 monitoring (April – November)
- 2015 Annual Report

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Relicensing Study 3.2.1

WATER QUALITY MONITORING STUDY

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to characterize baseline water quality [water temperature, dissolved oxygen (DO)] conditions in the Turners Falls Impoundment (Impoundment), bypass reach, power canal and in the Connecticut River below Cabot Station. The field work for this study will occur in 2015. Task 1 of the study is to develop a Field Sampling Plan. This plan was developed in consultation with stakeholders and includes the additional monitoring for water temperature below the Turners Falls Project.

1.2 Study Progress Summary

Task 1: Develop Sampling Plan

In the Federal Energy Regulatory Commission's (FERC) February 21, 2014 Study Plan Determination Letter (SPDL), it states "*We recommend FirstLight develop a temperature monitoring study plan for the reach between Cabot Station and the Holyoke dam to describe temperature and temperature rate of change associated with peaking operations. The plan should be developed in consultation with interested stakeholders and file for Commission approval with the Initial Study Report in September 2014*".

FirstLight emailed the Water Quality Monitoring Study Field Sampling Plan on June 30, 2014 to the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Massachusetts Department of Environmental Protection (MADEP), New Hampshire Department of Environmental Services (NHDES), Vermont Agency of Natural Resources (VANR), Massachusetts Division of Fish and Wildlife (MDFW), Connecticut River Watershed Council (CRWC), Trout Unlimited (TU), The Nature Conservancy (TNC), Landowners and Concerned Citizens for License Compliance (LCCLC), Franklin Regional Council of Governments (FRCOG) and Karl Meyer and requested written comments be provided by July 28, 2014. Through September 5, 2014, comments were received from the following entities:

- MADEP Division of Watershed Management
- CRWC
- MDFW (Natural Heritage and Endangered Species Program, NHESP)

The Field Sampling Plan has been revised to address the comments and is attached as Appendix A; the comment letters and a responsiveness summary is also appended to the revised Field Sampling Plan.

Task 2: Dissolved Oxygen and Temperature Monitoring

Field work to occur in 2015.

Task 3: DO and Temperature Profiles

Field work to occur in 2015.

Task 4: Data Analysis & Report

A final report will be completed in March 2016 per FERC's SPDL.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the study plan.

1.4 Remaining Activities

Tasks 2-4 are slated to occur in 2015.

Appendix A
Water Quality Field Sampling Plan

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Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

RELICENSING STUDY 3.2.1

WATER QUALITY MONITORING STUDY

FIELD SAMPLING PLAN

Filed with Initial Study Report - September 2014

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Table of Contents

1.0 Introduction....1
2.0 Study Goals and Objectives....1
3.0 Study Locations....1
4.0 Methodology for Continuous Dissolved Oxygen and Temperature Data Collection....3
5.0 Methodology for Dissolved Oxygen and Temperature Profile Data Collection....4
6.0 Methodology for Continuous Temperature Data Collection....5
7.0 Data Management and Reporting....6
7.1 Data Management....6
7.2 Data Review....6
7.3 Reporting....6
8.0 Schedule and Consultation....6
9.0 Literature Cited....8

List of Tables

Table 3.1: Water Quality Monitoring Sampling Locations....9
Table 4.1: Water Quality Monitoring Instrument Specifications....10

List of Figures

Figure 3.1: Overview of DO and Water Temperature Sampling Locations....11
Figure 3.2: Water Quality Sampling Locations Near Turners Falls Dam....12
Figure 3.3: Water Quality Sampling Locations Near the Northfield Mountain Tailrace....13
Figure 3.4: Turners Falls Impoundment Vertical Profile Locations....14
Figure 3.5: Continuous Water Temperature Monitoring Locations from Cabot Station to the Holyoke Dam....15

Appendices

Appendix A: MA DEP Water Quality Sampling Standard Operating Procedures....16
Appendix B: Example Temperature and DO Profile Field Data Sheet....18
Appendix C: Responsiveness Summary and Stakeholder Comment Letters....20

1.0 Introduction

FirstLight Hydro Generating Company (FirstLight) initiated the relicensing of its 1,119.2 MW Northfield Mountain Pumped Storage Project (FERC No. 2485) and 67.09 MW Turners Falls Hydroelectric Project (FERC No. 1889) with the Federal Energy Regulatory Commission (FERC or Commission). The Projects are located on the Connecticut River in the towns of Northfield, MA (River Mile (RM) 127.2) and Turners Falls, MA (RM 122), respectively.

In accordance with the relicensing process, multiple stakeholders requested FirstLight to conduct a water quality monitoring study to determine the effect of Project operations on water quality of the Connecticut River within the Turners Falls Impoundment (Impoundment), bypass reach, power canal, and the Cabot Station tailrace reach. FirstLight filed a Revised Study Plan (RSP) on August 14, 2013 with FERC. Study 3.2.1 contained the plan for conducting the Water Quality Monitoring Study.

FERC issued its Study Plan Determination Letter (SPDL) for the aquatic studies on February 21, 2014, approving the Water Quality Monitoring Study Plan with certain modifications. The primary modification required that FirstLight develop a study plan component for temperature monitoring of the Connecticut River between Cabot Station and the Holyoke Dam to describe temperature and temperature rate of change associated with peaking operations.

Task 1 of the RSP requires that FirstLight develop a sampling plan in consultation with interested stakeholders prior to sampling. The methods described in this plan were developed based on the FERC-approved RSP, as modified, and standard operating procedures provided by the Massachusetts Department of Environmental Protection (MADEP) which are included in Appendix A to this plan.

2.0 Study Goals and Objectives

The purpose of this field sampling plan is to provide a detailed description of the water quality and temperature monitoring protocols, procedures, data quality control, and reporting that will be conducted. The results of this study will provide information sufficient to enable agencies and stakeholders to understand water quality conditions and dynamics within the Project area and downstream to the Holyoke Dam.

The specific objectives of the study are to:

- Characterize water temperature and dissolved oxygen (DO) conditions within the Turners Falls Impoundment, bypass channel, power canal, and below Cabot Station;
- Determine potential impacts of the Turners Falls Project and Northfield Mountain Project on water temperature and DO;
- Compare collected data with applicable State water quality standards;
- Describe water temperature and temperature rate of change between Cabot Station and the Holyoke Dam.

3.0 Study Locations

The RSP contained 11 sampling stations from below Vernon Dam to downstream of Cabot Station. Seven additional temperature monitoring locations from below Cabot Station downstream to the Holyoke

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Dam have been added to this plan for a total of 18 sampling locations (Table 3.1). Continuous temperature and DO will be measured and recorded at nine locations within the project area, listed below and shown in Figure 3.1, Figure 3.2 and Figure 3.3.

- Below the Vernon Dam and Ashuelot River confluence
- Above the Northfield Mountain tailrace
- Northfield Mountain tailrace
- Below the Northfield Mountain tailrace
- Upstream of the Turners Falls Dam at boat barrier
- Bypass reach upstream of Station No. 1
- Bypass reach upstream of Rock Dam
- Turners Falls Power Canal
- Below Cabot Station tailrace

DO and temperature profiles will be collected at three relatively deep locations within the Impoundment (Figure 3.4), listed below.

- Upstream of the Turners Falls Dam at boat barrier (same location at continuous monitoring site)
- Approximately 3.0 mi upstream of the Turners Falls Dam, at the deepest known area within the impoundment.
- Approximately 4 miles upstream of the MA Route 10 Bridge.

In addition, continuous temperature data will be collected at seven locations downstream of Cabot Station to the Holyoke Dam (Figure 3.5). The locations were selected with input from the Connecticut River Watershed Council (CRWC) and MA Natural Heritage and Endangered Species Program (NHESP). The proposed locations of the temperature monitoring stations are listed below.

- Downstream of the Deerfield River confluence
- Second Island, Sunderland, MA
- Third Island, Sunderland, MA
- Sandbar above Mill River, Hadley, MA
- Sandbar below Mill River, Hadley, MA
- Side channel at Elwell Island, Hadley, MA

- Near Mitch's Island, Hadley, MA

4.0 Methodology for Continuous Dissolved Oxygen and Temperature Data Collection

Equipment

Continuous temperature and DO monitoring will be conducted using HOBO DO Loggers (Model U26-001), which also records temperature. The HOBO DO Loggers are ideal for long-term deployment (>10 days) because it is equipped with an optical sensor to measure DO, which is more resistant to biofouling than membrane sensors, and can last up to six-months after initialization. The logger has an operating temperature and DO range of -5 to 40°C and 0 to 30 mg/L, respectively. Specifications for the sampling equipment proposed for this study are provided in Table 4.1.

In order to collect DO as percent saturation (in addition to mg/L) the HOBO loggers require barometric pressure (BP) data. BP data will be continuously collected over the course of the study using a HOBO Water Level Logger (Model U20-001-04) as recommended by the manufacturer. Onset documentation specifies that the loggers operate between a pressure range of 0 to 145 kPa (0 to 21 psia) with a raw pressure accuracy of 0.3%. The BP sensor will be installed in the air in a secure location in the vicinity of the sampling sites for the study duration.

Calibration

The HOBO DO Loggers will be calibrated prior to deployment using the Lab Calibration tool found in the manufacturer's software. The loggers will need to be calibrated before deployment or after replacing an expired sensor cap. Sensor caps expire approximately 7 months after initialization. The Lab Calibration tool sets the gain and offset adjustment for the logger by: 1) restoring logger calibration values to factory defaults; 2) using your own gain and offset adjustment values; or 3) calculating the values with a three-step calibration procedure. If the three-step calibration procedure is chosen, the logger is first calibrated to 100% saturation by placing it in water-saturated air. Following this, the logger is then calibrated to 0% saturation by placing it in sodium sulfite or another 0% oxygen environment. The manufacturer recommends 0% saturation calibration only if the logger will be deployed in waters with possible DO levels ≤ 4 mg/L. These loggers will be tested in a common bath before deployment to ensure they are collecting data and similar measurements (MADEP, 2009). All pre-deployment calibrations will be performed in the laboratory (MADEP, 2007). In addition, a hand-held thermometer traceable to a NIST-certified thermometer will be used to check sensor accuracy; checks will be made prior to deployment, monthly, and at retrieval.

It may be necessary, and recommended by the manufacturer (Onset® Computer Corporation), to take DO field calibration readings if biofouling is present or likely to occur. Field calibration readings will be conducted following the manufacturers recommendations, which include: using another calibrated DO meter to obtain replicate DO measurements, downloading data from the logger, cleaning the sensor, and taking another field calibration reading. The DO readings will then be corrected using the field calibration readings and the manufacturer's software, HOBO DO Assistant, which compensates for any measurement drift due to biofouling *(i.e.*, correction of the DO measurements occurs *post hoc)*.

Field Sampling Specifications

Temperature (°C) and DO (mg/L) will be recorded *in situ* every 15 minutes at the nine locations identified above. Water temperature at the nine locations will be recorded from April 1 through November 15, while DO will be recorded during the summer low-flow, high temperature period from June 1 through September 30. Deployment of the continuous temperature and DO data loggers will generally follow procedures employed by the MADEP, Division of Watershed Management Standard Operating Procedure of Multiprobe Deployment (MADEP, 2007).

Five of the nine locations will be in the Impoundment (Figure 3.1). Each of these data loggers will be deployed in a representative location at a minimum of 4 ft from the surface, but not deeper than 25% depth. To confirm representativeness, periodic measurements of surface, logger depth and near bottom will occur.

The remaining continuous temperature and DO data loggers will be deployed in the bypass reach, power canal, and below Cabot Station (Figure 3.2). Loggers at these locations will be placed in a representative location in mid-channel or thalweg at mid-depth, or just off the bottom depending on site-specific characteristics. Installation locations will be selected that are low risk for vandalism and will be as unobtrusive as possible to minimize conflicts with recreational use of the river. Areas of low water velocities (~< 1 fps) and significant turbulence will be avoided to the extent possible (MADEP, 2007). All loggers will be encased in perforated pipe, and attached to an immovable object or anchor using polypropylene rope or cable (MADEP, 2009).

Bi-weekly site visits (i.e., once every two weeks) will occur to periodically inspect the loggers for biofouling, download data, and obtain replicate temperature and DO measurements for quality assurance/quality control (QA/QC) purposes. Data will be downloaded from the loggers on a bi-weekly basis to assure the logger is functioning correctly over the long deployment duration. GPS coordinates and photo documentation will be obtained of each location; and weather, river flow, and condition of the logger and battery life will be recorded in a field notebook during deployment, bi-weekly sampling, and retrieval.

5.0 Methodology for Dissolved Oxygen and Temperature Profile Data Collection

Equipment

The temperature and DO profiles will be collected using a portable handheld YSI ProODO meter equipped with a 50 m cable. The meter provides temperature (°C), DO (mg/L; % saturation), and BP (mmHg) readings. The YSI ProODO meter has an operating range of -5 to 70°C and 0 to 50 mg/L. Additional specifications for the YSI ProODO meter are provided in Table 4.1.

Calibration

A one-point calibration (water saturated air) will be conducted at the beginning (prior to sampling) and end (following all sampling) of each sample day. Calibration will follow the instructions described in the YSI ProODO manual. Calibration results will be saved on the logger and recorded on the applicable field data sheet (Appendix B). In addition, a hand-held thermometer traceable to a NIST-certified thermometer will be used to check sensor accuracy; checks will be made prior to deployment, monthly, and at retrieval.

Field Sampling Specifications

Temperature (°C) and DO (mg/L; % saturation) profiles will be collected on a bi-weekly basis at the locations described above to characterize the temperature and DO profile and timing of stratification within the Impoundment. The bi-weekly sampling will be conducted concurrently with the other water quality monitoring beginning April 1 through November 15, 2015. Profile sampling will generally follow procedures employed by the MADEP, Division of Watershed Management Standard Operating Procedure for Lake Sampling (MADEP, 2010) and Water Quality Multiprobe Data Collection (MADEP, 2005).

Vertical profile sampling will occur at a consistent time across sampling events and as early in the morning as possible. GPS coordinates and photo documentation will be obtained of each location.

Prior to taking the temperature and DO profile, the boat will be anchored with the bow facing upwind or upstream. When the boat becomes stabilized a portable depth sounder will be used to obtain a depth measurement. Starting at the surface, measurements of temperature and DO will be collected at 1.0 m depth increments[1]; the last measurement will be 0.5 m above bottom, but only if the primary user is certain the probe did not make contact with the bottom (MADEP, 2005). Measurements will only be recorded after waiting at least 30 seconds at each depth interval to allow the instrument to stabilize. Only after the instrument is stabilized will a reading be recorded and the probe lowered to the next interval. At least one replicate measurement at a random depth interval will also be measured. All data along with the approximate locations of the strata (epi-, meta-, and hypolimnia) and depth of the thermocline will be recorded on the field data sheets (MADEP, 2005). An example field data sheet is provided in Appendix B.

Replicate measurements will also be collected at least once per vertical profile, or after every twentieth measurement at a random depth interval. If the profile appears to be stratified, replicate measurements within the metalimnion (thermocline) will be avoided because temperature and DO gradients can express subtle changes in relation to depth in this layer of the impoundment. All replicate measurements will be recorded manually.

6.0 Methodology for Continuous Temperature Data Collection

Equipment

Continuous temperature data collected from Cabot Station to the Holyoke Dam will be collected using HOBO Water Temperature Pro v2 Data Loggers (Model U22-001). This logger has an operating range of -40 to 70°C. Specifications for the HOBO Water Temperature Pro v 2 Data Loggers are provided in Table 4.1.

Calibration

The HOBO Water Temperature Pro v2 Data Loggers (Model U22-001) are factory calibrated; therefore, no calibration is necessary. However, the loggers will be tested in a common bath prior to deployment to ensure they are functioning properly and that their measurements are similar (within± 0.5°C) (MADEP, 2009). In addition, a hand-held thermometer traceable to a NIST-certified thermometer will be used to check sensor accuracy; checks will be made prior to deployment, monthly, and at retrieval.

Field Sampling Specifications

Water temperature (°C) of the Connecticut River will be continuously monitored *in situ* every 15-minutes at five locations from Cabot Station to the Holyoke Dam from April 1 through November 15. Deployment of the continuous temperature loggers will generally follow procedures employed by the MADEP, Division of Watershed Management Standard Operating Procedure of Continuous Temperature Monitoring using Temperature-only Loggers (MADEP, 2009).

Each logger will be deployed at a representative location, and at a sufficient distance downstream of the mixing zone of any significant tributaries of the Connecticut River, such as the Deerfield and Fort Rivers.

[1] Because Station No. 6 is extremely deep, the vertical profile measurement intervals will be collected every 1.0 meter starting at the surface, until a homothermous condition is encountered in the hypolimnion.

The loggers will be encased in perforated protective housing, and secured off the bottom of the river with rocks or concrete blocks. The logger assembly will be tethered to an immovable object on shore with polypropylene rope or cable.

Periodic site visits will occur to inspect the meters, download data, and obtain replicate temperature measurements for QA/QC purposes. Replicate measurements will be collected adjacent to each continuous data logger during each site visit using a separate meter. Data will be downloaded from the loggers to assure the logger is functioning correctly over the long deployment duration. GPS coordinates and photo documentation will be obtained of each location; and the condition of the logger will be recorded in a field notebook during each site visit.

7.0 Data Management and Reporting

7.1 Data Management

All temperature and DO measurements collected at the three, vertical profiles will be recorded in a field notebook or on field data sheets on the day of sampling. Data will include DO and water temperature measurements, general weather and flow conditions, and QA/QC data records. Continuous temperature and DO data collected using the HOBO data loggers will be stored on the logger's memory and downloaded during each bi-weekly sampling event, and again at the end of the study period. Hourly operations data regarding the Impoundment elevation, periods of pumping, generating, or idle, discharge over Turners Falls Dam, and natural routed flow will be provided by FirstLight.

7.2 Data Review

All field-collected data will undergo a thorough QA/QC review process to ensure accuracy and completeness of the dataset. Adherence to standard methods and QA/QC procedures for all water quality monitoring helps ensure that the resulting data will be accurate, precise, comparable, and representative.

Data will be reviewed at the end of each day (vertical profiles) or periodically throughout (continuous data) the course of the study. All continuous water quality data will be analyzed for outliers or other aberrant data points. DO data collected from the continuous loggers will be corrected, as necessary, using the field calibration/replicate DO readings. The HOBOware DO Assistant corrects the DO values as a result from measurement drift due to biofouling. This correction process will only be performed if biofouling on the logger is believed to compromise the measurements or the readings from the loggers are not within the measurement error of the replicate data.

7.3 Reporting

At the conclusion of the study and following QA/QC of the data, results and findings will be summarized in a final report. The final report will be submitted to FERC as part of the Integrated Licensing Process (ILP) schedule. All water quality data collected as part of this study will be submitted to the regulatory agencies in an electronic format that can be automatically uploaded to their respective databases.

8.0 Schedule and Consultation

Per FERC's SPDL for the aquatic studies, this plan is to be developed in consultation with interested stakeholders and specific approval is required from MADEP, USFWS and NHDES. A draft of this plan was submitted to interested stakeholders on June 27, 2014. Comments were received from MADEP, CRWC, and the MA NHESP.

This sampling plan has been revised to address the comments received. Table 1 in Appendix C provides a summary of how the comments were addressed. Copies of the comment letters received are included in Appendix C.

Once the plan is approved by FERC, the field study will be implemented between April and November 2015.

Continuous DO data will be collected during the summer low-flow, high temperature period starting on June 1 (continuous temperature data collection will commence on April 1). As requested by MADEP, data through June 30 will be provided to MADEP along with the corresponding vertical profile data. FirstLight will then consult with MADEP to determine if early morning vertical profile collection is justified. If so, FirstLight will adjust the time of data collection, as directed by MADEP and as impoundment travel time constraints and safety considerations allow for.

9.0 Literature Cited

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Table 3.1: Water Quality Monitoring Sampling Locations.

Station No.	Type	Location	Comments
Connecticut River- Turners Falls Impoundment (Temperature and DO)			
1	Continuous	Below the Vernon Dam and Ashuelot River Confluence	Near thalweg at 25% depth
2	Profile	Deep area upstream of Northfield Mountain	Collect profile at one meter depth increments
3	Continuous	Above the Northfield Mountain Discharge; Downstream of Kidds Island	Near thalweg at 25% depth
4	Continuous	Northfield Mountain Tailrace	Within the Northfield Mountain Tailrace at 25% depth
5	Continuous	Below the Northfield Mountain Tailrace; Upstream of Millers River Confluence	Near thalweg at 25% depth
6	Profile	Deepest area of Turners Falls Impoundment	Collect profile at one meter depth increments until homothermous hypolimnion is encountered
7	Profile and Continuous	Upstream of the Turners Falls Dam at Boat Barrier	Collect profile at one meter depth increments and install continuous meter at 25% depth
Connecticut River- Bypass Reach (Temperature and DO)			
8	Continuous	Upstream of Station No. 1	Mid-channel, mid-depth
9	Continuous	Upstream of Rock Dam; west channel at Rawson Island.	Mid-channel, mid-depth
Turners Falls Power Canal (Temperature and DO)			
10	Continuous	At the 11th Street Bridge	Mid-channel, mid-depth
Connecticut River- Below Cabot Station (Temperature and DO)			
11	Continuous	Below the Cabot Station tailrace, upstream of Deerfield River confluence	Thalweg, mid-depth.
Connecticut River- Cabot Station to Holyoke Dam (Temperature)			
12	Continuous	Downstream of the Deerfield River confluence	Anchored near bottom, near shore
13	Continuous	Third Island	Anchored near bottom, near shore of island
14	Continuous	Second Island, near shore of island.	Anchored near bottom, near shore of island
15	Continuous	Submerged shallow sandbar	Anchored near bottom, at sandbar
16	Continuous	Submerged shallow sandbar	Anchored near bottom, at sandbar
17	Continuous	River right channel at Elwell Island	Anchored near bottom, near shore
18	Continuous	Upstream of Mt. Tom Station, near Mitch's Island	Anchored near bottom, near shore

Table 4.1: Water Quality Monitoring Instrument Specifications.

Parameter	Specification	Description
HOBO® Dissolved Oxygen Logger (U26-001)		
Dissolved Oxygen (mg/L)	Sensor type	Optical (dynamic luminescence quenching)
	Operating Range	0 to 30 mg/L
	Calibrated Range	0 to 20 mg/L (0 to 35°C)
	Accuracy	0.2 mg/L up to 8 mg/L; 0.5 mg/L from 8 to 20 mg/L
	Resolution	0.02 mg/L
	Sensor Life	6 months
Temperature (°C)	Operating Range	-5 to 40°C
	Accuracy	0.2°C
	Resolution	0.02°C
Depth Rating	—	100 m
Battery Life	—	3 years at 5-minute logging intervals
YSI ProODO		
Dissolved Oxygen (mg/L)	Sensor type	Optical (dynamic luminescence quenching)
	Range	0 to 50 mg/L
	Accuracy	± 0.1 mg/L (0 to 20 mg/L) or 1% of reading; ± 10% of reading (20 to 50 mg/L)
	Resolution	0.01 or 0.1 mg/L (autoscaling)
Dissolved Oxygen (% saturation)	Sensor type	Optical (dynamic luminescence quenching)
	Range	0 to 500% air saturation
	Accuracy	±1% 1% of reading (0 to 200% air saturation) or ± 10% (200 to 500% air saturation)
	Resolution	0.1% air saturation
Temperature (°C)	Range	-5 to 70°C
	Accuracy	±0.2°C
	Resolution	0.1°C
Barometer (mmHg)	Range	375 to 825 mmHg
	Accuracy	±1.5 mmHg (0 to 50°C)
	Resolution	0.1 mmHg
Cable Length	—	50 m
HOBO® Water Temp Pro v2 (U22-001)		
Temperature (°C)	Range	-40 to 70°C in air; 50°C maximum in water
	Accuracy	±0.21°C (o to 50°C)
	Resolution	0.02°C at 25°C
Battery Life	—	6 years at 1-minute logging intervals
Depth Rating	—	120 m

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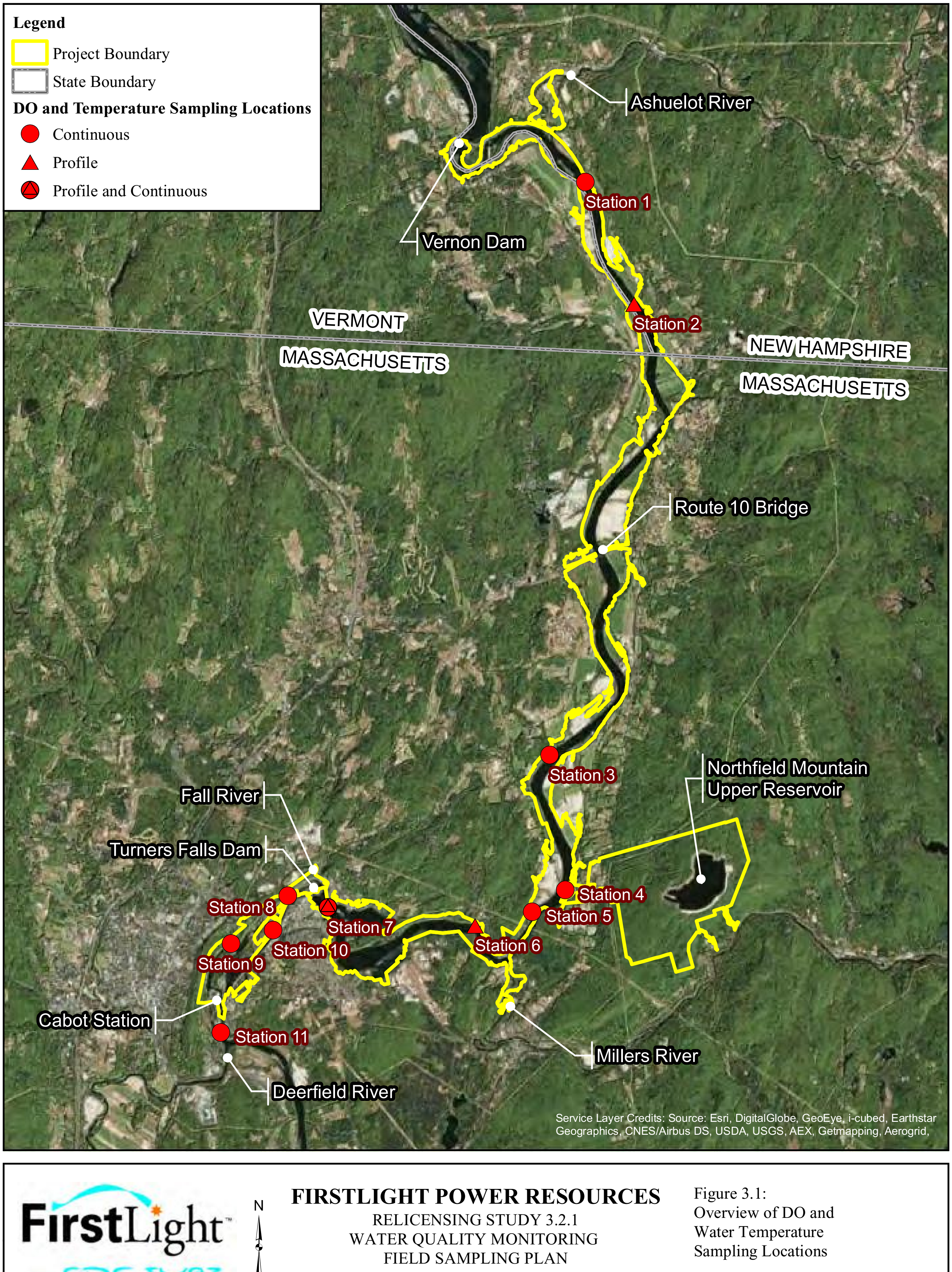

FirstLight GDF SUEZ

FIRSTLIGHT POWER RESOURCES
RELICENSING STUDY 3.2.1
WATER QUALITY MONITORING
FIELD SAMPLING PLAN

Figure 3.1:
Overview of DO and
Water Temperature
Sampling Locations

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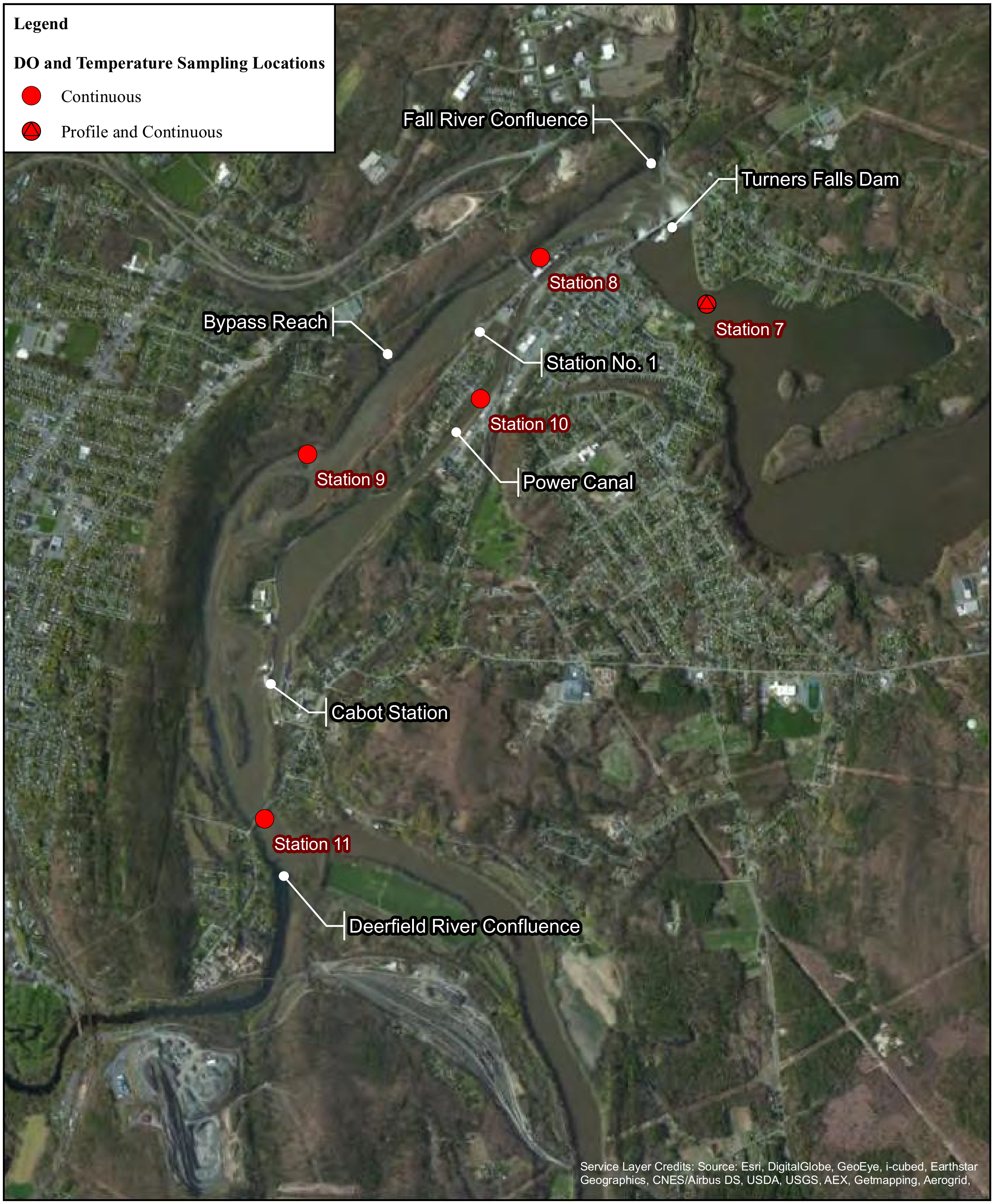

FirstLight GDF SUEZ

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FIRSTLIGHT POWER RESOURCES
RELICENSING STUDY 3.2.1
WATER QUALITY MONITORING
FIELD SAMPLING PLAN

0 0.25 0.5 1 Miles

Figure 3.2:
Water Quality Sampling
Locations Near Turners Falls Dam

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RELICENSING STUDY 3.2.1
WATER QUALITY MONITORING
FIELD SAMPLING PLAN

Figure 3.3:
Water Quality Sampling Locations Near the Northfield Mountain Tailrace

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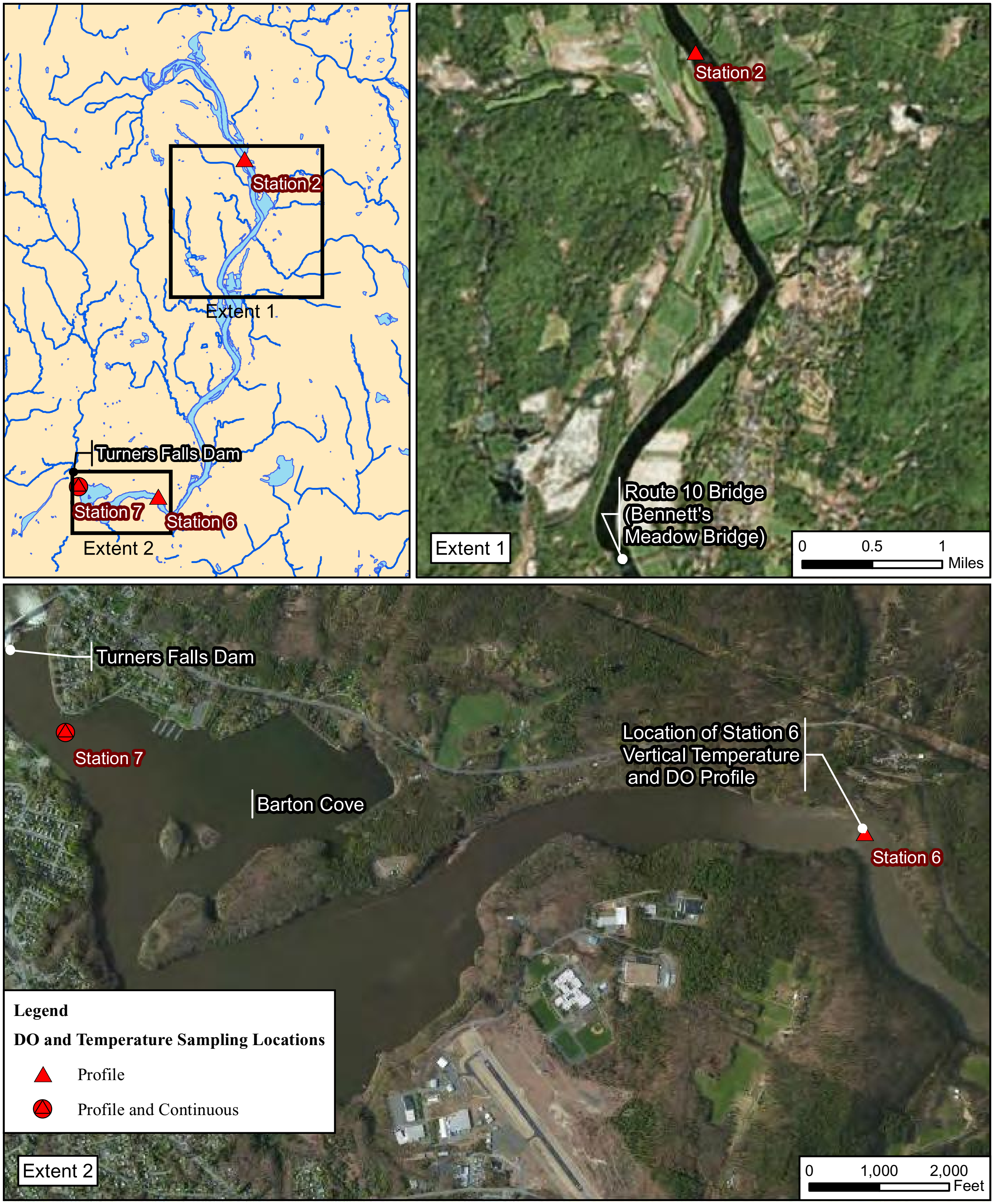
Path: W:\gis\studies\3_2_1\maps\Figure 3.3.mxd



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RELICENSING STUDY 3.2.1
WATER QUALITY MONITORING
FIELD SAMPLING PLAN

Figure 3.4:
Turners Falls Impoundment
Vertical Profile Locations

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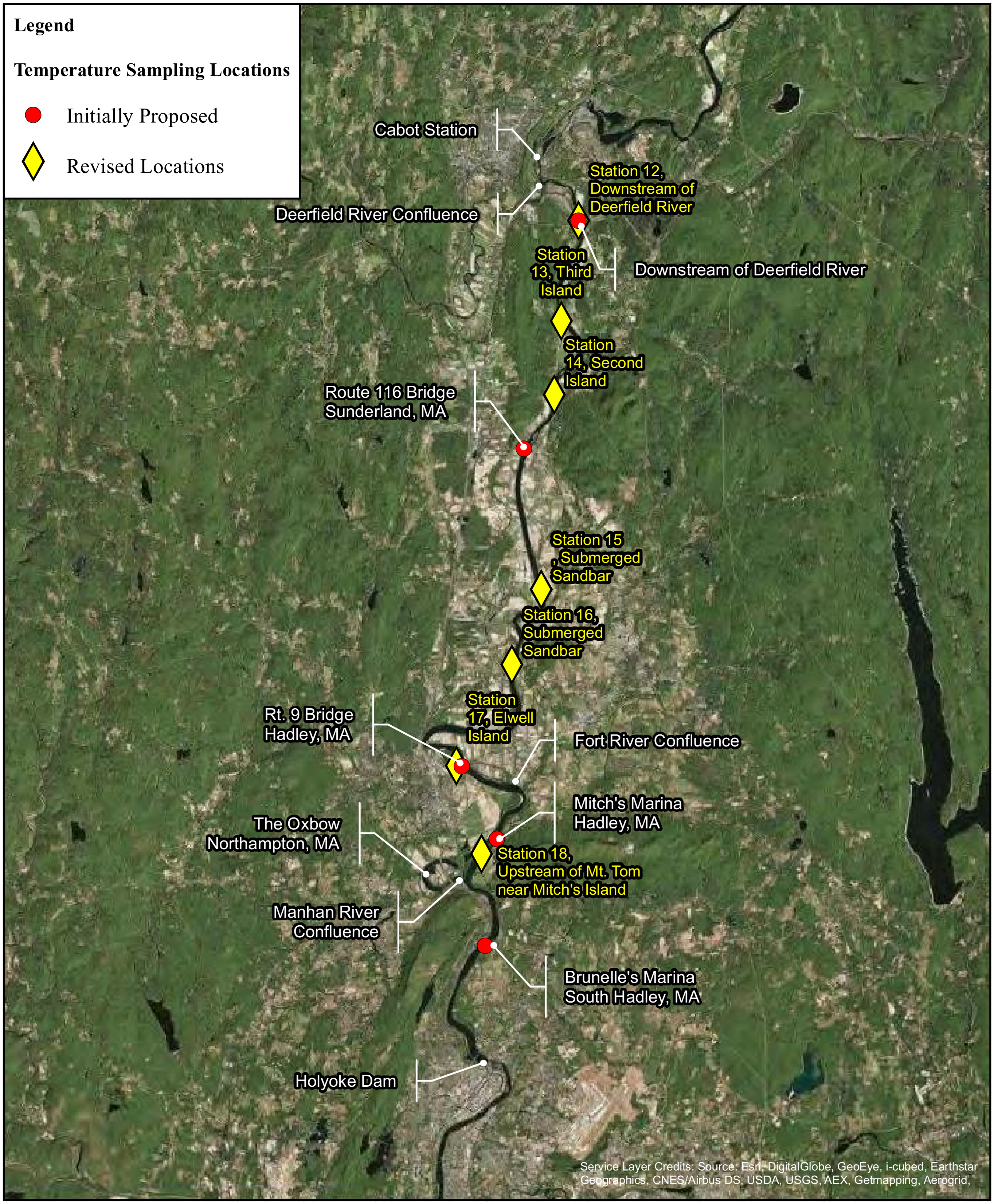

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FIRSTLIGHT POWER RESOURCES
RELICENSING STUDY 3.2.1
WATER QUALITY MONITORING
FIELD SAMPLING PLAN

0 1.25 2.5 5 Miles

Figure 3.5
Continuous Water Temperature Monitoring Locations
Cabot Station to Holyoke Dam
(revised based on stakeholder input)

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Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Appendix A: MA DEP Water Quality Sampling Standard Operating Procedures

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

MassDEP

Massachusetts Department of Environmental Protection
Division of Watershed Management

STANDARD OPERATING PROCEDURE

Water Quality Multiprobe Data Collection

CN 4.21
September, 2005

Prepared by:		Date:	9/1/05
	Jeff Smith, Environmental Analyst Richard Chase, Quality Assurance Analyst Laura Chan, Bob Haynes		
Approved by:		Date:	9/1/05
	Tom Dallaire, Database Manager		
Approved by:		Date:	9/2/05
	Arthur Johnson, Monitoring Coordinator		
Approved by:		Date:	9/3/05
	Dennis Dunn, Program Supervisor		

** This SOP also contains information pertaining to single-probe instruments used by DWM.*

SCOPE AND APPLICATION

Use of water quality probes is an integral component of the MADEP-Division of Watershed Management's ambient monitoring program. Use of probes is primarily designated for short term, hands-on monitoring and spot-checking of streams, rivers, ponds and lakes. Typically, setup consists of a display logger cabled to a submersible transmitter (multiple probe sonde or single probe). Single probe units are used "hands-on" in the field, while stand-alone multi-probe loggers can be used using either attended or unattended (see also CN 4.4) methods.

DWM's multiprobe workgroup responsible for purchases, setup, calibrations, maintenance, lab management, data retrievals, data validation and data management are as follows:

Staff	Primary Responsibilities	Secondary Roles
Jeff Smith	Overall management of calibration lab, calibrations and maintenance, preparation of standards, data validation and training, product testing and purchasing	Data retrieval (backup),
Richard Chase	Quality assurance for all activities involving probes (including field/lab safety, data accuracy and validation, SOP revisions, training), instrument calibrations/checks	Data retrieval (backup), product testing and purchasing
Bob Nuzzo	Instrument calibrations and checks	Data retrieval (backup)
Tom Dallaire	Data retrieval and management, database applications	Product testing, calibrations and checks (backup)
Misc. staff	Data retrievel, processing; cleaning deployed sondes after use…	---

COMPONENTS

As of 9/2005, DWM's fleet of single probes, multi-probe sonde transmitters (no internal data storage capability), display data loggers and multi-probe sonde loggers (with internal data storage capability) includes the following:

Make	Model	Serial #	Alpha Code	Software Version	Variables Measured
Hydrolab	SRV3	24571	A	2.02	NA (7070 scans)
Hydrolab	SRV3	24572	B	2.02	NA (7070 scans)
Hydrolab	SRV3	24573	C	2.02	NA (7070 scans)
Hydrolab	SRV3	31160	D	2.02	NA (3559 scans)
Hydrolab	Series 3 sonde logger	24569	E	1.35	Standard Sensors[1]
Hydrolab	SRV4	S1454	F	2.00	NA (1572864 MB memory)
Hydrolab	SRV4	S1455	G	2.00	NA (1572864 MB memory)
Hydrolab	MS4a-SE sonde logger	41215	H	3.31	Standard Sensors[1]
Hydrolab	MS4a-SE sonde logger	41217	I	3.31	Standard Sensors[1]
Hydrolab	MS4a	41705	J	3.31	DO & Temp
Hydrolab	MS4a	41706	K	3.31	DO & Temp
Hydrolab	MS4a	41707	L	3.31	DO & Temp
Hydrolab	DS4 sonde transmitter	36275	M	2.01	Standard Sensors + Turbidity
Hydrolab	DS4 sonde transmitter	36276	N	2.01	Standard Sensors (+ PAR[3] & Chl a[4]: removed)
Hydrolab	Series 3 sonde transmitter	15559	---	1.03	Standard Sensors[1]

Make	Model	Serial #	Alpha Code	Software Version	Variables Measured
Hydrolab	Series 3 sonde transmitter	15486	---	1.03	Standard Sensors + ORP[2]
Hydrolab	Series 3 sonde transmitter	24570	---	2.20	Standard Sensors + Turbidity
YSI	6920 sonde				Standard Sensors[1] and BGA, Chl a
YSI	6920 sonde				Standard Sensors[1] and BGA, Chl a
YSI	650 MDS				NA
YSI	650 MDS				NA
YSI	600XLM sonde logger	767AA	P	2.20	Standard Sensors[1]
YSI	600XLM sonde logger	767AB	Q	2.20	Standard Sensors[1]
YSI	650 MDS	1139 AI	R	1.09	NA
YSI	650 MDS	1139AJ	S	1.09	NA
Hydrolab	MS4a	42235	T		DO & Temp
Hydrolab	MS4a	42236	U		DO & Temp
Hydrolab	MS4a	42237	V		DO & Temp
Hydrolab	MS4a	42238	W		DO & Temp
Hydrolab	MS4a	42239	X		DO & Temp
Hydrolab	MS4a	42240	Y		DO & Temp
Hydrolab	MS5	42967	ZA		DO & Temp
Hydrolab	MS5	42968	ZB		DO & Temp
Hydrolab	MS5	42969	ZC		DO & Temp
Other probes					
YSI	33 S-C-T		---	---	Conductivity, salinity and temp.
YSI	57		---	---	D.O.
YSI	54				D.O.
Orion					pH
Markson					pH
Eutechnics			---	---	Temperature
Digi-Sense	Thermologger RTD		---	---	Temperature
Onset	Stowaway®	515486	---	---	Continuous temperature
Onset	Stowaway®	552434	---	---	Continuous temperature
Onset	Stowaway®	515472	---	---	Continuous temperature
Onset	Stowaway®	706751	---	---	Continuous temperature
Onset	Stowaway®	735455	---	---	Continuous temperature
Onset	Stowaway®	730537	---	---	Continuous temperature
Onset	Stowaway®	9140	---	---	Continuous temperature
Onset	Stowaway®	729121	---	---	Continuous temperature
Onset	Stowaway®	515474	---	---	Continuous temperature
Onset	Stowaway®	738001	---	---	Continuous temperature
Onset	Stowaway®	552435	---	---	Continuous temperature
Onset	Stowaway®	552426	---	---	Continuous temperature
Onset	Stowaway®	552431	---	---	Continuous temperature
Onset	Stowaway®	515471	---	---	Continuous temperature
Onset	Stowaway®	729118	---	---	Continuous temperature
Onset	Stowaway®	737992	---	---	Continuous temperature
Onset	Pro v2	1134422	---	---	Continuous temperature
Onset	Pro v2	1134432	---	---	Continuous temperature
Onset	Pro v2	1134433	---	---	Continuous temperature

Make	Model	Serial #	Alpha Code	Software Version	Variables Measured
Onset	Pro v2	1134434	---	---	Continuous temperature
Onset	Pro v2	1134435	---	---	Continuous temperature
Onset	Pro v2	1134436	---	---	Continuous temperature
Onset	Pro v2	1134437	---	---	Continuous temperature
Onset	Pro v2	1134438	---	---	Continuous temperature
Onset	Pro v2	1134439	---	---	Continuous temperature
Onset	Pro v2	1134440	---	---	Continuous temperature
Onset	Pro v2	1134441	---	---	Continuous temperature
Onset	Pro v2	1134442	---	---	Continuous temperature
Onset	Pro v2	1134443	---	---	Continuous temperature
Onset	Pro v2	1134444	---	---	Continuous temperature
Onset	Pro v2	1134445	---	---	Continuous temperature
Onset	Pro v2	1134446	---	---	Continuous temperature
Onset	Pro v2	1134447	---	---	Continuous temperature
Onset	Pro v2	1134448	---	---	Continuous temperature
Onset	Pro v2	1134449	---	---	Continuous temperature
Onset	Pro v2	1134450	---	---	Continuous temperature
Onset	Pro v2	1134451	---	---	Continuous temperature
Onset	Pro v2	1134452	---	---	Continuous temperature
Onset	Pro v2	1134453	---	---	Continuous temperature
Onset	Pro v2	1134454	---	---	Continuous temperature
Onset	Pro v2	1134455	---	---	Continuous temperature
Onset	Pro v2	1134456	---	---	Continuous temperature
Onset	Pro v2	1134457	---	---	Continuous temperature
Onset	Pro v2	1134458	---	---	Continuous temperature
Onset	Pro v2	1134459	---	---	Continuous temperature
Onset	Pro v2	1134460	---	---	Continuous temperature
Onset	Pro v2	1292378	---	---	Continuous temperature
Onset	Pro v2	1292379	---	---	Continuous temperature
Onset	Pro v2	1292380	---	---	Continuous temperature
Onset	Pro v2	1292381	---	---	Continuous temperature
Onset	Pro v2	1292382	---	---	Continuous temperature
Onset	Pro v2	1292383	---	---	Continuous temperature
Onset	Pro v2	1292384	---	---	Continuous temperature
Onset	Pro v2	1292385	---	---	Continuous temperature
Onset	Pro v2	1292386	---	---	Continuous temperature
Onset	Pro v2	1292387	---	---	Continuous temperature
Onset	Pro v2	2381495	---	---	Continuous temperature
Onset	Pro v2	2381496	---	---	Continuous temperature
Onset	Pro v2	2381497	---	---	Continuous temperature
Onset	Pro v2	2381498	---	---	Continuous temperature
Onset	Pro v2	2381499	---	---	Continuous temperature
Onset	Pro v2	2381500	---	---	Continuous temperature
Onset	Pro v2	2381501	---	---	Continuous temperature
Onset	Pro v2	2381502	---	---	Continuous temperature
Onset	Pro v2	2381503	---	---	Continuous temperature
Onset	Pro v2	2381504	---	---	Continuous temperature
Onset	Pro v2		---	---	Continuous temperature
ESD					Turbidity
Oakton					pH, temperature, conductivity

[1] Standard Sensors include water depth, temperature, dissolved oxygen, conductivity (or total dissolved solids; or salinity), TDS and pH.
[2] Oxidation-reduction potential.
[3] Photosynthetically-active radiation (ambient light)
[4] Via in-situ fluorometry

In addition, DWM owns accessory equipment to operate and maintain these units, such as auxiliary batteries, cables, solutions, misc. spare parts and hardware, etc. Series 3 and 4 Hydrolab system components include three 12-volt rechargeable battery packs and cables of various lengths. The battery packs are used during pre- and post-calibration as well as back-up voltage should one of the Surveyor 3 and 4 display logger internal batteries discharge completely during *in situ* monitoring. All of DWM's Hydrolab cables are enclosed in urethane jackets and equipped with high pressure marine connectors. Available cable lengths include 15 meters (4 each), 25 meters (1 each), and 50 meters (1 each). YSI units take either a rechargeable battery pack or 8 "C" cell batteries.

SPECIFICATIONS

Sensor resolution, accuracy and precision, as provided by the manufacturers, are provided below for each water quality parameter measured. These specifications represent a baseline of expected performance and for comparison to results. DWM's well-maintained, accurately-calibrated units typically display results well within these specifications.

Hydrolab Series 3	**Resolution**	**Range**	**Accuracy (+/-)**
Temperature (deg. C)	0.01	-5 to 50	0.15
Depth (m)	0.1	0-100	0.45
pH	0.01	0-14	0.2
Dissolved Oxygen (mg/l)	0.01	0-20	0.2
Specific Conductance (uS/cm)	4 digits	0-100000	1% of range
% Oxygen Saturation	NA	0-100	NA
Turbidity (NTU)	0.1,1 (100, 1000 ranges)	0-100	5% of range
Hydrolab Series 4/5			
Temperature	0.01	-5 to 50	0.1
Depth	0.1	0-100	0.3
pH	0.01	0-14	0.2
Dissolved Oxygen	0.01	0-50	0.2
Specific Conductance	4 digits	0-100000	1% of range
% Oxygen Saturation	NA	0-100	NA
Barometer, internal (mm Hg)	0.1	500-850	1-2 (at 25C)
Turbidity	0.1, 1	0-1000	5% of range
Chlorophyll a (in-situ) (ug/l)	0.01	0.03-75	3.5
YSI 600XLM			
Temperature (deg. C)	0.01	-5 to 45	0.15
Depth (m)	0.001	0-61	0.4
pH	0.01	0-14	0.2
Dissolved Oxygen (mg/l)	0.01	0-50	0.2
Specific Conductance (uS/cm)	0.1	0-100000	0.05% of reading
% Oxygen Saturation	NA	0-100	NA

STORAGE AND TRANSPORT OF PROBES

When not in use, all probes are stored per manufacturer recommendations or as otherwise specified herein, in order to maximize probe life and maintain probe accuracy. When not in use, the cased instruments shall be stored on separate shelves of locked metal cabinets in the calibration laboratory.

When used, each probe unit must be transported in a dedicated carrying case along with various accessories. Standard accessories can include a weighted stirrer, sonde weight, back-pack and over-the-shoulder straps for the carrying case, low-ionic standard check solution, temporary storage bottle for sonde tip, temporary storage cup for sonde tip (Series 3), clamps, extra field data sheets and COC forms, laminated field quickguides, and cleaning towels. When packed, the instruments and accessories shall be positioned properly in the cushioned sections of the carrying case. In particular, all transmitters and the Recorder shall be positioned so that the pH reference probe is in the 2:00 o'clock position when viewed from above. Carrying cases shall be zipped/closed to the closed position at all times during transport.

Transporting encased units in the beds of pickup trucks or in boats under tow is not allowed. Suitable locations for transport include the trunk or rear seat area of small sedans, the rear seat of pickup trucks, or the floor of a van.

Each unit is calibrated and provided to the survey coordinator with all cables attached. Cables should remain attached for the duration of the survey. This saves time and minimizes wear of the cable connections.

For the Hydrolab Series 3 (only), a threaded storage cup must be threaded securely into each Series 3 Hydrolab transmitter bulkhead to protect the multiprobe sensors at all times, except during *in situ* monitoring and calibration. Each storage cup shall be filled to approximately two-thirds of its volume with 1º (primary) Nanopure water to bathe the sensors, especially after each use in the "field." A cap for the storage cup is provided in the carrying case to prevent spillage when the instrument is being used. If spillage does occur, the Hydrolab operator shall replace the lost volume with low-ionic standard check solution that is stored in each carrying case. For all other units (Series 4 and YSI), a temporary storage bottle containing a moist sponge is used to cover the end of the sonde.

All cables shall be protected from abrasion, unnecessary tension, bending over sharp radii such as boat gunnels or bridges, repetitive twisting, and excessive weight. Cable connectors shall be kept clean and free of dust, sand, grit, and water. Protective "dummy" plugs shall be installed at the ends of each cable except when the cable is being used. And, when in use, opposing cable plugs shall be coupled and stored in the carrying case. Cables shall be coiled neatly after each use and stored within the carrying case. Upon return to the calibration laboratory, all cables shall be inspected by the calibrator or laboratory supervisor and then stored on shelves beneath the bench top.

PRE-SURVEY CALIBRATION & POST-SURVEY CHECKS

Accurate and reliable calibration of probes in both concentrated and dilute standards is essential for recording valid *in situ* water quality data. These activities shall be performed by competent DWM staff trained and supervised by the calibration laboratory supervisor or, if necessary, by the supervisor. Pre-survey calibration and post-survey checks shall be performed on all probes used for routine monitoring as well as special projects. All calibration and QC check data shall be stored in lab notebooks and electronically in calibration files.

NOTE: In the rare instance of an emergency fish kill, the specific conductance and dissolved oxygen sensors shall be pre-calibrated at a minimum prior to releasing the unit for immediate field use. However, data recorded simultaneously for all non-calibrated variables (excluding depth and temperature) shall be censored.

Equipment and Supplies

The equipment and supplies listed below are essential for routine calibration of DWM's multiprobes.

- Nanopure® water deionization system with 0.2µm porosity final filters. Use pretreated feed cartridge kit (Catalog No. D5026). Note: the Barnstead/Thermolyne Corporations's "Nanopure® Analytical Deionization System Operation Manual and Parts List," Series 851, is thorough and descriptive in all aspects of operation, maintenance, and diagnoses of problems. This Manual shall serve as the Standard Operating Procedure for the Nanopure Deionization system.

- 2000 ml ± 0.5 ml volumetric flask with plastic cap.

- Volumetric TD ("to deliver") pipets: 10 ml ± 0.04 ml @ 20ºC; 2ml ± 0.012 ml @ 20ºC.

- Advanced Polymer Systems, Inc., primary calibration standards for turbidity: Item nos. CRS-40 (40 NTUs); CRS-20(20 NTUs); CRS-10 (10 NTUs). *NOTE: use of this solution has been discontinued (from 2002 on)*

- 1.0 M KCl stock solution prepared by the Laboratory Manager for Inorganic Chemistry, Wall Experiment Station. Store in an amber-colored, 1 liter bottle and seal tightened cap with Parafilm®.

- Low-ionic phosphate standard stock solution developed by Metcalf and Peck (1993) as a quality control standard for pH, conductivity and acid-neutralizing capacity of dilute surface waters, such as those typical of central and southeastern Massachusetts. This standard has a theoretical pH of 6.98, a calculated conductivity of 75.3 µS/cm, and an acid neutralizing capacity of 12.5 mg/L (Metcalf and Peck 1993). A copy of the recipe for this standard is included as Attachment B. The stock solution is prepared by the Laboratory Manager for Inorganic Chemistry, Wall Experiment Station. It is stored in an amber-colored, 1 liter bottle and its tightened cap is sealed with Parafilm®.

- Fisher Scientific Gram-Pacs® of certified buffer salts (dry): Catalog Nos. B77 (10.4 ± 0.1 @ 25ºC); B78 (6.86 ± 0.02 @ 25ºC); and, B79 (4.01 ± 0.02 @ 25ºC).

- Nalgene® 250 ml LDPE dispensing bottle (Fisher 98/99 catalog no. 03-409-13B) with molded-in side arm spigot.

- Fisher brand silicone bulb-type safety pipet filler (Fisher 98/99 catalog no. 13-681-102B).

- PC Duster®2 (or comparable product); a non-flammable, ozone-safe, compressed gas canister with reusable nozzle.

- Misc. lab supplies, such as clean single-edge razor blades, Kim-Wipes, pH and DO probe electrolyte solutions, etc.

Material Safety and Waste Management

Stock and primary calibration standards (liquid) listed above are non-toxic, stable and safe to dispose of down the drain.

The Fisher Scientific dry buffer salts may cause irritation of the eyes, skin, respiratory tract, and digestive tract if handled improperly or in the case of an accident. Each box of 12 Gram-Pacs® includes a warning about the aforementioned irritations as well as precautions and first aid measures. A primary first aid measure is to "flush eyes with plenty of water for at least 15 minutes…," and there is an emergency shower and eyewash directly forward of the door to the calibration laboratory (Room 226). Material Safety Data Sheets (MSDS) for Fisher Scientific dry buffer salts are kept in Room 226 and 228.

There are no medical conditions generally aggravated by exposure to these solutions of 1% copolymer beads. MSDS sheets for Advanced Polymer Systems, Inc. primary turbidity standards are also kept in Room 226 and 228. *NOTE: use of this solution has been discontinued (from 2002 on)*

Preparation of Calibration Standards

Accurate, quantitative preparation of calibration standards is accomplished with skill, patience, and clean bench-top chemistry. Completion of this task on a routine basis shall be the responsibility of the calibration laboratory supervisor or by a skilled assistant trained by that supervisor.

<u>Specific conductance standards</u>

Quantitative preparations from a 1.0 M KCl stock solution to yield 2 liter or 1 liter volumes of the standards typically used to calibrate the conductivity sensor are presented in the tabulation below. Note that the milliliters of KCl stock are based on a 1 liter standard volume, whereas 2 liter volumes are typically prepared.

Specific Conductance @ 25ºC (µS/cm)	KCl Molar Concentration	Milliliters KCl Stock/L
1413	0.01	10.0
718	0.005	5.0
147	0.001	1.0

Consistency is achieved by adhering to the steps that follow for the preparation of **2 liter** volumes of specific conductance calibration standards.

- Prepare specific conductance standards from the most dilute to the most concentrated; for example, 147µS/cm, 718µS/cm, and 1413µS/cm.

- Add 1º Nanopure water to a clean 2 liter volumetric flask. Fill to approximately ϑ volume of flask. **Note**: 1º Nanopure water is contained in a separate carboy that is filled directly from the Nanopure® deionization and filtration system remote dispenser. It is used only for the preparation of calibration standards, calibration of Hydrolab sensors, and for final rinses of volumetric flasks, pipets, and multiprobe sensors. A second carboy of "flushing" Nanopure water is used to flush volumetric flasks and flush Hydrolab multiprobe sensors during calibration. The "flushing" carboy is partially filled directly from the Nanopure® system remote dispenser, but Nanopure "flush" water is added as well. The so-called "flush" water is the volume (typically 500 ml) withdrawn from either the remote dispenser or the auxiliary valve prior to filling the primary carboy or field blanks.

- Carefully add required dose of stock solution to the 2 liter volumetric flask with appropriate volumetric pipet (refer to tabulation above) and swirl to mix. **Note: the dose of stock solution needs to be doubled for preparation of 2 liter volumes.**

- Add another ϑ volume of 1º Nanopure water to the volumetric flask with periodic interruptions to swirl its contents.

- Fill with 1º Nanopure water to a point just below etched line on neck of flask.

- Carefully add 1º Nanopure water, drop-by-drop, from the side arm spigot of a 250 ml dispensing bottle (or "squeeze" bottle) until the bottom of the liquid meniscus is at the same plane as the etched line.

- Snap plastic cap securely to top of volumetric flask and invert ten (10) times slowly. Be sure to shake contents of flask when it is in the inverted position.

- Let flask stand at least 0.5 minutes to allow all of its fluid content to drain down its neck.

- Dispense contents of volumetric flask into the **appropriate** calibration standard carboy. **Double-check this step carefully**, else the consequences will be problematical. Update information on the manila tag attached to the carboy handle.

- Rinse volumetric flask five (5) times with flushing Nanopure water followed by one (1) rinse with 1º Nanopure water. Invert flask to drain and place on calibration rack. Collect drain water in glass or plastic vessel and discard in sink. Air dry flask in storage cabinet.

Low-ionic calibration check standard

The procedures described below are followed for preparation of the low-ionic standard. "Shelf life" or batch preparation cycle for the low-ionic standard is two weeks. See also Attachment B for preparation of stock solution.

- Add 1º Nanopure water to a clean 2 liter volumetric flask. Fill to approximately ϑ of its volume.

- Carefully add 20.0 ml of the low-ionic phosphate stock solution to the 2 liter volumetric flask with a volumetric pipet and swirl to mix.

- Add another ϑ volume of 1º Nanopure water to the volumetric flask with periodic interruptions to swirl its contents.

- Fill with 1º Nanopure water to a point just below etched line on neck of flask.

- Carefully add 1º Nanopure water, drop-by-drop, from the side arm spigot of a 250 ml dispensing bottle (or “squeeze” bottle) until the bottom of the liquid meniscus is at the same plane as the etched line.

- Snap plastic cap securely to top of volumetric flask and invert ten (10) times slowly. Be sure to shake contents of flask when it is in the inverted position.

- Let flask stand at least 0.5 minutes to allow all of its fluid content to drain down its neck.

- Dispense contents of volumetric flask into the **appropriate** calibration standard carboy. **Double-check this step carefully**, else the consequences will be problematical. Update information on the manila tag attached to the carboy handle. <u>Prepare new batch every two weeks.</u>

- Rinse volumetric flask five (5) times with flushing Nanopure water followed by one (1) rinse with 1º Nanopure water. Invert flask to drain and place on calibration rack. Collect drain water in glass or plastic vessel and discard in sink. Air dry flask in storage cabinet.

<u>pH standards</u>

Buffer salt pH standards are prepared similar to that described for specific conductance and low-ionic standards, except that there is **no stock solution**. Instead, pre-weighed dry buffer salts are sealed in Fisher Gram-Pac® packets. Empty the contents of two (2) packets of the same pH standard into the 2 liter volumetric flask following the basic steps listed below.

- Add ϑ volume 1º Nanopure water to the 2 liter volumetric flask as described previously for specific conductance and low-ionic calibration standards.

- Tap pH buffer packet on laboratory bench top to concentrate dry salt at bottom. Place packet horizontally on a cardboard backing and slice off top just below seal with a single-edge razor blade. Squeeze sides of packet (avoid touching top) to create a puckered, mouth-like opening.

- Carefully place lower part of packet opening into neck opening of 2 liter volumetric flask, and tap packet gently with index finger to **slowly** dislodge buffer salt, which should slide into flask without any spillage. **Note**: if spillage does occur, the preparer must begin anew by disposing of the remaining buffer salt, emptying the contents of the volumetric flask, rinsing the flask as described previously, *et cetera.*

- Rinse remaining buffer salt and fines from Gram-Pac® with a 250 ml dispensing (squeeze) bottle containing 1º Nanopure water, and pour the contents into the volumetric flask. Repeat several times to assure that no buffer salt remains within the Gram-Pac®. Open Gram-Pac® carefully to verify that all buffer salt has been dissolved and rinsed into the volumetric flask. Do not dispose of rinsed Gram-Pac® at this time.

- Repeat the aforementioned procedure for the second of two (2) Gram-Pac® packets that must be added to prepare 2 liters of pH standard (either 10.4, 6.86, or 4.01). Verify that both Gram-Pac® buffers are the same pH standard, then dispose of the empty packets.

- Rinse neck of volumetric flask with 250 ml dispensing bottle containing 1º Nanopure water, then fill and swirl the contents of the volumetric flask as described previously for specific conductance and low-ionic standards.

- Dispense the contents of the volumetric flask into the **appropriate** pH standard carboy (either 10.4, 6.86, or 4.01) as described previously. **Note: double check this step before proceeding**. Update information on the manila tag attached to the pH standard carboy handle.

<u>Turbidity standards</u>

Primary standards for calibrating the turbidity sensor are purchased directly from Advanced Polymer Systems, Inc., of Redwood City, California, or equivalent provider. Typically, 40, 20, and 10 NTU polymer standards are stocked in the calibration lab, and the one-year expiration date on each 1 liter bottle shall be highlighted.

0 mg/l D.O. Standard

For use in pre- and post-survey checks on dissolved oxygen for surveys in which low D.O.s are critical (e.g., lake hypolimnions, highly polluted/enriched waterbodies), a "zero" (0.0 mg/l) D.O. standard is used (starting in 2006).

Following Standard Methods and USGS TWRI Book 9, the zero standard is prepared daily as follows:

- Add sodium sulfite to excess in a 500-1000 ml container. This is achieved by dissolving approx. > 1 gram sodium sulfite per liter DIW.
- Add a trace (a few crystals) of cobalt chloride and mix (optional catalyst).
- Prepare weekly prior to use and/or as needed.

Following calibrations, perform final check using the zero DO standard by immersing DO probe into solution to confirm <0.5 mg/l result. If test fails, perform maintenance or use another probe. When done, rinse probe and store in storage cup.

Procedures for Calibration and Checks for Multiprobe Sensors

Laboratory calibration of sensors includes the following provisions:

- Detailed record keeping
- Annotation of text into logger memory (Hydrolab only)
- Instrument setup and configuration (including editing of Site List for YSI units)
- Sequential calibration of multiprobe sensors immediately preceding the survey
- QC checks within 24 hours following survey.

With a partial exception for turbidity (described below), calibration of multiprobe sensors is an intense and tedious process in which the same steps are performed for each standard. And, with the exception of multiple flushings of the multiprobe sensors, these steps are clearly and systematically presented on the two-page, back-to-back, "Hydrolab Multiprobe Calibration Record." A sample copy of the Calibration Record is included (Attachment A). For YSI calibration procedures, see Attachment G.

In general, calibrations of pH, sp. Conductance and D.O. follow the instrument manual directions, with slight modifications (e.g., more washes, post-cal checks using zero DO and low ionic solutions). Not evident on the Calibration Record is the fact that DWM's standard operating procedures include at least two (2) pre-survey calibration rinses with previously-used standard, one (1) rinse with the primary standard, and three (3) or more post-survey calibration rinses, as needed, with flushing and then 1º Nanopure water until specific conductance is reduced to the instrument's minimum recorded ("normal") value (typically within the range of 1.0 ±0.3 μS/cm). The "**thorough rinse protocol**" is a key element to the consistent and reliable sensor calibration that is routinely performed at DWM, primarily because it assures that every calibration begins with essentially residue-free sensors. Also, the "thorough rinse protocol" often reveals the first indication of change to a particular sensor's normal response pattern, which may signal that additional maintenance is necessary or that it may be a prelude to eventual replacement of that sensor.

The front page of the Calibration Record includes initial record-keeping steps, checks on instrument configuration, annotations, and systematic calibration of the multiprobe sensors. Post-survey quality control (QC) checks of the multiprobe sensors in the zero DO standard (starting in 2006), low-ionic standard and in 1º Nanopure deionized, filtered (0.2μm porosity) water are on the backside of the one-page Calibration Record. Since the zero DO and low-ionic standards "decay" over time, fresh "batches" of these solutions are prepared <u>daily</u> and <u>every two weeks</u>, respectively. The date of preparation is recorded manually and annotated electronically prior to each pre- and post-survey quality control check of the sensors in this standard. Specific conductance, pH and percent saturation of dissolved oxygen are the key variables that are monitored when the multiprobe sensors are checked in the low-ionic standard. The key variable in the second of two quality control checks is specific conductance (~1.0 ±0.3 μS/cm) of the deionized, filtered water. This is a measure of the lowest possible recording of that sensor when it has been thoroughly flushed and tested in this medium. If it is not within the range of 1.0 ± 0.3μS/cm, it will have affected adversely linearity checks of specific conductance performed previously in the 147μS/cm check standard and the low-ionic QC standard. This is an unlikely outcome, however, since the multiprobe sensors are checked in the same deionized, filtered water prior to the onset of the calibration process. Otherwise, it is an indication that the conductivity sensor needs to be cleaned and that its pins need to be polished.

Calibration of the turbidity sensor entails the "thorough rinse protocol" as well. But, a further requirement is that all multiprobe sensors be "blown dry" with compressed gas prior to each calibration or check on linearity with NTU (Nephelometric Turbidity) standards. The purpose of this step is to eliminate excess water and, therefore, excess use of NTU standard solutions, which are comparatively expensive. Based on DWM lab experience, calibration of the turbidity sensor is not done during every pre-survey calibration, but must be performed at least once for every 5 field trips. *Note: Hydrolab turbidity probes are currently (as of 3/2003) not being used due to as-yet unresolved QC problems, and replacement by lab turbidity measurement.*

TDS Calculation

Internal calculation of Total Dissolved Solids (TDS) by the Hydrolab is as follows: TDS (mg/l) = measured conductivity (uS/cm) x C, where C=0.6. (For YSI, the multiplication factor is 0.65)

Temperature Calibration

See Appendix K for an example of multi-probe thermistor calibration and check.

Depth Calibration in the field (at each site):

Set all multi-probes to 0.0 in air at each site, prior to deployment.

USE OF PROBES IN THE FIELD

The specific procedures for scheduling, using and returning multiprobe units back to the DWM lab are as follows:

Requests for Calibrated Probes

A seasonal river basin sampling schedule shall be issued each spring by DWM's Monitoring Coordinator. Subsequently, the survey coordinator or lead person for surveys in each basin shall complete a MultiprobeRequest Form (Attachment C). The completed forms (electronic copy at a minimum) shall be sent to the calibration laboratory supervisor and QA Analyst at least one (1) week prior to each scheduled survey. A one-time seasonal form may be submitted for repetitious monitoring. In this instance, the number of multiprobes, pick-up times, dates of monitoring, etc., are more-or-less set for the sampling "season." Coordinators for special purpose monitoring surveys shall follow these same procedures.

Multiprobe Use "Rules"

Use of multiprobes shall be restricted to DEP employees (primarily DWM staff) that have been trained by the calibration laboratory supervisor/QA Analyst and who are sufficiently experienced to set up these instruments properly so that valid *in situ* data are generated consistently. These individuals shall be designated as "primary users." Other trained DEP employees may assist in the monitoring effort, but the primary users shall assume complete responsibility for multiprobes assigned to them and for adhering to the standard operating procedures stated herein. The prohibitions listed below shall apply to all users of DWM multiprobe instruments.

- Use of multiprobes in canoes or other small, unstable boats is prohibited.

- Use of multiprobes from dangerous or precarious locations (cliffs, steep embankments, waterfalls, *et cetera*) is prohibited.

- Use of multiprobes at municipal or other waste treatment plants, or discharges therefrom, or any other discharge site or outfall other than stormwater, shall be prohibited. Such discharges, including chlorinated effluents, may "foul" and/or interfere with multiprobe sensors. Immediate and subsequent survey data would likely be invalid, as revealed in the post-calibration process and/or data quality control checks.

- Use of multiprobes from bridges or other such overpasses is allowed provided that it is safe to do so and provided that it is not otherwise prohibited or restricted in these standard operating procedures.
- Use of multiprobes in turbulent conditions or in areas containing sub-surface eddies is prohibited.
- Use of multiprobes in buckets containing waters of interest is not preferred and introduces a likely, unacceptable amount of measurement error.
- Use of multiprobes shall be performed such that the unit is rotated to a position where the "turbidity sensor well" is facing downward.

In situ Measurements of Multiprobe Parameters

The way multiprobes are used in the field will depend, in part, on project-specific objectives, as may be found in the monitoring QAPP. A detailed QAPP, coupled with proper training and adherence to this guidance, should produce quality multiprobe data.

The guidance contained in the laminated "QuickGuides" located in the inside zipper pocket of each carrying case should be followed. The most recent version for the Hydrolab units is included as Attachment D. The QuickGuides include instructions for assembling multiprobe components, deploying the multiprobe in surface waters, annotating essential information, and recording measured variables. Therefore, the most recently issued Guide is an integral component of these standard operating procedures. (Out-of-date Guides are kept on file in the calibration laboratory).

In general, readings are recorded every 30 seconds for five (5) minutes, and only after all enabled variables are stable. Recordings during colder months may require additional recording time, since certain multiprobe variables are slower to reach equilibrium at cooler water temperatures (~ 5-10°C). When any surface water is less than 5°C, readings should be recorded for at least seven (7) minutes at 30 second intervals. There are no standard operating procedures for monitoring water quality variables under ice cover since DWM generally does not engage in surveys under these conditions.

A duplicate set of multiprobe readings can be taken at a rate of once per trip by removing the multiprobe from the water (after all readings have been taken and the last recorded), immediately redeploying in the same location and storing an additional reading. The duplicate readings can provide information on overall precision or repeatability of the in-situ measurements. (Most of any variation observed will be assumed to typically be due to natural variation, but this assumption may not hold in all cases, which may lead to inferences regarding quality control).

<u>For Hydrolab data, users shall ONLY annotate (enter) a single OWMID prior to recording (storing) data</u>, consistent with the Guide.

Additional standard operating procedures not included in the Guides shall be required for different surface water sampling sites, as described below.

<u>Depth Calibration in the field (at each site):</u>
Due to elevation differences between sampling locations, it is necessary to calibrate the "depth" readings when using Hydrolab (and other) multi-probes. This is performed by the user at each station by entering a "0.00" meter offset in the depth calibration mode, with the sonde IN AIR.

Specifically for the DS3, "calibrate-depth" and enter "0.00".

For the DS4, go to "Set Up", "Cal", "Calibrate", "Sonde", "Depth", "0.00", "Select", and "Done".

<u>For depth calibration of YSI multi-probes, see CN 4.31.</u>

Rivers and stream monitoring from bridges and/or other suspended platforms

The following example procedures (using a Hydrolab unit) are relevant for any *in situ* monitoring from bridges and/or other suspended platforms, where it has been determined by the primary user that velocity and flow conditions are sufficient enough to necessitate the use of a multiprobe anchoring setup. In general, if the unit cannot be placed on the river/stream bed (ie.must be held in the water column), or if the unit does not stay sitting where placed (due to movement or potential for movement by high flow/velocity), then the anchoring setup as described below must be employed.

- Suspend an anchor over the bridge wall or railing, above a non-turbulent location, and release the line slowly until the anchor is at the surface of the river or stream. Mark the anchor line; then, lower it slowly to the riverbed. Estimate the depth of this sampling site from the distance "traveled" by the "mark." Secure the anchor line to the bridge railing.

- Wait several minutes to assure that the position of the anchor remains unchanged and that any plume of resuspended sediments has been carried downstream. If it is moved by water currents, use a heavier anchor or move it laterally to a more quiescent location. Monitoring Hydrolab variables shall be postponed unless a secure and suitable anchoring site can be located. See note below and proceed to the next step.

  Note: Measuring Hydrolab variables from a bucket of water drawn from the river or stream below a bridge is a less desirable alternative, it does not constitute *in situ* monitoring, and is generally not allowed. (The exchange rates of atmospheric and water soluble gases such as carbon dioxide and oxygen will likely be enhanced in such a large, open, sample container. Displayed values for dissolved oxygen and pH may differ from *in situ* values, which is especially likely in the low-ionic, poorly buffered waters of central and eastern Massachusetts). As a last resort to Hydrolab use in ambient water, the primary user of the Hydrolab multiprobe shall clearly note on the field data sheet that Hydrolab variables were measured and recorded from a bucket of river water. A brief annotation preceded by the OWMID number shall be entered into the Surveyor 3 or 4 manual file (5) as well.

- Assemble the Hydrolab stirrer to the transmitter, connect all cables, and secure the main cable eyebolt to the transmitter bail with one of the small clamps fastened to the carrying case zippers.

- Retrieve caribiner clamp from carrying case and press to the open position. Pass open end through one of the stainless steel eyebolts that secures the triangular bail to the transmitter bulkhead.

- Rotate caribiner so that its narrow end wraps around the eyebolt.

- Next, clamp broad end of caribiner around anchor line and release to lock.

- Check that all cable and clamp connections are secure and free of entanglements. Also, assure that there are no right-angle or other sharp bends in Hydrolab cables and that there will be no abrasion on coarse surfaces of the bridge.

- Press Surveyor 3 or 4 display logger "On/Off" keypad and assure that the stirrer is rotating.

- Slowly lower Hydrolab multiprobe transmitter to the desired water depth.

- Follow the standard operating procedures stated in the Guide for annotating information and recording equilibrated variables. Note: prior to storing lines of data at one-minute intervals, annotate the OWMID number for the particular sampling site and press the "Enter" keypad (Series 3) or "Done" keypad (Series 4a).

- Press "On/Off" keypad of Surveyor 3 or 4 Display Logger when *in situ* monitoring is completed.

- Carefully retrieve the Hydrolab and its component parts. Wipe off excess water with clean cloth stored in zipped pocket, and disassemble for storage in the carrying case. Retrieve anchor.

Multiprobe use in shallow water

At times, very shallow water may pose a problem for *in situ* monitoring of rivers and streams. The options may be few in such instances. If an alternative sampling location is not practicable, then the primary user shall attempt to excavate a depression that is longer, wider, and deeper than the transmitter and stirrer. The user must wait until resuspended sediments, etc., are flushed downstream before placing the transmitter in the excavated depression. Also, make sure that the probes are submerged, not floating or above the water line.

Unattended Multi-probe Deployments for Interval Data Collection

Standard operating procedures for deployment of multiprobe sondes to log continuous data at set recording intervals are contained in CN 4.4.

Water column profiles of lakes and ponds (general)

The same standard operating procedures described heretofore shall apply to *in situ* monitoring of ponds and lakes (referred to subsequently as "lakes"). However, additional procedures are necessary for developing water column profiles of lakes from measured multiprobe variables. It is acknowledged that these procedures may not be applicable at all times and to every single lake in Massachusetts since there is considerable variability in type (i.e., kettlehole, natural drainage, reservoir, and run-of-the-river), flushing rate, mean depth, surface area, morphometry, orientation of basin to prevailing winds, altitude, micro-climate, concentration of dissolved organic compounds, *et cetera*. Among these, depth is the primary criterion for developing vertical profiles of multiprobe variables.

In Massachusetts, maximum depths of lakes range from about one meter (~3 feet) to thirty-five meters (~115 feet). Given this disparity, the protocols that follow have been established to set standard operating procedures for lakes that typically exhibit distinct stratification into epilimnia, metalimnia, and hypolimnia from those lakes with less distinct or ephemeral stratification patterns, or that are more-or-less isothermal during the interval from mid-May to mid-September. Since mean depth is unknown for the vast majority of Massachusetts' nearly 3,000 lakes, the distinction between the two sets of procedures shall be set at a maximum depth of eight meters (26 feet).

NOTE: an "Abbreviated Standard Operating Procedures for Vertical Profiles of Lakes and Ponds" is located within the inside zipper pocket of each carrying case, and is included as Attachment E to these SOPs.

Sonar devices shall be used to locate the site of maximum depth for each lake. If inoperative, a graduated depth line shall be substituted. However, if the weighted depth line is used, the site of the water column profile shall be offset horizontally by a minimum distance of five (5) meters to avoid monitoring multiprobe variables within a possible plume of resuspended sediments.

Two Anchor Method: Anchors shall not be lowered to the lake bottom at or near the location where water column profiling will be done. Instead, a bow anchor shall be lowered upwind (if applicable) of the maximum depth site, and the anchor line shall be payed out until the boat is positioned downwind of this site. Then, a stern anchor shall be lowered. The lengths of each anchor line are adjusted and secured to position the boat in a fixed location above the lake's maximum depth. This procedure shall be followed even under no wind conditions. Further, any attempt to profile multiprobe variables through the water column shall be aborted if the suspended transmitter-stirrer assembly cannot be maintained in a vertical position that is perpendicular to the lake's surface.

While readings may fluctuate at any given depth more than for river surveys, it is paramount that readings be as stable as possible prior to storing data.

Water column profiles of lakes and ponds (Lakes with maximum **depths ≤ 8 meters**)

multiprobe measurements shall be recorded at 0.5 meters and at each subsequent one (1) meter interval (e.g., 1.5m, 2.5m) until the multiprobe transmitter and its attached stirrer are positioned 0.5 meters above the sediment - water interface. The last set of measurements shall be recorded at this depth, but only if the primary user is certain that the transmitter-stirrer assembly has not made contact with lake sediments.

Three (3) recordings at one-minute intervals shall be stored at each depth during the months of June, July, and August, but only after all enabled variables are at equilibrium values. Recordings at the fourth (4^{th}) minute interval shall be added during the months of May and September since certain variables are slower to reach equilibrium at cooler water temperatures. At other ice-free times of the year when water temperature is greater than 5°C, five (5) recordings at one minute intervals shall be made at 0.5 meters below the lake's surface, at mid-depth, and at 0.5 meters above the sediment-water interface. Seven (7) or more recordings at one minute intervals shall be required when any surface water is less than 5°C.

Water column profiles of lakes and ponds (Lakes with maximum **depths > 8 meters**)

Perform a preliminary scan of most of the water column by slowly lowering the transmitter-stirrer and observing the displayed variation in temperature and dissolved oxygen. The lowermost depths of the hypolimnion need not be scanned; in fact, the primary user shall assure that the transmitter-stirrer does not contact lake sediments. Approximate boundaries of the three lake strata (epi-, meta-, and hypolimnia) shall be recorded on a DWM field data sheet. Next, the primary user shall document the water column profile by following the procedures stated below.

- Data recordings shall be completed at the 0.5 meter depth, mid-epilimnion, and lower depth of this stratum. It is preferable that whole-meter or half-meter increments be used to monitor this stratum (e.g., 0.5m, 2.5m, 4.5m).

- Similarly, data recordings shall be completed at the upper, mid-, and lower depths of the metalimnetic and hypolimnetic strata. If practicable, record variables at half-meter or whole meter increments (e.g., 6.5m, 9.0m, 11.5m; and 14.5m, 18.0m, and 21.5m, respectively).

- Any subsurface peak(s) in dissolved oxygen shall be recorded (along with other enabled variables) even if additional depths need to be added to the water column profile to document this phenomenon.

- The minimum number of one-minute interval recordings shall be three (3) for both the epilimnion and hypolimnion, and four (4) for the metalimnion during the interval mid-May through mid-September.

In summary, a minimum of thirty (30) recordings shall be stored at nine (9) discrete depths in stratified lakes with maximum depths exceeding eight (8) meters. Additional recordings shall be required to profile subsurface peaks in dissolved oxygen, if any. These procedures shall apply during the interval from mid-May to mid-September, or unless the preliminary water profile scan of temperature reveals that the lake is not in a state of thermal stratification. In that instance, the procedures described in the following paragraph shall apply.

When *in situ* monitoring of "deep" lakes coincides with a transition state or probable holomixis (so-called lake "turnover"), then data shall be recorded at four (4) depths as follows: 0.5 meters; at depths representing one-third and two-thirds of the maximum depth (e.g., 7.5m and 14.5m); and at 0.5m above the sediment-water interface. At a minimum, five (5) recordings at one-minute intervals shall be stored at all four depths. Again, no data shall be stored until all enabled variables are at equilibrium values.

QUALITY ASSURANCE, QUALITY CONTROL, AND TRAINING

Quality assurance operating principles and quality control measures to produce credible multiprobe data are integral components of these standard operating procedures. DWM's multiprobes have consistently been proven to be accurate and reliable instruments for measuring basic physico-chemical water quality variables because they are maintained, stored, calibrated and used properly by trained and experienced personnel (DWM's "primary users"). However, some primary users occasionally generate data for one or more variables that are subsequently censored or qualified by DWM's data quality control group. Common problems resulting in censored or qualified multiprobe data are:

- Variables in question had not come to equilibrium prior to initiating the standard logging procedure
- Improper placement of the multiprobe transmitter
- Inattention of the primary user to on-screen fluctuations of variables

A duplicate set of readings can be taken at a rate of once per trip by removing the multiprobe from the water (after all readings have been taken and the last recorded), immediately redeploying in the same location and storing an additional reading. The duplicate readings can provide information on overall precision or repeatability of the in-situ measurements. (Most of any variation observed will be assumed to typically be due to natural variation, but this assumption may not hold in all cases, which may lead to inferences regarding quality control).

Other points to consider are as follows:

1) The conductivity and turbidity sensors will not display equilibrium values when the multiprobe is placed in turbulent water, or even in a location of more subtle, subsurface eddies.
   NOTE: Placement at stream locations exhibiting laminar-type flows should lead to equilibrium values.

2) Another recurrent problem is also traceable to *in situ* placement of a multiprobe. In this instance, some experienced users are inattentive to the appearance of a question mark immediately to the right of the turbidity data display. This symbol signifies that ambient radiation is interfering with the turbidity photodiode sensors. All logged data displaying the question mark shall be censored.
   NOTE: Primary users shall adopt one or more of the following options to resolve this problem: a) rotate the transmitter to position the "turbidity sensor well" in a downward "facing" position; b) cast a body shadow over the multiprobe sensor; and/or c), move the transmitter to a shaded, non-turbulent location.

3) A third monitoring problem occurs infrequently when primary users fail to recognize that some of the multiprobe sensors take longer to reach equilibrium in the cold waters of late fall through spring. For this reason the number of required one-minute recordings increases to five (5) during ice-free months when water temperatures are greater than 5°C. Seven or more recordings at one minute intervals shall be required when any surface water temperature is less than 5ºC, and primary users shall not commence logging of data until all variables appear to be at equilibrium values.
   NOTE: The number of required readings at one minute intervals is temperature-dependent,as follows

WATER TEMPERATURE	# of REQUIRED ONE-MINUTE INTERVAL READINGS
>10 deg. C	3
Between 5 and 10 deg. C	5
<5 deg. C	7

The aforementioned "problems" are neither pervasive nor complex, but measures to ameliorate them and other similar issues shall be an ongoing component of these standard operating procedures. This shall include *in situ* training. In-lab training and field guides have proven to be successful for the vast majority of primary users of multiprobes, and that practice shall be continued.

DATA RETRIEVAL (DOWNLOADS)

DWM's database manager shall be responsible for periodic downloading and archiving of all logged data and relevant information stored in sonde and logger files. The following procedures shall be performed by members of the multiprobe group only. When it has been established that all logged data have been downloaded and archived successfully, then all logged data shall be erased from memory. Standard operating procedures for these tasks are described in detail in Attachment F.

NOTE: Any disconnect of a lithium battery will erase all stored data. If a lithium battery needs to be disconnected or replaced, then the database manager shall download, archive, and erase all stored data before the display logger case is opened.

DATA VALIDATION and MANAGEMENT

Multiprobe data will be reviewed, validated and assessed for usability by the multiprobe coordinator, QA analyst and Database Manager, consistent with this SOP and DWM's SOP for data validation, CN 056.2. Once downloaded and archived, multiprobe data will be managed by DWM's Database Manager, who will be responsible to ensure that the long-term integrity of data is maintained.

MAINTENANCE AND REPAIR

Frequent inspection and regular maintenance of DWM's multiprobe instruments and accessories shall be performed by the calibration laboratory supervisor (or his agents) to assure continuous and reliable operation. Maintenance activities shall be based on training, knowledge of instruments, experience, and reference to technical manuals. Consultation with technical personnel at Hach/Hydrolab and YSI may be required when there is uncertainty about a particular maintenance or repair problem. Otherwise, instruments and/or their component parts shall be shipped to the company for special maintenance problems or for repairs that cannot be performed in DWM's calibration laboratory.

The key to continuous and reliable performance of multiprobes, display loggers, and accessories is adherence to the principle of responsible care, frequent inspection and proper use by all users.

The following standard operating procedures shall be followed to prevent and/or resolve the more common maintenance problems.

- Multiprobe sensors shall be protected with a calibration cup or storage cup except during *in situ* monitoring or maintenance and repair. Storage cups shall be filled to about two-thirds of their volume (Hydrolab Series 3 and 4 large cups) or about ¾" (Series 4 mini-sonde and YSI) with 1º Nanopure water or low-ionic standard solution to protect the sensors from drying out and/or damage.

- The calibration laboratory supervisor shall inspect each multiprobe sensor prior to its pre-calibration, and routinely during storage. Calibrators shall inspect the sensors prior to post-calibration. A multiprobe shall not be pre-calibrated and used for *in situ* monitoring if the dissolved oxygen membrane is damaged or wrinkled, or if air bubbles are detected beneath the membrane. And, if a dissolved oxygen membrane is replaced by the laboratory supervisor, the multiprobe must be stored overnight (12-24 hours) prior to its calibration and use.

- Post-survey checks shall include inspection of the dissolved oxygen sensors. When membranes are abraded, torn, or wrinkled, or if air bubbles are detected, calibrators shall record their observations on the Calibration Record, prior to initiating post-calibration procedures.

- The pH reference probe shall be inspected prior to pre-calibration and routinely during storage. A multiprobe shall not be calibrated or used for *in situ* monitoring if a sizeable (>2mm) air bubble is detected at the base of the reference probe when the transmitter is inverted. However, this problem can be resolved quickly by the laboratory supervisor, and the multiprobe can be calibrated immediately thereafter.

- Post-calibrators shall inspect the pH reference probe. They shall record the observation of an air bubble as described previously for the dissolved oxygen sensor.

- If pH begins to "drift" from its normal response to calibration standards, the calibration laboratory supervisor shall "rebuild" the reference probe, including replacement of the Teflon® cap and both O-rings (for "rebuildable pH probes).

- Occasionally a slight "drift" in the normal display of specific conductance (e.g., 1.0µS/cm to 1.3µS/cm) is observed when that sensor is tested in 1º Nanopure water. Most often this occurs following calibration of pH at 4.01 units. When this happens, the calibrator shall flush the sensors in pH 10.4 buffer followed by several flushes with Nanopure water. If the normal value displayed for specific conductance is not restored in 1º Nanopure water, the cell block for that sensor shall be loosened to expose the bases of the six pin-shaped nickel electrodes and their O-rings. Flush the electrodes and O-rings with 1º Nanopure water, tighten the cell block, and retest the sensor in 1º Nanopure water. These simple procedures are usually sufficient. If not, the process of calibration shall be continued to its conclusion. For Hydrolab units, the calibration laboratory supervisor can "polish" the six nickel electrodes per Part 3.4 of Hydrolab Corporation's H20® Multiprobe Operating Manual or Section 10.2 of the Customer Service Technical Manual (refer to "References" on page 13).

- The calibration laboratory supervisor shall inspect cables and dummy plugs following their use. The supervisor shall clean dummy plug inserts and reapply silicone grease as needed. The rubber post and electrode pins on the bulkheads of multiprobe transmitters and the Recorder shall be inspected periodically as well.

- For Hydrolab stirrers, calibrators shall remove the magnetic impeller from the stirrer post after each use, and then dislodge water droplets from the post and impeller with short blasts directed from a PC Duster® 2 nozzle. The calibration laboratory supervisor shall apply a thin coating of silicone grease to the post, but only periodically or as needed. And, immediately thereafter, the supervisor shall test that the impeller spins freely when cabled to a Surveyor 3 display-logger.

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Attachments

A. Pre-Survey Calibration and Post-Survey Check Record

B. Low Ionic Stock Solution

C. Multi-probe Request Forms

D. Hydrolab Series 3 Quick Guide

E. Guide for Vertical Profiles in Lakes

F. Guide for Downloading and Storing Probe Data

G. YSI 600XLM Quick Guide

H. Hydrolab DS4/4a QuickGuide

I. YSI Model 33 S-C-T Meter QuickGuide

J. Single pH probe meter QuickGuide

K. Thermistor Check (example)

L. Eureka QuickGuide

ATTACHMENT A:

HYDROLAB MULTIPROBE PRE-SURVEY CALIBRATION RECORD (example)

Cable(s): _ 10 M _ 15M _ 25 M _ 50 M. Guide **clamp** for anchor line: Y/N

Date: / /99 Calibrated by: Watershed Team/Other use:

H20/Recorder **Serial No**. **15559** **SRV3**/Scout II **Serial No**. **24573**
Conductivity cell block: Freshwater? Saltwater? (Circle one)

Dissolved oxygen membrane: Standard? Low flow? (Circle one)

SRV3 NiCad Battery Check: . volts (% charge remaining)

Local Barometric Pressure: . mmHg (Circle either AirGuide or Swift Barom.)

Check instrument configuration: Press **Variable** Macro-keypad and **Report**. **[ ]**

Check date and time (especially), and calibrate if necessary. **[ ]**

. **Annotate purpose of using instrument and name of calibrator. [ ]**

. **Annotate calibration ranges. Example: cal ranges. 718 SpCond. 40 NTU. [ ]**

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0. **Calibrate Turbidity** sensor to **0.0** NTUs with filtered, deionized water.
Initial reading = NTUs. Calibrate to **0.0** NTUs __. **[ ]**

Calibrate Turbidity slope to **20** or **40** NTUs with Advanced Polymer Standard.
Initial reading = NTUs. Calibrate to **20** or **40** NTUs __. **[ ]**

CHECK linearity of sensor at **10** or **20** NTUs with Advanced Polymer Standard.
Record displayed reading: NTUs. **DO NOT CALIBRATE**. **[ ]**

*************** **Typical Starting Point of Calibration** **************

1. **Cal. SpCond** to **718**, **1413** or **2760** uS/cm. Initial reading ____. **Set to _____ uS/cm**

TDS = **.** g/L pH = **.** units

Calibrate D.O. percent saturation. **Set B.P. to . mmHg.** O_2 % = **.**

O_2 = **.** mg/L (@ **.** ºC) Table value = **.** mg/L

2. **CHECK SpCond** linear.@ **147**, **718**, or **1413** uS/cm. **Displayed reading=_____ uS/cm [ ]**
TDS = **.** g/L pH = **.** units

3. **Calibrate pH** at 6.8_ (@ **.** ºC). Initial reading = **.** **Set to pH = 6.8_ [ ]**
Sp. Cond. = uS/cm TDS = **.** g/L

4. **Calibrate pH** at 4.0_ (@ **.** ºC). Initial reading = **.** **Set to pH = 4.0_ [ ]**

Sp. Cond. = uS/cm TDS = **.** g/L

Or Calibrate pH at 10.40 ±0.02@25ºC. Initial reading = **.** **Set to pH = 10.40 [ ]**
Sp. Cond. = uS/cm TDS = **.** g/L

PRE-SURVEY QUALITY CONTROL CHECKS

. **ANNOTATE: PRE-survey QC check of low-ionic standard. Batch __/_/99_.** [ ]

5. **QC check** of low-ionic standard solution.

Sp. Cond. = . uS/cm pH = . TDS = . g/L

D.O.= . mg/L @ . ºC [Table value = . mg/L] O_2 Sat. = . %

. **ANNOTATE: PRE-survey QC check of Nanopure deionized, filtered water.** [ ]

6. **QC check** of Nanopure deionized and filtered (0.2u) water.

Sp. Cond. = . uS/cm pH = . TDS = . g/L

D.O.= . mg/L @ . ºC [Table value = . mg/L] O_2 Sat. = . %

Record displayed Turbidity if applicable: . NTUs

POST-SURVEY QUALITY CONTROL CHECKS Calibrator: Date: / /99.

1. SRV3 NiCad Battery Check: . volts (% charge remaining)

. **ANNOTATE general purpose of using instrument + name of calibrator.** [ ]

. **ANNOTATE: POST-survey QC check of low-ionic standard. Batch __/_/99.** [ ]

2. **QC check** of low-ionic standard solution.

Sp. Cond. = .uS/cm pH = . TDS = . g/L

D.O.= . mg/L @ . ºC [Table value = . mg/L] O_2 Sat. = . %

. **ANNOTATE: POST-survey QC check of deionized, filtered water.** [ ]

3. **QC check** of Nanopure deionized and filtered (0.2u) water.

Sp. Cond. = . uS/cm pH = . TDS = . g/L

D.O.= . mg/L @ . ºC [Table value = . mg/L] O_2 Sat. = . %

Record displayed Turbidity if applicable: . NTUs [ ]

[1] Local barometric pressure will likely vary between pre-calibration and post-survey QC checks. However, dissolved oxygen readings in mg/L will be accurate during use of the instrument even though sampling site barometric pressure may vary from that used to calibrate the instrument. Performance of the oxygen sensor should be verified if deviations in percent saturation exceed 100% ±0.5% during the post-survey check in the low-ionic standard. Simply re-calibrate percent saturation to the existing barometric presure and record the results as the last task. Also, the same information should be stored in the "manual"file following an annotated comment.

NOTES:
a) "**store**" the **initial displayed reading** for each calibration solution (sp. cond.718 and 147; D.O.; pH 6.86+; and pH 4.0+ or 10.4);
b) **store** the **displayed reading** for each **QC check solution** (low-ionic standard solution and Nanopure deionized,filtered water); and,
c) copy the stored data onto this printed calibration record.

ATTACHMENT B

Low-Ionic Phosphate Standard Stock Solution (Metcalf and Peck, 1993)

The stock concentrate solution is the U.S. National Institute of Standards and Technology 0.025 mol kg^{-1} (of solvent) KH_2PO_4 and Na_2HPO_4 primary pH standard solution having a pH of 6.865 at 25ºC (Bates and Acree 1945; Bates 1973). The essential reason for this stock composition is that we felt that if our inferences about unpredictable pH changes (caused by varying CO_2 gas concentrations) in previous dilute, neutral pH standards were correct, that a successful new standard would have more H^+ complexed by non-carbonate species than the previous carbonate-based standards (Peck and Metcalf 1991). Even when diluted 200 times, the stock solution's chemical characteristics are controlled by phosphate equilibria, rather than carbonate equilibria (Peck and Metcalf 1991). Additionally, the necessary high purity reagents are readily available and inexpensive. The equilibrium constants for the controlling equilibria have been measured very accurately (Bates and Acree 1945), which allows accurate computer modeling of the pH of diluted stock solution (Peck and Metcalf 1991). In undiluted form, the stock concentrate solution has been found to change less than 0.007 pH units during 28 months of storage (Bates 1973).

A "Small Stock" concentrate solution is prepared to yield about 1 L of solution. The following analytical reagent grade chemicals, dried at 120ºC for three hours and stored desiccated, are dissolved in 1000.0 g (1.0018 L at 20C; 1.0029 L at 25ºC) of deionized, or distilled water (with a conductivity less than 2.0 µS CM^{-1} at 25ºC): 3.4022 g of KH_2PO_4 and 3.5490 g of Na_2HPO_4. Alternately, a "Large Stock" concentrate solution is prepared by dissolving 68.0447 g of dry KH_2PO_4 and 70.9795 g of dry Na_2HPO_4 in 20,000.0 g (20.0355 L at 20ºC; 20.0588 L at 25ºC) of deionized, or distilled water (with a conductivity less than 2.0 µS cm^{-1} at 25ºC). This is readily done in a large polyethylene carbuoy container, which can be rotated around its vertical axis on the floor to ensure mixing. The 100:1 dilute phosphate standard is prepared by adding 200.0 grams of stock concentrate solution (either Small Stock or Large Stock) to 20000.0 g of deionized water. Rotating the carbuoy on its edge for one minute is sufficient to adequately mix the solution. (If a balance weighing to within 0.1 mg is not available, the Large Stock can still be accurately made by weighing to the nearest 0.01 g).

Multiprobe Request Forms (examples)

Primary User's Name:________________________

Assistant(s):_________________________________

Purpose of Using Hydrolab (3and/or describe)

DWM Schedule__ River Basin____________________

"Smart" Survey__ River Basin____________________

Special Purpose (describe):_____________________

____

____

____

Single Work Day Reservation

Date of Use:____/____/99 Rain Date: ____/____/99

Day (Circle One) M Tu W Th F Day (Circle one) M Tu W Th F

Number of Hydrolab(s) needed for Monitoring: 1 2 3 (Circle One)

Hydrolab(s) needed by ___:___a.m. **or** p.m. (Circle One)

Hydrolab(s) returned by (approximately) ___:___ a.m. **or** p.m.

Notes:____

____

____

Surface Water type (3 if applicable)

________ Wadable River(s) or Stream(s)

________ Non-Wadable River(s)

________ Use Hydrolab from Bridge

________ "Shallow" Pond(s) or lake(s) (≤ 8M or 26feet)

________ "Deep" pond(s) or lake(s) (> 8M or 26 feet)

________ Tidal Zone or Estuary

________ Other:________________________________

Multiple Work Day Reservations

Day One Date:___/___/99 Day: M Tu W Th F

Pickup Time___:___ a.m. **or** p.m. Return___:___a.m. **or** p.m.

Day Two Date:___/___/99 Day: M Tu W Th F

Pickup Time___:___ a.m. **or** p.m. Return___:___a.m. **or** p.m.

Day Three Date:___/___/99 Day: M Tu W Th F

Pickup Time___:___ a.m. **or** p.m. Return___:___a.m. **or** p.m.

NOTE: Circle a.m. or p.m. as appropriate

Preferred Multiprobe Sensors (3first choice)

______ Standard (includes depth, temp, DO, % Sat, pH, and spec. cond. with total dissolved solids)

______ Standard plus turbidity

______ Standard plus oxidation-reduction potential (currently not available for use)

Date Needed	Time Needed	Project	Crew #	Crew Lead	Fresh/Salt	pH range	Bridge Drops?	# of Probes Needed	Multi-probe OWMID#s (YSI Site #s)	OWMID#s for Redeployed Probes (as needed)	Redployment Date	Pickup Date

ATTACHMENT D

QUICK GUIDE
HYDROLAB MULTIPROBE INSTRUMENTS

NOTE: AS OF APRIL 2008, THIS QUICKGUIDE AND THE SERIES 3 HYDROLABS ARE NO LONGER IN USE

1. Lay out cable, with eyebolt and transmitter connectors on top.

2. Attach "bottom" end of cable to "Multiprobe/Charger" connector on display/logger (blue box). Match grooves and ridges, insert, and twist knurled knob clockwise to lock in place.

3. Carefully attach 6 pin cable connector at "top" of cable to H20 transmitter. Align raised rubber knob (above large pinhole) with large pin, and carefully force the two together. If you do not hear a popping sound, squeeze rubber end of connector to expel trapped air. It may be necessary to bend the connector slightly to the left and right during the "squeeze." Refer to no. 10, Note #1 below re "Error" message.

4. Place all protective rubber "boots" and cable dummy plugs in carrying case, and join matching dummy plugs to prevent dust and dirt from clinging to silicone lubricant.

5. Connect triangular, stainless steel bale mounted on the H20 transmitter bulkhead to the cable eyebolt with snap-lock device attached to one or both zippers on the carrying case. Will the $3000 transmitter still be attached when you go to retrieve it?

6. Grasp H20 transmitter firmly and unscrew storage cup that protects the probes. Cap storage cup to prevent spillage.

7. Carefully insert multiprobes into the stirrer housing, then thread stirrer into H20 bulkhead.

8. Carefully plug the 2 pin cable connector to the stirrer cable by aligning raised rubber knobs. Connection is complete when expelled air "pops." Press Surveyor 3 "**ON**/Off" pad to be sure stirrer is rotating. Press "On/**Off**" again.

9. Immerse H20 transmitter in stream, etc., soon after connecting the stirrer. Immerse probe-end first, at a 450 angle, with the white conductivity block facing upwards. Note: the stirrer weight keeps the multiprobe sensors submerged and, when used in streams and wadable rivers, the opposite end of the transmitter will tend to rise above the streambed.

10. Press Surveyor 3 "**On**/Off" pad, and scan variables on both screens (Screen 1 = core variables; Screen 2 = auxiliary variables, digital clock, and battery voltage). Note #1: an "ERROR" message indicates that one or both of the cable connections performed in nos. 2 and 3 above is/are not secure. Note #2: if the specific conductance reading is fluctuating up and down, there is too much turbulence within the white conductivity block. The same is true for the turbidity sensor. Reposition the H20 transmitter to a deeper and/or a less turbulent stream location. If monitoring from a bridge or on a lake, simply jerk the cable quickly to release trapped bubbles. Otherwise, proceed to No. 11 while the variables stabilize at equilibrium values.

11. Follow the standard operating procedures stated in the Guide for annotating information and recording equilibrated variables. **Note: prior to storing lines of data at 30 second intervals for five (5) minutes, annotate the OWMID number for the particular sampling site and press the "Enter" keypad (Series 3) or "Done" keypad (Series 4a).** Also, note that a single OWMID number is all that is needed to perform vertical profiles of lakes and ponds. Refer to no. 15 below regarding the assignment of OWMID numbers.

12. Check data screens 1 and 2 again. If data are stable, press the "Store" keypad (note: the hundredth digit of certain variables may fluctuate slightly). Record at 30 second intervals for five (5) minutes (use clock on screen 2). Record the last data stored on field data sheets (see no.13 below). WARNING: multiprobe sensors require more time to stabilize when placed in cold water; record at least seven (7) minute-interval lines of data when water temperature is ≤ 50C.

13. To review the data and text that you have just logged, press the gray-colored "Logging" macro-keypad and then "Review." The cursor should be on "**5**" (Manual File); if not, scroll to "**5**" with right arrow. Press "Enter." Scroll right one space on the next screen from (**B**)eginning of file to (**E**)nd, and press "Enter" to review the last line of information logged. Press **Screen** to view

screen 2, and vice versa. Use “up” arrow to scroll from the 5th line of data (5th minute) to the 4th, 3rd, 2nd, 1st, and Annotation, respectively. Press **Escape** to return to real time data (Screen 1 or 2).

14. Press "On/**Off**" keypad to turn the Surveyor 3 off. Disassemble instrument and cable, and wipe off excess moisture (except near multiprobes) with cloth provided in inside zipper pocket. Repackage instrument and cable in carrying case. Note: do not transport a Hydrolab instrument unless it is properly packaged in a fully zipped carrying case.

15. Each river basin has been assigned a unique set of numbers that identify sampling events for database management. Use one string of numbers (e.g., 84-0001) to "tag" the Hydrolab measurements and samples of water, but only if both tasks were completed more-or-less simultaneously at each station. Otherwise, use a separate, sequential string of numbers (e.g., 84-0002) to "tag" the second of these two tasks. Note: QC samples must be tagged with separate OWMID numbers, even if collected or filled at the same time as other samples. Confer with Tom Dallaire for specifics and for the next available OWMID number in each basin. The full range of DWM database numbers for river basins that may be sampled during 1999, and decades thereafter, are listed below.

?Boston Harbor:

Mystic River	71-0000 through **71**-9999
Neponset River	**73**-0000 through **73**-9999
Weymouth & Weir Rivers	**74**-0000 through **74**-9999

?Cape Cod	**96**-0000 through **96**-9999
?French River	**42**-0000 through **42**-9999
?Merrimack River	**84**-0000 through **84**-9999
?Mount Hope Bay	**61**-0000 through **61**-9999
?Narragansett Bay	**53**-0000 through **53**-9999
?Parker River	**91**-0000 through **91**-9999
?Quinebaug River	**41**-0000 through **41**-9999

16. Finally, you can **check** the calibration of pH and specific conductance with a dilute standard (pH 6.9 and Sp. Cond. 73 ìS/cm) included in the carrying case, but usually this is not necessary. The step-by-step procedures are printed directly on the standard container, and they are repeated in the statements that follow as well. Thus, empty water from the multiprobe storage cup, add a **small volume** of standard, attach cup to the H20 transmitter, and rinse probes with a gentle shaking. Repeat two (2) more times. Add remaining volume of standard **slowly**, attach storage cup to H20 transmitter again, and then **slowly** invert it so the probes are facing upward. Assure that the standard covers both pH probes (small glass and large reference) and that there are no bubbles trapped in the white conductivity block. Allow probes to stabilize in dilute standard for about 2 minutes, then check pH and specific conductance on Screen 1. **Notes: a) both conductivity and pH will decline in the standard if it is not replaced frequently (every other week); b) do not pour standard back into its original container - leave it in the storage cup to bathe probes during transport; and c), do not attach calibration standard cup directly to H2O transmitter.**

ATTACHMENT E

ABBREVIATED STANDARD OPERATING PROCEDURES FOR VERTICAL PROFILES OF LAKES & PONDS

MAXIMUM DEPTHS GREATER THAN 8 METERS (26 FEET)

#	Time of Year	Data Logging Procedure
1	5/15-9/15	Perform preliminary scan of water column to see if stratified and to what extent; Record approx. depths to metalimnion and hypolimnion. **If stratified, go to # 2. If not stratified, proceed to #3 or #4**
2		In epilimnion, record 3 readings at 1 minute intervals at 3 depths---0.5 meter, mid-epilimnion and lower-epilimnion, for a minimum of 9 readings.
		In metalimnion,, record 3 readings at 1 minute intervals at 4 depths (equally spaced depths), for a minimum of 12 readings. Note any points of metalimnetic D.O. maxima.
		In hypolimnion, record 3 readings at 1 minute intervals at 3 depths (equally spaced depths), staying at least 0.5 meters off the bottom, for a minimum of 9 readings.
3	At temps>5 deg. C, and lake is not stratified	Record 5 readings at 1 minute intervals at each of 4 depths---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom (total of 20 readings).
4	At temps<5 deg. C,	Record 7 readings at 1 minute intervals at each of 4 depths---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom (total of 28 readings).

MAXIMUM DEPTHS LESS THAN 8 METERS (26 FEET)

#	Time of Year	Data Logging Procedure
1	6/1-9/1	Record 3 readings at 1 minute intervals at 0.5 meters and then every meter down until 0.5 meters from the bottom.
2	May, September	Record 4 readings at 1 minute intervals at 0.5 meters and then every meter down until 0.5 meters from the bottom.
3	At temps>5 deg. C.	Record 5 readings at 1 minute intervals at 0.5 meters, mid-depth and 0.5 meters from the bottom.
4	At temps<5 deg. C.	Record 7 readings at 1 minute intervals at 0.5 meters, mid-depth and 0.5 meters from the bottom.

ATTACHMENT F

Multiprobe Data Setup, Download, Archive and Erase Procedures

OBJECTIVES:

- Download logged data from the sonde loggers and display units on a periodic basis and as needed.
- Archive downloaded data files
- Erase memory from all units after confirming proper download.

MATERIALS LIST:

- Hydrolab® or YSI sonde loggers and display loggers containing files to be downloaded.
- Cables
- Network PC or Grid 1680 Laptop (486, DOS, 4 MB ram) or Equivalent
- Qmodem 4.52 terminal emulation software or Equivalent
- Calibration and Testing, Inspection and Maintenance Logbook

REQUIRED STAFF:

- One member of the multiprobe workgroup (for downloading and archiving). First in line to perform downloads/archiving are Laura Chan and Tom Dallaire. Backup shall be provided by Jeff Smith, Richard Chase and Bob Nuzzo. See Table below for multiprobe work group staff and responsibilities.
- Two members of the multiprobe work group (for erasing).

Multiprobe Work Group:

Staff	Primary Responsibilities	Secondary Roles
Tom Dallaire	Data retrieval and management, database applications	Product testing, calibrations and checks (backup),
Jeff Smith	Overall management of calibration lab, calibrations and maintenance, preparation of standards, data validation and training, product testing and purchasing	Data retrieval (backup),
Richard Chase	Quality assurance for all activities involving probes (including field/lab safety, data accuracy and validation, SOP revisions, training), instrument calibrations/checks	Data retrieval (backup), product testing and purchasing
Bob Nuzzo	Instrument calibrations and checks	Data retrieval (backup)
Misc. staff	Data downloads	---

SETUP PROCEDURES:

DOWNLOAD PROCEDURES:

1. Document download activity in the appropriate Testing, Inspection and Maintenance Logbook. At a minimum, provide the name(s) of staff conducting download, the date and time of download, and the serial number(s) of the unit(s) to be downloaded.
2. Download all of the raw data files on the unit(s) according to the specific instructions provided for the unit to be downloaded.

Surveyor 3 (SRV3)

a. Connect SRV3 to computer using SRV3-IC Cable
b. Run communications software in terminal mode
c. Press the space bar to get the Hydrolab® SRV3 menu
d. For each file to be downloaded, repeat Steps (e) through (dd)
e. Select "L" from the menu (Logging)
f. Select "D" from the menu (Dump)
g. Select "N" in response to "Power down probes during dump?" prompt
h. Select log file to be downloaded (i.e. "5")
i. Select "P" for "Printer ready"
j. Select "F" for "Follow variable and calibration changes"
k. Select "N" for "No Statistics"
l. At the "Activate Printer and/or open capture file, then press any key to continue…" prompt, activate terminal emulation screen capture file feature
m. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer's local hard drive
n. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
o. Press any key – Data should scroll down the screen
p. At the "Deactivate printer and/or close capture file…" prompt, close the screen capture file
q. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
r. Press any key to continue
s. Select "L" from the menu (Logging)
t. Select "D" from the menu (Dump)
u. Select "N" in response to "Power down probes during dump?" prompt
v. Select log file to be downloaded (i.e. "5")
w. Select "S" for "Spreadsheet importable"
x. Select "F" for "Follow variable and calibration changes"
y. At the "Starting XMODEM Transfer" prompt, activate terminal emulation software file download protocol ("Receive File")
z. Select XMODEM as Download Protocol
aa. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer's local hard drive
bb. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
cc. Start file download and wait for completion of download
dd. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.
ee. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from SRV3 unit being handled
ff. Repeat the above steps for each individual SRV3 unit, then proceed below to "Archive Data Steps"

Surveyor 4a (SRV4a)

a. Connect SRV4a to computer using SRV4a-IC Cable
b. Run communications software in terminal mode
c. On the SRV4a, select "Files" from the menu, and then select "Review" to determine how many files are on the unit.
d. Select files one at a time and repeat Steps (e) through (x) for each file.
e. Select "Files" from the menu

f. Select “Transmit” from the menu
g. Select Printer-Ready
h. Select “N” for No Statistics
i. At the “Activate Printer and/or open capture file, then press any key to continue…” prompt, activate terminal emulation screen capture file feature
j. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer’s local hard drive
k. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
l. Press any key on SRV4a – Data should scroll down the screen
m. At the “Deactivate printer and/or close capture file…” prompt, close the screen capture file
n. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
o. Select “Files” from the menu
p. Select “Transmit” from the menu
q. Select upload Spreadsheet (SS) Importable
r. Select “N” for No Statistics
s. At the “Starting XMODEM Transfer” prompt, activate terminal emulation software file download protocol (“Receive File”)
t. Select XMODEM as Download Protocol
u. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer’s local hard drive
v. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
w. Start file download and wait for completion of download
x. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded
y. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from SRV4a unit being handled
z. Repeat the above steps for each individual SRV4a unit, then proceed below to “Archive Data Steps”

MiniSonde (MS4a or MS4a-SE)

a. Connect the MiniSonde to the computer
b. Run communications software in terminal mode. Use the following settings in HyperTerminal:
    Bits per second: 19200
    Data bits: 8
    Parity: None
    Stop bits: 1
    Flow Control: X on/X off
c. Press the space bar to get the MS4a menu
d. Select “Files” from the menu, and then “Status” to check number of files
e. For each file, repeat Steps (f) through (dd)
f. Select “File” from the menu
g. Select “Transfer” from the menu
h. Select Sensors – Off
i. Select Printer-Ready
j. Select Statistics – None
k. Select log file to be downloaded (i.e. “5”)
l. At the “Activate Printer and/or open capture file, then press any key to continue…” prompt, activate terminal emulation screen capture file feature
m. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer’s local hard drive
n. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
o. Press any key – Data should scroll down the screen
p. At the “Deactivate printer and/or close capture file…” prompt, close the screen capture file
q. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
r. Press any key to continue
s. Select “File” from the menu
t. Select “Transfer” from the menu
u. Select Sensors – Off

v. Select Spreadsheet Importable (XMODEM)
w. Select Statistics – None
x. Select log file to be downloaded (i.e. "5")
y. At the "Starting XMODEM Transfer" prompt, activate terminal emulation software file download protocol ("Receive File")
z. Select XMODEM as Download Protocol
aa. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer's local hard drive
bb. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
cc. Start file download and wait for completion of download
dd. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.
ee. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from MS4a unit being handled
ff. Repeat the above steps for each individual MS4a unit, then proceed below to "Archive Procedure"

Series 3 Sonde ("Big Bertha")

a. Connect the Sonde to the computer
b. Run communications software in terminal mode. Use the following settings in HyperTerminal:
    Bits per second: 9600
    Data bits: 8
    Parity: None
    Stop bits: 1
    Flow Control: X on/X off
c. Press the space bar to get the Series 3 Sonde menu
d. For each file to be downloaded, repeat Steps (e) through (ee)
e. Select "L" from the menu (Logging)
f. Select "D" from the menu (Dump)
g. Select "N" in response to "Power down probes during dump?" prompt
h. Select log file to be downloaded (i.e. "5")
i. Select "P" for "Printer ready"
j. Select "F" for "Follow variable and calibration changes"
k. Select "N" for "No Statistics"
l. At the "Activate Printer and/or open capture file, then press any key to continue…" prompt, activate terminal emulation screen capture file feature
m. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer's local hard drive
n. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
o. Press any key – Data should scroll down the screen
p. At the "Deactivate printer and/or close capture file…" prompt, close the screen capture file
q. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
r. Press any key to continue
s. Select "L" from the menu (Logging)
t. Select "D" from the menu (Dump)
u. Select "N" in response to "Power down probes during dump?" prompt
v. Select log file to be downloaded (i.e. "5")
w. Select "S" for "Spreadsheet importable"
x. Select "F" for "Follow variable and calibration changes"
y. Select "N" for "No Statistics"
z. At the "Starting XMODEM Transfer" prompt, activate terminal emulation software file download protocol ("Receive File")
aa. Select XMODEM as Download Protocol
bb. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer's local hard drive
cc. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
dd. Start file download and wait for completion of download
ee. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.

ff. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from Series 3 unit being handled
gg. Proceed below to "Archive Procedure"

DS4

a. Connect the DS4 to the computer
b. Run communications software in terminal mode. Use the following settings in HyperTerminal:
   Bits per second: 19200
   Data bits: 8
   Parity: None
   Stop bits: 1
   Flow Control: X on/X off
c. Press the space bar to get the DS4 menu
d. Select "Files" from the menu, and then "Status" to check number of files
e. For each file, repeat Steps (f) through (dd)
f. Select "File" from the menu
g. Select "Transfer" from the menu
h. Select Sensors – Off
i. Select Printer-Ready
j. Select Statistics – None
k. Select log file to be downloaded (i.e. "5")
l. At the "Activate Printer and/or open capture file, then press any key to continue…" prompt, activate terminal emulation screen capture file feature
m. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer's local hard drive
n. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
o. Press any key – Data should scroll down the screen
p. At the "Deactivate printer and/or close capture file…" prompt, close the screen capture file
q. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
r. Press any key to continue
s. Select "File" from the menu
t. Select "Transfer" from the menu
u. Select Sensors – Off
v. Select Spreadsheet Importable (XMODEM)
w. Select Statistics – None
x. Select log file to be downloaded (i.e. "5")
y. At the "Starting XMODEM Transfer" prompt, activate terminal emulation software file download protocol ("Receive File")
z. Select XMODEM as Download Protocol
aa. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer's local hard drive
bb. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
cc. Start file download and wait for completion of download
dd. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.
ee. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from DS4 unit being handled
ff. Repeat the above steps for each individual MS4a unit, then proceed below to "Archive Procedure"

YSI 650

a) **SETUP**: Take out all 650 units and set up next to Room 226 computer. Connect 650 to PC via dedicated 9-prong cable (COMM2).
b) **SONDE FILES**: (OPTIONAL) Upload all sonde files to the 650 logger by connecting to sonde via 650 and selecting "File" then "Upload". [Now all files of potential interest, including internal calibration .glp file(s) are on the logger. Upload the .glp file as a .glp (binary) file as well as a .txt (comma-delimited) file. Upload .dat files as file type "PC6000."]
c) **UPLOAD**: Login to PC and launch "**EcoWatch**" software. Go to *COMM* menu and set COMM2 (or other) under ***Settings, Sonde* and *Terminal.*** *(x-modem or kermit; 8 bits, parity none and 9600 BAUD).* Hit "Enter" to get # prompt on the PC.
d) On 650 logger, select ***File/Upload* to PC** to upload all 650 .DAT files to PC. Individually select all files and upload from the 650 to PC memory, including CAL, GLP, TXT files. The files will automatically be saved in c:\winnt\ecowin\data folder. **[**If EcoWatch does not ask you to overwrite an existing file, click Esc on the 650 logger and cancel the upload. Then try to upload the file again. When prompted to overwrite, click "No" and type in a filename based on this naming convention: yymmddun.dat, where u is the letter corresponding to the YSI unit, and n is the file number (1-9). The .dat extension is important.]
e) After uploading all files off the 650 logger, **open each .dat file in Ecowatch, and "export" as comma-delimited file (.cdf)** by selecting "export" and keeping the same filename based on the naming convention: yymmddun.dat, where u is the letter corresponding to the YSI unit, and n is the file number (1-9), but with .cdf extension. EXAMPLE: 040815j1.cdf for data downloaded from the "J" logger on August 15, 2004.
f) **SPREADSHHEET OPTION**: Open .cdf file using EXCEL. Convert "text to columns" (move units row to be the top row, then select column 1 (all) and convert as comma, delimited). Save columner spreadsheet as .xls file.
g) **DATA MANAGEMENT**: Copy all .dat, .cdf and .xls files from c:\winnt\ecowin\data to protected W/dwm folder (*W:\dwm\SOP\DatLog\YSI-Raw and/ or other)*.
h) **PRINT OPTION** (on screen QC checks are preferred over printing): In Word, open each .cdf file (delimited/ comma/ general) for printing. *Print* out columnar data for each file using the following tools: *Select all/convert to table/autofit to contents/ 8 font/page setup/0.5 margins/print layout/repeat column headings for first two rows/insert header&footer text (filename\path\page x of y\date\time).* Save Word .doc files to *W:\dwm\SOP\DatLog\YSI-Raw\.*
i) **SECURITY**: Copy the files from *W:\dwm\SOP\DatLog\YSI-Raw\ to W:\dwm\owmdata\DatLog\2004\YSI* for more secure, permanent storage. (Database Manager) In WinExplorer, change the properties of all *W:\dwm\owmdata\DatLog\2004\YSI* files to READ-ONLY.
j) Proceed to archive and erase procedures (below).

YSI 600XLM

a. See above (i.e., transfer all files to 650, then download 650 files).

ARCHIVE PROCEDURES:

Files downloaded in the previous step will be archived in 5 locations:

- On the hard disk of the computer assigned to downloading files (e.g., Grid 1680)
- On a network drive (in directory w:\dwm\owmdata\hyd-raw)
- On a floppy disk for transport off-site (to be kept at the home of the Database Manager)
- 1 Hard copy submitted to the Hydrolab® Coordinator
- 1 Hard copy maintained in Hydrolab® Data Management paper file

Confirm that "All" SRV3 units have had data downloaded for each log file before proceeding to the steps listed below:
1. Copy downloaded files to a 1.44 mb floppy disk
2. Label floppy disk with date and file names
3. Copy downloaded files on floppy disk to the following network drive - w:\dwm\owmdata\hyd-raw
4. Import individual *.hlp files into MSWord (DO NOT OVERWRITE FILE WITH SAME FILENAME!)
5. Change properties to "Read Only"
6. Add the download filename, date and time to an inserted header (as variables), select "Line printer" or other appropriate font and print hard copy of each file
7. Repeat steps 4 and 5 until all *.hlp files have been printed
8. Make 1 copy of each print out and submit to Hydrolab® Coordinator

ERASE MEMORY PROCEDURE:

First, compare each downloaded and archived hardcopy file to unit's files to ensure that all data has been downloaded completely and accurately. When it has been established independently by 2 members of the multiprobe group that all data has been successfully downloaded and archived, each unit's memory will be erased using the following procedures.

<u>Hydrolab Units:</u>

1. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook. At a minimum, the Name(s) of staff erasing the unit, the date and time of the erasure of memory, and the serial number(s) of the unit(s) to be erased
2. Connect Hydrolab® unit to computer
3. Run communications software in terminal mode
4. Press the space bar to get Hydrolab® menu
5. For Series 3 units, follow steps a-d below.
    a. Select "L" from the menu (Logging) or go to "Files"
    b. Select "R" from the menu (Review)
    c. Select log file to be reviewed (i.e. "5")
    d. Select "B" (Beginning of file) at the "Starting location for review ?" prompt
6. For Series 4 units, there is no menu available to view beginning and end of file; therefore, you should execute the steps to transfer the data as Printer-Ready in HyperTerminal (allow text to scroll on-screen, but do not capture text). Scroll up to view the beginning of the file.
7. Compare the first several lines of data on-screen to the hard copy print out, confirm that these lines are the same if not identical (Navigation instructions are on-screen)
8. If both the Hydrolab® Coordinator and the Database Manager agree that the beginning of the file is the same, proceed to the next step
9. For Series 3 units, press Ctrl-H to reselect location and then select "E" (End of file)
10. For Series 4 units, scroll down in the HyperTerminal window to view the end of the file.
11. Compare the last couple of lines of data on-screen to the hard copy print out, confirm that these lines are the same
12. If both the Hydrolab® Coordinator and the Database Manager agree that the end of the file is the same, proceed to the next step. If there is any doubt about the sameness of data expressed by either the Hydrolab® Coordinator or the Database Manager, the Erase Procedure is aborted and steps taken to identify the source of difference
13. Press the "Esc" key (Escape)
14. Press the space bar to get Hydrolab® menu
15. For Series 3 units, select "L" from the menu (Logging), then select "E" from the menu (Erase)
16. For Series 4 units, go to "File", then "Delete"
17. Select log file that is to be erased
18. At the "Are you sure you want to erase?" prompt, both the Hydrolab® Coordinator and the Database Manager must confer and agree or disagree. If both agree enter "Yes", if not enter "No"

<u>YSI Units:</u>

After all data files have been uploaded to PC and archived, go to 650 Main Menu and select ***File***, and then enter ***Delete All Files,*** then ***Delete***.
NOTE: All data stored in 650 memory will be irretrievably lost!!! This will not, however, affect the site designations in the Site List.

ATTACHMENT G

QuickGuide for YSI 600XLM and 6920V2 Multi-Probes

Application: The YSI 600XLM and 6920V2 multi-probe sonde units are used with the YSI 650 MDS data logger to measure and store temperature, pH, dissolved oxygen and specific conductance (and other parameters for the 6920) data collected in the field at rivers, lakes, estuaries, etc.. This QuickGuide covers pre-survey calibration, field use and post-survey QC checks. These QuickGuide steps are consistent with the MADEP-DWM SOP for Multi-probe use (CN 4.21), and should be followed for all field surveys. For info on data retrieval, see CN 4.21.

Field Use (station to station):

1. Schedule to pick up a pre-calibrated YSI kit(s) VIA E-MAIL to Jeff Smith, Richard Chase and Art Johnson ONE WEEK PRIOR to the survey date(s) by filling out a Multi-probe Request Form, providing the following information (see example below):
    a. Project Name, # of crews and survey lead names, dates/times needed
    b. pH ranges expected for each crew (e.g. 5-7, 6-8, etc)
    c. fresh and/or salt water use for each crew
    d. List of ***MULTI-PROBE OWMIDs*** to be used by each crew, sequentially from first to last station visited .

2. Upon receipt of the YSI Kit, inspect contents and review Multi-probe User Report form accompanying the kit. The top part of this form has been filled out by the Multi-probe calibrator and lists kit contents. The bottom part of the Multi-probe User Report needs to be filled out by the survey crew leader upon completion of the survey and return of the unit back to DWM-Worcester.

3. IMPORTANT: Do not remove the attached YSI field cable from the sonde. Keeping the cable connected for the duration of the survey will prevent potential contamination of the o-ring inside the sonde connector plug.

4. At first station, unscrew the storage cup surrounding the probe assembly and install the probe guard. Discard the water in the storage cup and store the cup in the case. REMEMBER: Use the field storage cup (containing wet sponge) after each use and during transport.

5. Connect the 650 to the open end of the sonde cable. Also, connect the strain relief connector to the bail. (if these are not already connected).

650 Keypad:
a. ***ESC*** key= back to previous screen (REMEMBER: use ***ESC*** to backout of toggle options and ***Enter*** to change)
b. Arrow key= "***ENTER***" ; Right/Left/Up/Down arrow keys (4)= scroll menus and rows of data
c. Number and Letters are input by successive key presses as follows: (1=1); 2 = ABC2abc2; 3 =

6. Turn ON the YSI 650 recorder (if the unit does not respond, try battery removal and re-insertion/replacement) and go to Sonde Menu/Calibrate/Pressure. WITH THE SONDE IN AIR, ENTER 0.00 METER TO CALIBRATE THE UNIT FOR WATER DEPTH. THEN PRESS "ENTER" AGAIN. **PERFORM DEPTH CALIBRATION AT EACH STATION IMMEDIATELY PRIOR TO USE.** PRESS ESC 3 TIMES TO RETURN TO MENU.

7. **Multi-Site List Method**: (PREFERRED METHOD; for typical "wade-in" station where sonde and logger are held while standing in the water).
    a. Select a suitable location and wade into the stream (with the YSI 650 in one hand secured by the hand-strap and with thumb-keyboard control; and the wound cable and sonde in the other hand) for the taking of a representative sample (e.g. center stream, completely-mixed, flowing, non-turbulent, etc.).
    b. NOTE: The multi-probe calibration staff person has already created a project-specific multi-site list in coordination with the project coordinator PRIOR TO THE SURVEY (using the OWMID list provided per #1 above). The operator will use this list in the field to record data to the correct file and site #. **DO NOT EDIT PRE-SET SITE LIST ENTRIES**. Additional Site Names and Site #s, however, can be added in the field, if needed, using the "Edit Site List" menu.

c. At each station, go to ***Logging Setup*** to make sure "Use Site List" mode is ON. If not, scroll down and toggle to check "Use Site List" box.

d. Facing upstream, hold the sonde in the water in front and away from your body with the probes approx. 6-12 inches (typical) below the surface. If the sonde is placed on the stream bottom for shallow sites, make sure there are no undesirable effects due to sediment disturbance or sonde movement. <u>DO NOT ***Start Logging*** UNTIL PROBES ARE IN THE WATER AND READINGS ARE STABLE.</u>

e. Go to and select ***Sonde Run*** (Main Menu)

f. Scroll to and select (Enter) ***Start Logging*** (to 650, not sonde!), after verifying stability of readings. The automatic logging interval has been pre-set to take readings every 30 seconds.

g. The multi-site list will appear. Scroll to select the correct ***FileName***, then scroll to and select the pre-assigned ***Site Num*** (the multi-probe OWMID# for the station). This is the same File Name and Site Number that are on the pre-loaded Fieldsheet for the station.

h. The unit is now recording data at the pre-set interval (30 seconds). <u>Record the time logging was initiated (in order to stop logging at the approp. time). Note the stability of real-time readings throughout the logging period.</u> Examples of "unstable" readings include unidirectional pH changes every few seconds, moderately fluctuating DO, and large jumps in conductivity. The 650 display is ordered as follows:

650	Sonde
Log One Sample	Log One Sample
Start Logging	Start Logging
Date	D.O.
Time	D.O. Charge
Temp	pH
Sp. Cond.	pH (mV)
D.O. %SAT	Battery (V)

i. <u>**AFTER 5 MINUTES** of stable recorded readings</u> (10 rows of data), select ***Stop Logging***, and then ***ESC.*** NOTE: Do not "stop logging" until 3 minutes of stable readings have been taken. <u>Note</u>: The unit shuts off automatically after 15 minutes of no keypad use. Turn unit back ON and continue where you left off (e.g. review file to see if you logged 4-5 minutes of good quality data).

j. On the Main Menu, select ***File***, and then ***View File***. Scroll to select the correct ***File Name*** and ***Site Num*** (e.g., "810105". Note: no dash in OWMID) for that station.

k. Scroll down using the down arrow key to view the last row of data and record this data on the fieldsheet manually (scroll sideways to view all data), including the site #.

l. IMPORTANT: ***ESC*** to Main Menu and turn 650 OFF prior to proceeding to the next site.

8. Use the extra ID (-0000) provided in the Site List (e.g. 810000 for Nashua) for any unplanned station visits or in situations where the correct ID #s are not in the site list (due to miscommunication). Upon return to DWM, coordinate with the QC Analyst and Database Manager to ensure that new, proper multi-probe ID#s are provided to replace the –0000(s).

9. After data collection at each station, replace the field storage cup containing wet sponge, and clean the sonde, cable and 650 with the clean rags in the case. Pack securely in case using rags for extra cushion and placing end of sonde in bubble wrap sleeve. Zip up case. After the last station, securely pack the cleaned kit as above for transport back to DWM, <u>leaving the cable connected as always and with the storage cup back on.</u>

10. Complete the Multi-Probe User Report, noting any problems encountered during field use of the YSI 600XLM. Deliver this report and the YSI 600XLM kit to the DWM water lab.

Field Use (@ bridge drop locations): Same as above, except for the following:

1. Due to the very light weight of the YSI 600XLM sonde and the potential for the sonde to drift into non-vertical position, attach screw-in anchor weights to bottom of sonde prior to deployment. If weights (one each per kit) are not available for some reason, attach the carbiner on the cable to an anchor rope (to stabilize the sonde in a vertical position and not drifting downstream with the current and/or bobbing on the surface). If this method is used, the preferred option (as with the Hydrolab units) is to deploy and tie off the anchor rope, attached the YSI sonde carbiner to the anchor rope and lower the YSI into position. Alternatively (if the preferred method is not possible) tie a loop in the anchor rope at the desired depth for sonde deployment, making sure that the sonde will not bang into the metal anchor when deployed. Then, attach the sonde carbiner to

the loop and slowly lower the anchor/sonde assembly down into the water. When the anchor is stable and the sonde is at the desired depth, tie the anchor rope to the bridge.

Additional Considerations for Use of the YSI 6920:
Clean optics: The 6920V2 has an additional option to clean the optic sensor(s). Using this feature cleans optics on one or both optic probes (e.g., ODO, Chlorophyll, phycocyanin).

Field Use (fixed deployment): See CN 4.41

Field Use (Lake-specific procedures): See CN 4.21

Project Key for YSI 650 File & Site # List: Actual OWMIDs must be supplied by survey coordinators prior to survey.

Project	2-Number Prefix
Lakes Baseline (LB)	24
Lakes Nutrient Criteria (LC)	25
CERO/SMART (SM)	26
TBD	27
TBD	28
Training	29
Hoosic	11
Kinderhook	12
Bash Bish	13
Housatonic	21
Farmington	31
Westfield	32
Deerfield	33
Connecticut	34
Millers	35
Chicopee	36
Quinebaug	41
French	42
Blackstone	51
Ten Mile	52
Narragansett Bay	53
Mt. Hope Bay	61
Taunton	62
Boston Harbor	70
Mystic	71
Charles	72
Neponset	73
Weymouth & Weir	74
Nashua	81
Concord	82
Shawsheen	83
Merrimack	84
Parker	91
Ipswich	92
No. Coastal	93
S. Coastal	94
Buzzards Bay	95
Cape Cod	96
Islands	97

* **REMEMBER**: Provide the approp. extra ID# in the Site List during calibration using the “0000” format (e.g. 810000)

Pre-Survey Calibration and Post-Survey Checks of the YSI 600XLM and 6920*:* *(for station-to-station use)*
<u>Pre-Survey Calibration</u>:

Use Multi-probe Calibration Record form for pre-calibration and post-check data. IMPORTANT: Use pre-set 650 "CALcircuitboardserial#" File (e.g., "CAL7A7B") for logging and storage of ALL calibration and check data to the 650 memory, using the ***Site*** # 999999.

1. Power supply for pre-calibrations and post-checks is C cell alkaline or Ni-Cd rechargeable.
2. Connect sonde to 650 logger using 25'/50'field cable. OPTION: If two units needed, consider pre-/post- calibrating two at the same time.
3. Fill out individual calibration sheet with preliminary information for pre- and post-calibration of each sonde, recording the final readings for each calibration to the calibration sheets. Use DWM standard rinse procedures: 2 pre-rinses and 2 rinses prior to standard. Fill cal cup each time 2/3rd full and shake. Be careful removing cup each time.
4. Remove storage/calibration cup from sonde and inspect DO membrane and other sensors for any potential problems. DO membrane should be changed as needed and once a month during heavy use.
5. Install probe guard to verify secure fit and to perform depth calibration.
6. Turn ON 650 logger, go to *Sonde Menu* to *Calibrate "Pressure" (depth).* To approximate the depth from the water surface to the probe array, enter 0.15 meter (not 0.0) with the sonde in air. Press enter again to calibrate. LOG 1 sample to the 650 "CAL" file by *ESC*ing to the 650 Main Menu ("disconnecting" from sonde) and selecting *Sonde Run/* log one sample and selecting the "CAL" file from the Site List.
7. Add 718 uS/cm conductivity std. to just below the DO membrane and just above the temp sensor for an inverted sonde (using DWM rinse protocols).
8. Remove probe guard, screw cal cup (containing 718 cond. solution) onto sonde, hand-tighten, invert and place securely in bench-top double-clamp ringstand. Loosen the bottom part of the cal cup to vent (only 1-2 threads). Ensure that sonde unit is securely situated in ringstand clamps at all times (and not over the edge of the counter---just in case…).
9. Examine liquid level in cal cup of inverted sonde to ensure that the level is just below the DO probe o-ring with temp sensor and pH probe completely submerged. Make sure that DO membrane is free of droplets. Wait 15 minutes before calibrating conductivity and D.O.
10. While waiting, review Multi-Probe Request Form from monitoring coordinator and perform #11-19.
11. Check and record the following parameters on the 650 Main Menu (for a specific survey):

    □ 650 Battery status   □ Barometer & units   □ Date & Time   □ Lat/Long (if GPS)

12. Scroll to *650 System Setup* to verify/edit proper system parameters (for a specific survey):

□ Deactivated 'Power Sonde'   □ Baud rate 9600   □ Shut off time 15 minutes   □ Date/Time   □ Deactivated 'Comma radix'   □ Barometer calibration (if necessary; use calibrated Swift barometer)

13. *Esc* to *650 Logging Setup* to check/edit proper logging parameters (for a specific survey):

    □ Logging interval 15 seconds   □ Use of Multiple Site List ON (unless single site method to be used)

    □ Store Barometer readings ON   □ Store Site # ON   □ Store Lat/Long (if GPS)

    □ Select *Edit Site List* to create the appropriate survey *File Name* and *Site #s* (Site Names are optional) by annotation for a specific crew's survey, based on information provided on the Multi-Probe Request Form. Provide one extra *Site Num* for every survey using the standard format for extra IDs as follows: e.g., 810000 (for Nashua), in case one or more unplanned stations are visited. Also, DELETE ALL PREVIOUSLY-USED SITE #S FROM THE SITE LIST.

    Examples: *File Names* (up to 8 char.): use sonde unit ID

    Site Names: leave blank (or station-specific unique ID or station locator)

    Site #s (sequential in order of use for each file): 810105, 810108, 810113, etc. (Nashua file);

    250001, 250002, etc. (Lakes LC file); 260001, 260002, etc. (SMART file), 999999 for CAL file.

14. Select *Sonde Menu* to connect to the Sonde Main Menu and scroll to *Advanced/Sensor* to verify setup parameters:

    □ Moving probe ON   □ Altitude 0 feet

15. *Esc* to *Advanced/Setup* and *Filter* to verify setup parameters:

□ VT100 emulation ON □ All other parameters OFF □ Data Filter enabled

16. *Esc* to Sonde Main Menu to check *Sensor(*s) enabled:

□ Time □ Temperature □ Cond. □ D.O. □ Pressure □ ISE pH □ Battery

17. *Esc* to Sonde Main Menu to check *Report* parameters enabled:

□ Date □ Time □ Temperature □ Spec. Cond. (uS/cm) □ TDS □ Salinity (ppt, if SW) □ DO (%sat)
□ DO (mg/l) □ DO charge □ Depth (feet) □ pH □ Battery volts

18. *Esc* to Sonde Main Menu and edit *System* as needed:

□ Sonde date/time □ Sonde ID □ Comm (Auto ON; 9600 ON)

19. *Esc* to Sonde Main Menu and verify *Status*:

□ Battery volts (max = 6) □ Logging "inactive"

20. Now, go to *Sonde Run* and log one 718 COND sample (before calibration COND value). Then, *ESC* to Sonde Main Menu to *Calibrate* sensors, and select "*Conductivity" and "SpCond"*. Enter concentration in mS/cm (0.718). When readings are stable, press enter again to calibrate (inverted sonde). LOG 3 after-calibration samples to 650 "CAL" file by *ESC*ing to the 650 Main Menu ("disconnecting" from sonde) and selecting *Sonde Run/* log one sample and selecting the "CAL" file from the Site List (at 30 second intervals). *ESC/disconnect* to view file and record readings on lab data sheet.

21. *Esc* to Sonde Main Menu to *Calibrate "Dissolved Oxygen"* to 100% saturated air using 718 Cond solution (with "AutoSleep OFF!). Enter barometric pressure. When readings are stable, press enter again to calibrate. LOG 3 after-calibration samples to 650 "CAL" file by *ESC*ing to the 650 Main Menu ("disconnecting" from sonde) and selecting *Sonde Run/* log one sample and selecting the "CAL" file from the Site List (again, at 30 second intervals). NOTE: the calibrated %sat value will usually not be exactly 100% (unlike for the Hydrolab) due to correction for the barometric pressure entered (e.g. 94.7% sat value for 720BP; (720/760)*100). Compare table values for saturated DO to 650 readings to confirm calibration.

22. Screw cal cup cap back on tight before removing sonde from ringstand holder. Perform linearity check using the 147 uS/cm conductivity std. by discarding the 718 std and replacing with 147. Record readings. NOTE: Do not calibrate to 147, just take the reading. (inverted sonde). LOG 3 check samples to 650 "CAL" file

23. Screw cal cup cap back on fully and remove sonde from ringstand, discard conductivity solution in the cup, perform rinses, and add pH 6.86 standard to the cup to the black fill line and replace in clamp holder in a straight-up position. LOG one before-calibration pH sample to "CAL" file before entering the "calibrate" mode.

24. *Esc* to Sonde Main Menu to *Calibrate "pH"* using the 2-point method. Enter 6.86 for standard #1. When readings are stable, press enter again to calibrate. Manually record 3 pH readings. (Alternatively, LOG 3 after-calibration pH 6.86 samples to 650 "CAL" file by backing out and logging to "CAL" file. Then, re-do 2-point pH calibration starting with 6.86, followed by 4.01 (or 10.04, 9.18)). Put 2nd pH solution into cup before pressing *Enter* to calibrate.

25. Discard, rinse and add 4.01 (pH 9.18 or 10 as appropriate) to the cal cup and replace in clamp holder. Enter standard pH value #2 (4.01). When readings are stable, press enter again to calibrate. (straight-up position) LOG 3 samples to the 650 "CAL" file as previously described.

26. Discard pH solution, rinse and perform Low Ionic Std. check (LI solution up to black fill line). LOG 3 samples to 650 "CAL" file at approx. 30 sec. intervals . (inverted sonde)

27. Perform DI water check (DIW up to black fill line). LOG 3 samples to 650 "CAL" file at approx 1 minute intervals. (inverted sonde)

28. Complete Multi-Probe User Report checklist for calibrated sonde unit, including multiple site list information (created Files and Site #s) NOTE: the data output file will contain the date, time and Site # only (not File or Site Name).

29. Pack YSI kit for field use, placing ½ inch DI water in the cal cup.

Additional Considerations for Calibration of the YSI 6920:
pending

Post-Survey Checks:

1. Review Multi-probe User Report, and use it to make additional notes as necessary in addition to the Calibration Sheet.
2. Inspect YSI 600XLM kit for cleanliness, function and quality, including each probe. Clean and maintain as necessary.
3. Turn 650 logger ON and review file/directory to verify field data has been logged to 650 as required (and not to sonde), and general setup parameters to verify that nothing was inadvertently/intentionally changed in the field that should'nt have been.
4. Perform Low Ionic Std. check (see #26 above). LOG 3 samples to 650 "CAL" file. (inverted sonde). Record data.
5. Perform DI water check. (see #27 above) LOG 3 samples to 650 "CAL" file. (inverted sonde). Record data.
6. Replace storage cup onto sonde with 1/8 inch DI water.
7. Go to ***Sonde Menu*** and transfer any files resident on the sonde memory to the 650 memory as ASCII files (e.g. .glp file).
8. Disconnect sonde, add ½ inch DI water to the cal cup and pack entire kit for short-term storage (until the next survey), and file completed Multi-probe User Report.
9. Dry out sponges in sonde storage bottles.

ATTACHMENT H

QuickGuide for Field Use of HYDROLAB MS4/5 and SVR4a/5

- Take cup off sonde unit and put on weighted strainer. Connect Cable to sonde.
- Push On/Off key and check to see if the stirrer is on. (If for some reason the stirrer isn't on push the Setup/Cal key then the setup key then the sonde key. After a short wait you'll get a screen with options. Scroll down 1 to 'Circulator' with arrow keys then press 'Select'. You'll get another screen with "Circltr: off on". 0: off 1: on Old: ? New: ? 0123456789. Using the arrow keys move cursor to 1 then press select. Press done to enter your selection. Press 'Go Back' until you reach the main menu.

TO CALIBRATE DEPTH

- Make sure the sonde is in air near the surface of the water. Press Setup/cal. then press calibrate then sonde. After a short wait you'll get a screen with options, scroll to Dep 100: Meters using arrow keys. Press select you'll get another screen: Dep 100: meters. Old: ? New: ? -0123456789. Use arrow keys and select for each character. **Enter 0.00.** Press 'done'. Go back to the main menu using 'Go Back'.

TO ANNOTATE

- **Annotate OWMID# ONLY** for the station (e.g., SM-0389).
- To annotate press 'Files', then 'Svr4a', then choose file (usually 2: Surveyor 4a) and press 'Select'.
- The cursor should now be on Annotate, if not, move it there with arrow key's, press select.
- Using the arrow keys and 'Select' for each character, type the OWM-ID (remember 2 characters a dash and 4 numbers). Use the 'Backspace Key' to correct errors.
- When typed correctly press 'Done' to store the annotation to the file. Go back to the main menu using the 'Go Back' key.

TO SAMPLE

- Place sonde in the water.
- Wait for probes to equilibrate and stabilize. When readings are stable press 'Store'. Select again to use the "manual" file. It will store one set of readings automatically to the logger.
- **Continue to store readings manually @ 30 second intervals for a minimum of 5 minutes.**

TO REVIEW DATA

- To review files, press 'Files', then 'Svr4a' next screen arrow down to review, press 'Select'. Arrow to correct file if necessary. Press 'Select'. It will ask Beginning or Date/ Time. Move to 'Beginning' press 'Select'. Press the up arrow from the next screen to get the last readings. Record on fieldsheet.
- Go back to the main menu using 'Go Back'.
- Press on/off key.

ATTACHMENT I

YSI S-C-T METER (MODEL 33) QUICK GUIDE

Operation

1. Adjust meter to zero (if necessary) by turning the Bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity scale. When reading the meter make sure the needle and the reflection in the mirror on the scale line up. This will give you an accurate reading.
2. Calibrate the meter by turning the **MODE** control to **REDLINE** and adjusting the **REDLINE** control so the meter needle lines up with the red line on the meter face. If this cannot be accomplished, replace the batteries.
3. Plug the probe into the probe jack on the side of the instrument.
4. Put the probe in the solution to be measured (see back).*

Temperature

Set the **MODE** control to **TEMPERATURE**. Allow time for the probe temperature to come to equilibrium with that of the water before reading. Read the temperature on the bottom scale of the meter in degrees Celsius. Record to nearest 1/10 degree.

Conductivity

1. Switch to X100. If the reading is below 50 on the 0-500 range (5.5 on the 0-50 mS/m range), switch to X10. If the reading is still below 50 (5.0 mS/m), switch to the X1 scale. Read the meter scale and multiply the reading appropriately (x1, x10, x100). The answer is expressed in micromhos/cm (mS/m) (e.g. if the **meter reading**=247 and **the scale**= X10, then **conductivity**= 2470umhos/cm (247.0 mS/m)). Record data and scale used. **Measurements are not temperature compensated**.
2. When measuring on the X100 and X10 scales (does not function on the X1 scale), depress the **CELL TEST** button. The meter reading should fall less than 2%; if greater, the probe is fouled and the measurement is in error. The probe needs to be cleaned (This should only be done in the lab).

Salinity

1. Determine the sample temperature and adjust the temperature dial to that value.
2. Switch to X100. If the reading is above 500 umho/cm (50 ms/m), the salinity value is beyond the measurement range.
3. If the reading is in range, switch to **SALINITY** and read salinity on the red 0-40 ppt meter scale. Record the data (it is temperature compensated).
4. Depress the **CELL TEST** button. The fall in meter reading should be less than 2%; if it is greater, the probe is fouled and the measurement is in error. The probe needs to be cleaned (This should only be done in the lab).

Pack-up

- Put unit back in storage case.
- Keep probe moist/wet in DI solution.

ATTACHMENT J

pH METER QUICK GUIDE

Calibration and Set-Up

- Use 2-point calibration in the lab (pH 7 and 4). Use CAL dial to adjust to pH 7. Mark CAL dial pointer with pencil mark on unit face. Use inset screw to adjust to pH 4.
- Ensure battery condition

Operation

- Make sure CAL knob is set at pencil mark.
- Take ambient temperature and set TEMP knob.
- Plug the probe into the unit.
- Put the probe in the solution to be measured. Only immerse probe ½ way in to solution to avoid the potential for contaminating the electrolyte solution.
- Press ON and hold until stable readings (to .05). Record.

Pack-up

- Put probe back in case with end of probe facing down when the closed case is held by the handle.
- Disconnect probe and turn off unit.

Appendix K

HYDROLAB THERMISTOR CHECK (example)

A check of the thermistors on the Hydrolab DS3 units was performed on July 2, 2001. A cooler chest was filled with water was set up in the Instrumentation Lab a circulation pump was used to make sure the water was well mixed assuring consistent temperatures throughout the cooler. The Hydrolab sonde units were the placed in the cooler and a certified thermometer was placed on a rack under water toward the front of the cooler where it would be easy to read. The thermometer used is an ERTCO NIST Model 1003-FC Certified Thermometer Ser# 1537 (Total Immersion). The range is –1 to 51° C with scale divisions of 0.1°C and a resolution under magnification of 0.01. The last date of certification was 12-13-01. The Hydrolab thermistors have a range of –5 to 50°C and an accuracy of 0.15°C (The standard thermistor provides +/- 0.20°C accuracy worst case and 0.13°C using the 95% Certainty method for calculating accuracies). As the test chamber we used wasn't capable of fine temperature control or of working to the ends of the thermometer range we attempted to test at the lower end of our observed sample temperatures, at the high end, and two points in between. Again these numbers aren't at specific temperatures but we used the Certified Thermometer to compare the Hydrolab readings. The following is a table of the readings obtained by both the Certified Thermometer and each Hydrolab unit.

Certified Thermometer@	Sonde* 15486	Sonde* 15559	Sonde* 24569	Sonde* 24570
6.71°C	6.74°C	6.72°C	6.54°C	6.56°C
10.18°C	10.09°C	10.19°C	10.08°C	10.08°C
15.17°C	15.08°C	15.18°C	15.08°C	15.08°C
23.40°C	23.36°C	23.40°C	23.31°C	23.31°C

*All Sonde units are +/- 0.15C.
@"Uncertainty" for the Certified Thermometer is as follows:

Test Temperature C°	Standard Uncertainty
0.00	0.01
10.00	0.04
20.00	0.04
30.00	0.04
37.00	0.04
40.00	0.04
50.00	0.04

Appendix L

QuickGuide for EUREKA MANTA AND AMPHIBIAN

SETUP

- Take cup off sonde unit and put on weighted strainer.
- Press **Bottom Right key** on ipaq (Eureka program should come up. If not go to **START** and click on the **Eureka icon**).
- Check to see if the stirrer is on. If for some reason the stirrer isn't on, tap on the **Circulator Icon** on the bottom right of the screen to start it.

TO CALIBRATE DEPTH

- Make sure the sonde is in air near the surface of the water. Tap on '**Probe'** (bottom middle of screen) then tap **Calibration** then under Probe Info (top of screen) tap **down arrow** then '**Depth'** (it should be set for 0.0 m. if not **highlight present setting** bring up the keyboard at the bottom of the screen and **type 0.00**, then tap '**Calibrate'** and then '**Okay'**. Go back to the main screen using '**OK**' in the top right part of the screen and tapping **Yes** to save the calibration..

TO ANNOTATE and SAMPLE

- Place sonde in the water.
- When readings are stable tap **green 'LOG' icon** then '**Append'**, Program will ask for new annotation. Type it in. The unit will automatically start logging. When finished logging tap the **Red 'Stop' Icon** on the bottom of the screen.

TO REVIEW DATA

- To review files, tap '**File'**, then **Highlight file used** (there should only be one) tap '**Select'** and scroll to the bottom of the data to get the last reading. Record on fieldsheet.
- Go back to the main screen by tapping **ok** in the upper right corner of the screen.
- Press **power key** on the upper right corner of the ipaq

AT THE FINAL STATION

To Shut Off Tap 'File', Then 'Exit', Then Press power key on the upper right corner of the ipaq

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Massachusetts Department of Environmental Protection
Division of Watershed Management

STANDARD OPERATING PROCEDURE

Multi-Probe Sonde Deployments
for Continuous Unattended Water Quality Data Collection

CN 4.41
June, 2007

Prepared by: ______________________ Date: 6/1/07

Richard Chase, Quality Assurance Analyst
Jeff Smith, Environmental Analyst
Mark Mattson, Environmental Analyst

Approved by: ______________________ Date: 6/2/07

Arthur Johnson, Monitoring Coordinator

Approved by: ______________________ Date: 6/3/07

Dennis Dunn, Program Supervisor

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List of Revisions

Revision Date	Revision	Pages #s
2004	Original	
2007	General updates	throughout

1.0 SCOPE AND APPLICATION

This SOP describes the procedures necessary for the proper field deployment of multiprobe sondes, in order to collect unattended, continuous monitoring data for D.O. and temperature (and pH and specific conductance if available). It is intended to provide specific guidance on how to deploy multi-probes in rivers, streams, lakes and impoundments under typical conditions and for short-term (~2-10 days). Project-specific circumstances may require that these guidelines be modified during planning or in the field, based on consensus amongst DWM project staff.

For information (not contained in this SOP) related to laboratory instrument setup, calibrations, QC checks, etc., see CN 4.21 (SOP for Multiprobe Use).

For information on continuous temperature monitoring using small temperature loggers (e.g., Stowaways), see CN 103.1.

This SOP does not address permanent or semi-permanent (>~10 days) installations.

2.0 SUMMARY

As of 5/2007, DWM has approx. 20 multiprobe (Hydrolab®) sondes that are available for deployment. This SOP has been developed to ensure protective, effective and efficient use of the instruments to meet project objectives. **Example project objectives** include:

- Diurnal dissolved oxygen (D.O.) fluctuations.
- Spikes in conductivity, pH or temperature indicating possible episodic events, such as illegal discharges or stormwater runoff
- Evaluate stream temperature dynamics for cold water vs. warm water fisheries
- Provide greater quantity of data at selected locations over time.

3.0 SAFETY CONSIDERATIONS (including equipment protection)

The following personal safety and equipment protection points should be considered when deploying multiprobes for continuous monitoring:

- Follow field safety guidelines in CN 1.21
- Follow lab safety guidelines in CN 0.3 and CN 4.21
- Choose deployment locations that are low risk for vandalism, gunplay, troll fishing, etc.
- Make installation as unobtrusive as possible (i.e., invisible)

- Wherever possible and necessary, use protective sleeves for sondes, and always in river installations to protect sondes from damage
- Anchor unit to an immovable object or otherwise so it does not move

4.0 SAMPLE COLLECTION, PRESERVATION AND HANDLING

Typically, water quality samples are not taken because sonde data quality is verified through pre-calibration and post-survey checks. If water samples are taken and analyzed to generate data to compare to the sonde data, follow CN 1.21 for sample collection, and project QAPP and lab QAP for analytical quality control.

5.0 APPARATUS, EQUIPMENT AND MATERIALS

The following equipment is needed for the proper setup and field installation of deployment sondes. Extra materials as may be needed in the field should also be taken when deploying.

- ❑ Calibrated multiprobe sonde with internal logging capability and setup for interval recording
- ❑ Anchoring assembly (cable and lock)
- ❑ Protective sleeve or tube for sonde (preferably black color)
- ❑ GPS device, buoys, digital camera and/or other locating tools as necessary (to reference deployment location)
- ❑ Carbiners, hooks, cable/crimps, polypro rope, buoyancy devices (lakes), ABS plastic pipe, etc. (installation hardware), as necessary
- ❑ deploment fieldsheets (pre-loaded top section ONLY)

6.0 REAGENTS N.A.

7.0 CALIBRATIONS and CHECKS

Perform all instrument calibrations in the lab (per CN 4.21) prior to deployment using logger display units. Do not perform calibrations in the field. Following sonde calibration in the lab, enable circulator/stirrer (for Hydrolab units). Calibration includes use of a “zero” DO standard in pre- and post-survey checks on dissolved oxygen for surveys in which low D.O.s are critical (e.g., lake hypolimnions, highly polluted/ enriched waterbodies). Confirm <0.5 mg/l result for D.O., per CN 4.21 SOP. Upon retrieval, perform post-survey checks.

Perform side-by-side QC using an additional pre-calibrated sonde at deployment, when moving a sonde from one location directly to another location and at pickup/retrieval.

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8.0 PROCEDURES

The general procedures for unattended multiprobe monitoring (instrument setup, deployment apparatuses and field placement and retrieval) in streams/rivers and lakes/impoundments are as follows:

Multi-Probe Setup:

1. Coordinate with survey crew leader to get required information re: # of probes requested, parameters, file setup, etc. Survey Coordinator should fill out a multiprobe request form.

2. Replace D.O. probe membranes prior to deployment, and a minimum of 12 hours prior to pre-calibration. Perform calibration of DO (prior to each use) and conductivity (prior to each use or periodically if only to ensure DO accuracy) probes using the display units. Record calibration data to file. For D.O./T –only sondes, use DIW cal solution. Also, check battery life and memory to ensure that the sonde has sufficient charge to record all desired data.

3. Unattended Setup (Hydrolab): For Hydrolab units, use PC or laptop computer (QMODEM or Hyperterminal program) with 9-pin cable and auxillary battery to setup sonde to log data in unattended mode. Settings= 19200 baud rate, 8-0-1, create file, enter start date/time and end date/time. For file name, use OWMID # or record to the manual file for file name. As the final step, go to Setup/System/Circulator "ON".

4. Unattended Setup (YSI): Use the 650 display unit. Go to Sonde menu, Run, Unattended sample". Set desired parameters: Enter file name, site name, interval, start date, start time, stop date, stop time, sensor warmup (2 min.), circulator warmup (2 min.), and enable audio and all applicable water quality parameters. For file name, use OWMID # or record to the manual file for file name.

5. Enable "AUTOLOG" feature as a backup in case setup is flawed (optional).

6. A log file will contain parameters that are enabled at the time of creation and "enabling" parameters after a log file is created will not be successful. Therefore, select "ALL" parameters to be enabled prior to file creation.

7. Verify setup parameters (esp. logging "armed"). If pre-set start time not used, start logging.

8. Disconnect cable and return sonde to deployment setup.

9. Pack sonde deployment apparatus with probe storage cup on and necessary accessories for transport to site.

Stream/River Deployments:

1. Review sampling plan for any last-minute changes re: locations, intervals, analytes, etc.

2. Complete multi-probe request form and coordinate with multiprobe coordinator to schedule/reserve required instruments, and to discuss type of installation(s) needed. Select sonde type (D.O.&T, or D.O./T/pH/Cond) needed based project-specific objectives.

3. Attend pre-deployment meeting with all involved staff to review setup and deployment procedures.

4. In general, the accuracy of D.O. readings may diminish over time, dependent on ambient water quality, type of DO probe used and flow conditions. If possible, avoid low velocities (~<1 fps), turbulent conditions and elevated suspended solids near the sensor/membrane. In some cases, D.O. data may only be valid for only 1-2 days, due to membrane fouling. Make sure stirrers are engaged during deployments.

5. Only deploy stand-alone units with internal logging capability (i.e., no cable connections to separate logger boxes)

6. In general, do not download data in the field; retrieve instruments for data download at an office PC.

7. The default sampling interval is **every 30 minutes**.

8. Place sonde in representative location (with the bottom of the unit (and probes) off the bottom!) and one that is well hidden.

9. <u>For deployment AND retrieval, record location, time, condition, etc. on ONE standard DWM fieldsheet (or an 'Unattended Logging Fieldsheet' for this "event", if available). That is, use the same fieldsheet for deployment and retrieval.</u>

10. Protect sonde units in rivers using protective tubes, cages or other (see Appendix A). Securely anchor the assembly to an immovable object at the site using metal cable and crimps.

11. Photo-document installation and retrieval (recommended, but optional).

12. Use standard start/stop times for all deployed data files.

<u>Lake/Impoundment Deployments</u>:

1. Follow steps above (as approp.), and

2. Assemble lake deployment sonde apparatus IN THE LAB. Refer to <u>Appendix B</u> for lake/impoundment deployment apparatuses (or similar). This method places the sonde unit a minimum depth of approx. 4 feet down from the water surface (protecting it from boat motors) and allows it to be relocated for pickup. <u>Perform demonstration of exactly what will be done once on the lake to deploy the unit.</u>

3. Prepare survey equipment, including GPS device.

4. Heavy duty float jug should be filled with 1/3 foam insulation/2/3 air (or ½ water ½ air).

5. Motor to desired location (typ. deep hole). Drop boat anchor. Record location, time, etc. on standard DWM fieldsheet for Lakes or on an 'Unattended Logging Fieldsheet' for this "event".

6. Drop sonde anchor attached to polypropylene rope. Marking rope at the surface, pull anchor in and tie loop ~7.5-8 feet below the mark. Clip sonde deployment assembly to loop and lower anchor in place. The large loop should be floating about 4 feet below the surface allowing it to be hooked with a boat hook. Attach thin 6 foot long string with bobber as an additional aid in finding unit.

7. For additional specifics on lake deployments, see Appendix B.

Post-Event QC Checks and Data Retrieval:

1. Retrieve units from the field and deliver back to DWM lab for data download and processing. Before pulling units, run QC checks using separate probes or water samples right beside the unit to check field accuracy. Use a separate fieldsheet for these data.

2. Perform post-survey checks per CN 4.21, and as follows: Low ionic (if needed) and DI checks both before and after membrane cleaning.

3. After every deployment, use logger/display unit to transfer and store sonde data file(s) to appropriate display unit files (create files in all loggers for downloaded "unattended" data). Verify transfer. After transfer, delete sonde data files.

4. After each deployment, contact the Database Manager to transfer logger data files to PC (per CN 4.21) for long-term storage. Raw data files will be stored as read-only files on the network server. The Database Manager and QC Officer (or another appointed staff member) will verify that the downloaded raw data files and the files on the units contain the same information (by comparing the header and first and last lines of data). Once verification is complete, the Database Manager and QC Officer will erase the memory of the units and record all actions affecting data (download, erase) in the Data Maintenance Logbook.

5. For more specific details on post-deployment data management, see current deployment data team staff at DWM. See also procedures as described in CN 4.21.

9.0 QUALITY CONTROL

The following actions to control data quality are required:

- Planning to collect continuous multi-probe data should be performed by developing sampling plans (locations, frequencies, schedules etc.) and QAPP information to ensure the quality of the data.

- Employ comparison sampling where possible in order to evaluate instrument accuracy throughout the deployment using periodic and/or end-of-survey water samples for lab analysis, co-located duplicate sonde/single probe measurements and/or field check samples (e.g., 0.0 mg/l D.O. standard) . This will allow decisions re: whether any data "shifts" should be performed during data validation.

- If used, prepare "zero" D.O. standard by adding sodium sulfite to one full liter of water until no more dissolves, then add a trace of cobalt chloride (optional catalyst), top off and cap (no head space). Always maintain this standard with no headspace.

- Adherence to quality control procedures for probe calibration and checks, maintenance and use contained in CN 4.21. Note: any deployment data not supported by pre-survey calibration and post-survey check data shall be censored.

10.0 DATA DOCUMENTATION, REVIEW AND VALIDATION

Field documentation shall follow standard DWM protocols, including the use of fieldsheets (standard or other) and photo-documentation. Likewise, data validation shall generally follow DWM's data validation SOP, as well as USGS guidance on data acceptability (USGS, 2000).

In the review and validation of the data, the performance criteria for DO and temperature data shall be as shown in Appendix C, based on both post-survey checks and in-situ comparisons to duplicate multi-probe measurements.

11.0 CORRECTIVE ACTIONS

Corrective actions shall be taken as needed, and may include the following: TBD

12.0 WASTE AND POLLUTION PREVENTION N.A.

13.0 REFERENCES

USGS. 2000. Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation and Reporting, WRIR 00-4252

EPA. 2003. SOP for Calibration and Field Measurement Procedures for the YSI Model 6 Series Sondes. USEPA-New England, OEME

Battelle. 2002. Generic Verification Protocol for Long-Term Deployment of Multi-Parameter Water Quality Probes/Sondes

14.0 APPENDICES

Appendix A: Standard Apparatus for Rivers
Appendix B: Standard Apparatus for Lakes
Appendix C: Decision Criteria for Deployment Data
Appendix D: Multiprobe Deployments: Survey Reminders
Appendix E: OTT Hydras3 LT Manual *(by reference)*
Appendix F: Hydrolab Series 4/5 User's Manual *(by reference)*
Appendix G: YSI Environmental Operations Manual *(by reference)*

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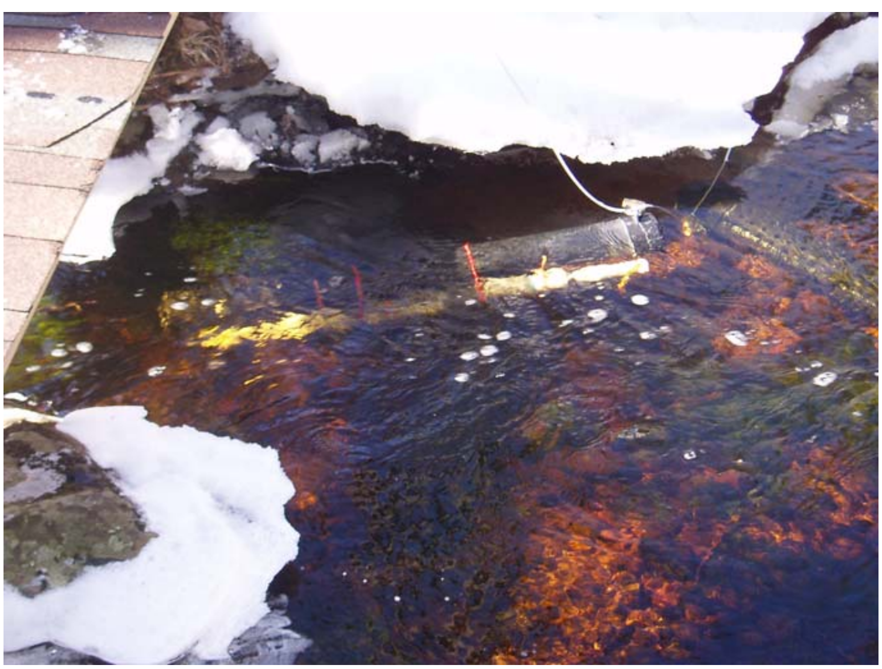
Appendix A: Standard Apparatuses for Rivers (circa 2004-06)



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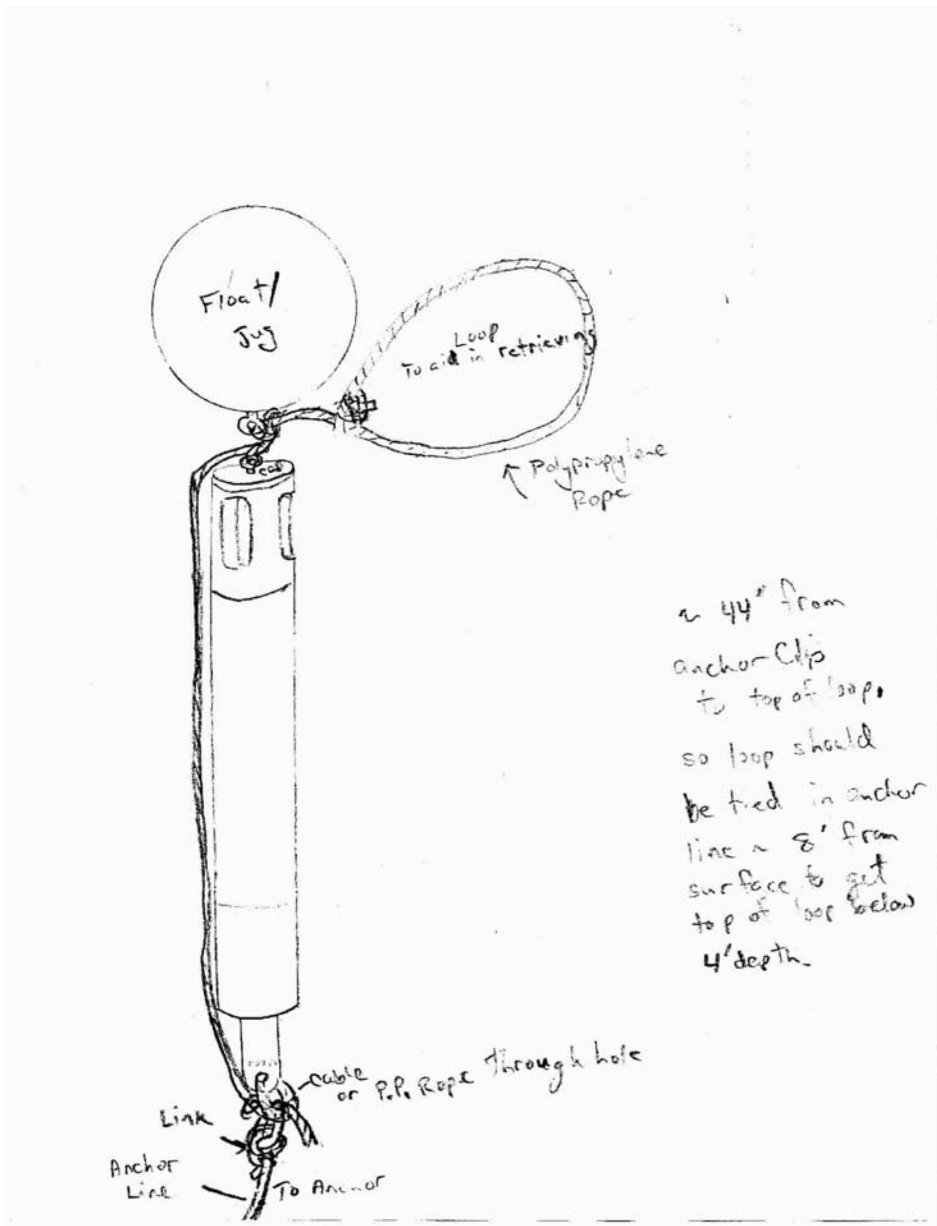
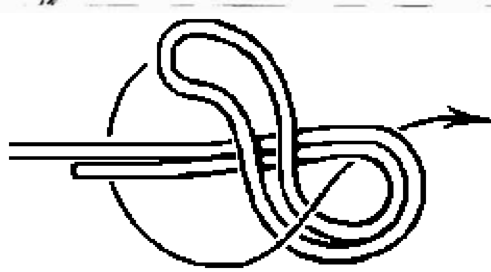
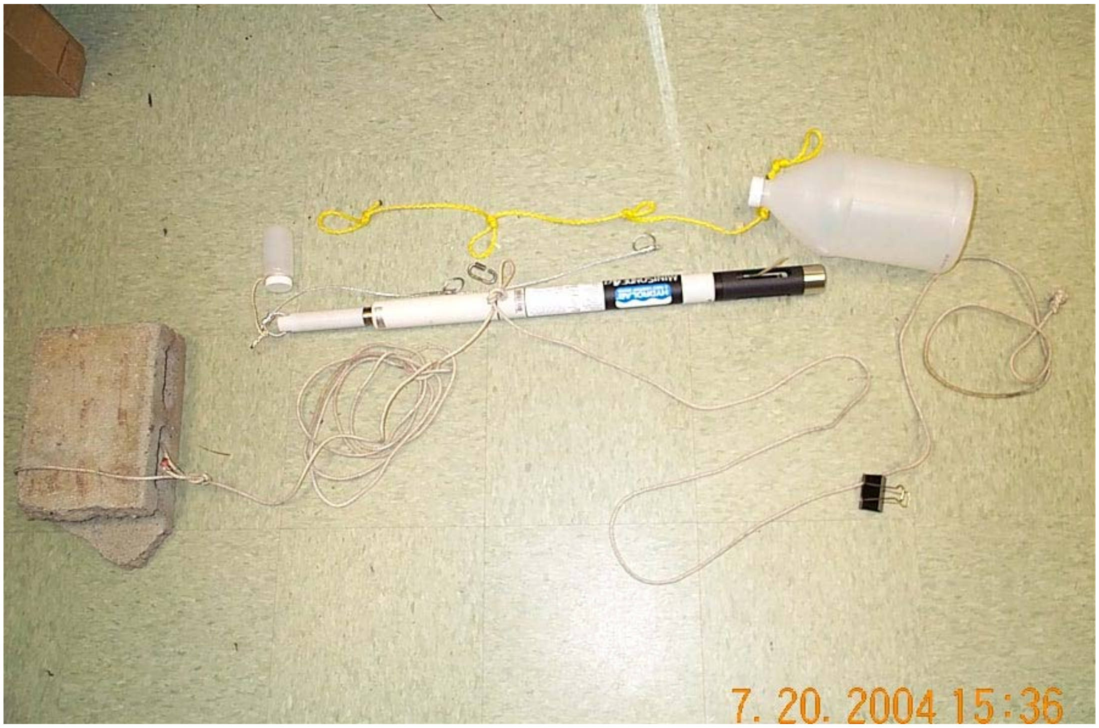
Appendix B: Standard Apparatuses for Lakes (circa 2004)







Lakes Deployment:

Pick up GPS unit, hydrolab probes, floats, rope and cinderblocks and large chain linknut, bobber and string, field sheet owmid, Prepare lakes field sheet and write down probe serial numbers for each lake on field sheet.

Carry probe etc to center of lake (or near deep hole but at least 20feet off to the side of any existing floats). Anchor and immediately record GPS lat long. Refer to the labeled photograph below. Lower cinderblock on 3/8 inch rope to bottom and clip or otherwise mark surface on rope. Tie tag end of rope to boat tempoprarily. Pull up cinderblock and rope. Measure surface clip minus about 5 ½ feet (below the surface) and tie a figure 8 loop knot (see attachment) using about 9 inches of loop to tie the knot and ending with a 2 inch loop. Using the large chain linknut secure 3 loops inside the linknut, one loop being the cinderblockline figure 8 loop, the second loop being the middle loop on the probe cable, and the third loop being the center loop on the jug. Tighten chain linknut finger tight. Use a tiewrap to loosely secure sonde near probe end to both the jug rope near the jug and the tag end of the cinderblock rope. If you put the tiewrap inside probe guard be sure it **<u>is on the slot away from mixer</u>**! Jug should be half filled with air with cap on so it is buoyant enough to easily float probe but not so buoyant as to lift the cinderblock. Check to make sure all three loops are in the chainlink (probe, cinderblock line and float line). Lower the cinderblock and with it the probe/jug using the excess tag end of the cinderblock rope. Check to see that the probe is floating about 4 feet below the water with the top of the jug at least 3 feet below the water (to avoid direct hits by boat propellers). Attach a thin 6 foot string with a bobber as an additional aid to finding the float. If necessary to adjust up or down a foot, simply pull everything up and unscrew the chain linknut and reattach the cinderblock loop to the higher or lower loops on the probe and/or on the jug and retighten. The jug should always be next to and slightly above the probes. You should be able to see jug clearly when boat is overhead, otherwise raise jug and/or also attach a string and surface bobber to the float if algal bloom prevents seeing jug. When jug is suspended 3-5 feet below surface, the bobber on the surface and all looks well you can untie and drop cinderblock rope into water. Before you move you must record position again using GPS lat long etc.

Record visual position:
Record general position on field notes (e.g. probe SN 040600074123 deployed at 10:12am approx, 25 feet sw of deep hole float in center of lake with float 4 feet below surface. In line with dock and south corner of white house on west shore and inline with lone white pine and pumphouse on north shore.

Record GPS position as follows.
Open lowrance, velcro round white antenna to lid, power on. Hit PAGES < or > to navigate screen enter and when position is acquired Lat and Long should be stable (not flashing). Record lat and long on field sheet. Next, set a waypoint position on the GPS as follows: To get to map screen hit PAGE < or > to MAP enter. Hit WPT button and toggle > to save, new. Toggle down v to new and choose create waypoint at current position. You can give it a new name or use default numbername. Record name of waypoint and check lat long agrees with previous position.

Pull up anchor and carry on with sampling.
If you wish to test the sonar you can move 50 feet away and scan the sonar horizontally under the surface. The sonar typically has a blank screen with a flashing constant depth to warn you it can not see the bottom or the float. Rotate the sonar probe 360 degrees slowly. At some point in the scan you should pick up a solid signal from the jug that looks like a hard bottom and the sonar will give a depth in feet which is steady (not flashing).

To recover probes the following day.
Take copy of yesterdays field sheet, lowrance GPS unit or hummingbird sonar, and a long handle rake or boat hook to lake. You may need an extra sonar and the Secchi view tube (and skin diving mask) as well. Turn on lowrance, wait for position. Hit PAGE < or > to navigate enter. Hit WPT, select mywaypoints enter, select nearest, enter. Navigate to nearest waypoint which should be the one you set yesterday, if it is a previous waypoint then select yours from the list. Use PAGES <> navigate enter to show the navigation screen showing magnetic bearing and distance to waypoint. Go there. Look for bobber and look down. Find subsurface float. If you don't see it turn on sonar screen split with map and then take sonar pole and hold it level at arms length under water and sweep it in a circle while observing sonar screen to see if the sonar screen shows a solid signal like the bottom; (that is the float) go and get it. If you can't find it check deployment notes and either go swimming or come back and tell Mattson that he needs a swim. When you find it, hook the float loop rope with the rake and pull it up, checking SN and note condition of probes. Record recovery time on field sheet. Bring everything back to DWM and give probe to Jeff for downloading.

Appendix C

Decision Criteria for Unattended Multi-Probe D.O./Temp Data

(for Lakes and Rivers, unless otherwise specified)

Assumptions:

- decisions are based on trimmed datasets (i.e., data when unit out of water, away from site, otherwise affected, etc. deleted.)
- parameter-specific decisions apply to all data within "blob" unless further review dictates otherwise
- lab pre-cals and post-checks performed on all units
- DO membranes changed and acclimated prior to each deployment
- all deployments "representative" of site conditions (at least at dropoff)
- typical deployment duration 2-7 days
- for lakes, deployment depth = QC probe depth (if not specified; should be available on fieldsheets)

1. If side-by-side QC data (attended) is available at deployment and pickup, and post-check acceptable, then:

TABLE 1	**Avg QC diff < 0.5 mg/l**	**Avg QC diff 0.5<x<1.0 mg/l**	**Avg QC diff > 1.0 mg/l**
D.O.	accept	Qualify with "i"	Censor with "i"
D.O. (post-check not acceptable)	Qualify with "i"	Censor with "i"	Censor with "i"
Temperature	Avg QC diff < 0.3 C	Avg QC diff 0.3<x<0.6 C	Avg QC diff > 0.6 C
	accept	Qualify with "i"	Censor with "i"

* avg difference calculated by taking the mean of dropoff DO diff and pickup DO diff (between QC probe and nearest-in-time deploy QC)

2. If no QC side-by-side field data available, but only lab pre- and post-check of deployed unit available, then:

TABLE 2	**Post-check acceptable (< +/- 0.2 mg/l)**	**Post-check not acceptable (> +/-0.2 mg/l)**
D.O.	Qualify with "i"	Censor with "i"
Temp.	same as above (Table 1)	

3. If only side-by-side QC for one end of the deployment (dropoff or pickup) is available: use Table 1 above using the one value as "avg QC DO diff".

4. Review data recorded following deployed unit "power loss" normally as above (no special criteria), subject to data availability and integrity (if downloadable, readable, etc.).

5. Use BPJ as needed for deployment-specific situations affecting data quality (e.g. censored or qualified QC data, availability of duplicate tube data, etc.).

6. For tidally-influenced deployments, % SAT data using DO/T-only sondes (ie, no conductivity/salinity data) will not be accurate when conditions other than freshwater are encountered. If % SAT readouts

are not internally-compensated for salinity (and no related data is available (e.g., chloride) to estimate equilibrium oxygen concentrations), then censor all % SAT data.

Appendix D

Multiprobe Deployment Survey Tips

To expand the quantity and quality of dissolved oxygen and temperature data collected by DWM, in-situ, continuously-monitoring multiprobe (DO and temperature) and temperature data loggers will collect data at selected stations. Multiprobes are deployed on multiple (3-4 times during the summer low flow period) 48-96 hour-long occasions throughout the assessment monitoring period. Temperature loggers are deployed once at selected locations for 2-3 months. This approach captures "worst-case" dissolved oxygen and temperature data (without the risks and logistical problems associated with "pre-dawn" surveys). Although deployed units are secured and locked, leaving probes unattended does carry some risk of loss and/or damage to one or more of the multi-probe units due to improper installation, theft or vandalism.

MULTIPROBES (DO/TEMP):
In 2009, a multiprobe "pool" of approx. 10-12 stand-alone DO/T loggers are available. These units can be deployed at pre-selected stations in the year-2 watersheds on a weekly basis, as illustrated below.

Three distinct groups of DWM staff facilitate data collection and management:

1) Calibration Team (Jeff Smith with Richard Chase, Matt Reardon and Bob Nuzzo available as backup)

2) Deployment Team (Richard Chase, Brian Friedmann, Jamie Carr, Matt Reardon, James Meek, Peter Mitchell, Chris Duerring, Bob Maietta and 2-3 dedicated seasonal staff)

3) Data Group (Tom Dallaire, Steve Daukas, Jane Ryder, Jeff Smith, and R. Chase)

Probes are calibrated and programmed on Fridays by one or more DWM calibration staff using either saturated air or saturated water techniques. Calibrated probes are then placed in protective deployment cases, such as perforated, black PVC pipes with cable attachment. These are cabled securely to fixed objects at each site and deployed in the water column at locations where they can collect representative data and be hidden from view/vandalism. On ensuing Mondays or Wednesdays (after 3-5 nights of data collection at 30 minute intervals) deployment staff visit each site to retrieve the probes (and redeploy them if necessary on Mondays). The units are transported back to DWM for post-survey checks for precision and accuracy. General inspection, cleaning and QC checks are performed in the field upon deployment and retrieval. Instrument maintenance, data uploads to PC and project coordination are performed on Thursdays. Project OWMIDs are used for probe and QC data. The above process is repeated each week for each successive watershed project.

Logged multiprobe data are uploaded to a PC once a week by the multiprobe data group. Data are stored and managed in the WQD database. Multiprobe use for other projects (e.g., CERO-SMART, lake surveys, other) is provided via DWM's existing non-internal-logging units.

Data to date indicate that DO and temp data are not affected by placement of the multiprobe sensors inside the deployment tube (insignificant or no "container effects"). Recent data also indicate that redeployment in the field (moving probes from their original location to another without re-calibration) does not compromise the accuracy and/or reproducibility of DO data. If further testing indicates otherwise, then the field crew shall perform field calibration for DO.

Efforts to promote and maintain quality assurance, data quality, safety and efficiencies for all probes in use include the following:

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

- Side-by-side, simultaneous probe readings at deployment and pickup using just-calibrated sonde unit
- Unique fieldsheet for deployments
- Project planning/coordination meetings as needed during the project
- Adequate field training for seasonal staff re: transport, pickup and deployment
- Daily oversight by project manager
- Detailed and complete photodocumentation
- Safe and representative station locations
- Secure placement and anchoring of sonde assembly
- Prompt, expedient data upload to PC at the office
- Accurate and precise data processing and management
- Pre-evaluation of possible "enclosure effects" (i.e., tube vs. no tube side-by-side)

Potential pitfalls to guard against include:
Lab:

- Late start for time-consuming pre-calibrations affecting deployment schedule.
- One or more units found to be not working or to have unacceptable calibration data, resulting in the need for backup units

Field:

- Poor locating of units resulting in vandalism
- Poor placement of units resulting in poor quality data, movement and/or loss
- Lost/misplaced equipment (locks, keys, tube caps, L-brackets, etc.)
- Forgot QC muli-probe (esp. needed for retrieval) or other equipment (anchors, cable, probe guards)
- Poor scheduling/timing resulting in time loss

DWM SOP REFERENCES: (DWM network access)
W:\DWM\SOP\CN 004.41 - SOP_Multiprobe Deployment.doc
W:\DWM\SOP\CN 103.1 - SOP_Continuous Temperature Monitoring.doc

Massachusetts Department of Environmental Protection
Division of Watershed Management

STANDARD OPERATING PROCEDURE

Continuous Temperature Monitoring using Temperature-only Loggers

CN 103.1
May, 2009

Prepared by:		Date:	5/12/09
	Richard Chase, Quality Assurance Analyst		
Approved by:		Date:	5/13/09
	Arthur Johnson, Monitoring Coordinator		
Approved by:		Date:	5/15/09
	Dennis Dunn, Program Supervisor		

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

List of Revisions

Revision Date	Revision	Pages #s
May, 2007	---	---
June, 2008	Added additional units to inventory	11
May, 2009	Added additional units to inventory	11
May, 2010	Added additional units to inventory	11

1.0 SCOPE AND APPLICATION

Automated, cost-efficient, high-frequency-interval (continuous) water temperature data can be useful to environmental managers trying to understand surface water temperature dynamics in single waterbodies or at many locations within watersheds. Specifically, validated data can be used to determine statistics such as maximum, minimum, and mean daily temperatures, to examine the timing of diurnal temperature fluctuations, to assess the potential for exceedances of State Surface Water Quality Standards (SWQS), to determine appropriate thermal NPDES permit limits and discharger impacts, and assist in waterbody classifications based on temperature (e.g. cold vs. warm water fishery).

This SOP is mainly intended for continuous temperature sensor deployment in streams and rivers for durations up to several months.

2.0 SUMMARY

Standard procedures for collecting and analyzing continuous temperature monitoring data using inexpensive, stand-alone sensors are provided.

3.0 SAFETY CONSIDERATIONS

Standard safety considerations for DWM field surveys, as contained in *Sampling Techniques for DWM Surface Water Quality Monitoring (*CN 1.21), apply. There are no SOP-specific, additional safety "rules", other than to review standard protocols and to consider any project- and/or location-specific safety issues that may exist.

4.0 SAMPLE COLLECTION, PRESERVATION AND HANDLING

No water samples are collected during this type of monitoring. If water quality or other type samples are taken in the vicinity of the placed sensors, monitors must be aware of potential effects on the continuously-logged temperature data. This also applies to nearby construction and other activities in the water.

See Section 8.0 for discussion regarding the use of the field thermometer(s) for QC accuracy checks.

5.0 APPARATUS, EQUIPMENT AND MATERIALS

The following materials and procedures can be used to collect continuous temperature data (see Appendix A for additional information regarding Optic Stowaway® sensor specifications):

<u>Sensing and Data Retrieval Equipment</u>: Optic Stowaway and ProV2 temperature sensors, optic shuttles, optic base stations and BoxCar® Pro and Hoboware Pro software (Onset Computer Corp.). The 6" long, sealed polycarbonate optic sensors are initially launched (data logging initiated) using the appropriate software (BoxCar® program for older Stowaway units and Hoboware for the newer ProV2 units). These programs are loaded on specific DWM PCs. The units are tested for logging capability and accuracy over several days. All sensors must be deemed fit to use and re-launched prior to placement in rigid plastic tubes for field use. At the same time, the optic shuttle (used for field downloading without a laptop) and the optic base station (for data transmittal from a sensor or the shuttle to the PC) are also tested to make sure they are working satisfactorily. After placement in the plastic tubes, the sensors are anchored at representative stream/river locations at each location.

Sensor Housing and Anchoring Assembly: To protect each sensor, each unit is placed in a 9-12” long, 2” O.D. ABS plastic pipe with caps on both ends. Several ¾” holes are drilled into each pipe section to reduce buoyancy. Also, the enclosures are numbered to keep track of which sensors are at which locations. Flexible plastic coated cables with looped ends and locks are used to secure the units at each location.

Field Deployment and Retrieval: Units are typically deployed from June through September for a 3-4 month period. All locations and placements are selected to be representative of typical stream/river conditions. At each station, the enclosure containing the temp logger is secured off the bottom with rocks and/or concrete block. The cable must be hidden as much as possible. The pipe number, station name and number, exact time and other relevant field data are documented on dedicated deployment fieldsheets.

NIST-traceable accuracy checks: A hand-held digital thermometer (e.g., Eutechnics 4400 Series or similar) traceable to a NIST-certified thermometer must be used in the lab prior to deployment and in the field to check sensor accuracy. At a minimum in the field, checks should be made at deployment, monthly, and at retrieval).

Data Upload: After retrieval, units are transported back to the office for upload to PC. Units are cleaned and dried. The optic base stations are used to connect the loggers to the PC (Room 226). Using READOUT, each logger’s datafile is uploaded into BoxCar® Pro 4 and Hoboware Pro, where they are then exported to read-only EXCEL files on C:/ and W:/. While data can be viewed, graphed and analyzed using the BoxCar® Pro 4 and Hoboware Pro software programs, data processing is done using EXCEL or other at the discretion of DWM database managers.

Data Validation, Management and Analysis: Data are exported to MS EXCEL or other database tool(s) for trimming, validation, analysis and graphics. Data may be ultimately managed as large “blobs” in DWM’s database.

6.0 REAGENTS

NA

7.0 CALIBRATION

Continuous temperature sensors are factory-calibrated. No DWM lab or field “calibration” is necessary. Quality control checks or audits, however, are required prior to, during and after use to verify accuracy. A NIST-certified or traceable thermometer is required to perform the QC checks.

The precision thermometer used to check (audit) the field sensors is factory calibrated, but should be re-calibrated about once a year. To re-calibrate the Eutechnics unit, forward it (postage paid) to:

Eutechnics @ Alpha Sensor Inc.
1560 Orangethorpe Way, Anaheim, Ca. 92801
(ph. 714-578-9205; fax 714-773-9327).

8.0 PROCEDURE

Perform the following procedures (approximately sequential) to plan, design and implement a continuous temperature monitoring project:

Quality Assurance Project Plan and/or Sampling & Analysis Plan Development:

1. Provide sufficient time for project documentation (e.g., to prepare the project QAPP/SAP, fill out continuous temperature monitoring fieldsheets, report data in a detailed, organized manner, etc.) and for proper implementation of SOP(s). Note: Use of continuous temperature sensors should follow adopted SOPs, but may not require a dedicated QAPP (although it should be discussed in a watershed-based monitoring QAPP, if applicable).
2. Target sampling period consistent with project objectives. For example, if interested in maximum mean monthly temperature(s), deploy sensors long enough to estimate the statistic, and during "worst-case" months (June through August-September) when daytime air temperatures are highest and flows lowest.
3. When evaluating thermal impacts from a discharge, deploy a sufficient number of properly-placed sensors to be able to draw conclusions. Ensure that upstream and downstream sensors are spaced as close as possible (outside mixing zones) to minimize effects of natural heat gain, which complicate the analysis.

SOP Review:

1. Review this SOP when planning a monitoring project and prior to deploying sensors.
2. Discuss any deviations from this SOP with DWM's QA Analyst, as appropriate.

Equipment Inventory:

1. Take inventory of available equipment to perform work well in advance. When not deployed, continuous temperature monitoring equipment is stored on the second floor at DWM's offices at 627 Main St., Worcester, Ma.
2. As of 2009, DWM has approx. 60 Onset temperature loggers (each with protective cases, cables and locks) and Boxcar Pro/Hoboware Pro software.

Documentation:

1. Use probe deployment fieldsheets for all fieldwork, including deployment, QC audits and sensor retrieval. Important "metadata" to document at each site include on exact sensor location, flow, water velocity, average water depth, channel width, habitat type, riparian cover, weather (cloud cover, air temperature, precipitation, etc.).
2. Report data in a detailed organized manner, preferably in a technical memorandum using validated data, and undergoing internal review.

Launching and Pre-Testing of Sensors/Software:

1. Follow manufacturer's steps to initiate data logging for each sensor using office PC and Hobo software. Set measurement interval (**30 minutes** typical), units (**degrees Celsius**) and **delayed start date/time on the ½ hour**.
2. Make sure that the PC clock is accurate, as this time is used by the sensors. Launch at the same time (preferred) so that data files have same time stamp for each logged datum (at least at the start).
3. Once "launched", perform pre-deploy QC testing by placing all sensors in a completely mixed room temperature bath. Allow the sensors to record temperature data for sufficient time to be able to evaluate unit accuracy and precision. Also record water temperatures using a calibrated NIST-traceable thermometer, and compare results to acceptance limits/data quality objectives (typically +/- 0.5 °C). After equilibration, sensor temperature data taken in the ice bath should

be about 0.0-0.2 °C (blow up the data graph to show results more clearly). Document the pre-test results accordingly.
4. Upload the QC files to PC for analysis. Notify staff NOT TO USE any loggers that do not meet acceptance criteria.
5. When ready, launch "approved" units for deployment.

<u>Sensor Placement and Retrieval</u>:
1. Place all **water temperature sensors** in locations shaded from direct sunlight during most/all daylight hours. This will prevent direct solar heat gain by the sensors.
2. Make sure encased sensors are properly secured and anchored in the water column (not in air or sediment). Ensure that sensors are adequately protected from the elements (debris, erosion) and potential vandalism. Camouflage sensor assembly sufficiently and as needed. Make sure deployment does not create a hazard (e.g., tripping).
3. Place in locations that are well mixed horizontally and vertically, and outside any mixing zones from thermal discharges.
4. For placements downstream of a discharge, keep the sensor as close to the discharge as possible without mixing zone effects (site-specific). This will minimize the issue of natural solar heat gain over river length.
5. For **air temperature sensor placement** (associated with a specific water sensor location), place in air in a shaded area, cable to a fixed object at approximate chest/head height and make sure deployment does not create a hazard (e.g., tripping).

<u>Field Quality Control Sampling</u>:
1. Perform adequate quality control audits (accuracy checks using high-quality, NIST-certified/traceable thermometer(s)) to increase confidence in the data.
2. Consider duplicate (side-by-side) sensors @ 10% of sites to better estimate instantaneous mean temperatures for each location (and to estimate sampling precision).
3. Beware that one or more sensors may fail before or during the monitoring period. Have additional, back-up sensors on hand to replace failed sensors. Weekly, bi-weekly or monthly data downloads using a "shuttle" device or laptop can be employed to verify sensors are in working order.
4. When available, duplicate loggers can be deployed side-by-side in the water (precision) or in air at the site to measure air temperature.
5. See also Section 9.0.

<u>Data Upload and Post-Deploy QC</u>:
1. After all units have been retrieved and cleaned, use Hobo software with base station to upload data from loggers to PC (READOUT). Set units to **degrees Celsius** for uploaded files.
2. Retain original raw uploaded files in Hobo software (unaltered) and also export files to EXCEL (.csv) as read-only.
3. All temperature data files are stored electronically at DWM offices in Worcester, MA. to C:/ (working PC); W:/sop/temp (network temporary); W:/dwm/sop/datlog (permanent read-only); and in secure database areas. **<u>Immediately after upload, contact DB Manager and QA Officer for import to protected network locations.</u>**
4. Use uploaded files for processing, validation and analysis.
5. Additional steps related to DWM database management of large temp files : TBD
6. Perform post-deploy QC (as done for pre-deploy QC---see above)

<u>Data Validation</u>:
1. Although data can be "shifted" to account for sensor drift over time (USGS, 2000), this is not recommended for short-duration projects. For projects lasting more than a month, shifts to the data record can be employed provided drift is within acceptable limits.

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

2. Data generated through the use of continuous temperature sensors must be validated prior to use. This can be performed by DWM's QA Analyst (preferred) and/or by project staff with concurrence from DWM's QA Analyst and Database Manager. Validation steps include:
    a. Raw data are reviewed for obvious errors.
    b. The beginning and ends of the data records for each deployment are trimmed (i.e. censored) as appropriate to discard inappropriate and problematic data (i.e. those data not logged as intended).
    c. Excel data files, spreadsheets and charts are reviewed for errors.
    d. Quality control data (as recorded, un-rounded) are used to provide qualification or censoring of data where necessary, using data qualifiers as contained in DWM's SOP for data validation (CN 56.2).
    e. All data are rounded for reporting purposes to the tenths digit, reflecting the lack of confidence in the hundredths place.

Data Management: in g*eneral; TBD*

1. Perform standard data management procedures for continuous temperature data
2. Given the large amount of data, organization and storage of data files are very important considerations to avoid misuse of data and/or use of erroneous ("censored") data.
3. Consider the use of automated spreadsheet/database "macros" to facilitate standardized data storage, manipulation and analysis, similar to that developed by the State of Idaho (Idaho DEQ, 1999).

Data Analysis and Reporting*: in general; project-specific*

1. When analyzing the data, use appropriate tools and data sets based on project objectives and the results of QC sampling. Statistical estimates, such as means, medians and maximums, may vary greatly depending on what data is used. Perform adequate data validation prior to analysis to ensure data is usable.
2. Include monitoring period rainfall, air temperature and streamflow data (if available) in the evaluation of ambient water temperatures. For nearby gages, perform reasonable extrapolation if appropriate.
3. Data can be analyzed both for the "total" deployment period (minus any censored and clipped data), as well as for a selected "low-flow" period. For each time period, standard statistics are calculated for each sensor data set using the same time interval ("apples-apples"). Where appropriate, data are related to temperature thresholds, such as those contained in State Water Quality Standards (SWQS) (e.g. 20° C and 28.3° C) and permit limits (e.g. 33.3° C). Inter-station data comparison can be performed both without respect to water time-of-travel (no time shift) and accounting for travel time from upstream to downstream using estimated average water velocities (time shift).
4. Perform standard analysis procedures for continuous temperature data, in order to streamline and focus the reporting of results. Although some projects may require specific data analyses, calculate the following baseline statistics for each location. When comparing upstream-downstream locations, use time-shifts as appropriate to account for time-of-travel between locations (measured or estimated):
    a. Monthly (and overall) mean temperature
    b. Daily mean temperature
    c. Maximum and minimum overall temperature
    d. Average daily duration > 20° C.
    e. Average daily duration > 28.3° C. (and other "thresholds" as applicable)
    f. T-test for statistically-significant differences in means (as applicable; e.g. mean daily temperatures upstream/downstream of a discharge).
    g. Instantaneous "delta T"s (temperature changes) from one location to another, as applicable.

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

9.0 QUALITY CONTROL

Typical data quality objectives (DQOs) for use of continuous temperature sensors are as follows:

Table 1: Typical DQOs for Continuous Temperature Sensors

Analyte	Units	Expected Range	Accuracy (+/-)	Resolution	Overall Precision (RPD)
Temperature	°C	0-35°	0.5° (vs. NIST-traceable thermometer)	0.15°	< 0.5 difference when compared to side-by-side field measurements
Time (sensor internal clock)	minutes, seconds	---	< 5 minutes over an approximate 2 month deployment	1 sec.	---

Based on manufacturer specifications, the Eutechnics QC lab thermometer is accurate within 0-50° C to +/- 0.015° C (plus probe tolerance). The resolution is listed as 0.01° C, with a one year probe drift of +/- 0.010° C.

See also Section 8.

10.0 INTERFERENCES

See Section 8.0 for discussion of potential complications and problems related to sensor setup, location and poor quality control.

11.0 PREVENTIVE MAINTENANCE

Upon retrieval and transport back to the office, thoroughly wash and clean sensor units, cases, cables and anchors with soap and warm water. Store in labeled box/bin accordingly for the next user.

12.0 CORRECTIVE ACTIONS

Take the following corrective actions (as needed) during and following data collection:

1. Inspect sensor placement immediately following deployment and during data collection for problems related to sensor placement. If encased sensor is not in the water column, retrieve and replace correctly. Document on fieldsheet that sensor was re-positioned (even if for a moment).
2. Take necessary measures during data validation to edit the data record, based on the need to qualify, shift (see Section 8, data validation, for discussion of "shifts") and/or censor data. Document all data decisions in a report.

13.0 WASTE AND POLLUTION PREVENTION

Consider the following in order to minimize waste during continuous temperature sensing projects:

1. Reuse sensor PVC/ABS cases as much as possible by cleaning and storing after use.

2. When planning QC field checks/audits of the sensors, combine the effort with water quality and/or other field surveys to save staff resources, gas, etc.

3. When analyzing data, focus on meeting objectives as outlined in the QAPP. Perform appropriate statistical and graphical analyses, in order to avoid inefficient use of staff time.

14.0 REFERENCES

USGS. 2000. Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation and Reporting, WRIR 00-4252

Idaho Division of Environmental Quality. 1999. Protocol for Placement and Retrieval of Temperature Data Loggers in Idaho Streams. Report#10

Oregon Dept. of Environmental Quality. 2002. Consolidated Assessment and Listing Methodology for Oregon's Draft 2002 303(d) List and 305(b) Report, Draft

MADEP. 2003 *Continuous Temperature Data at Four Locations in the Hoosic River Watershed (September-October, 2002).* CN 132.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

USGS. 1998. National Field Manual for the Collection of Water Quality Data, TWRI-Book 9

15.0 DEFINITIONS/ACRONYMS

NA

16.0 APPENDICES

16.1 Appendix A: Temperature Logging Equipment and Accuracy Check Form
16.2 Appendix B: Example Statistical Analysis
16.3 Appendix C: Example Graphical Analysis

Appendix A: Typical Temperature Logging Equipment (circa 2003)

Stowaway sensor, plastic tube and cable (anchor screw optional; unit assemblies typically cabled to fixed object, e.g., large tree)

Available Temp Loggers

	SN #	Manufacturer	Description	Status (5/2010)
1	515486	Onset	Stowaway	OK
2	552434	Onset	Stowaway	OK
3	515472	Onset	Stowaway	OK
4	706751	Onset	Stowaway	OK
5	735455	Onset	Stowaway	OK
6	730537	Onset	Stowaway	OK
7	9140	Onset	Stowaway	missing
8	729121	Onset	Stowaway	OK
9	515474	Onset	Stowaway	OK
10	738001	Onset	Stowaway	OK
11	552435	Onset	Stowaway	OK
12	552426	Onset	Stowaway	OK
13	552431	Onset	Stowaway	OK

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

	SN #	Manufacturer	Description	Status (5/2010)
14	515471	Onset	Stowaway	OK
15	729118	Onset	Stowaway	OK
16	737992	Onset	Stowaway	OK
17	1134422	Onset	Pro v2	OK
18	1134432	Onset	Pro v2	OK
19	1134433	Onset	Pro v2	OK
20	1134434	Onset	Pro v2	OK
21	1134435	Onset	Pro v2	OK
22	1134436	Onset	Pro v2	OK
23	1134437	Onset	Pro v2	OK
24	1134438	Onset	Pro v2	OK
25	1134439	Onset	Pro v2	OK
26	1134440	Onset	Pro v2	OK
27	1134441	Onset	Pro v2	OK
28	1134442	Onset	Pro v2	OK
29	1134443	Onset	Pro v2	Lost in 2007
30	1134444	Onset	Pro v2	OK
31	1134445	Onset	Pro v2	OK
32	1134446	Onset	Pro v2	OK
33	1134447	Onset	Pro v2	OK
34	1134448	Onset	Pro v2	Lost in 2009
35	1134449	Onset	Pro v2	OK
36	1134450	Onset	Pro v2	OK
37	1134451	Onset	Pro v2	OK
38	1134452	Onset	Pro v2	OK
39	1134453	Onset	Pro v2	OK
40	1134454	Onset	Pro v2	OK
41	1134455	Onset	Pro v2	OK
42	1134456	Onset	Pro v2	OK
43	1134457	Onset	Pro v2	OK
44	1134458	Onset	Pro v2	OK
45	1134459	Onset	Pro v2	OK
46	1134460	Onset	Pro v2	OK
47	1292378	Onset	Pro v2	OK
48	1292379	Onset	Pro v2	OK
49	1292380	Onset	Pro v2	OK
50	1292381	Onset	Pro v2	OK
51	1292382	Onset	Pro v2	OK
52	1292383	Onset	Pro v2	OK
53	1292384	Onset	Pro v2	OK
54	1292385	Onset	Pro v2	OK
55	1292386	Onset	Pro v2	OK
56	1292387	Onset	Pro v2	OK
57	2381495	Onset	Pro v2	OK
58	2381496	Onset	Pro v2	OK

	SN #	Manufacturer	Description	Status (5/2010)
59	2381497	Onset	Pro v2	OK
60	2381498	Onset	Pro v2	OK
61	2381499	Onset	Pro v2	OK
62	2381500	Onset	Pro v2	OK
63	2381501	Onset	Pro v2	OK
64	2381502	Onset	Pro v2	OK
65	2381503	Onset	Pro v2	OK
66	2381504	Onset	Pro v2	OK
67	9734121	Onset	Pro v2	OK
68	9734122	Onset	Pro v2	OK
69	9734123	Onset	Pro v2	OK
70	9734124	Onset	Pro v2	OK
71	9734125	Onset	Pro v2	OK
72	9734126	Onset	Pro v2	OK
73	9734127	Onset	Pro v2	OK
74	9734128	Onset	Pro v2	OK
75	9734129	Onset	Pro v2	OK
76	9734130	Onset	Pro v2	OK

Appendix B: Logger Specs

Optic Hobo Pro v2 and Stowaway® Specifications: (as provided by Onset Computer Corp.)

PARAMETER	HOBO PRO v2 (U-22)	STOWAWAY
Range	-20 to 70 C in air (max. 50 C in water)	
Accuracy	0.2 C (from 0-50 C)	0.2 C (from 10-30 C)
Resolution	0.02 C at 25 C	0.02 C
Response time (90%)	5 minutes in water (12 minutes in air @2m/sec)	
Stability (drift)	0.1 C per year	
Real-time clock	+/- 1 minute per month @ 0-50 C	up to 1 hour per year
Battery	factory-replaceable (3.6 V lithium) only	
Battery life (typical)	6 years	
Sleep mode	yes; low power mode after 30 minutes of no communication	
LED indications	LED blinks every 1-4 seconds AND when logging a sample LED blinks every 8 seconds when awaiting start (delayed start mode)	
Logging modes	samples and events	
Memory	64K bytes ; non-volatile (approx. 42,000 measurements)	
Case	polypropylene, EPDM o-rings, SS retaining ring	
Cleaning	warm water; mild detergent if necessary	
Buoyancy	slightly +	
Water resistance	waterproof to 120 m	> 100 feet
Exposure risks	chlorinated water; other non-aqueous liquids; harsh chemicals, abrasives, solvents	
Logging interval	1 second to 18 hours; user-defined	
Launch modes	immediate start and delayed start	
Battery indication	low battery indication in datafile; if repeatedly < 3.3 V, return for battery replacement	
NIST certificate	available at extra cost	
EU compliance	yes	

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Appendix C: QC Check Forms

Continuous Temperature Logger

Accuracy Check Form

Date: ________________________

QC Check Staff: ____

Logger Serial #: ____

NIST-Traceable Thermometer Used: ____

Reference SOP: SOP for Continuous Temperature Monitoring (CN 103.1)

Time	Bath Temp, °C (using NIST thermometer)	Bath Temp, °C (using logger)	Difference (°C)	Comments

Appendix D: DWM QuickGuide for Logger Launch and Readout Procedures

(general for both Stowaway and Pro V2 units; assumes pre-QC checks prior to launch)

To LAUNCH logger…

1) Connect logger to PC (room 226 or cube 232 @DWM-Worcester) using base station and serial (Stowaway)/USB (ProV2) ports. For ProV2, align arrows for proper fit.

2) Open Boxcar (Stowaway) or Hoboware (ProV2) program

3) "Launch" using predetermined setup parameters, as follows:

   a) file= serial # (default) or OWMID# (logger location must be tracked via fieldsheet info)

   b) delayed start= deployment day (am) to verify operation of unit before deployment AND to synchronize same times for each temp data file. <u>Do not launch using "now" option</u>.

   c) interval= 30 minutes (standard) or other (e.g., 15 minutes)

   d) units= deg. C

   e) for ProV2 units, check for "good" battery indication (NA for Stowaway units)

4) Prior to field placement the day of deployment, verify operation by green blinking light (Stowaway) and red blinking light (ProV2). If problems, re-launch/replace as necessary.

5) Proceed to field deployment using black tubes, cable, lock, block, bungee cords, field QC thermometer, "deployment" fieldsheets, etc.

To READOUT data file…

1) After retrieving units from the field and returning to the lab, clean tube assemblies, cables, etc. thoroughly. Remove logger and rinse well with warm tap water. Use mild soap if necessary. Avoid shock and scratches to units.

2) When loggers are dry, connect to PC using base station and open program as appropriate.

3) "Readout" to stop logging and upload file to read-only (protected) folders as follows:

   a) Raw (native) file format= .dtf (Stowaway) and .hobo (ProV2)

   b) Units= deg. C

   c) Locations: C(working PC); W:/sop/temp (network temporary); W:/dwm/sop/datlog (permanent read-only). And i<u>mmediately after upload, contact DB Manager and QA Officer for import to protected network drive (w/dwm__________________)</u>

4) "Export" points as single file (not details) to upload file to EXCEL as follows:

   a) .csv Excel file format

   b) Units= deg. C

   c) Locations= same as above

5) To protect data on logger (in case needed) and preserve internal battery, do not re-launch until necessary for next deployment.

6) Verify that all files have been downloaded, are in correct format and are read-only (protected)

Appendix E: Example Statistical Analysis

Standard and Paired T-Tests Using Daily Mean Temperatures at Hoosic 1 and Hoosic 4 (MADEP, 2003):

t-Test: Paired Two Sample for Means	**(EXCEL)**				Hoosic River (upstream)	Hoosic River (downstream)	
				Date	#1	#4	diff
	Variable 1	*Variable 2*		9/6/2002	16.8	17.7	0.9
Mean	16.72581	17.92258		9/7/2002	17.2	18.3	1.1
Variance	2.841978	3.423806		9/8/2002	17.9	19.4	1.5
Observations	31	31		9/9/2002	18.9	20.4	1.5
Pearson Correlation	0.985053			9/10/2002	19.8	21.3	1.5
Hypothesized Mean Difference	0			9/11/2002	17.9	19.5	1.6
df	30			9/12/2002	15.4	16.6	1.2
t Stat	-19.20965			9/13/2002	15.9	17.2	1.3
P(T<=t) one-tail	1.04E-18			9/14/2002	17.4	18.9	1.5
t Critical one-tail	1.69726			9/15/2002	18.2	20.5	2.3
P(T<=t) two-tail	2.08E-18			9/16/2002	18.1	19	0.9
t Critical two-tail	2.04227			9/17/2002	17.7	18.7	1
				9/18/2002	17.3	18.1	0.8
				9/19/2002	17.5	18.5	1
				9/20/2002	18.2	19.4	1.2
				9/21/2002	19.1	20.5	1.4
				9/22/2002	19.2	20.8	1.6
				9/23/2002	18.1	19.2	1.1
				9/24/2002	16.2	17.4	1.2
				9/25/2002	15.3	16.3	1
				9/26/2002	14.7	16.4	1.7
				9/27/2002	14.1	15.4	1.3
				9/28/2002	15	15.6	0.6
				9/29/2002	13.8	14.7	0.9
				9/30/2002	14.2	15	0.8
				10/1/2002	15.8	16.7	0.9
				10/2/2002	17.1	18	0.9
				10/3/2002	16.8	18	1.2
				10/4/2002	14.4	15.7	1.3
				10/5/2002	16.1	17	0.9
				10/6/2002	14.4	15.4	1
			MANUAL	mean	16.72580645	17.92258	1.196774
				sd	1.685816863	1.850353	0.346875
				n	31		
				F	1.204726376		
				Fcrit (est.)	1.5		
					F<Fcrit, so variances not signif different---run t-test		
				Standard t-test			
				pooled var	3.132892473		
				Sm	1.053412274		
				t*	1.136092889		
				df	60		
				tcrit, 1side	1.68	est	
				tcrit, 2side	2	est	
					t*<tcrit, so no signif diff between monitoring stations		
				alpha	0.05		
				t* using diff (paired)	19.20965184		
				df	30		
				alpha	0.05		
				tcrit, 1side	1.68	est	
				tcrit, 2side	2	est	
					t*>>tcrit, so there is a signif diff between monitoring stations		

Appendix C: Example Graphical Analysis (MADEP, 2003)

Figure 11: Continuous Temperature Monitoring at Four Locations Associated with the Specialty Minerals Inc. Discharge Canal, Hoosic River Watershed, MA.

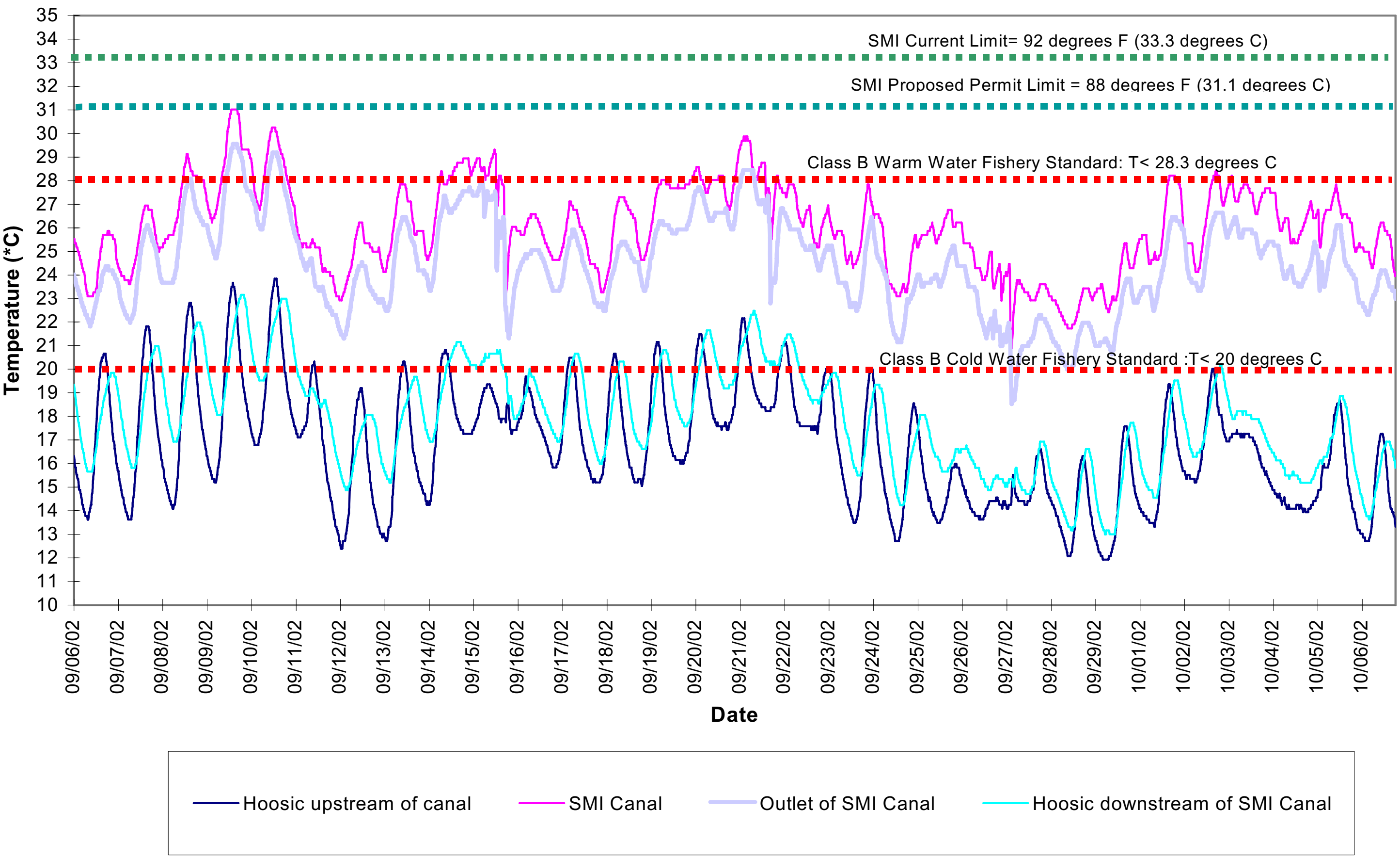
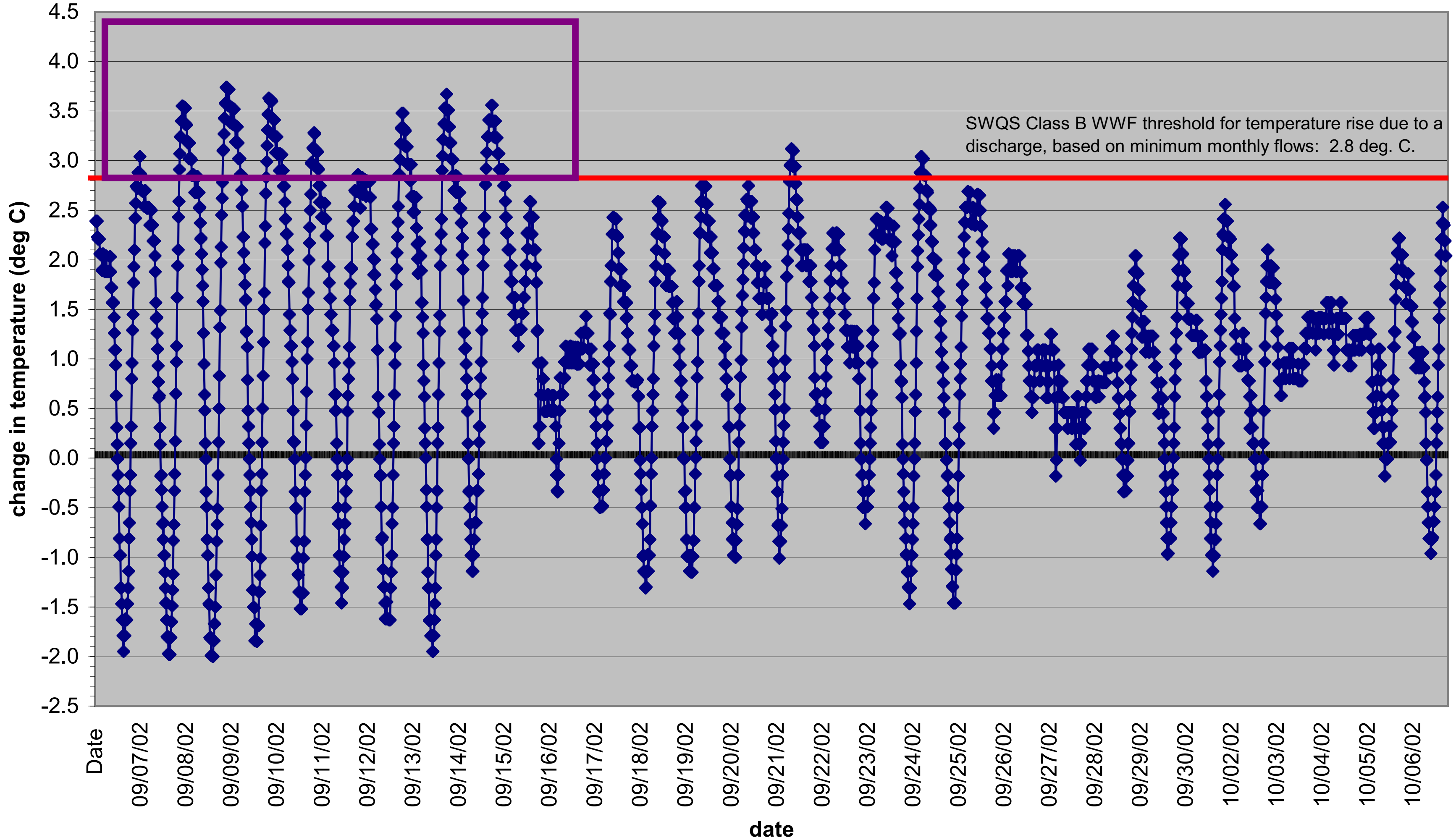


Figure 16: Instantaneous "delta T"s between upstream and downstream assuming a time of travel of 1 hour



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Massachusetts Department of Environmental Protection
Division of Watershed Management

STANDARD OPERATING PROCEDURE

Lake Sampling

CN 151.0
January, 2010

Prepared by:	Richard Chase, QA Analyst and Mark Mattson, Environmental Analyst	Date:	1/21/10
Approved by:	Arthur Johnson, Monitoring Coordinator	Date:	1/29/10
Approved by:	Dennis Dunn, Program Supervisor	Date:	2/1/10

List of Revisions

Revision Date	Revision	Pages #s
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Table of Contents

1.0 SCOPE AND APPLICATION 4

2.0 SUMMARY 4

3.0 HEALTH & SAFETY CONSIDERATIONS 4

4.0 LAKE SURVEY TRAINING 5

5.0 LAKE SURVEY EQUIPMENT 5

6.0 SURVEY PREPARATION 8

7.0 LAKE SAMPLING PROCEDURES 8

8.0 POST-SURVEY PROCEDURES 12

9.0 MACROPHYTE SURVEYS 12

10.0 BATHYMETRIC SURVEYS 12

11.0 MULTI-PROBE DEPLOYMENT (LAKES) 13

12.0 QUALITY ASSURANCE & CONTROL 13

13.0 REFERENCES 14

14.0 APPENDICES 15

NOTE: References to trade names, commercial products and manufacturers in this SOP does not constitute endorsement.

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) document is to describe Massachusetts Department Environmental Protection (MassDEP) Division of Watershed Management's (DWM) standard monitoring procedures for lakes (including ponds and impoundments). Adherence to these procedures is "required" for DWM lake monitoring, unless otherwise specified in an approved, project-specific Sampling & Analysis Plan (SAP).

This SOP covers lake survey preparation, health and safety issues, sample collection, field documentation, *in-situ* measurements, quality control, equipment decontamination and sample delivery to laboratories. Where necessary, reference has been made to other existing DWM SOPs that provide a greater level of detail (e.g., operation of multi-probe instruments). For general sampling information, refer to DWM's main sample collection SOP (CN 1.21). For overall monitoring objectives and quality assurance and control for the DWM monitoring program, refer to DWM's current Quality Assurance Program Plan (QAPP), CN 365.0.

This SOP does not address lake sampling design considerations nor is it intended to cover sampling of reservoirs for compliance with drinking water quality requirements. Project-specific, special-purpose and tributary monitoring are not covered in this SOP (these topics can be found in project-specific SAPs).

2.0 SUMMARY

Proper field collection of representative lake samples helps to generate useable data of known and documented quality for use in decision-making. MassDEP-DWM typically samples selected lakes, ponds and reservoirs throughout the State to assess waterbody health and to develop and implement Total Maximum Daily Loads (TMDLs). Common parameters include nutrients (phosphorus, nitrogen), chlorophyll a, Secchi disk transparency, vertical dissolved oxygen (DO)/temperature profiles, water color, aquatic plant cover, algal composition and cell counts for cyanobacteria blooms.

3.0 HEALTH & SAFETY CONSIDERATIONS

DWM lake survey staff shall practice the "safety first" principle at all times during sampling trips. Specific safety guidelines, include the following. For additional field safety guidance, see DWM SOP CN 0.2.

- Always **sample in teams of two or more**, unless otherwise approved by the monitoring coordinator or the sampler's direct supervisor.
- Use good judgment in **clothing and personal protection items**. Dress based on anticipated conditions, but be prepared for "worst case". Items to consider include protective clothing, sunshade, sunscreen, hats, insect repellent and adequate footwear (e.g., no flip-flops).
- Equipment used to sample must be checked for defects prior to use to prevent accidents. Do not assume sampling gear is **free from defects** or normal wear and tear.
- **A standard DWM field kit and first aid kit** must be taken on all sampling trips. It is the responsibility of the sampling crew to inspect and re-stock the kits as needed before leaving DWM offices.
- **Boating emergency gear,** such as "Res-Q" whistles, glow lanterns, Type IV throwable device flotation (even if <16 foot-long vessel), etc. should be on-board.
- **Personal flotation devices (PFDs)** are required for each occupant in the boat, must be US Coast Guard approved, and must be readily available (not stowed). It is highly recommended that these be worn at all times.
- **Massachusetts boating laws** shall be adhered to at all times. Participation in a boating safety course is recommended. http://www.boat-ed.com/ma/ma_specific_images/pdfs/MA_handbook_entire.pdf
- **Pay close attention to weather forecasts** leading up to and during the lake survey. Discontinue sampling and seek cover if heavy rain, wind or lightning is forecast or appears to be approaching (if any of these conditions become imminent, you have waited too long!). Use best professional judgment in deciding if/when to resume sampling.

- **Sulfuric acid preservative (~9N H_2SO_4)** is a strong acid. If splashed on skin or eyes, rinse with lots of water and seek immediate medical attention. Never wear contact lenses when working with acids, bases or solvents. Make sure the preservatives are tightly capped and replaced in the acid kit container after use. (Mouth pipetting is an unacceptable procedure and should never be performed in the field or at the laboratory.) Review Material Safety Data Sheets (MSDS) as needed (at DWM offices).
- **Avoid contact with potentially harmful algae blooms (HABs), potentially hazardous sediments and suspected bacteria-laden waters**. Elbow-length rubber gloves and disposable gloves are available as needed.
- **Do not combine eating/drinking with sampling activities.** Always wash hands thoroughly before and after handling samples. Do not use sample coolers to store food or drinks.
- It is recommended that at least one person on any given lakes sampling crew be trained by the American Red Cross (or similar) in Adult **CPR/first aid.**
- **Work at a reasonable pace** to ensure personal safety (and data quality). Rapid, frantic or rushed sampling will usually lead to poor results and increase the potential for accidents.
- **Inspect** boat trailers, boat motors, batteries, gas tanks/cans, tow truck lighting, etc. for working condition and defects prior to leaving DWM offices. Beware of engine problems due to old gas and lack of maintenance. Also, take precautions against lead-acid battery leaks and explosions (this can happen if hydrogen/oxygens gases accumulate and are ignited by a spark) by storing and charging in well-ventilated areas; avoiding spark and arc potential, overcharging and over-filling; and following maintenance instructions for the battery. See also Section 7-12 regarding boating equipment inspection for invasive organisms.
- During transport, ensure that **cargo is fastened and secured**.
- **Use outdoor safety building to store gasoline cans and tanks**. DO NOT ENTER THE OFFICE BUILDING OR BASEMENT PARKING LOT WITH ANY FLAMMABLE MATERIALS.
- Use common sense and always err on the side of safety. **SAFETY FIRST!**

4.0 LAKE SURVEY TRAINING

All staff engaged in the planning and implementation of DWM lake surveys shall have a working knowledge of DWM's lake sampling procedures and/or be trained in these procedures by experienced DWM staff. New staff and temporary staff shall receive office training and hand-on field training. Existing staff participating in lake surveys shall receive annual review training.

DWM lake sampling training videos are located here (internal link):
w\dwm\sop\Manuals & Training\FIELD\training videos\Field Sampling SOPs\lake sampling2

5.0 LAKE SAMPLING EQUIPMENT

The following MassDEP equipment (and potential personal items) is available for use on DWM lake surveys (as of 1/2010).

MassDEP-DWM sampling gear and materials
State vehicle (truck w/ hitch)
Vehicle book w/ directions to lake(s), emergency hospitals, car washes (and registrations)
Boat trailer (w/ trailer lights) (size of ball hitch must match trailer hitch), adequate safety chains must be used)
Boat, oars, oarlocks, bilge and boat plugs (boat must be tied in truck or trailer with 2 sets of ropes/straps)
Outboard motor (Nissan 5HP, Tohatsu 5HP, electric, etc)
Charged battery (and spare if available)
Gas tank, gas can, oil (determine if oil mix for engine and gas line coupling is appropriate)
Engine tool kit with spare parts, shear pins?, knife, pliers etc.
2 anchors, rope (sufficient length)
PFDs (one for each crew member and throwable)
Deionized water (DI) rinse jug one gallon for rinsing Van Dorn

MassDEP-DWM sampling gear and materials	
Secchi disk with line calibrated to 0.1 m intervals	
(2) Weighted hoses (Tygon tube 1 cm ID) for integrated Chlorophyll *a* (chl *a*) samples, and/or rigid white PVC integrated depth sampler (3'/6')	
Funnel for tube chl *a* blank	
Multi-probe kit (precalibrated with appropriate length cable), extra battery, DO membranes, calibration solutions, etc.	
View scope	
Van Dorn bottle(s), line and messenger	
Depth sounder	
Cooler and ice	
H2SO4 (9.4N) preservative and disposable pipettes	
Lugol's preservative (if needed)	
Sample bottles (and extra bag of bottles) & labels	
1 liter DI bottle for TP, color and chl *a* field blanks	
DWM Global Positioning System (GPS) unit	
7.5 minute USGS map of area	
Geographic Information System (GIS) ArcMap printed bathymetric maps of lake	
Field data sheets, Chain of Custody (COC) forms, fieldsheet labels (extra), list of OWMID #s	
Waterproof field pens and Sharpies	
SOP Quickguides	
Probe clamp for boat	
Extra clamp	
DWM Field kit (includes insect repellent, sunscreen, hand sanitizer, poison ivy wash, etc.)	
DWM first aid kit	
DWM cell phone (w/ contacts)	
Gloves (heavy duty and disposable types)	
Clipboard	
Duct tape	
Basic tool kit	
Emergency whistle (or horn if required)	
DWM digital camera	
Compass	
Fire extinguisher (if required)	
Aquatic plant identification guide	
Field filtration apparatus (syringes, filters), if needed	
Aquatic plant rake (if needed)	
Plankton tow (if needed; note mesh size used on fieldsheet)	
Decontamination equipment (e.g. sprayer) and cleaning solutions (as needed)	
Sediment dredge (e.g., Ekman, Ponar) (as needed)	
Personal Gear	
Proper footwear and protective clothing	Insect repellant, sun screen
Rain gear (if needed)	Food and water
Extra clothing (dry)	Cell phone (personal)
Sunglasses	Field notebook (optional)
Business cards	Swiss army knife
Miscellaneous items (bathing suit, fishing pole, beach towel)	Money (Quarters for pressure washing boat, trailer, etc after use)

** For items that are available both through MassDEP-DWM and as personal gear, equipment choice is left to individual discretion, as long as the personal equipment item is equal or better functionally*

At-depth sample collection for DWM lake sampling is typically done using **Van Dorn or other "thief"-type samplers**, as shown below. When needed for dissolved constituents, field-filtering is done using **high-volume syringe and filter kits**. Other direct sampling and measurement equipment includes Secchi disk (and viewscope), electronic depthfinder, multi-probe sonde instrument, GPS and plankton tow.

Van Dorn Bottle

Secchi Disk

Depth-Integrated Chlorophyll a Samplers

Field Filtration Kits

Sample requirements (bottle types, test methods, hold times, preservatives) for lake sampling surveys are as follows (**more common analytes in bold**).

Group Designation	N	R	A	B	C	Z
Bottle Group	Nutrient	Color (true)	Algae	Bacteria	Chemistry	Zooplankton
	Ammonia-N (SM4500 -NH_3-H; EPA350.1)		**Chlorophyll-*a*** (EPA 445-modified; SM10200H)	*E. Coli* (modified M-TEC EPA 1603; SM 9223B)	Alkalinity (SM2320B; EPA310.1)	
	Nitrate/Nitrite-N (SM4500-NO_3-H; EPA353.1)		Phytoplankton Identification	Enterococci (EPA 1600; Enterolert)	Chloride (SM4500CL^{-E}E)	
ANALYTE	**Total Nitrogen** (USGS-I-4650-03)	**Color** SM2120B (EPA110.2)	Phytoplankton Counts (SM10200F)		Hardness (SM2340B/C)	Zooplankton (SM 10200)
	Total Phosphorus (USGS-I-4650-03; SM4500P-E)				Turbidity (SM2130B; EPA180.1)	
	Dissolved-P (USGS-I-4650-03; SM4500P-E)				Specific Conductance (SM2510B; EPA120.1)	
Bottle Type	500-1000 ml NM/WM HDPE foam- lined caps; pre-cleaned	250mls NM/WM HDPE Teflon™ lined caps pre-cleaned	250-1000 ml WM HDPE foam lined caps pre-cleaned	120 ml secure capped HDPE sterile; 1000ml if for HM sampling	500-1000 ml NM/WM HDPE foam- lined caps; pre-cleaned	125-250 ml WM HDPE foam lined caps pre-cleaned
Preservative	H2SO4 to pH<2 & 4 °C (except diss. P no acid). Field filter is preferred for diss.P	4 °C	4 °C & dark Lugol's/M3 for phyto ID samples	(Na-thiosulfate) 4 °C	4 °C	CO2 (narcotizer) 70% ethanol
Holding Time	28 days 48 hr. (diss.P)	48 hrs	24 hrs (filter chl *a*) 21 days if chl *a* frozen	6 hrs	14 days ALK 28days Chloride/ Spec. Cond. 48hrs Turbid	---

6.0 LAKE SURVEY PREPARATION (AT THE OFFICE)

Lakes planned for sampling are listed and described in project-specific Sampling & Analysis Plans (SAPs). The SAPs are produced in addition to DWM's 5-year programmatic QAPP and provide specific sampling objectives, locations, frequencies, parameters and logistics for the lake monitoring.

In general, lake survey preparation involves the following tasks:

1) **Review SAP and weather forecasts**, especially regarding boat launch location(s), directions to the lake and expected conditions. Print out locus and bathymetric maps for each lake. (example weather web site: http://www.erh.noaa.gov/box/dailystns.shtml)
2) **Work with DWM's Monitoring Coordinator to schedule specific lake sampling days**
3) **Reserve vehicle(s).** Make sure a current copy of the boat and trailer registration is in the vehicle book.
4) **Submit electronic multiprobe request** to Multi-probe Coordinator (1 week in advance of day(s) needed; include required cable length, desired make (e.g., YSI, Hydrolab), dates/times needed, planned OWMID#s to be used for the multiprobe readings, etc.)
5) **Pre-login samples** to be delivered to the Wall Experiment Station (WES) State laboratory per SOP CN 1.9 using designated PC (with Sample Master Pro software), including COC and sample bottle label printouts. Determine sample allotment (including QC samples) prior to pre-logging samples. For non-WES samples, coordinate with other labs as needed.
6) **Label sample bottles** with Laboratory Information System (LIMS)-generated labels on side and cap of bottles. If no cap label available, copy OWMID codes onto lid of bottle with a Sharpie pen. Make sure to take extra, new sample bottles of different sizes for use if needed (if not used, keep clean and return bottles to supply room)
7) **Fill out fieldsheets with survey information and affix OWMID# fieldsheet labels** (get project fieldsheet labels from DWM Database Manager). For lake surveys, one ID label is physically affixed on the fieldsheet (one fieldsheet per lake station) in the top corner of pg.2 and controls up to 10 samples IDs, where the last digit is filled in by the survey lead (e.g., LC - 435_) for each separate sample (with "0" always being the multi-probe ID). Any sample taken at a different depth should have a separate row and separate OWMID. Duplicates and blanks should each have separate OWMIDs. For duplicate samples use the line immediately under the original sample and check the "duplicate" box on both rows and skip a row for the next sample. (Note that any inlet samples are considered "streams" and the stream field sheet should be used, not the lake field sheet). For all pre-filled-in information on the fieldsheets, make sure to correct any entries that have changed (and date/initial the changes).
8) **Inspect and prepare all sampling gear.** Inspect sampling equipment for proper operation. Make sure all calibrated lines (Secchi, depth-integrated samplers, plankton tow, etc.) are accurately marked. If necessary, DI rinse Van Dorns, plankton tows, depth-integrated samplers and label as "clean" for specific survey date. Use only unused acid preservation kits.
9) **Load cart with survey trip gear,** including sign-out items such as cell phone, GPS and DWM digital camera.
10) **Inspect and prepare boat, motor, battery, trailer, truck hitch, anchors and emergency supplies.** Choose a boat appropriate for the size of the lake, condition of boat access (ramp or carry in), motor restrictions and number of people and weight of equipment. Do not overload or overpower boats beyond rated capacity. A lightweight canoe/boat with electric motor is also available for carry-in sites and restricted motor size lakes. Make sure boat plug(s) stowed securely so they are not lost in transport. Prior to departure, discuss status and maintenance issues for boats, motors, etc. with DWM's Maintenance Coordinator for boat and motor use.
11) Perform pre-survey maintenance or repairs as needed. If not used recently, hook up the motor and perform start/run test in the office parking lot (do not run motor out of water for longer than 1 minute).
12) **Calibrate and perform pre-survey checks on multi probe sondes** (within 24 hours of field use; performed by lab calibration staff only per SOP CN 4.21; no field calibrations are done without prior approval)
13) **Use the Pre-departure Checklist (Appendix A)**

7.0 SAMPLING PROCEDURES (AT THE LAKE)

Typical survey sampling can be conducted at anytime during daylight hours when conditions are appropriate, provided Secchi disk readings are taken between 10:00AM and 16:00PM. Flexibility in both the day and time is allowable, especially in consideration of weather conditions. Common sense and good judgment will dictate when it is appropriate to sample. Under no circumstances should you be on the water during electrical storms, high winds or other unsafe conditions. If such conditions exist, the trip should be postponed until the unsafe conditions subside.

The general procedures upon arrival and while at the lake are as follows:

1) **Prepare boat for launch** (via boat ramp or manually along shoreline for smaller boats). Load boat and inspect all gear for the presence of invasive species. Ensure that samples are chilled immediately after collection by taking a sample cooler on-board (use small ice cooler with ice if no room for large cooler).

2) **Launch boat.** At ramps, release tie downs, insert drain plug, tilt motor up, pack/secure equipment on board, carefully back boat down into water, unlock winch, push boat off and pull to shore with rope. Tips on operating outboard: Determine how to shut off engine and gas supply and general operating controls. Determine if it is 2 or 4 stroke. 2 cycle engines do not have an oil reservoir in the engine and use mixed gas typically at 50:1 ratio. 4 strokes have an oil reservoir which you should check to see if it has adequate oil. Connect gas line if needed, squeeze primer bulb until firm, adjust gear lever to neutral, adjust throttle to mid-range, and if engine is cold (has not been started that day) pull out choke. Pull starter rope (hard and long pull) until it fires or even sputters once, then push in choke halfway. If it runs adjust throttle and in next minute push choke in all the way. If it does not run try pulling with 1/2 choke (squirt starter fluid in carburetor if needed) and pull starter repeated until it fires and runs. Immediately check for cooling water to squirt out back, if you do not see it immediately stop engine and fix problem. After 1 minute of running push choke in all the way adjust speed to slow and proceed to engage shift lever to forward. Restarting engine later in same day should not require the choke or else the motor may flood. If the motor does not run and smells of gas, it is probably flooded. Remove sparkplug and pull starter 20x and leave it to air out 10 minutes, reassemble, do not use choke, increase throttle to ¾ and try starting.

3) **Record whole-lake information.** Take a few moments to navigate around the lake and record “whole-lake” information, such as aquatic plant cover, shoreline erosion, presence of scums, objectionable deposits, potential pollution sources, recreational uses observed and wildlife sightings, on the fieldsheet. A lake-specific rough base map can be used to geographically locate observances as you navigate (then recorded to the fieldsheet later).

4) **Motor to first station/drop anchor.** Confirm maximum depths with depth finder and by lowering Secchi disk part way down to check depth finder accuracy. Use GPS waypoint navigation and shoreline features to find station (usually “deep hole”). At station, drop two anchors (bow and stern), unless very calm and shallow. Once at station, re-confirm maximum depth using depth sounder or metered line.

5) **Begin sampling.** In general, do not collect samples just after anchoring, especially in shallow lakes (as needed, wait for any disturbance from anchoring to dissipate). One person will perform the DO/temperature profile using the multi-probe, while the other takes water quality samples and fills out the fieldsheet. Take digital photos as needed.

6) **Take multi-probe depth profile.** Attach probe guard, turn unit on, annotate OWMID# (if necessary), place unit into the water (0.5m depth) at the surface and begin to perform DO, temperature, specific conductance and pH measurements with depth, as described in DWM SOP CN 4.21 and using depth criteria below. Ensure that readings are stable before starting to record. <u>As a general rule, if temperature changes by 1C/m or more, then the lake is stratified.</u> To determine trout space it is most important to identify the depth where temperature drops below 20C as well as the depth where DO drops below 6 mg/l, so you may need to take some close interval sampling in the metalimnion. If you accidentally hit the bottom with the multi-probe (or Secchi disk), simply retrieve the multi-probe and move the boat about 15 feet by adjusting the anchor lines. Then recheck the depth reading and continue with the measurements. When finished with storing data at a depth, log review data, hit manual, end of file and then copy (or read off to partner) last set of data from the screen onto the field sheet. Repeat for each depth. If needed, repeat procedure using a separate OWMID#.

MAXIMUM DEPTH > 8 METERS (26 FEET): REVISED

Conditions	Data Logging Procedure
Check for stratification	Perform preliminary scan of water column to see if stratified and to what extent. Record approx. depths to metalimnion and hypolimnion. If stratified, proceed as follows for each layer. If not stratified, proceed as below.
Stratified	In epilimnion, record **every 30 seconds for 3 minutes at 3 depths**---0.5 meter, mid-epilimnion and lower-epilimnion
Stratified	In metalimnion, record **every 30 seconds for 3 minutes at 3 depths** (equally spaced depths). Note any points of metalimnetic D.O. maxima.
Stratified	In hypolimnion, record **every 30 seconds for 3 minutes at 3 depths** --- equally spaced depths, but staying at least 0.5 meters off the bottom
Not Stratified (spring to fall; (temps>5 deg. C)	Record **every 30 seconds for 5 minutes at each of 4 depths**---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom
Not Stratified (fall-spring) (temps<5 deg. C)	Record **every 30 seconds for 7 minutes at each of 4 depths**---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom.

MAXIMUM DEPTH < 8 METERS (26 FEET) REVISED

Conditions	Data Logging Procedure
Stratified	Record **every 30 seconds for 3 minutes** at 0.5 meters and then every meter down until 0.5 meters from the bottom.
Not Stratified (temps>5 deg. C)	Record **every 30 seconds for 5 minutes at each of 3 depths (at a minimum) ----** 0.5 meters, mid-depth and 0.5 meters from the bottom.
Not Stratified (temps<5 deg. C)	Record **every 30 seconds for 7 minutes at each of 3 depths (at a minimum) ----** 0.5 meters, mid-depth and 0.5 meters from the bottom.

7) **Fill out lakes fieldsheet**. Dates should be recorded as month day year (e.g. 7/30/01). Time should be recorded in 24 hour military local time (e.g. 14:25). Convert lake depth from feet to meters, if necessary (0.305 m/ft). Water color refers to the apparent color against the white Secchi disk as it is lowered into the water (ex. clear, light brown, green etc.). Record ID#s of samplers to be used. Use aquatic plant ID guide(s) as needed to note dominant plant types for stations and whole lake. See Appendix C for example fieldsheet.

8) **Measure Secchi depth.** One person measures Secchi depth per SOP CN 55.0. Use viewscope (w/o sunglasses) on sunny side outside boat's shadow. If no viewscope, take Secchi readings on shady side of boat. Repeat procedure with a 2^{nd} person to confirm final reading. Timing of the Secchi disk reading is flexible but should conform to the 10:00AM to 16:00PM time window. Record on fieldsheet.

9) **Collect samples (and process).** In general, collect samples on the windward side (upwind from the boat). Do not touch the inside of the caps or bottles at any time. Pre-rinse all bottles, except bacteria, with sample water prior to actual sample collection. Ideally, samples should be processed and preserved immediately after collection to minimize biological activity and chemical changes (compared to the in-situ condition). Where this is not feasible or desired, processing should take place as soon as possible or within processing times allowed in the QAPP, SAP or this SOP. Record time-collected, relative depth, etc. for each sample.

   - Surface samples (manual): Pre-rinse bottle and cap before collecting sample (dumping rinse water on opposite side of boat from collection). Remove container lid and hold it on its side. Invert bottle above the water surface, lower bottle 6-12 inches below the surface while slowly turning bottle upright under the water. Raise full container vertically out of the water, immediately pour off the top ½-1 inch (for headspace) and replace cap securely. Preserve (1 ml 9N H_2SO_4 per 250 mls. sample for nutrient or NUTS samples) and chill immediately.

- Surface samples (pole sampler): If/when sampling needs to be performed from dock or pier (and assuming samples are representative of lake water quality), a sampling pole can be used to extend sampling reach up to ~12 feet beyond the edge of the structure. Secure bottle in sampler and follow steps for manual sampling above.

- Fixed-depth samples (e.g., Van Dorn sampler): Pre-rinse Van Dorn by collecting a sample at the collection depth prior to actual sample collection (dump rinse water on other side of boat). If a visible residue remains attached to sampler after rinsing, wipe the inside clean with towels and rinse again three times. Open both ends of sampler (holding messenger), lower unit to desired depth using metered line, wait about 10 seconds at desired depth prior to sending messenger down. Pull unit up slowly. Make sure that there is a good seal at both ends before pulling the unit into boat. Visually inspect sample, especially for near-bottom samples that may contain sediment or flocculent material indicating the sample was collected too close to or has hit the bottom (collect hypolimnetic, near-bottom samples where the bottom of the sampler (vertical or horizontal) is 0.5-1.0 meter off the sediment). Open valve to dispense sample into bottle. Leaving ½-1 inch (for headspace) and replace cap securely. Preserve (1 ml 9N H_2SO_4 per 250 mls. Sample for NUTS samples) and chill immediately.

- Depth-integrated samples: mainly for chlorophyll *a* samples
  i. *Variable-depth tube sampler:* Multiply Secchi disk reading by 3 to determine depth of integrated sample. If the lake depth is less than 3x the Secchi disk depth adjust the depth of the integrated sample to 0.5 m from the sediment surface. Pre-rinse sampler by collecting a depth-integrated sample prior to actual sample collection (dump rinse water on other side). Lower the thin-walled polyethylene tube sampler (3/8 inch internal diameter with a weighted end) down to the desired depth (3 times the Secchi depth reading), then crimp the tube above the water surface and pull the tube up and out of the water. The tube end is held near the mouth of the sample container, but held so that the tubing does not contact the inside of the container. De-crimping allows the water to drain out; the sampling procedure is repeated until the desired volume is collected. Preserve as needed and chill immediately.
  ii. *Fixed-depth pipe sampler (3 feet/6 feet)*: Pre-rinse sampler by collecting a depth-integrated sample prior to actual sample collection (dump rinse on other side). Open both ends of pipe sampler, lower vertically to submerge entire unit, close top ball valve (below the surface), vertically raise unit until bottom end is just below the surface, then close bottom ball valve (below the surface). To fill sample bottles, hold vertically and partially open top end, hold bottom end over open sample container and then open bottom ball valve slowly. Fill container(s) leaving ½-1 inch (for headspace) and replacing cap(s) securely. Preserve as needed and chill immediately.

- Dissolved P: Samples for total dissolved P (TDP) and/or dissolved reactive P (DRP) should be field-filtered using a high-volume syringe/filter kit (0.45µM or 0.2µM pore size, depending on method). Collect a sample using the above techniques into a pre-cleaned, field-rinsed, WM HDPE 1000 ml container (primary), then use the syringe/filter kit to repetitively draw and filter the required volume into a second container. Do not acidify dissolved P samples.

- Chlorophyll *a*: Use depth-integrated sampler. Immediately put in cooler out of sunlight. Do not field-filter. Iced samples in the dark can be filtered back at the lab within 24 hours of collection (without significant loss of pigment)

- Algae bloom grab: If a surface bloom of algae is observed (or if a metalimnetic bloom is suspected from the %oxygen saturation data) a grab sample can be collected. Algae sampling can be used to determine if blooms are toxic, i.e. Harmful Algal Blooms (HAB).

- Aquatic plant specimens: As needed for later ID confirmation, collect examples of aquatic macrophytes present at the lake. This is especially important for dominant types and suspected invasives. Place stem/leaf section (and flowering and/or fruiting parts if present) in clear, labelled plastic Zip-lock® baggies.

- Plankton: Use plankton net sampler (e.g., Wisconsin net, fine mesh (80μM)). Make sure the collection basket is secured to the net and do a final check on the apparatus for holes, loose fittings, etc.. Slowly lower net vertically to desired depth (down to 0.5 – 1.0m off the bottom, or to the top edge of a low DO (<1ppm) hypolimnion). Slowly pull the net up vertically at a steady rate of approximately one foot per second until the mouth of the net is above the surface. Rinse net contents into the basket using an up/down, swirling motion without submersing the net mouth. Use DI squirt bottle for final rinsing into the basket, then carefully remove basket. For zooplankton, narcotize with CO_2 for 30-60 seconds (e.g., club soda) by placing basket in CO_2 solution up to the rim, then add basket contents to sample container, using DI rinses as needed to thoroughly rinse basket, the preserve in 70-95% ethanol. For phytoplankton, preserve with Lugol's solution (1 ml/100 ml). Record tow depth on fieldsheet.
- Lake sediment: See SOP CN 71.0 for sediment sampling procedures and analytical considerations.
- Other sample types: As needed (see project-specific SAP)
- Field QC samples: In general, take field duplicates and field blanks at approximately 10% of crew trip samples and for each bottle group. Preserve and store QC samples as if they were regular samples. Depending on sample type, proceed as follows.
  - *Surface grabs*: Collect co-located/simultaneous or sequential (one right after the other) field duplicates and simple-pour ambient field blanks.
  - *Fixed-depth (thief type) samplers:* Take equipment blank first by adding DI water to lab-cleaned sampler, mixing and then dispensing into sample bottle. For duplicates, deploy the sampler a 2nd time to collect another (sequential) sample. NOTE: usually either a surface or an at-depth duplicate is collected, not both.
  - *Depth-integrated samplers:* (same as for fixed-depth samplers) -- It is recommended to rinse the equipment with DI water each day before taking the blank sample. Take equipment blank first by adding DI water to lab-cleaned sampler (for convenience, this can be done at the shore prior to the survey), mixing and then dispensing into sample bottle. For duplicates, deploy the sampler a 2nd time to collect another (sequential) sample.
  - *Secchi disk depth:* Two persons measure Secchi disk depths sequentially (same side of boat).
  - *Filtered samples* (e.g., dissolved P): Do field (filter) blank first. Use syringe/filter kit to filter DI water from a wide mouth container (primary) into the sample bottle. For field duplicate, repeat entire sampling procedure, including the re-filling of the primary sample bottle.
  - *Plankton tows*: Repeat entire procedure for 2nd sample.
  - *Multi-probe samples*: For a duplicate depth profile (optional/as needed), repeat entire procedure starting at the top of the water column.

10) **Visit other sampling stations OR return to boat launch.** Prior to pulling the anchor(s), review all sampling activities that have just been performed to ensure that all intended sampling has been completed successfully. Make sure that the fieldsheet is complete, desired photos have been taken, samples and equipment are stowed properly, etc. Go to other sampling stations on the lake, as necessary. At boat ramps, back the trailer down and guide the boat onto the trailer manually using tow ropes (preferred, instead of motoring the boat). Attach, lock and crank the winch to pull the boat completely in. Make sure the winch control level locks the handle and the winch rope is tight. Fasten boat straps. Pull trailer out of water and park.
11) **Unload boat.** Drain water from the boat and motor. Secure all equipment again for transport. Check trailer lights for operation prior to departure.
12) **Decontamination.** Following each survey, all equipment shall be visually inspected for the presence of biological materials, such as aquatic plant fragments, epiphyton, veligers, etc. (since some of these organisms may be invasive). Remove macroscopic materials by hand and rinse off smaller materials per SOP CN 59.5. For best results, plan to stop at a self-service, coin-operated pressure-wash facility to thoroughly clean trailer and boat. In addition, DI rinse fixed-depth and depth-integrated samplers.

Example of regional wash facility availability in MA.: http://maps.google.com/maps?hl=en&source=hp&um=1&ie=UTF-8&q=car+washes+in+Berkshire+County+Massachusetts&fb=1&gl=us&hq=car+washes&hnear=Berkshire+County+Massachusetts&ei=O10pS_zDJ9ve8Aa12_iwDQ&sa=X&oi=local_group&ct=image&resnum=1&ved=0CB8QtgMwAA

8.0 POST-SURVEY PROCEDURES (BACK AT THE OFFICE & AT THE WES LAB)

Upon return to the office, use COC form to sign samples into the main sample storage fridge (<6 degrees C). Then insert COC forms into the large COC envelope on the fridge. Acidified samples may be stored at <6C for up to 3 days at DWM, then must be transferred to WES by 1400PM Monday-Friday with all COC forms. Alternatively, samples may be delivered directly to WES following the lake survey.

When delivering samples to the lab, review COC form for consistency with the fieldsheets and that all required analyses are checked off, add special instructions as needed, and ensure that all samples are signed for by applicable WES staff during the COC sample transfer process.

Complete Multi-probe User Report to document returned items and report any problems. Clean multi-probe case and contents to the same level as they were received. Place user report with the cleaned case outside the DWM Instrumentation Lab.

Rinse all gear with tap water to clean, except for Van Dorn bottles (rinse these at least three times with deionized water, place in clean plastic bags and mark as rinsed and date on label on bag). Coolers are rinsed with tap water and allowed to dry (open). Store all gear in designated locations for the next user. Clean, hang to dry and store all boating equipment for the next user. DO NOT LEAVE CLEANING AND DECONTAMINATION PROCEDURES FOR OTHERS. If there were any problems on the survey with equipment or procedures, make sure to inform other staff for their information and to initiate corrective action.

Review survey paperwork (fieldsheets, plant maps, etc.) for completeness and file in QA Analyst's in-box. Upload and store photo-documentation per current DWM procedures (date, location, photographer at a minimum).

9.0 AQUATIC MACROPHYTE SURVEYS

Aquatic macrophyte surveys are conducted according to procedures contained in SOP CN 67.2. These surveys result in semi-quantitative maps of overall percent cover, percent biovolume and species distribution for aquatic plants throughout the lake. See Appendix E for example "plant maps". These surveys can also be used to determine the presence of existing and new invasive species.

Macrophyte surveys require significantly more time to conduct than water quality surveys. Most plant surveys require one full day per lake to complete accurate plant maps.

10.0 BATHYMETRIC SURVEYS

Bathymetric surveys are conducted according to procedures contained in SOP CN 82.1. If no bathymetric map of the lake is available then use the depth finder (sonar, survey rod, etc.) to determine depths. Test the accuracy of the depth finder in deep water with the use of the Secchi disk lowered to the bottom. In weedy areas use a survey rod or calibrated oar or Secchi disk to check bottom depths. Adjust sensor position as required. If you use the GPS Lowrance® 240 you can simply log the sonar data to a file (see SOP), otherwise record water depths and units at 10-20 locations on an 81/2x11 inch print of a USGS image map of the lake (from ArcMap). Record points along the long transect and several cross transects by motoring slowly along the transect and recording depths and positions where the depth finder indicates a five foot interval depth contour (e.g. 5, 10, 15…). Use using a GPS unit or use triangulation of landmarks and the range finder as needed to document locations. If using GPS confirm location of at least one fixed location before and after use of the GPS unit and check against same location on GIS upon return to shore. Find the deepest site and triangulate the location on the map from several points around the shore and note depth directly on map. For large lakes, either use GPS or write a description of the location. Date and write observers names on map. Confirm lake is nominally full by observation of shoreline vegetation or waterlines, and/or water level at dam or other fixed reference point and make notes on how to correct depths if lake is above or below normal level. Correct map for filled in bays or new islands, etc. Upon returning to the office, draw a bathymetric map of depth contours by interpolation between points. Include a scale on the map with lake name and the Pond and Lake Information System (PALIS) code number.

11.0 LAKE MULTI-PROBE DEPLOYMENT SURVEYS

Multi-probe deployments in lakes, ponds and impoundments to collect continuous probe data (DO, pH, temperature, conductivity) shall follow setup and installation procedures contained in SOP CN 4.4.

12.0 QUALITY ASSURANCE & CONTROL

Attention to detail and adherence to standard procedures for all lake monitoring tasks help ensure that the resulting data will be accurate and precise, representative, comparable and complete (PARCC QA concepts). In addition to this document, Standard Operating Procedures (SOPs) related to lake sampling and included here by reference (and internal link) are as follows:

- CN 1.21, Sampling (general) (..\..\CN 001.21 - SOP_Field Sampling.doc)
- CN 1.25, GPS (W:\DWM\SOP\CN 001.25 - SOP_GPS Data Collection and Use (DRAFT).doc)
- CN 2.3, Water color analysis (DWM\SOP\CN 002.3 - SOP_Analysis for True Color.doc)
- CN 3.4, Chlorophyll a analysis (DWM\SOP\CN 003.4 - SOP_Analysis for Chlorophyll a.doc)
- CN 4.21, Multi-probe use (W:\DWM\SOP\CN 004.21 - SOP_Water Quality Multiprobes.doc)
- CN 4.41, Multi-probe deployment (W:\DWM\SOP\CN 004.41 - SOP_Multiprobe Deployment.doc)
- CN 55.0, Secchi depth (W:\DWM\SOP\CN 055.0 - SOP_Secchi disk transparency.doc)
- CN 59.5, Decontamination (..\..\CN 059.5 - SOP_Field Equipment Decontamination (invasives) 3-12-08.doc)
- CN 67.2, Macrophyte surveys (W:\DWM\SOP\CN 067.2 - SOP_Macrophyte Survey Mapping.pdf)
- CN 67.5, Underwater camera (..\..\CN 067.5 - SOP_Aqua-Vu Camera Use.doc)
- CN 71.0, Sediment sampling (..\..\CN 071.0 - SOP_Sediment Sampling & Analysis.doc)
- CN 82.1, Bathymetry (W:\DWM\SOP\CN 082.1 - SOP_Bathymetric Mapping.doc)
- CN 150.0, Algal ID & enumeration (inc. cyanobacteria) (..\..\CN 150.0 - SOP_Cyanobacteria Counts.doc)
- CN 230, Algal toxins (..\..\CN 230.0 - SOP_Algal Toxins (pending).doc)

In general, field quality control samples (field duplicates and field/equipment blanks) are collected on each crew trip at a rate of approximately 10% of trip samples and for each bottle group. See Section 7 for QC sample collection procedure. Laboratory quality assurance is provided via lab QA Plans and SOPs (which include provisions for lab QC sampling).

All lake sampling personnel receive training in survey preparation, sampling techniques, documentation and safety prior to and during (as needed) surveys. Corrective actions (e.g., re-training) are taken as needed to ensure staff health & safety and data quality.

Documentation (paper and/or electronic) related to individual lake surveys includes the following. Completed records are placed in one of the following project paper files:

- COC forms
- Fieldsheets (one per lake)
- Photos
- Lake maps
- Aquatic plant survey maps (if done)
- Field notebook pages (optional)

Resulting lake survey data are validated and managed per DWM's data validation and management SOPs.

13.0 REFERENCES

Baker, J.R., Peck, D.V. and Sutton, D.W. 1997. Environmental Monitoring and Assessment Program Surface Waters: Field Operations Manual for Lakes. EPA/620/R-97/001, USEPA, Washington, D.C.

Ohio EPA. 2006. Lake Sampling Procedures. 1/31/06

Maine Volunteer Lake Monitoring Program. Secchi Simulator.
http://www.mainevolunteerlakemonitors.org/waterquality/AboutVirtualSecchiRecertification.php

Minnesota Pollution Control Agency. 2009. Standard Operating Procedures, Lake Water Quality Sampling, Rev. 2.0

Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005. APHA, AWWA, WEF

University of New Hampshire. 2007. Center for Freshwater Biology Field Team Sampling SOPs (for lakes)

USEPA Office of Water. Volunteer Lake Monitoring. EPA 440-4-91-002.
http://www.epa.gov/volunteer/lake/lakevolman.pdf

APPENDIX A
PRE-DEPARTURE CHECKLIST (LAKES)

	MassDEP-DWM sampling gear and materials
	State vehicle (truck w/ hitch)
	Vehicle book w/ directions to lake(s), emergency hospitals, car washes (and registrations)
	Boat trailer (w/ trailer lights)
	Boat, oars, oarlocks, plugs
	Motor (Nissan 5HP, Tohatsu 5HP, electric)
	Charged battery (and spare if available)
	Gas tank, gas can, oil
	Engine tool kit with spare parts, shear pins, knife, pliers etc.
	2 anchors, rope (sufficient length)
	PFDs (one for each crew member and throwable)
	DI rinse jug one gallon for rinsing Van Dorn
	Secchi disk with line calibrated to 0.1 m intervals
	(2) Weighted hoses (Tygon tube 1 cm ID) for integrated Chl a samples, and/or rigid white PVC integrated depth sampler (3'/6')
	Funnel for tube chl a blank
	Multi-probe kit (precalibrated with appropriate length cable), extra battery, DO membranes, calibration solutions., etc.
	View scope
	Van Dorn bottle(s), line and messenger
	Depth sounder
	Cooler and ice
	H_2SO_4 (9.4N) preservative and disposable pipettes
	Lugol's preservative (if needed)
	Sample bottles (and extra bag of bottles) & labels
	1 liter DI bottle for TP, color and chl *a* field blanks
	DWM GPS unit
	7.5 minute USGS map of area
	GIS ArcMap printed bathymetric maps of lake
	Field data sheets, COC forms, fieldsheet labels (extra), list of OWMID #s
	Waterproof field pens and Sharpies
	SOP Quickguides
	Probe clamp for boat
	Extra clamp for depth sounder
	DWM Field kit (includes insect repellent, sunscreen, hand sanitizer, poison ivy wash, etc.)
	DWM first aid kit
	DWM cell phone (w/ contacts)
	Gloves (heavy duty and disposable types)
	Clipboard
	Duct tape
	Basic tool kit
	DWM Rain gear
	Emergency whistle (or horn if required)

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MassDEP-DWM sampling gear and materials			
	DWM digital camera		
	Compass		
	Fire extinguisher (if required)		
	Aquatic plant identification guide(s)		
	Field filtration apparatus (syringes, filters), if needed		
	Plant rake (if needed)		
	Plankton tow (if needed; note mesh size used on fieldsheet)		
	Decontamination equipment (e.g. sprayer) and cleaning solutions (as needed)		
	Sediment dredge (e.g., Ekman, Ponar) (as needed)		
Personal Gear			
	Proper footwear and protective clothing		Insect repellant, sun screen
	Rain gear (if needed)		Food and water
	Extra clothing (dry)		Cell phone (personal)
	Sunglasses		Field notebook (optional)
	Business cards		Swiss army knife
	Miscellaneous items (bathing suit, fishing pole, beach towel)		Money (Quarters for pressure washing boat, trailer, etc after use)

APPENDIX B

LAKE SURVEY QUICKGUIDE

1) **Safety 1st :** Take care and protect crew safety at all times. Do not take unnecessary risks, such as skin contact with potentially toxic algae blooms. Work at a reasonable pace to avoid rushing and making mistakes. One PFD per person and additional throwable PFD. Adhere to all applicable Mass. Boating laws.

2) **Prior to departure from the office, double-check survey gear** to make sure nothing is forgotten and gear is functional and calibrated (e.g., metered lines). Use pre-departure checklist (e.g., 2 anchors, not just one; extra bottles, safety gear, etc.). Take copies of relevant SOPs, extra maps if needed. Review lake access and any boat motor restrictions. Make sure multi-probe cable is of sufficient length.

3) **Boat motor operation:** 2 cycle engines use mixed gas typically at 50:1 ratio. 4 strokes have an oil reservoir which you should check to see if it has adequate oil. Connect gas line if needed, squeeze primer bulb until firm, adjust gear lever to neutral, adjust throttle to mid-range, and if engine is cold (has not been started that day) pull out choke. Pull starter rope (hard and long pull) until it fires or even sputters once, then push in choke halfway. If it runs adjust throttle and in next minute push choke in all the way. If it does not run try pulling with 1/2 choke (squirt starter fluid in carb if needed) and pull starter repeated until it fires and runs. Immediately check for cooling water to squirt out back, if you do not see it immediately stop engine and fix problem. After 1 minute of running push choke in all the way adjust speed to slow and proceed to engage shift lever to forward. Restarting engine later in same day should not require the choke or else the motor may flood. If the motor does not run and smells of gas, it is probably flooded. Remove sparkplug and pull starter 20x and leave it to air out 10 minutes, reassemble, do not use choke, increase throttle to ¾ and try starting.

4) **Record whole-lake information on fieldsheet:** Take a few moments to navigate around the lake and record "whole-lake" information, such as aquatic plant cover, shoreline erosion, presence of scums, objectionable deposits, potential pollution sources, recreational uses observed and wildlife sightings, on the fieldsheet.

5) **Fill out station information on the fieldsheet:** Discuss fieldsheet elements with other crew member as needed. Make sure all applicable sections of the fieldsheet are completed. Record GPS latitude-longitude data using NAD83 datum, in DECIMAL DEGREE units and record stated accuracy. Take photo-documentation.

6) **Secchi disk depth (CN 55.0)**: Measure twice (once each per crew member); use viewscope (w/o sunglasses) on sunny side outside boat's shadow. If no viewscope, take Secchi readings on shady side of boat. Timing: 10:00AM to 16:00PM

7) **Pre-rinsing sample bottles and samplers:** Pre-rinse all bottles prior to sample collection, except for sterile bacteria bottles. Pre-rinse all samplers with sample water prior to collection. Post-rinse with DI water.

8) **Nutrient sample preservation:** 1 ml 9N H_2SO_4 per 250 mls. Sample (acidify and chill right after collection (preferred)

9) **Multi-probe depth profile (CN 4.21):** Ensure that readings are stable before starting to record. <u>As a general rule, if temperature changes by 1C/m or more, then the lake is stratified.</u> When finished with storing data at each depth, log review data and record on fieldsheet. Record readings using the following guidelines.

<u>MAXIMUM DEPTH < 8 METERS (26 FEET):</u>

Stratified	Record **every 30 seconds for 3 minutes** at 0.5 meters and then every meter down until 0.5 meters from the bottom.
Not Stratified (temps>5 deg. C)	Record **every 30 seconds for <u>5 minutes at each of 3 depths</u> (at a minimum) ----** 0.5 meters, mid-depth and 0.5 meters from the bottom.
Not Stratified (temps<5 deg. C)	Record **every 30 seconds for <u>7 minutes at each of 3 depths</u> (at a minimum) ----** 0.5 meters, mid-depth and 0.5 meters from the bottom.

MAXIMUM DEPTH > 8 METERS (26 FEET):

Check for stratification	Perform preliminary scan of water column to see if stratified and to what extent. Record approx. depths to metalimnion and hypolimnion. If stratified, proceed as follows for each layer. If not stratified, proceed as below.
Stratified	In epilimnion, record **every 30 seconds for 3 minutes at 3 depths**---0.5 meter, mid-epilimnion and lower-epilimnion
Stratified	In metalimnion, record **every 30 seconds for 3 minutes at 3 depths** (equally spaced depths). Note any points of metalimnetic D.O. maxima.
Stratified	In hypolimnion, record **every 30 seconds for 3 minutes at 3 depths** --- equally spaced depths, but staying at least 0.5 meters off the bottom
Not Stratified (spring to fall; (temps>5 deg. C)	Record **every 30 seconds for 5 minutes at each of 4 depths**---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom
Not Stratified (fall-spring) (temps<5 deg. C)	Record **every 30 seconds for 7 minutes at each of 4 depths**---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom.

10) **Depth-integrated sample depth:** 3X Secchi depth (variable-depth sampler). If a fixed integrated depth (3' or 6' long) sampler used, make sure the sample depth equals or approximates 3X Secchi depth, or is otherwise acceptable. To meet the 3X Secchi criteria, the 3' sampler can be used in situations where the Secchi depth is very low (about 0.3m) or when the pond is very shallow (maximum depth of 1.5-2.0m at the sampling station). Similarly, the 6' sampler can be used when the Secchi disk depth is about 0.6m or when the pond maximum depth is about 2.5-3.0m at the sampling station.

11) **Plankton tow depth:** to 0.5-1.0m off bottom or to top edge of low DO (<1ppm) hypolimnion.

12) **Field QC samples**: As pre-designated on the fieldsheets (approx. 10% field blanks and duplicates of crew trip samples).

- Ambient field blanks (surface samples): Pour DI water into labeled sample bottle
- Equipment blanks: Do first. Pour DI water into lab-cleaned sampler, close sampler and mix as needed, then pour into labeled sample bottle. Same for filter-blanks: Push DI water through filter into labeled sample bottle.
- Field duplicates: Co-located/simultaneous or sequential. When using samplers, repeat entire collection procedure to take sequential duplicate samples.

13) **Dissolved analytes:** Use syringe/filter kit (one high-volume filter per station). Take filter blank first. Take one liter sample into a pre-cleaned bottle, then use syringe to pull water from this bottle, through filter and into the labeled sample bottle. (e.g., soluble P; Note: chl *a* samples do not need to be field-filtered; filter back at lab within 24 hours).

14) **Plant specimens:** As needed for later ID confirmation, collect examples of aquatic macrophytes present at the lake. Place stem/leaf section (and flowering parts if present) in clear, labelled plastic zip-lock baggies.

15) **Decontamination (CN 59.5)**: Do not launch the boat without assurance that proper decontamination for invasives species has taken place. Use coins at manual pressure wash facility to clean boat, trailer, etc. and get reimbursed for money used.

16) **COC Procedures:** Examine completed COC form for consistency with lakes fieldsheets prior to submittal to WES and other labs. Make sure special instructions are included on the form for special circumstances. E-copies of completed COC forms are sent to DWM by WES (paper copies from the lab no longer needed).

17) **Survey data package:** Review survey paperwork (plant maps, fieldsheets, etc.) for completeness and accuracy, and then submit them to the QA Analyst.

18) **Bathymetric mapping:** See CN 82.1.

19) **Aquatic macrophyte surveys:** See CN 67.2.

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APPENDIX C

LAKE & PROBE DEPLOYMENT FIELDSHEETS *(EXAMPLES)*

Massachusetts Departr[...] of Environmental Protection/Division of V[...]rshed Management

Lake and Pond Survey Field Sheet

2007

Project Lead (initial) MM . Station Sheet __ of __.

General Information (*fill out prior to departure*)

PROJECT Baseline Lakes 2007	Weather conditions last 3 days: (*see attached;* http://www.erh.noaa.gov/box/dailystns.shtml)
Lake East White Island Pond	Sampling Survey Crew: (*use full names; last name is OK for year-round DWM employees*)
Town Plymouth	Crew Lead(s): M. Mattson
PALIS # 95166	Others: with Jim Sullivan WIP Conservation Asso.
Site Name A	Van Dorn ID#: —

Station Information (*fill out at station*)

Date 10/18/07 Time (*24 hr.*) 11:15 am X pm ___ □ No Water □ Stagnant □ Ice-covered □ No Access

Station Description and Access (*describe precisely where samples are taken using shore markers, GPS, etc. Also, note any posted restrictions on access*)

via Jim Sullivan

Samples or Measurements Taken? ☒ yes □ no If not, why?:

"Deep Hole" sampled? ☒ yes □ no Aquatic Plant Survey conducted? □ yes ☒ no

Lake Level Measurement (*if available, note source/type*): — ☒ Low (estimate minus 1 feet) □ Normal □ High (estimate plus ___ feet)

Current Weather (*check one only*)	Air Temp	Wind Conditions	Water Odor (*surface*)	Water Clarity (*check one only; If unobservable, note why*)	Water Color (*color at ½ Secchi depth as appears on white Secchi parts*)
□ Clear	□ <20°F	□ Calm (0-1 mph)	☒ None	□ Unobservable	□ Unobservable (____)
□ Mostly sunny	□ 21-30	☒ Slight breeze (1-5 mph)	□ Sulfide (rotten egg)	□ Clear	□ Clear □ Light yellow
□ Mostly cloudy	□ 31-40	□ Moderate winds (5-15 mph)	□ Fishy □ Raw sewage	□ Slightly turbid	□ Greyish □ Dark tan
☒ Overcast	□ 41-50	□ Gusty (15-25 mph)	□ Effluent ("treated")	☒ Moderate turbid	□ Brownish □ Rusty (orangish)
□ Foggy	□ 51-60	□ Strong winds (> 25 mph)	□ Chlorine	□ Highly turbid/ suspended solids/ murky	□ Blackish ☒ Greenish
□ Drizzly	☒ 61-70		□ Petroleum		□ Reddish □ Blue
□ Rain	□ 71-80		□ Musty (basement)		□ Other
□ Sleet □ Snow	□ 81-90		□ Rotten vegetation		
	□ 91-100		□ Other		

Wind Direction (*blowing from the ..*)	Wave Height	Algae @ Station (*0-1 m. deep; check ONE only*)	Aquatic Plants @ Station (*check ONE for each and list exotics*) Sparse (~1-25%) Moderate (25-50%) Dense (50-75%) Very Dense (75-100%)			
			Floating (F)	Emergent (E)	Submerged (S)	Overall density
□ Calm	□ Calm (0 in)	□ None □ Dense (50-75%)	☒ None	☒ None	☒ None	☒ None
□ North □ East	☒ 0-2 in	□ Sparse (~1-25%) ☒ Very Dense (75-100%)	□ Sparse	□ Sparse	□ Sparse	□ Sparse
□ Northeast	□ 2-5 in	□ Moderate (25-50%) □ Floating scum	□ Moderate	□ Moderate	□ Moderate	□ Moderate
□ Northwest	□ 5-10 in	Algae Description (*describe shapes if possible: spherical, filaments, etc.; genus/sp. if known*):	□ Dense	□ Dense	□ Dense	□ Dense
☒ South □ West	□ 10-15 in	pin point floc in water	□ Very Dense	□ Very Dense	□ Very Dense	□ Very Dense
□ Southeast	□ 15-20 in		% Duckweed: 0 %	Exotics:		
□ Southwest	□ >20 in					

Whole Lake Information (*fill out for the lake as a whole; check multiple boxes if applicable and note locations of observations; if unobservable, note why*)

Aquatic Plant Cover (WHOLE LAKE) □ Unobservable ☒ None □ Sparse (~1-25%) □ Moderate (25-50%) □ Dense (50-75%) □ Very Dense (75-100%)

- Describe dominant plants (*in order of dominance; circle type (E, S, F) ; also list any EXOTICS*): 1) ____ (E / S / F)
- Is Duckweed present on the lake ? ☒ no □ yes (____%) 2) ____ (E / S / F)
- If wind-driven, average width of Duckweed band at shore: ____ meters 3) ____ (E / S / F)
- Exotics: □ Trapa □ Cabomba □ P. crispus □ Egeria □ Nymphoides pelt. (yellow) □ Lythrum 4) ____ (E / S / F)
  □ Najas minor □ Phragmites □ Milfoil (□ spicatum □ heterophyllum □ aquaticum □ Other) 5) ____ (E / S / F)

Floating Scum(s) □ unobservable □ no ☒ yes *If yes:* □ oily sheens □ pollen/dust blankets ☒ algal mat □ foam □ other
Describe Scum(s) (*esp. if sheen and/or foams are natural, petroleum-based or man-made*): Blue green scum along east shore
If wind-driven, average width of algal mat band at shore: 1 meters In some places 4 m wide and others 0 meters.

Uses Observed □ unobservable □ no ☒ yes *If yes:* □ swimming ☒ boating □ water intake □ fishing □ other
Description of Observed Use(s) or Indicators of Use(s) (*include numbers as applicable*): Some boats on shore

Objectionable Deposits □ unobservable □ no ☒ yes *If yes:* □ trash ☒ flocculent mass □ other
Description of Objectionable Deposits (*type, extent and area affected...*): Blue green scum along 20 percent of east shore

Shoreline Erosion □ unobservable ☒ no □ yes (*note locations for undercut banks, existing and potential slope failures, landslides, etc.*)
Description of Erosion:

Wildlife Sightings □ unobservable □ no ☒ yes *If yes:* □ fish □ mammals □ birds □ reptiles ☒ waterfowl □ amphibians □ other
Description of Wildlife Sightings and/or Indications (*e.g. geese droppings, nests, etc.; include numbers as applicable*): 4 swan 20 mallards

Potential Pollution Sources □ none ☒ outfall pipes (*storm, wwtp, etc.*) □ garbage dumping □ land clearing ☒ lawns ☒ septic □ road runoff □ other
Description of Potential Pollution Sources: cranberry bog discharge

For office use only Field Sheet Login # ____ Unique ID # ____ Revision Date 3/20/2007

Example of completed Lakes Field Sheet (side one).

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

LB-403_

SAMPLE DATA

Bottle Sample(s) collected?	☒ Yes ☐ No	VAN DORN Serial # : —	(if > one used, clarify in notes)
Secchi Time (24 hr.)	11 30 am X pm		
Secchi depth (m)	0.8 Dup. 0.75	General Notes: Took sample from Pipe J	
Secchi viewfinder used?	☒ Yes ☐ No		
Secchi on bottom?	☐ Yes ☒ No		
Secchi in weeds?	☐ Yes ☒ No	Sample-Specific Notes: LB 4035 close sample	
Secchi taken in sunlight?	☐ Yes ☒ No	collected near shore North basin East WIP	
Station Maximum Depth (m)	13 feet = 4. m		
Maximum Depth Method	☐ Secchi disk line ☐ Lead line ☒ Sonar ☐ Survey rod ☐ Other: ______		

"X" all applicable boxes. Provide sample times for all samples. Provide separate OWMID#s for each matrix and sample type, and for QA/QC samples. Use sequential last digits in OWMIDs (1,2,3...)

OWMID #	Sample Time (manual, 24 hr.)	Sample Depth (m): Relative Depth (S, M, NB)[4]	Sample Depth (m): Measured depth/ Integrated depth	Matrix: Sediment (Z)	Matrix: Water	Analyte/Bottle Group: Chemistry (C)	Nutrients[1] (N)[2]	Solids (S)	Bacteria (B)	Chlorophyll a (I)	Algae (A)	Zoops (G)	Color / Turbidity (R)	Other[2]	Sample Type (1 per sample): Grab: Manual Grab	Van Dorn Bottle[2]	Petite Ponar	Composite: Depth Integrated / tube	Grab Composite	Ambient Field/ Other[2]	QA/QC: Field Blank	Duplicate[3]	Other[2]	Total # of Bottles
LB-4031	1129		—		x		x						x		x						x			
LB-4032	1130	5	0.2		x		x						x		x							x		
LB-4033	1130	5	0.2		x		x						x		x							x		
LB-4035	1200	5	0.01		x						x													
__-_____																								
__-_____																								
__-_____																								
__-_____																								

Preservatives used (for water matrix nutrients) (check all that apply) ☒ *9N H_2SO_4* ☐ *1:1 HCl* ☐ *To Be Frozen*
Describe specifically in notes
For duplicate samples:** use different ID# for each sample and check 'Duplicate' column for each ID* [4] ***[S=surface M=mid-depth NB=near bottom]

Multi-Probe DATA

Record last (stable)readings at each depth. Use another field sheet form if more rows needed. For TDS or Salinity, circle one. Make sure to use a separate, unique ID# for Multi-probe data. If single probe units used, specify in notes.

OWMID#: - 0	Sonde #: Logger #:
Duplicate readings taken? ☐ Yes ☐ No	Multiprobe (sample-specific) Notes:
Duplicate OWMID#:	
Depth calibrated at (24 hr):	
Manual (watch) Sample Time (24 hr):	
Single Probe used? ☐ Yes ☐ No	Single Probe Model and Serial #:

Time	Temp. (°C)	DO (mg/l)	Depth (meters)	Scond (µS/cm)	pH	% Sat	Turb (NTU)	TDS/Salinity (g/l)/(ppt)	Redox (mV)
				Not Done					

Cooler Temperature (post sampling at Lab): __________ deg. C Project Lead (initial) MM

Example of completed Lakes Field Sheet (side two).

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Massachusetts Department of Environmental Protection/Division of Watershed Management

Project Lead (initial) JC.

Probe Deployment (2007)

Station Sheet ___ **of** ___.

Site and Survey Information

Project Housatonic (2007)	**Weather for last 3 days**: *see attached (http://www.erh.noaa.gov/box/dailystns.shtml)*
River Onota Brook	**Current weather:** Partly cloudy, 75°
Town Pittsfield	**Crew Lead:** Jamie Carr
Site Name OB01	**Other(s):** Reid Lockwall

OWMID #:	**Sonde ID#:**	**Tube #:**
21-0648	42235	5

DEPLOYMENT *(Determine left or right bank by looking downstream.)*

Start Date: 8/17/2007 **Immersion Time (24 hr):** 11:53 AM X PM ____

Probe Type: ☑ DO/T ☐ TEMP ☐ DO/T/pH/Cond. ☐ Other: ________

Apparatus *(check all that apply)* ☑ ABS tube ☐ anchor block ☑ cable & locks security ☑ storage cup removed?

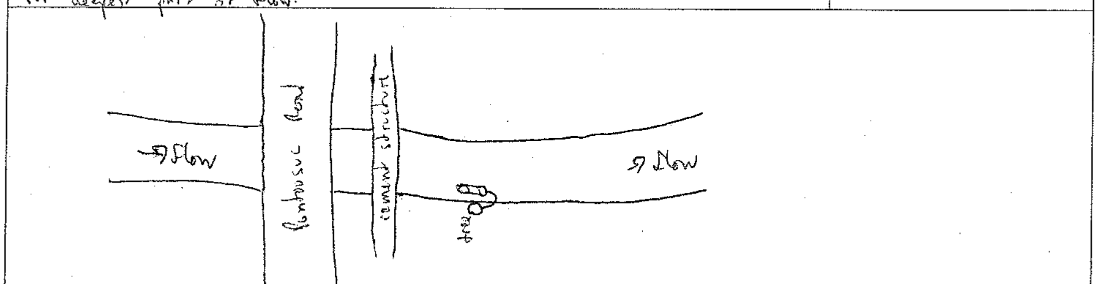
Deployment station maximum depth (*in meters*): 0.2 **Deployment probe depth** (*in meters*): 0.15

Deployment site--- *general description of site & access AND detailed description & sketch of installation:*

Most downstream crossing of Peck's Road

Deployed downstream of road and downstream of square cement overpass. Cabled to large tree on right bank & deployed along right bank in deepest part of flow.

Photos *(# and subject)* —



Sample-specific comments:

Flow condition: ☑ Flowing ☐ No Water ☐ Stagnant ☐ Ice-covered ☐ No Access

Est. water velocity: ☐ ~0 fps ☐ < 1 fps ☑ 1 - 3 fps ☐ 3 - 5 fps ☐ >5 fps

Water Odor: ☐ None ☐ Sulfide ☐ Chlorine ☐ Petroleum ☒ Musty ☐ Sewage/Septic ☐ Other:

Water Clarity: ☒ Clear ☐ Slightly turbid ☐ Moderately turbid ☐ Highly turbid

Water Color: ☐ Clear ☐ Greyish ☐ Brownish ☐ Blackish ☒ Yellow/Tan ☐ Rusty/Reddish ☐ Other

NON-DEPLOYED MULTI-PROBE DATA (for QC duplicate using separate OWMID#, at deployment)

OWMID#:	**Sonde #:**	**Logger #:**
21-0667	41215	1454

Manual (watch) Time *(24 hr)*: 11:52

Depth calibrated at *(24 hr)*: 11:51

Non-deployed multi-probe notes: 11:55

Time	Temp. (°C)	DO (mg/l)	Depth (meters)	Scond (µS/cm)	pH	% Sat	Turb (NTU)	TDS/Salinity (g/l)/(ppt)
12:00:01	20.90	7.95	0.1	263.3	8.06	90.7	—	.1685

For office use only: Field Sheet Login # 07-D508-05 **Unique ID:** W1570 **Revision Date 3/20/2007**

Example of completed Probe Deployment Field Sheet (side one).

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RETRIEVAL *(Determine left or right bank by looking downstream.)*	
End Date: 8/22/2007	**Time (24 hr):** 11:42 AM X PM ____
Evidence of sonde movement during deployment? ☐ yes ☒ no	**Sonde submersed in water?** ☒ yes ☐ no
Crew Lead: Dan Davis	**Other(s):** Reid Lickwell
Observations (sample-specific comments)---- *description of retrieval*	**Photos** *(# and subject)* —
Sample-specific comments:	

Est. water velocity:	☐ ~0 fps	☐ < 1 fps	☒ 1 - 3 fps	☐ 3 - 5 fps	☐ >5 fps	
Water Odor: ☒ None	☐ Sulfide	☐ Chlorine	☐ Petroleum	☐ Musty	☐ Sewage/Septic	☐ Other:
Water Clarity: ☒ Clear	☐ Slightly turbid	☐ Moderately turbid	☐ Highly turbid			
Water Color: ☒ Clear	☐ Greyish	☐ Brownish	☐ Blackish	☐ Yellow/Tan	☐ Rusty/Reddish	☐ Other

NON-DEPLOYED MULTI-PROBE DATA (for QC duplicate using separate OWMID#, at retrieval)

OWMID#: 21-0686	**Sonde #:** 41215	**Logger #:** 1454
Manual (watch) Time *(24 hr):* 1134	**Non-deployed multi-probe notes:**	
Depth calibrated at *(24 hr):* / 1135		

Time	Temp. (°C)	DO (mg/l)	Depth (meters)	Scond (µS/cm)	pH	% Sat	Turb (NTU)	TDS/Salinity (g/l)/(ppt)
11:40:01	16.89	8.92	0.2	287.9	8.11	92.7	–	.1843

3/2006

Project Lead (initial) JC

Example of completed Probe Deployment Field Sheet (side two).

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APPENDIX D

LAKE CHAIN OF CUSTODY (COC) FORM *(EXAMPLE)*

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Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection
Senator William X. Wall Experiment Station

Sample Tracking/ Chain-of-Custody Record

Cooler Temperature at Receipt 4 °C

WES Sample Log-In # ____________

Project Description

Name: Baseline Lakes
Site Name: Fake Lake
RTN: ____
Case #: ____
Coordinator MATTSON

Region-Bureau-Division

NERO ___ SERO ___
CERO ___ WERO ___
Bureau: BRP
Division: DWM
Phone: 508 767 2868
Fax: 508 791 4131

Analytical Laboratory
(for samples sent to a laboratory other than WES)

Name: ____
Address: ____
Contact: ____
MA Cert# ____
Phone# ____

Field Locator (within Site)	Client ID (Field #)	Lab # (Log-In # above plus # below)	Collection Date	Collection Time	Receipt Date	Receipt Time	Sample G/C*	Sample Matrix**	Sample Preservative	Collector	Chlorine Residual (yes/no)	Analysis Requested
541 Deephole 0.5	LB1201 C		7/21/01	1435			G	SRW	4°C	Smith		Low Alkalinity
541 "	LB1201 N								H2SO4			TP Low
541 Deephole 4.5	LB1202 C								4°C			Low Alkalinity
"	LB1202 N								H2SO4			Low TP
641 NW Inlet	LB1205 N								"			Low TP
722 Composite ABC	LB1212 S			1510			C	SED	4°C	MATTSON		TP TFe % solid % organic

Remarks:

*G/C = Grab/Composite

Chain of Custody: (*signatures required only for COC*)

Relinquished by: Printed name	Signature	Org.	Date	Time	Received by: Printed name	Signature	Org.	Date	Time
MARK MATTSON	Mark Mattson	DWM	7/21/01	1710	Summer Isn	Summer Isn	DWM intern	7/21/01	1710
Summer Isn	Summer Isn	DWM intern	7/22/01	1100	Mr Laboratory	Mr L	WES	7/22/01	1100

**** MATRIX CODES**

AC = Air Canister	FBT = Fish/Biological Tissue	LL = Landfill Leachate	SOIL = Soil	WO = Waste Oil
ACT = Air Cartridge Tube	GW = Ground Water	LW = Liquid Waste	SRW = Surface Water	WW = POTW Wastewater
AF = Air Filter	GRYW = Greywater	ME = Marine/Estuarine Water	STW = Stormwater/CSO	WWS = Wastewater Sludge
DW = Drinking Water	IWW = Industrial Wastewater	SED =-Sediment	SW = Solid Waste	

Rev. # 1.0, January 2001
W:\office\coc-form\FORMCOC.DOC

APPENDIX E

AQUATIC PLANT SURVEY MAPS *(EXAMPLES OF RAW DATA)*

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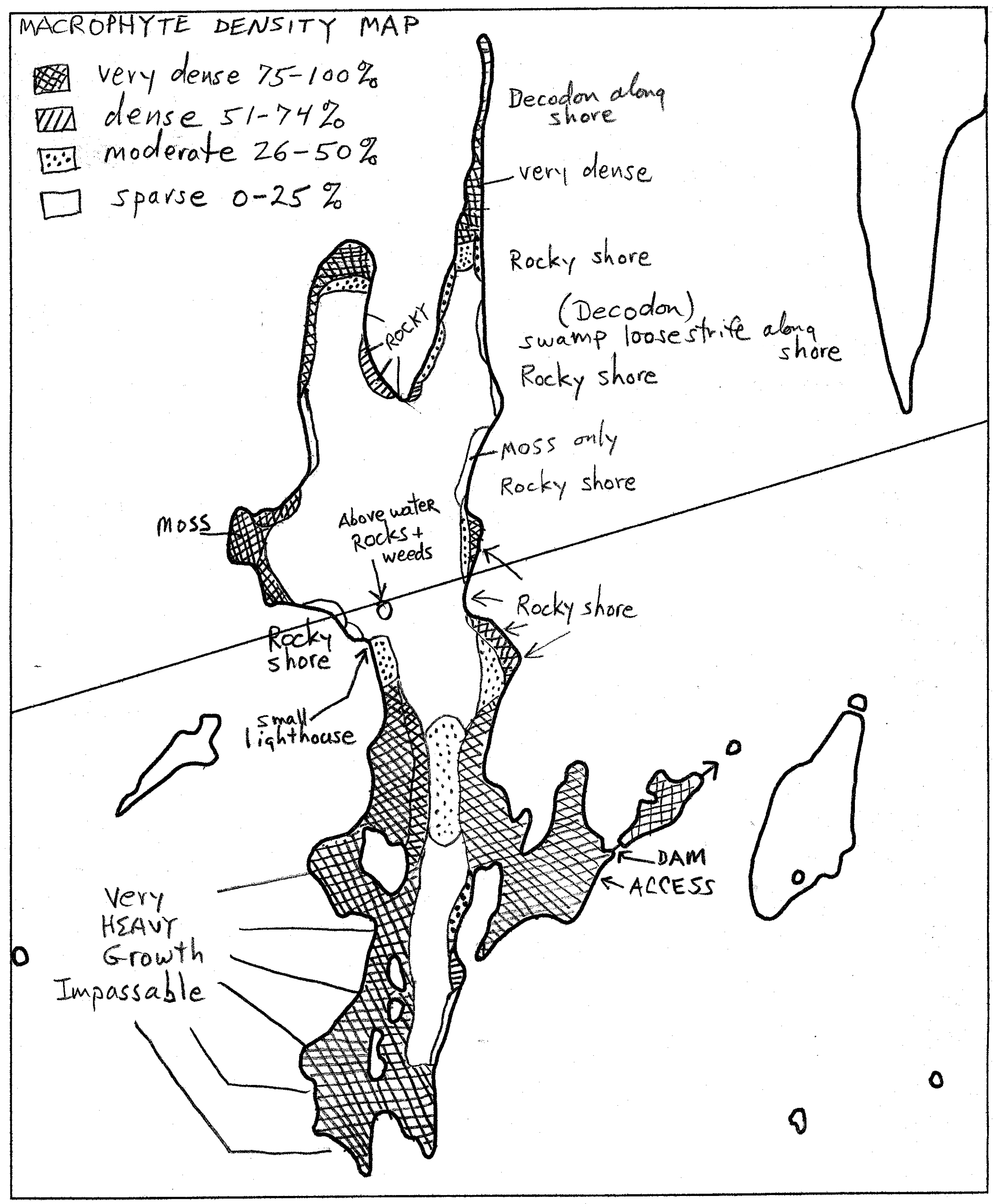


Gore Pond (Baker Pond)
Dudley/Charlton
date: 7-20-99
observers: DeCesare
Chesebrough

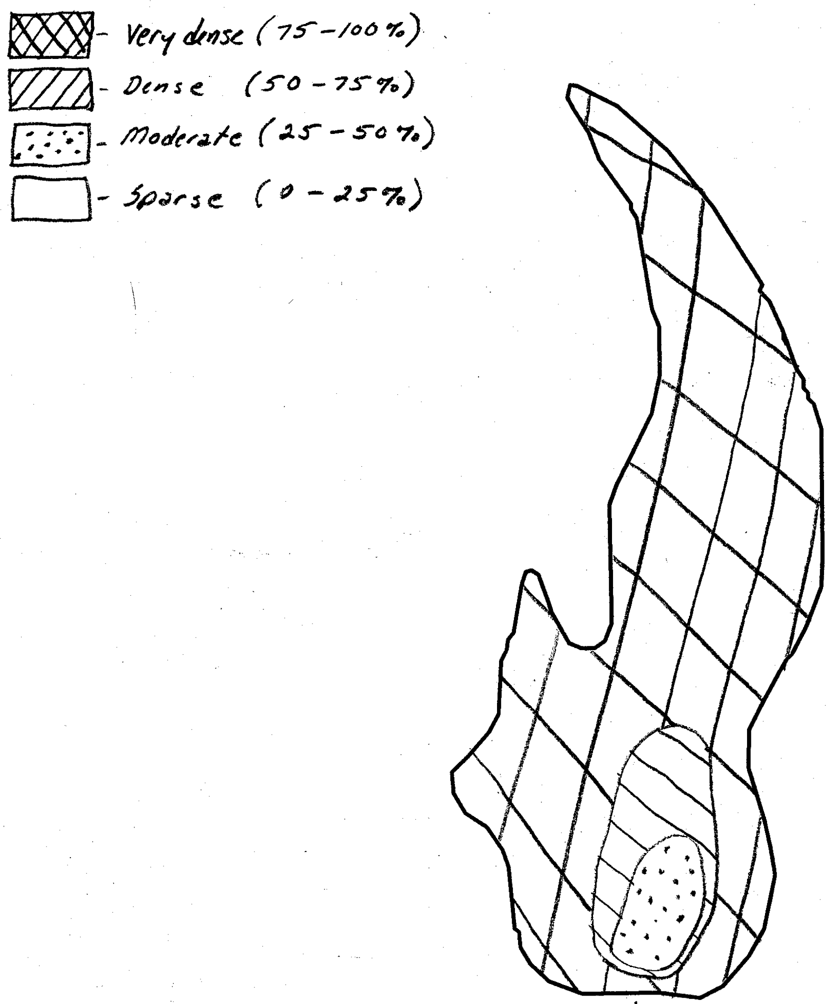
N

100 0 100 200 300 400 500 Meters

300 0 300 600 900 Feet

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Macrophyte Biovolume (% Water column) Map

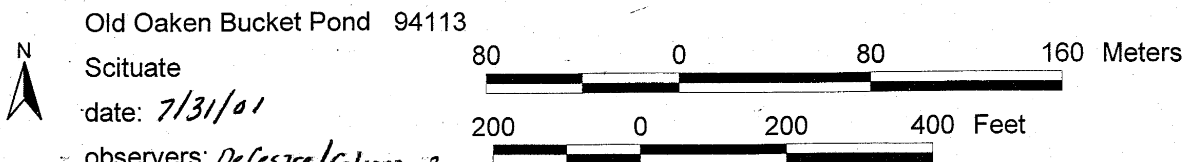


Old Oaken Bucket Pond 94113

Scituate

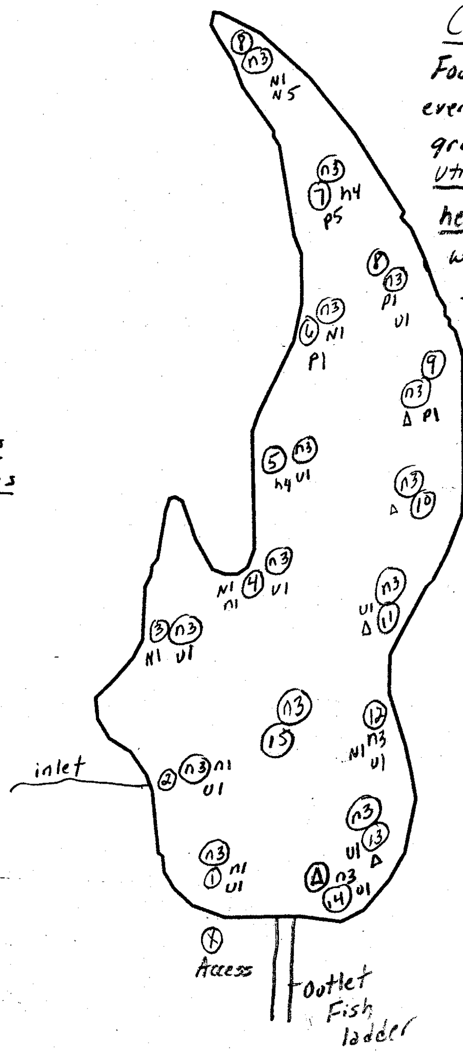
date: 7/31/01

observers: DeCesare/Colonna-Romano



Macrophyte Species Map

n3 – Cabomba
N1 – Nymphaea
N5 – Nuphar
n1 – Brasenia
U1 – Utricularia vulgaris
L1 – Spirodela polyrhyza
L4 – Lemna
W2 – Pontedaria cordata
Q2 – Polygonum
b10 – Clethra alanifolia
V4 – Lythrum salicaria
Δ – Algae
H2 – Elodea
P1 – Potamogeton amplifolius
P5 – Potamogeton epihydrus
a1 – Peltandra virginica
B1 – Scirpus validus
A3 – Sagittaria
B2 – Scirpus cyperinus
E – Eleocharis
V1 – Decodon verticillatus
h4 – Myriophyllum heterophyllum
C1 – Ceratophyllum demersum
K1 – Callitriche
H1 – Vallisneria americana
T – Typha latifolia



Cabomba exceedingly abundant. Found as most dominant macrophyt everywhere in the pond. Cabomba growing to surface in most areas. Utricularia vulgaris + Myriophyllum heterophyllum mixed in patches with cabomba. Very heavy surface film of green algae, brown (dynoflagellates?) and blue-greens all along dam + burm @ south end. Nymphaea + Nuphar common in near shore, shallow areas.

Old Oaken Bucket Pond 94113
Scituate
date: 7/31/01
observers: DeCesare / Colonna-Romano

N

80 0 80 160 Meters

200 0 200 400 Feet

Appendix B: Example Temperature and DO Profile Field Data Sheet

NORTHFIELD MOUNTAIN AND TURNERS FALLS HYDROELECTRIC PROJECT
TEMPERATURE/DISSOVLED OXYGEN PROFILE - FIELD DATA SHEET

Location/Station No.:	Personnel:	
Date:	Time Start:	Time End:
Meter:	Calibration Date:	Calibration Time:
Calibration Baro. Press (mmHg):	Calibration DO%:	Calibration Temperature (°C):
Weather:		

Depth (m)	Temp (°C)	DO (mg/L)	DO (% sat)	NOTES
Surface				

Notes:

Appendix C: Responsiveness Summary and Stakeholder Comment Letters

Table 1: Responsiveness Summary to Stakeholder Comments on Draft Field Sampling Plan.

Stakeholder Comment Summary	FirstLight Response
Robert Kubit, P.E., MADEP Division of Watershed Management: July 28, 2014	
The profile sampling for temperature and dissolved oxygen conducted manually do not specify a time of collection. It is unclear to us if this presents a problem in trying to document a worst case scenario in regards low dissolved oxygen. We believe using the data from the continuous data loggers will show the significance of a diurnal cycle and whether the need for early morning sampling of the profile sites is needed. Data from April, May and June from the continuous data loggers should be provided to the MassDEP along with the time and dissolved oxygen values from the profile data collection. If we believe justified, an early morning (within 2 hours of dawn) time of sampling may be required for the profile collection efforts for the rest of the year.	Continuous DO data will be collected during the summer low-flow, high temperature period starting on June 1 (continuous temperature data collection will commence on April 1). Data through June 30 will be provided to MassDEP along with the corresponding vertical profile data. FirstLight will then consult with MassDEP to determine if early morning vertical profile collection is justified. If so, FirstLight will adjust the time of data collection, as directed by MADEP and as impoundment travel time constraints and safety considerations allow for. There are three vertical profiles stations (two in Massachusetts) separated by approximately 18 river miles. In July and August, sunrise is approximately 5:00-5:30 am
Andrea Donlon, Connecticut River Watershed Council: July 28, 2014	
Temperature logger depths Concerned that the varying depths and locations off shore proposed for the loggers are inconsistent and will likely yield a set of results that can't be compared with the other river sections. Therefore, we recommend FirstLight determine the best approach for locating the loggers at a consistent depth and location off shore that will give "representative" results for the study objectives.	FirstLight proposed deployment configurations consistent with MA DEP Standard Operating Procedures, as follows. At the continuous temperature monitoring locations: Per CN 103.1 - SOP_Continuous Temperature Monitoring, "All locations and placements are selected to be representative of typical stream/river conditions. At each station, the enclosure containing the temp logger is secured off the bottom with rocks and/or concrete block." At the continuous temperature and DO monitoring locations, for stream/river deployments: Per CN 4.41 - Multi-Probe Sonde Deployments for Continuous Unattended Water Quality Data Collection, "Place sonde in representative location (with the bottom of the unit (and probes) off the bottom!) and one that is well hidden." For deployments in deeper impounded areas, we proposed to deploy the logger a minimum of 4 ft from the surface, but not deeper than 25% depth. To confirm representativeness, periodic measurements of surface, logger depth and near bottom will occur.
Calibration of temperature loggers	The temperature loggers proposed for this study come factory calibrated and include a calibration certificate from the manufacturer. The sampling plan has been revised to include calibration of temperature loggers according to MADEP protocols. A hand-held thermometer traceable to a NIST-certified thermometer will be used to check sensor accuracy; checks should be made prior to deployment, monthly, and at retrieval.
Vertical profiling at a consistent time Rationale and depths at Station 2 and 7	The sampling plan has been revised to specify that profile sampling will occur at consistent time and as early in the morning as possible. Rationale for Station 2 is that the stakeholders requested profile information from this area. Station 2 is the deepest area upstream of the Northfield Mountain project intake/discharge. The rationale for Station 7 is that data from this site will determine if the Impoundment stratifies in this location and how the operations of the Turners Falls Project (surface spill, generation, etc.) may affect downstream water temperature and dissolved oxygen conditions. Approximate depth at Station 2 = 70 feet, and approximate depth at Station 7 = 45 feet.
Temperature Data Collection between Cabot Station and the Holyoke Dam Suggest alternate locations for temperature data collection.	Additional water temperature sampling locations have been added to the revised sampling plan.
If MassDEP standard operating procedures referenced in the plan are not available online, it would be helpful to attach them in an appendix.	The MADEP SOPs have been added as appendices to the revised field sampling plan.
Jesse Leddick, MA NHESP: July 31, 2014	
Temperature & Dissolved Oxygen Depths -	See response above.
Calibration of Temperature Loggers - We concur with comments provided by CRWC	See response above.

Stakeholder Comment Summary	FirstLight Response
Dissolved Oxygen and Temperature Profiling in the Impoundment - We concur with comments provided by CRWC	See response above.
Site Selection of Dataloggers in the Bypass Reach - recommend moving the location of Sample Station 9	This site was moved as recommended, however the site should be located upstream the effects of Cabot backwater.
Site Selection of Dataloggers Below Cabot Station - We agree with CRWC	Additional water temperature sampling locations have been added or moved in the revised sampling plan.
Move Site 9 to west channel around Rawson Island	See response above.
Move Site 13 and add logger for nearshore/thalweg comparison	Site 13 was moved as recommended. However, we disagree that an additional logger is needed for nearshore/thalweg comparisons. The sampling site is in a riverine, flowing environment, and it is reasonable to assume the variations in temperature across the channel will be insignificant. Furthermore, these comparisons are not part of the MA DEPs SOP. FirstLight is not proposing to add an additional logger to this site for thalweg/nearshore comparisons.
New Site upstream of Hatfield boat launch	A new site was added as recommended.
New Site downstream of Mill River and add logger for nearshore/thalweg comparison	A new site was added as recommended. However, we disagree that an additional logger is needed for nearshore/thalweg comparisons. The sampling site is in a riverine, flowing environment, and it is reasonable to assume the variations in temperature across the channel will be insignificant. These comparisons are not part of the MA DEPs SOP. FirstLight is not proposing to add an additional logger to this site for thalweg/nearshore comparisons.
Move Site 14 to side channel at Elwell Island	This site was moved as recommended.

From: Howard, John
To: Jason George
Cc: Mark Wamser - Gomez and Sullivan Engineers, P.C. (mwamser@gomezandsullivan.com)
Subject: Comments from MADEP to Field Sampling Plan 3.2.1
Date: Monday, July 28, 2014 3:38:46 PM

From: Kubit, Robert (DEP) [mailto:robert.kubit@state.ma.us]
Sent: Monday, July 28, 2014 3:27 PM
To: Howard, John
Cc: McCollum, Robert J (DEP); Harrington, Brian D (DEP); 'Andrea Donlon'; Melissa Grader
Subject: Comments to Field Sampling Plan 3.2.1

Good afternoon John,

The draft Water Quality Monitoring Study Field Sampling Plan has been reviewed by the MassDEP and we offer the following comment:

The profile sampling for temperature and dissolved oxygen conducted manually do not specify a time of collection. It is unclear to us if this presents a problem in trying to document a worst case scenario in regards low dissolved oxygen. We believe using the data from the continuous data loggers will show the significance of a diurnal cycle and whether the need for early morning sampling of the profile sites is needed. Data from April, May and June from the continuous data loggers should be provided to the MassDEP along with the time and dissolved oxygen values from the profile data collection. If we believe justified, an early morning (within 2 hours of dawn) time of sampling may be required for the profile collection efforts for the rest of the year.

If you have any questions, please let me know.

Bob

Robert Kubit, P.E.
MassDEP
Division of Watershed Management
627 Main Street
Worcester MA 01608
Telephone: (508) 767-2854
Email: robert.kubit@state.ma.us
Fax: (508) 791-4131

From: Howard, John
To: Jason George
Cc: Lana Khitrik
Subject: FW: FirstLight Field Sampling Plan for Study 3.2.1 Water Quality Monitoring Study
Date: Thursday, July 31, 2014 8:48:08 AM

From: Leddick, Jesse (FWE) [mailto:jesse.leddick@state.ma.us]
Sent: Thursday, July 31, 2014 8:44 AM
To: John_Warner@fws.gov; Ken_Sprankle@fws.gov; Melissa_Grader@fws.gov; Slater, Caleb (MISC); William.McDavitt@noaa.gov; jessica.pruden@noaa.gov; aharo@usgs.gov; Hazelton, Peter (FWE); Marold, Misty-Anne (FWE); Andrea Donlon; 'Don Pugh'
Cc: kenneth.hogan@ferc.gov; Howard, John; mwamser@gomezandsullivan.com; Chris.tomichek@kleinschmidtusa.com; Stira, Robert; lkhitrik@gomezandsullivan.com
Subject: RE: FirstLight Field Sampling Plan for Study 3.2.1 Water Quality Monitoring Study

John,

In response to the letter submitted by FirstLight dated June 27, 2014 re: Field Sampling Plan for Study No. 3.2.1 Water Quality Monitoring Study, the Natural Heritage and Endangered Species Program of the MA Division of Fisheries and Wildlife would like to offer the following comments:

1. Temperature & Dissolved Oxygen Depths - We agree with the comments provided by the Connecticut River Watershed Council (CRWC) in their letter dated July 28, 2014. Although site specific characteristics may require the selection of either nearshore, thalweg, or midchannel location of dataloggers, it is crucial to understand the effect that these locations have on data interpretability. If FirstLight is unable to determine the best approach because of time constraints, we recommend deployment of more than one datalogger per site that will stratify the location specific changes in temperature and dissolved oxygen. For example, at a subset of sites along each reach a datalogger should be placed at depth in the thalweg and a second datalogger placed nearshore at a shallower depth. Differences in near surface and thalweg temperature and DO may then be used to infer temperature at different strata across other sites.
2. Calibration of Temperature Loggers - We concur with comments provided by CRWC.
4. Dissolved Oxygen and Temperature Profiling in the Impoundment - We concur with comments provided by CRWC.
5. Site Selection of Dataloggers in the Bypass Reach - In the Study Plan Determination for Aquatic Studies, FERC recommended two data logger locations within the bypass reach to capture changes in water quality. We agree with FirstLight's stratification of dataloggers above and below the influence of Station 1; however we recommend moving the location of Sample Station 9 to the side channel west of Rawson's Island. During low flows this side channel is relatively dewatered and reductions in flow may result in higher instream temperatures. Peaking operations will result in greater rates of temperature change at this site than in the proposed location upstream. Though the pool location is adequate to capture the effects of peaking on temperature in the majority of the bypass above Rawson's Island, the goal of the study is to determine the effects of peaking on water quality parameters throughout the bypass, and representation in this side channel is important to assess changes in water quality as a it relates to occupancy and movement of rare aquatic species.
6. Site Selection of Dataloggers Below Cabot Station - We agree with CRWC that much of the water quality monitoring locations have been selected in areas far downstream from Cabot Station, and that data collected at these locations may bias effects of peaking operations as temperatures are likely to attenuate downstream as the river receives additional inputs from tributaries and is effected by the Holyoke Dam Impoundment.

Additional Recommendations:

Recommended Action	Station Number	Reach	Type	Location	Thalweg/nearshore	Purpose
Move Site	9	Bypass Reach	Continuous	Move station 9 to Approximate location: 42°35'48.79"N 72°34'51.30"W Western channel from	Mid channel, mid depth	Side channel is likely to see greater changes in temperature from peaking operations. Water quality in this reach is critical as passage is not possible for many species to the

				Rawson's island		east of the Island because of Rock Dam.
Move Site & Add logger	13	CT River to HD	Continuous	Approximate location: 42°29'12.10"N 72°34'10.07"W Second Island	Anchored nearshore at Second Island	Shorelines of midchannel islands may provide important habitat for freshwater mussels based on historic records. Recommend temperature loggers here to assess nearshore/island and thalweg water quality.
See Above	13	CT River to HD	Continuous	Approximate location: 42°29'12.10"N 72°34'10.07"W Second Island	Thalweg	As above. Should be used as comparison of changes in thalweg vs. shoreline locations of temperature loggers.
New Site	*	CT River to HD	Continuous	Approximate location: 42°24'34.68"N 72°34'30.77"W	Anchored nearshore /sandbar	The river becomes quite shallow and changes in water level may drive alterations in temperature. Recommend either nearshore along western shore or on submerged shallow sandbar.
New Site	*	CT River to HD	Continuous	Approximate location: 42°22'42.73"N 72°35'25.39"W	Anchored nearshore/sandbar	The river becomes quite shallow and changes in water level may drive alterations in temperature. Recommend either nearshore along western shore or on submerged shallow sandbar.
See Above	*	CT River to HD	Continuous	Approximate location: 42°22'42.73"N 72°35'25.39"W	Thalweg	Similar to above, a comparison between shallow water and thalweg temperatures is needed to compare validity of using both.
Move Site	14	CT River to HD	Continuous	Approximate location: 42°20'10.27"N 72°37'28.15"W	Southwestern channel - anchored nearshore	Similar to the concerns with Station #9: temperatures in side channels are likely to experience the greatest rates of change from peaking operations. We recommend moving this logger to the side channel of Elwell Island to assess changes in water quality in this refuge habitat for rare aquatic species.

Thank you for the opportunity to comment. Please contact me or Dr. Peter Hazelton, the Division's Aquatic Biologist, if you have any questions or if we can provide additional information.

Jesse Leddick

Endangered Species Review Biologist
Natural Heritage & Endangered Species Program
Massachusetts Division of Fisheries & Wildlife
100 Hartwell Street, Suite 230, West Boylston, MA, 01583
Phone: 508-389-6386 | Fax: 508-389-7890

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CONNECTICUT RIVER WATERSHED COUNCIL
The River Connects Us
15 Bank Row, Greenfield, MA 01301 crwc@ctriver.org www.ctriver.org

July 28, 2014

John S. Howard
Director, FERC Hydro Compliance
FirstLight Power Resources/GDF Suez
Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360

Re: Field Sampling Plan for Study No. 3.2.1, Water Quality Monitoring Study

Dear John,

I have reviewed the "Relicensing Study 3.2.1. Water Quality Monitoring Study Field Sampling Plan" dated June 2014, and below are comments submitted on behalf of the Connecticut River Watershed Council (CRWC).

Temperature logger depths

According to page 4 of the draft sampling plan, the five loggers in the Turners Falls impoundment will be deployed in a "representative location at a minimum of 4 ft from the surface, but not deeper than 25% depth." The loggers in the bypass reach, power canal, and below Cabot Station will be placed in a "representative location in mid-channel or thalweg at mid-depth, or just off the bottom depending on site-specific characteristics." Then, on page 5, it says that the five temperature loggers to be placed between Cabot Station and the Holyoke Dam will be secured "off the bottom of the river with rocks or concrete blocks,… tethered to an immovable object on shore with polypropylene rope or cable."

We don't know how much variation there is in the Connecticut River at different widths and depths, and this sampling plan proposes a single logger at each proposed location. While CRWC thinks this approach may be appropriate within a given budget, we are also concerned that the varying depths and locations off shore proposed for the loggers are inconsistent and will likely yield a set of results that can't be compared with the other river sections. Therefore, we recommend FirstLight determine the best approach for locating the loggers at a consistent depth and location off shore that will give "representative" results for the study objectives. That is, if the loggers are to be placed at mid depth in the thalweg, they be put there at ALL locations, not just some of the locations.

Calibration of temperature loggers

CRWC recommends that the loggers be placed in a room temperature bath and an ice water bath along with a NIST-certified thermometer prior to deployment. CRWC has a NIST-certified thermometer and a log sheet for doing this quality check procedure -- FirstLight's consultants are welcome to perform this calibration in our laboratory, if that would be helpful.

Dissolved oxygen and temperature profile sampling at three locations in the impoundment

The sampling plan does not specify time of day that the profile sampling will be performed. Dissolved oxygen levels vary in rivers during the day and are lowest just before dawn. CRWC recommends that the profile sampling be performed biweekly at a **consistent** time, preferably as early in the morning as feasible. CRWC concurs with MassDEP's suggestion that you look at the DO diurnal patterns from the installed loggers to make your decision, but we add that you try to sample at the same time for each site during each monitoring event.

The sampling plan does not provide the rationale for the profile sampling. The plan does not provide the river depth information for Station No. 2 or 7. Please provide a rationale for the location of Station No. 2.

Temperature Data Collection between Cabot Station and the Holyoke Dam

New to the study plan are five loggers proposed for placement in the Connecticut River between Cabot Station and the Holyoke Dam, roughly a 33-mile stretch. Page B-6 of FERC's Study Plan Determination dated 2/21/2014, stated, "We recommend FirstLight develop a temperature monitoring study plan for the reach between Cabot Station and the Holyoke dam to describe temperature and temperature rate of change associated with peaking operations… We note that effects of peaking operations may attenuate downstream due to tributary inflow and the backwatering effect of the Holyoke dam. These effects should be accounted for in the study's design."

Given the purpose of this part of the study being to look at temperature effects due to peaking, we are perplexed about the choice of logger locations. There are relatively few loggers proposed in the reach unaffected by the Holyoke impoundment (according to Holyoke Gas & Electric, the upstream extent of the Holyoke impoundment is just downstream of the Route 116 Bridge in Sunderland), and then there is a cluster of three closely-placed loggers in the Hadley area.

In addition, based on our own experience with temperature loggers, we do not recommend locating the loggers at marinas or locations of high recreational use. They will be stolen or the lines will be cut, and you will not have any data. See also our comment above on depth and location off banks proposed. If the loggers are tethered off shore and weighed down with cement blocks, the outside curve of the stream is often a good place to sample since the main current tends to hug this bank.

Additional comments are in the table below.

Station No.	Proposed Logger Location	Approx. River Mile	Comment/Recommendation
	Deerfield confluence	114	
12	Downstream of Deerfield River confluence	112	Location seems okay.
13	Route 116 Bridge, Sunderland	104	8-mile gap between sites as proposed. Move to downstream of Third Island (RM 107) or further upstream to capture peaking effects.
14	Route 9 Bridge, Hadley	92	12-mile gap between sites as proposed. Move to RM 101 vicinity (Sunderland-Hadley town line).
15	Mitch's Marina, Hadley	88.5	Move to RM 94-90 vicinity, away from heavy recreation use.
16	Brunelle's Marina, South Hadley	85	Move away from heavy recreation use, perhaps at upstream end of Mt Tom generating station property.
	Holyoke Dam	81	

Additionally, if the MassDEP standard operating procedures referenced in the plan are not available online, it would be helpful to attach them in an appendix.

Thank you for the opportunity to provide input on the draft water quality sampling plan.

Sincerely,

Andrea F. Donlon

Andrea F. Donlon
River Steward

Cc: Bob Kubit, MassDEP
Brian Harrington, MassDEP
Caleb Slater, MA Dept. of Fish and Game
Owen David, NHDES
Melissa Grader, USFWS
Ken Hogan, FERC

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Relicensing Study 3.2.2

HYDRAULIC STUDY OF TURNERS FALLS IMPOUNDMENT, BYPASS REACH AND BELOW CABOT

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

This study requires the development, calibration and verification of two hydraulic models in the project area including a) Turners Falls Impoundment (Impoundment) from Vernon Dam to Turners Falls Dam and b) from Turners Falls Dam to Holyoke Dam.

1.2 Study Progress Summary

Task 1: Update Turners Falls Impoundment HEC-RAS model

FirstLight has updated the Impoundment hydraulic model to include major tributary inflows, specifically the Ashuelot and Millers Rivers, which are both equipped with United States Geological Survey (USGS) gages.

FirstLight collected updated bathymetry in the Impoundment at the following reaches:

- From Vernon Dam downstream to about a half mile below the New Hampshire/Vermont and Massachusetts border bathymetric data was collected between June 5 and 11, 2014. Although data had been collected originally in 2006, due to the overlapping project boundaries in this area, FirstLight opted to re-do the bathymetry again on a much denser and detailed scale. In this approximately 6-mile long reach, the bathymetry was collected by the use of about 45 cross sections and normally 7 longitudinal lines within the Impoundment.

- As part of Study No. 3.3.9 (*Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace)*, FirstLight collected bathymetric data approximately 5 km upstream and downstream of the Northfield tailrace between May 27 and June 4, 2014. Similar to the new bathymetry data collected in the upper Impoundment, this data was collected on a dense spacing consisting of about 15 cross sections and between 7 and 11 longitudinal lines within the impoundment.

The 2014 bathymetric data was combined with the bathymetric data collected elsewhere in the Impoundment in 2006 and a revised and more detailed bathymetry map was created for the Turners Falls Impoundment. Shoreline and overbank topography was obtained from LIDAR (Light Detection and Ranging) data from TransCanada as a result of a data sharing agreement with TransCanada. This data was combined with the bathymetry data to create a topographical map of the Impoundment area, including the bathymetry and up to about 15 feet above the normal water surface elevations (WSELs). Based on this information, revised cross sections were developed and are being used in the HEC-RAS hydraulic model of the Impoundment.

Task 2: Installation of Water Level Recorders in Turners Falls Impoundment for Model Verification

During 2013, five temporary water level recorders set to collect data on 15-minute intervals were installed on August 1st, 2013 and were removed on November 11th, 2013. These loggers were located at: Downstream of Vernon Dam, Downstream of the confluence with the Ashuelot River, Near W. Northfield Road, at the Route 10 Bridge, and upstream of the Northfield tailrace. In addition, FirstLight maintained its permanent loggers at the Vernon Tailrace, the Northfield Tailrace, the Turners Falls Boat Barrier[1], and at the Turners Falls Dam.

[1] There have been some issues with the WSELs at the boat barrier line.

Per FERC's September 13, 2013 Study Plan Determination Letter (SPDL), it required additional water level data loggers be installed at transect 14000 (French King Gorge) and 70000 and that all loggers be deployed during the period April through November 2014. Data logger locations are shown in Figure 1 at the end of this Initial Study Report (ISR). FirstLight installed most of the loggers on March 24th and 25th, 2014, but could not deploy the FERC-requested logger at transect 14000 in the same time frame due to safety concerns related to ice, and later, very high flows. The logger at transect 14000 is located in the French King Gorge area and since flows were high, velocities through the gorge area created safety issues. FirstLight's Health and Safety Plan curtails normal boating access to the Impoundment when flows exceed 18,000 cfs. The logger was installed on April 29, 2014, from a land based access point when flows receded (but were still above 18,000 cfs) and it was safer to install the equipment.

Most loggers, other than the logger in the French King Gorge area as described above, were installed before the spring runoff. When servicing/downloading the loggers (normally done on a bi-weekly basis other than when very high flows curtailed access) it was discovered that three loggers had been affected by sediment during the high flows in April 2014 that exceeded 60,000 cfs released from Vernon Dam. Table 1 highlights the logger location/name, the installation date, and any issues with the logger through August 1, 2014.

Table 1: 2014 Status of Water Level Loggers in Turners Falls Impoundment.

Logger Location	Installation Date	Issues
Turners Falls Dam (existing gage maintained by FirstLight year round)	NA	None
Transect No. 486.259: Turners Falls Boat Barrier Line (existing gage maintained by FirstLight year round)	NA	Data from this gage has been unreliable since the fall of 2012. Data may need to be adjusted based on a vertical datum correction.
Transect No. 14000: French King Gorge (New Transect added by FERC in its SPDL	April 29	None
Transect No. 33486.3: Located upstream of Northfield tailrace	March 25	None
Transect No. 56926: Located at Route 10 Bridge	March 24	None
Transect No. 70000: New Location added by FERC in its SPDL located below Pauchaug	March 25	None
Transect No. 71986.3: Located approximately 8.5 miles upstream of Northfield tailrace near the Stateline	March 25	During April, this logger had issues recording the water elevation. Preliminary QA/QC indicates that the data is not usable and the logger was reinstalled on May 9, 2014. Since the reinstall, the data has been reliable.
Transect No. 92986.3: Located	March 24	During April, this logger was impacted by high flows. Preliminary QA/QC indicates that the data

Logger Location	Installation Date	Issues
below Stebbins Island		is usable and the logger was reinstalled on June 24, 2014.
Transect No. 102986: Located approximately 2,500 feet above upper most section of Stebbins Island	March 24	During April, this logger was washed out and buried, but was reinstalled on June 10, 2014. Preliminary QA/QC indicates the water level data is not usable due to the combination of burial and movement.
Vernon Tailrace (existing gage maintained by TransCanada)	NA	Minor erratic behavior of the gage has been occurring since late May, 2014 and is being investigated by FirstLight, but the data seems mostly reliable.

In addition to the water level logger data, FirstLight has been recording other data during the same period the loggers have been deployed including:

- Vernon Dam discharge (cfs)
- Northfield flows used for generation (cfs)
- Northfield generation (kW) and pumping (kW)
- Station No. 1 generation (kW), which will be converted to flow through a ratio of design flow to design capacity be converted to flow
- Cabot Station generation (kW), again this will be converted to flow
- Flow recorded at the USGS gages on the Ashuelot and Millers Rivers.

All flow, water elevation and generation data is recorded on a 15 minute time increment.

Task 3: Model Verification and Calibration (Turners Falls Impoundment)

With the WSEL data obtained in Task 2, FirstLight is currently in the process of calibrating the hydraulic model to measured WSELs and select flows. The HEC-RAS model is being operated as steady state with no pumping or generating occurring at Northfield Mountain Project such that flow conditions through the length of the Impoundment are relatively steady for several hours. FirstLight has developed a relationship between flow and travel time (in hours) through the Impoundment. As a guide, at flows less than 20,000 cfs, the travel time is approximately 10 hours, and at flows near 80,000 cfs, the travel time is approximately 4 hours. The HEC-RAS model is being operated for a given flow and the WSELs measured at FirstLight monitoring locations will be compared to the model results. Calibration has consisted of adjusting Manning n values (roughness) or adjusting contraction/expansion coefficients within reasonable measures such that the measured and modeled WSELs are reasonably close.

Task 4: Unsteady Flow Model (Turners Falls Impoundment)

After calibration is complete, the model will be updated to simulate unsteady flow conditions. In this case, time varying flows will be simulated to determine changes in the WSEL at select locations in the

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Impoundment. Several production runs/sensitivity analyses will be conducted to evaluate various sources relative to WSELs. For example, a time varying discharge hydrograph from Vernon Station will be simulated while the Northfield Mountain Project remains idle to determine the contribution of WSEL fluctuations caused by the Vernon Station. Similarly, a constant discharge hydrograph from Vernon Station will be simulated while the Northfield Mountain Project is operated as a pump or generator. A matrix of proposed model runs was included in Table 3.2.2-3 of the Revised Study Plan (RSP). Output from the model will include WSEL and mean channel velocities for the flows simulated.

<u>Task 5: Contact FEMA and Obtain FIS Hydraulic Model (Turners Falls Dam to Holyoke Dam)</u>

In the RSP, FirstLight proposed to develop a hydraulic model of the Connecticut River from Turners Falls Dam to Holyoke Dam. Transect data for the hydraulic model was to be based on past Federal Emergency Management Agency (FEMA) flood insurance studies (FIS) developed for the various towns along the river. FirstLight contacted FEMA, MA Department of Transportation and other state/local agencies to secure the original HEC-2 hydraulic models developed for each town and data for the bridges crossing the Connecticut River. FirstLight was provided with microfiche for most of the towns along the Connecticut River between Turners Falls Dam and Holyoke Dam and the bridge data; however, data for the town of Hatfield could not be located. Extensive efforts were made to locate this information, but to no avail.

Given this, FirstLight opted to collect eight (8) transects in the Hatfield area such that the upper and lower portion of the hydraulic model could be connected. Transect data was collected on May 29, 2014.

<u>Task 6: Development of HEC-RAS model and Model Calibration (Turners Falls Dam to Holyoke Dam)</u>

The data on the printed input files were entered into the HEC-RAS model and combined with the new transects collected by FirstLight from the Hatfield area. The FIS hydraulic model was re-constructed and validated by simulating the 100-year flood flow to ensure that the HEC-RAS model output—specifically, the water surface profile—reasonably matched the output shown in the FIS. Then the model was used to simulate various steady state flows similar to the methodology described above. For example, one of the flows simulated was a relatively constant flow throughout the 35-mile long reach experienced during the period for which FirstLight has WSEL data at the Route 116 Bridge and Rainbow Beach (4/30 to 10/24/2012). The measured WSEL at these two locations and at the Montague USGS gage was compared to that predicted by the model. The model was calibrated by adjusting Manning n values, within the reasonable range of n values.

After the FIS model was recreated and calibrated, it was updated by inserting the HEC-RAS transects included in the Corps/TNC hydraulic model of the Northampton area. The model was rerun again to ensure that the measured WSELs reasonably match modeled WSELs.

<u>Task 7: Unsteady Flow Model (Turners Falls Dam to Holyoke Dam)</u>

The model is being used to simulate unsteady flow conditions. Time varying flows are being used to determine WSEL changes at select locations in the 35-mile long reach. Sensitivity analyses are being conducted to evaluate the effect of various sources on WSEL fluctuations. WSEL fluctuations can be a function of, or influenced by, the Turners Falls Project, the Deerfield River Project, the WSEL maintained at Holyoke Dam and to a lesser extent, tributary inflow. For example, a time varying discharge hydrograph from the Turners Falls Project is being simulated while flows from the Deerfield River remain stable to determine the effect of the Turners Falls Project operations on water level fluctuations. Similarly, a constant discharge hydrograph from the Turners Falls Project is being simulated while the Deerfield River Project discharges vary. Finally, other combinations of flows, operating conditions at the Turners Falls and Deerfield River Project, and starting downstream boundary conditions (Holyoke Dam elevation) are being evaluated. A matrix of proposed model runs is included in Table 3.2.2-4 of the RSP. Output from the model will include WSEL and average channel velocities for various flows.

Task 8: Report

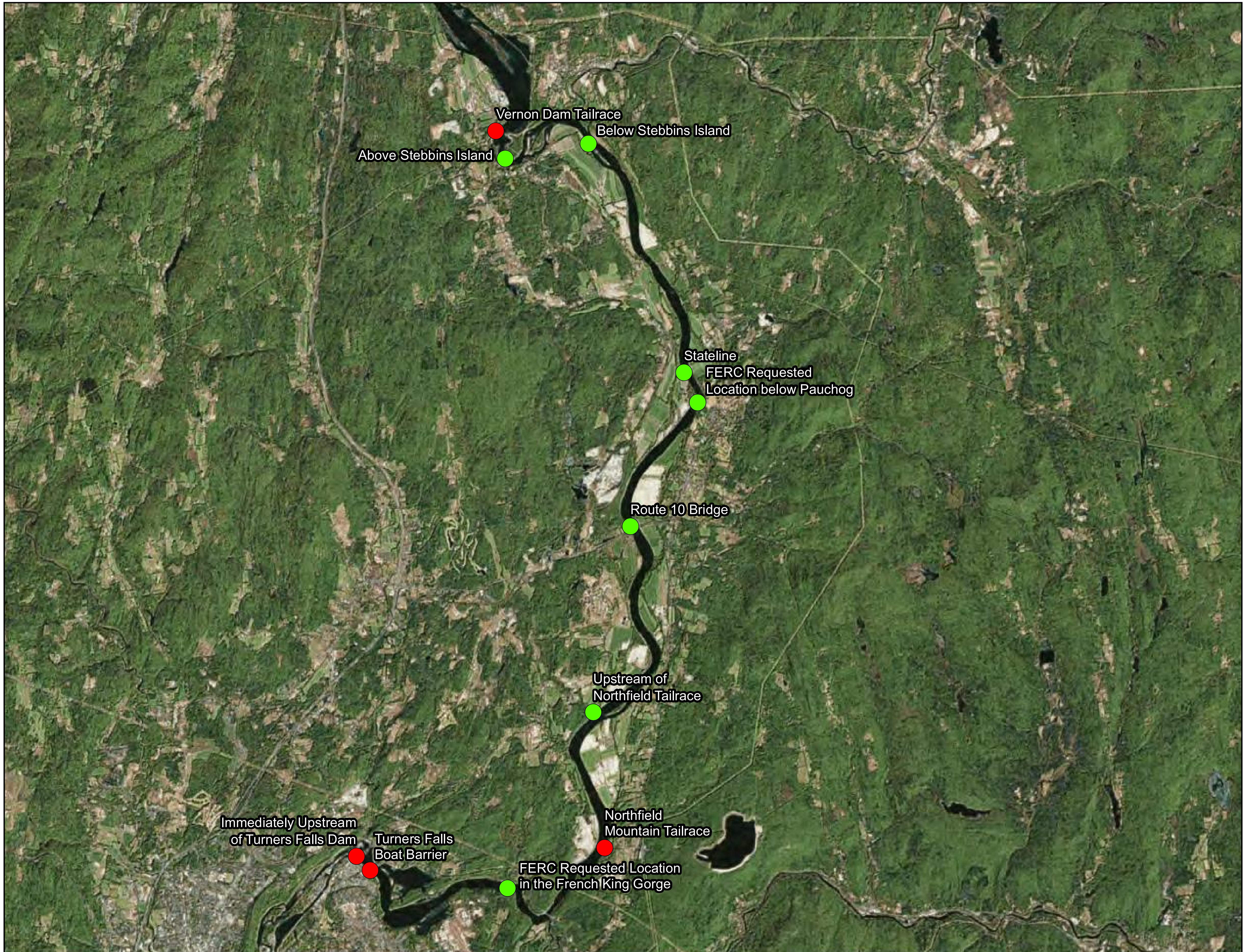
A report will be prepared for completion in the 1st quarter of 2015.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the RSP with the exception of a) having to collect transect data in the Hatfield area and b) FERC, in its SPDL, requested that water level loggers be installed in April 2013. As noted above the water level logger at the French King Gorge could not be installed until late April 2013 due to safety concerns.

1.4 Remaining Activities

Complete the hydraulic modeling and prepare the report.



Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.2.2
Figure 1
Plan Map of Turners Falls Impoundment Water Level Recorder Locations

Legend

- Existing Water Level Recorder
- Temporary Water Level Recorder

N

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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1 inch = 7,920 feet

FirstLight
GDF SUEZ

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Relicensing Study 3.3.1

CONDUCT INSTREAM FLOW HABITAT ASSESSMENTS IN THE BYPASS REACH AND BELOW CABOT STATION

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt

Gomez and Sullivan Engineers

SEPTEMBER 2014

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1.1 Study Summary and Consultation Record to Date

The purpose of this study is to assess the potential effects of a range of discharges from Turners Falls Dam, Station No. 1, and Cabot Station on wetted area and aquatic habitat suitability in the bypass reach and below Cabot Station. The study area for the Turners Falls Hydroelectric Project instream flow study comprises five separate reaches that are being evaluated using a variety of methods given their varying hydraulic and habitat characteristics. The first four study reaches (Reach 1-4) extend approximately 14 miles downstream from the Turners Falls Dam to the Route 116 Sunderland Bridge. The fifth reach (Reach 5) starts at the Route 116 Sunderland Bridge and extends downstream 22 miles.

Reach 1. Upper Bypass Reach. This reach is approximately one mile long, and extends downstream from the Turners Falls Dam to the confluence with the Station No. 1 tailrace. Instream flow methods in Reach 1 include a one-dimensional (1-D) Physical Habitat Simulation (PHABSIM) model and an empirical flow demonstration ("BOBSAR").

Reach 2. Lower Bypass Reach. This reach is approximately two miles long, and extends downstream from the Station No. 1 tailrace to an island complex (Rawson Island) and natural ledge drop known as "Rock Dam." Instream flow methods in Reach 2 include 1-D PHABSIM between Station No. 1 to just upstream from Rawson Island, and two-dimensional (2-D) hydraulic modeling in the lower portion of the reach where flow bifurcates around Rawson Island.

Reach 3. Tailrace Reach. The tailrace reach extends downstream approximately 1.75 miles from the Rock Dam/Rawson Island complex to USGS Gage No. 01170500 at Montague. Instream flow methods in Reach 3 include 2-D hydraulic modeling.

Reach 4. Downstream Reach. This reach is approximately nine miles long and extends from the Montague gage downstream to the Route 116 Sunderland Bridge. Instream flow methods in Reach 4 include 1-D PHABSIM modeling.

Reach 5. This reach extends downstream approximately 22 miles from the Route 116 Sunderland Bridge to a natural hydraulic control located in the vicinity of the Dinosaur Footprints wilderness reservation in Holyoke. The hydraulic modeling approach in this reach will rely on the Hydrologic Engineering Centers River Analysis System (HEC-RAS) model that is being developed as part of Study 3.2.2 (*Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station*) along with Delphi-developed habitat suitability index (HSI) criteria for any state or federally listed mussels found there.

FirstLight initiated habitat and hydraulic data collection in Reaches 1-3 in 2014. A summary description of the field data collection techniques employed and plans for 2014 and 2015 activities, as well as a summary of consultation to date, is provided below.

1.2 Study Progress Summary

<u>Task 1: Consult with Agencies and Interested Stakeholders to Determine Study Area, Study Reaches, and Habitat Suitability Index Curves</u>

The consultation documents described below are included in Appendix A to this Initial Study Report (ISR) summary.

FirstLight consulted with the stakeholders throughout the development of the study plan, and provided a record of consultation in the RSP (see RSP Section 3.9, *Matrix of Comments and Responses*), which was submitted to the Federal Energy Regulatory Commission (FERC) on August 14, 2013. Since issuance of the Study Plan Determination Letter (SPDL) on February 21, 2014, FirstLight has consulted with the stakeholders to further define the study approach.

On **March 28, 2014**, FirstLight emailed three documents to United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), United States Geological Survey Conte Lab (USGS), Massachusetts Division of Fish and Wildlife (MDFW), Massachusetts Natural Heritage and Endangered Species Program (NHESP), Connecticut River Watershed Council (CRWC), Trout Unlimited (TU), The Nature Conservancy (TNC), American Whitewater Association (AWWA), New England Flow (NE FLOW), Appalachian Mountain Club (AMC) and Karl Meyer for review and comment:

- Meeting notes from November 12, 2013 stakeholder meeting;
- Method for coding bedrock substrates found in the study area; and
- Draft method for conducting the Reach 1 empirical flow habitat assessment (braided riffle area).

Emailed comments were received from the CRWC (April 14, 2014), TNC (April 14, 2014) and MDFW (April 22, 2014). FirstLight provided responses to these comments via email on **May 5, 2014**.

On **June 6, 2014**, FirstLight emailed an addendum to the habitat suitability information regarding lamprey incubation and zone of passage, freshwater mussel host fish species criteria, and water level logger locations. Emailed comments were received from Karl Meyer (June 19, 2014), CRWC (June 20, 2014), and letter (July 3, 2014) was received from the USFWS.

On July 11, 2014, FirstLight emailed responses to these comments and provided information on the data collection schedule for the study. On July 14, 2014, Karl Meyer emailed additional comments.

Concurrent consultation occurred with the NHESP. On **March 13, 2014**, NHESP filed a letter requesting additional data collection and/or analysis for yellow lampmussel in Reach 3 of the bypass. Teleconferences with FirstLight, FERC, and NHESP were held on **May 6** and **May 15, 2014**. FERC issued meeting minutes and agreements of the May 15, 2014 teleconference.

The correspondence occurred in order to resolve issues related to this study plan, as outlined in FERC's SPDL. The issues where FERC determined additional consultation or modification of the study plan was warranted are summarized below:

- *Habitat Suitability Index (HSI) Development for Sea Lamprey*: FirstLight revised the HSI criteria for sea lamprey as recommended by USFWS, attached as Figure 1.

- *Transects at Shad Spawning Sites*: As recommended by FERC, FirstLight will place transects in representative spawning habitat within the project-affected areas of Reach 5 utilizing existing shad spawning data, in consultation with the technical study team.

- *Host Fish Habitat Modeling*: FERC recommended FirstLight evaluate project effects on the primary host fish of all state-listed mussels present in the project-affected area. FirstLight provided a proposed approach to stakeholders on June 6, 2014 (Appendix A). No additional comments were received on this proposal.

- *Velocity Profiles for Mussels:* FirstLight will collect mean column and benthic velocity data at representative transects at all three calibration flows in Reaches 4 and 5 to validate mean column velocities and any simulated benthic velocities, as recommended by FERC.

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- *Water Surface Level Monitoring Locations:* FirstLight installed additional water level loggers to validate/calibrate the proposed models in this study, as recommended by FERC. The locations were selected by the hydraulic modeling team and installed in places that would best facilitate model calibration.

- *Temperature Modeling for Mussels:* FERC recommends against collecting temperature data, modeling temperature, or including temperature in persistent habitat analyses for state-listed mussels as part of this study. FirstLight intends to collect temperature data as part of Study 3.2.1, *Water Quality Monitoring Study*.

- *Transect Locations for Mussels:* FirstLight proposes to identify transect locations in Reach 4 in consultation with the technical study team. All representative habitat types will be represented, as determined in the field by consensus of the technical study team.

Task 2: Method for Assessing State and Federally Listed Mussels

Under Task 3 in RSP 3.3.16 *Habitat Assessment, Surveys and Modeling of Suitable Habitat for State-Listed Mussel Species in the Connecticut River below Cabot*, FirstLight will develop quantitative binary HSI criteria for all state-listed mussel species documented in the 35-mile reach between Cabot Station and Dinosaur Footprints Reservation.

The field surveys for mussels in these areas were completed in 2014. The binary HSI criteria will be developed in Fall/Winter 2014, and then the screening level assessment tasks (2a) will occur after the field data for the respective reaches is complete.

Task 3: Field Data Collection

Reach 1 (Upper Bypass) and Reach 2 (Lower Bypass). FirstLight surveyed 11 cross-sectional habitat transects at three calibration flows from July 21-26, 2014. Each transect was located between cell boundary pairs that were established during the September 2013 site visit with agencies and stakeholders. Headpin and tailpins were located on the river banks above the 10,000 cfs water elevation, field blazed and geo-referenced with GPS. Four additional hydraulic transects were located as necessary to enhance modeling by defining backwatering and water surface profiles.

Habitat Data Collection – At each of the 11 habitat transects, FirstLight collected microhabitat data (*i.e.*, water depth, water velocity, water surface elevation, and substrate information) in accordance with the techniques described in the RSP. Field data were collected at three calibration flow targets (approximately 120, 700, and 4,000 cfs) released from the Turners Falls Dam. The low flow was released via the Turners Falls fishway and it was supplemented with discharge from Fall River (gaged at approximately 60 cfs) and leakage from Station No.1 (gaged at approximately 98 cfs). The mid- and high flows were released through the spillway fishway and Bascule Gate number 4.

Stream bed and bank cross-sectional profiles were surveyed during the low flow release (Photo 1). Bed elevation (to the nearest 0.01 foot) and substrate data were collected at intervals along each transect. All bed and bank elevations were surveyed to a common datum (*i.e.*, pre-established benchmarks). Temporary staff gages were established to monitor river stage during data collection both throughout the study area and on Fall River. Physical habitat data were collected with standard instream flow and stream gauging equipment (*e.g.*, autolevels and electronic velocity meters).

Hydraulic Data Collection **–** Velocity data were collected with an Acoustic Doppler Current Profiler (ADCP) or with a digital flow meter (Photo 2 – 3) at all habitat transects at both the low- and mid-calibration flow. The ADCP was used to collect physical and hydraulic data in Reaches 1 and 2 in non-wadable run or pool type habitats and to provide an estimate of calibration flow discharge. The ADCP was attached to a floating platform, tethered to the transect line, and drawn laterally across the stream channel to collect water velocity, depth, and discharge information throughout the water column.

In wadable areas, the velocity meter probe was attached to a topset wading rod that enabled measurements to be taken at 60 percent of total water depth (at stations less than 2.5 feet deep) and at 20 and 80 percent of total water depth (at stations greater than 2.5 feet deep). In non-wadable and/or turbulent water, a velocity meter was deployed from a boat-mounted USGS stationing rig mounted on a 14 foot raft that was used to traverse the transect during data collection. Surveyors typically collected three replicates of time-averaged velocity readings at stations where water depth was less than 2.5 feet and six time-averaged velocity readings (three replicates each at 20 and 80 percent of water depth) at stations where water depth was greater than 2.5 feet.

Water surface elevations were surveyed at each transect at each of the three calibration flows concurrent with associated microhabitat data collection.

Photo 1. Bed profile and water velocity data collection on a wadable transect at low flow.

Photo 2. Raft and stationing rig used for bed profile and water velocity data collection in unwadable areas.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Photo 3. Velocity data collection with an ADCP unit.

Reach 3. Water level recorders were installed from May 15-16, 2014 at 20 locations throughout the reach, plus one barometric pressure recorder; the sensors were programmed to collect data on 5-minute intervals and are still in place at the time of this report. The locations were selected by the hydraulic modeling team and installed in places that would best facilitate model calibration. During this time, two recorders were vandalized and reinstalled. One logger is buried in substrate and will be removed during low water conditions.

Depth and velocity data were collected using an ADCP at approximately 30 transects during a flow scenario of 8,500 cfs from Cabot Station and 120 cfs in the bypass reach (July 22-23, 2014).

On July 24, 2014, and August 28, 2014 depth and velocity data were collected using an ADCP during a flow scenario of 4,500 cfs from Cabot Station and 700 cfs in the bypass reach.

Bathymetry, topography, and habitat data were collected in wadable and walkable areas on July 1, 2014 using an RTK GPS upstream of Rock Dam. This survey is not complete, and is expected to be completed during the 3rd quarter of 2014. In deeper areas above Rock Dam, bathymetry data were collected using an ADCP on July 24-25, 2015. More bathymetry data will be collected during the third quarter of 2014 in the remainder of Reach 3 below Rock Dam.

Task 4: Hydraulic Modeling (Reaches 1-4)

FirstLight plans to complete hydraulic modeling in Reaches 1-4 in 2015. Survey data are presently being reviewed and entered into a format for use in modeling.

Task 5: Hydraulic Modeling (Reach 5)

FirstLight plans to complete hydraulic modeling in Reach 5 in the 4th quarter of 2015.

Task 6a: Habitat Modeling (Reaches 1-4)

FirstLight plans to complete habitat modeling in Reaches 1-4 4th quarter of 2014. Habitat modeling will commence following preparation of calibrated hydraulic models. FirstLight plans to review habitat modeling results for Reaches 1-3 in consultation with agencies and stakeholders in late 2014, and collectively will use the data to target flows for the empirical flow demonstration in the upper portion of Reach 1.

Task 6b: Persistent Potential Habitat Modeling (Reach 4 (if necessary) and 5, mussels only)

FirstLight plans to complete persistent potential habitat modeling in Reach 4 in the 1st quarter of 2015, if necessary. Persistent potential habitat modeling in Reach 5 for mussels will be undertaken in the 4th quarter of 2015.

Task 7: Habitat Time Series (Reaches 3 and 4)

FirstLight plans to undertake this task in the 4th quarter of 2015.

Task 8: Persistent Habitat Analysis and Mapping (Reach 3) and Dual Flow Analysis (Reach 4)

FirstLight plans to undertake this task in the 4th quarter of 2015.

Task 9: Study Report

FirstLight plans to provide a progress report to the stakeholders describing the initial results of habitat and hydraulic modeling in Reaches 1-3 by the 2nd quarter of 2015. This report will be used to guide additional scoping of work to be performed in Reach 1 and Reaches 4-5. FirstLight plans to provide a report of completed instream flow study activities in the ISR by the 4th quarter of 2015. A final instream flow study report is due to the Commission by March 1, 2016 (see Study Plan Determination Letter, Appendix C).

1.3 Variances from Study Plan and Schedule

The schedule for this study has deviated from the RSP. As described above, most of the field data collection for Reaches 1-3 has occurred in 2014, and remaining field data collection for Reaches 1, and 4-5 is proposed to occur in 2015, after stakeholder consultation. The reporting schedule is described above.

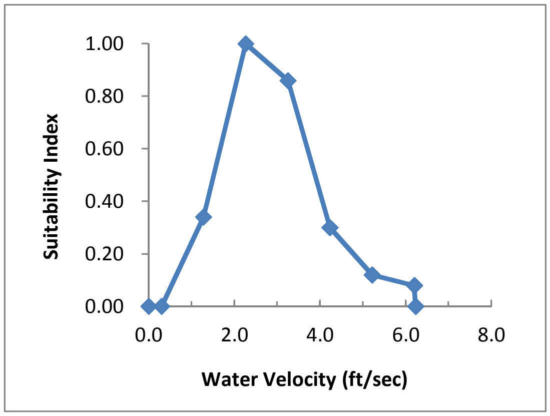
1.4 Remaining Activities

FirstLight anticipates that data analysis and reporting related to Reaches 1-3 will take place throughout the remainder of 2014 and early 2015. Scoping and stakeholder consultation for the Reach 1 (BOBSAR) and Reach 4 - 5 habitat and hydraulic assessments will take place prior to the 2015 field season. FirstLight anticipates completing Tasks 2 and 4-8 in 2014 and 2015.

Figure 1: Habitat Suitability Index, Sea Lamprey- Spawning & Incubation
Species: Sea lamprey
Lifestage: Spawning and Incubation

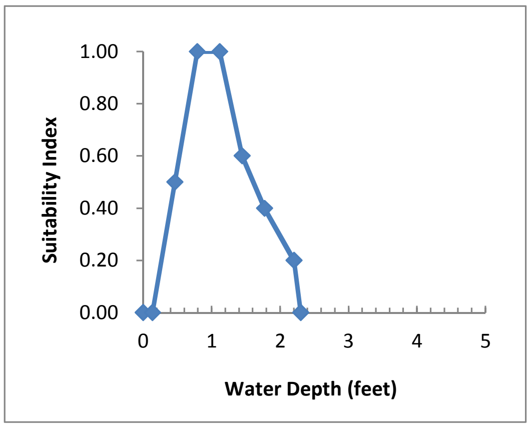
Velocity

Velocity	SI Value
0.00	0.00
0.30	0.00
1.28	0.34
2.26	1.00
3.25	0.86
4.23	0.30
5.22	0.12
6.20	0.08
6.23	0.00



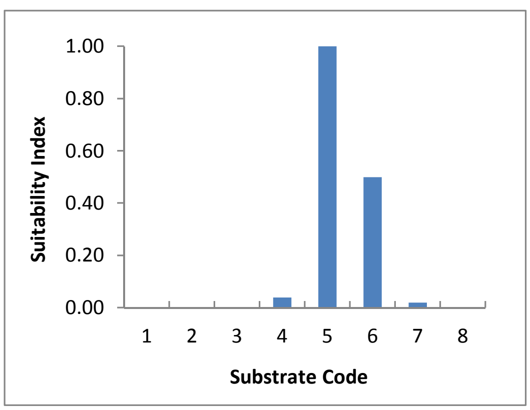
Depth

Depth	SI Value
0.00	0.00
0.13	0.00
0.46	0.50
0.79	1.00
1.12	1.00
1.44	0.60
1.77	0.40
2.20	0.20
2.30	0.00



Substrate

Substrate	SI Value	Type
1	0.00	Detritus/Organic
2	0.00	Mud/soft clay
3	0.00	Silt
4	0.04	Sand
5	1.00	Gravel
6	0.50	Cobble/rubble
7	0.02	Boulder
8	0.00	Bedrock



Source: Habitat Suitability Index for Sea Lamprey redds
Kynard and Horgan 2013
Revised depth and substrate per USFWS July 3, 2014 letter, extrapolated from Yergeau, 1983

Appendix A
Consultation Record from FERC SPDL through Initial Study Report Summary.

From:	Jason George
To:	"Tom Christopher"; "Andrea Donlon"; "Melissa Grader"; "peter.hazelton@state.ma.us"; "kkennedy@tnc.org"; "micah_kieffer@usgs.gov"; "Jesse Leddick"; "Bill McDavitt"; "karlm@crocker.com"; "Jessica Pruden"; "don.pugh@yahoo.com"; "sims@honors.umass.edu"; "Caleb Slater"; "Ken Sprankle"; "brett_towler@fws.gov"; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"
Cc:	"Howard, John"; "Brandon.Kulik@KleinschmidtUSA.com"; "glemay@gomezandsullivan.com"; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"
Subject:	FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting
Date:	Friday, March 28, 2014 3:33:00 PM
Attachments:	2013-11-12 Turners Falls IFIM agency meeting notes.pdf Turners Falls IFIM Study - Bedrock Coding Memo.pdf DRAFT Method for Conducting the Reach 1 Assessment - Stakeholder Copy.pdf

Dear FirstLight IFIM Study Stakeholders,

Attached are the meeting notes from our last meeting on this study, held on November 12, 2013. As a follow-up to this meeting, we have developed two documents which detail methods proposed for the following specific elements of this study:

Method for coding bedrock substrates found in the study area

Draft method for conducting the reach 1 empirical flow habitat assessment (braided riffle area)

Please submit any comments you may have on the attached within two weeks, or by April 14, 2014. Please address technical comments to Brandon Kulik (Brandon.Kulik@KleinschmidtUSA.com).

Since the last meeting, FERC issued its Study Plan Determination Letter on February 21, 2014 in which the Instream Flow Study Plan was approved with modifications. FirstLight is currently investigating the modifications to the study plan which may require further consultation, including specific HSI criteria for sea lamprey and related HSI criteria for primary host fish of state-listed mussels of concern in the project-affected area. We anticipate distributing draft recommendations on these subjects for your review and input in the near future.

Additionally, in response to your comments and as directed by the FERC Study Plan Determination Letter, FirstLight plans to install over 20 water level loggers in Reach 1-3 in order to ensure the accuracy of modeled conditions. The specific locations of the logger deployment will be determined in the field, and your previous comments regarding logger placement will be considered. Once installed, a map showing the locations will be provided to you.

Finally, we anticipate that additional consultation will be required to conduct the work in the downstream reaches in 2015. We look forward to working with you to make this a successful study.

Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, PO Box 2179

Gomez and Sullivan
Engineers and Environmental Scientists
41 Liberty Hill Road, PO Box 2179
Henniker, NH 03242
603-428-4960
FAX 603-428-3973

MEETING MINUTES

Meeting Date: November 12, 2013

Attendees: See attached sign in sheet

Re: Turners Falls IFIM Study- Study Team meeting - review of site visit, methodologies, and substrate code

All attendees met at the FirstLight Northfield Visitor's Center. Mark W. welcomed everyone and opened the meeting.

1. *Review Site Visit*

   Brandon K. led a discussion summarizing the outcome of the September 10-11, 2013 site visit (*notes detailing the site visit were provided*), in which the participants (most of whom were at today's meeting) viewed the study area on foot, to confirm study area boundaries, set 1-D model cell boundaries, and made other site-specific adjustments to the overall study plan based on direct observation and group discussion. Maps and aerial photos of each reach, overlaid with cell boundaries and transects were projected on a screen during the presentation.

2. *Approach for Reaches 1-3*

   The study area extends from the Turners Falls dam downstream to the confluence with the Deerfield River near the USGS gage. This area is divided into three distinct study reaches (*numbered consecutively from upstream to downstream*) with boundaries located at points where significant sources of flow such as tributaries or project discharges enter the river. At Melissa Grader's request, the review progressed from downstream to upstream, consistent with the order in which the site visit was conducted.

   Reach 3. This reach extends from the lower study area boundary upstream to the upstream end of the braided channel and Rawson Island complex and also defined by Rock Dam. The geomorphology of this reach is highly alluvial, with some bedrock outcrops, and is primarily riffle and run. This study area is influenced by both Cabot Station discharge and also collective flow releases from the Turners Falls dam as well as Station No. 1. Cabot Station is located at approximately the midpoint of this reach, and station flows are passed downstream but also backwater upstream to Rock Dam and into the braided channels under some conditions. These circumstances will be modeled using a 2-D model. Gary L. summarized the major data collecting and modeling approaches to be employed in this reach.

   Bill McDavitt asked why we broke reach two and three where we did – implying that it may be worth renaming the 2-D portion of reach 2 as part of reach 3. Brandon responded that it is worth differentiating where we have designated it since it will be easier to break out the area that is influenced by Cabot backwater. After some discussion, everyone agreed that we should keep the Cabot backwater influence limit as the reach 2-3 break.

   Reach 2. This reach extends from the Reach 3 boundary upstream to the discharge of Station No. 1. The stream geometry in this reach is primarily bedrock controlled, and is comprised of a large pool at the downstream end, and a run/riffle complex in the upper end. The lowermost segment of this reach will be represented by a 2-D model to account for the hydraulic where the channel braid bifurcations occur. The remainder of the reach will be represented by a traditional

1-D PHABSIM model. The study team broke this section up into a series of contiguous longitudinal cells (Cells A-K), based on the channel characteristics observed during the September walkover. Within each cell the channel characteristics are considered to be reasonably homogenous so that habitat within a cell can be represented by one transect within the cell. In a few limited cases, a repeating pattern of channel geometry was observed. In such cases the transect data from one similar cell will be used to represent habitat in the other similar cell to avoid redundancy. This scheme resulted in a total of 11 cells and nine transects.

Bill McDavitt was wondering if the angle of Station No. 1 entry would impact the model results in transect T9.

Reach 1. This reach extends from the Reach 2 boundary upstream to the Turners Falls dam. The stream channel of this reach is also bedrock controlled. It includes a large plunge pool immediately below the dam. The pool has two outlets, the primary one is a relatively well-defined channel (river right) that follows the right bank around a 90 degree outside river bend. It has numerous riffles and elevation breaks created by bedrock seams; the other outlet is less well defined, and cascades through bedrock and rubble micro-braids. Both channels converge and discharge to a pool that backwaters from just slightly above Station No. 1. A run extends from this pool to the Station No. 1 discharge.

The study team agreed that the plunge pool can be characterized by a bathymetric survey, and that the outlet channels would be difficult to accurately model. Instead, the team will jointly perform an empirical evaluation of demonstration flows that will be released to the reach from the dam and fishway. The specific flows will be targeted by the study team after reviewing IFIM model output from reaches 2 and 3. The team will collect empirical data in the two stream channels at each demonstration flow, and review and discuss the observations using applicable Habitat Suitability Criteria (HSC) and zone of passage criteria. First Light will draft a proposed plan to detail specifics for team review. Run habitat at the downstream end of Reach 1 will be modeled, using two 1-D PHABSIM transects. The team located cell boundaries as in Reach 2.

There was some discussion on what to do for the plunge pool area, with some confusion that a 2D hydraulic model would be implemented. Tom explained that at this time a 2-D model is contemplated to assess fish passage flows. For habitat, simply a bathymetry and topography survey is proposed to understand how wetted area changes with flow. John Warner mentioned that while he understands that the IFIM study doesn't have to understand pool hydraulics, the fish passage studies may need to address how the different bascule/tainter gates will impact pool velocities during passage seasons, and that we will have a discussion about this at a later date.

Melissa was wondering if there was an empirical data component to the braided riffle BOBSAR approach. Brandon explained that there would be an element of empirical data collection, probably with in-field transects and/or designated spot measurement locations chosen. Mark explained that we need to more clearly define our data collection and study objectives relative to this reach. **[Action Item –Circulate a study plan for the BOBSAR to stakeholders]**. In general, the group agreed that there will be more of an empirical approach to the braided riffle study area, rather than any modeling or simulation work.

John Warner mentioned that while we will use reach 2 and 3 results to inform reach 1 work, there is also the possibility that the reach 1 and reach 2/3 results may require looking at flows outside of those that reach 2/3 would initially suggest.

Melissa was wondering if the 1D model in reach 1 will be able to account for the backwater from Station No. 1. She was wondering if a 2D model would be needed. Tom explained that a 1D model can handle the backwater, and the only reason you would need a 2D model is if you were concerned about flow splits or other phenomena not easily explained in a 1D model.

Don was wondering how we would be tying all of the water surface elevations and bed elevations together in the 1D model. Tom and Brandon explained that the transect surveys will be surveyed into the same datum.

John Warner asked about how the Station No. 1 flows will be addressed in the 1D model portion of reach 1. Tom explained that Station No. 1 will essentially be modeled as a tributary where the backwater induced by the station flows will carry through both the reach 2 and reach 1 one-dimensional modeling.

Bill, Andrea and others had questions about why no habitat transect was going to be placed in cell M (the long pool upstream of Station No. 1 and downstream of the “elbow” area in the river). There was a discussion about the characteristics of that reach versus the area that is clearly a pool upstream of the bridge. The group thought that we should split cell M into two sections, with the split occurring about ~300 feet upstream of the bridge. Everyone agreed that T11 should be a habitat transect, with cell M being split into two cells. Everyone agreed that the pool portion of cell M does not need a transect (hydraulic or habitat).

3. *Substrate Coding*

Since the last meeting, GSE and Kleinschmidt had developed standardized substrate coding definitions, using the Wentworth scale to define particle sizes as a means to boulder distinguish boulder, cobble, gravel, etc. in the field. One issue that the team discussed during the September site visit is how to site-specifically rate habitat suitability in the bedrock controlled parts of the study area.

The group recognized that the available HSC that they team has selected are adequate overall other than that they consistently rate the suitability of bedrock as zero; this is based on the common definition of bedrock as a smooth featureless surface with few crevasses or refugia. However, portions of the study area dominated by bedrock differ from this description, as portions of the bedrock in this instance are comprised of folds and striations that provide a degree of refuge and foraging for aquatic organisms, and therefore, do not function as classically defined bedrock.

Katie suggested that we simply substitute boulder coding for folding bedrock in the field. Bill McDavitt mentioned that hydraulically that the folded bedrock probably acts more like cobble from a roughness standpoint. Katie was concerned with changing the HSI that have been established at this point, since we are essentially changing the coding for all bedrock (even the non-folded bedrock). John Warner and others suggested that we come up with a consistent method for identifying what the bedrock acts more like.

The team felt that such types of bedrock should be assigned a suitability value greater than zero, and discussed three alternatives:

A. Treat all crevassed-type bedrock as “Boulder” and assign the resulting HSC index value for a given species and lifestage,
B. Develop classifications for types of bedrock and assign new HSC values to each, possibly corresponding to those ranging from bedrock to cobble, or
C. A photo-based classification of Bedrock with unique HSC values for each. Under this scheme FirstLight would:
    a. Submit “field guide” definitions and photos of each bedrock sub-category to a committee of stakeholder. The stakeholder committee would agree on categories and proposed SI values.

[Action Item: It was agreed that Kleinschmidt would develop a first draft for group review.]

4. *Implications of Vermont Yankee Nuclear Power Plant Closure*

   Mark led a discussion about the upcoming FERC and agency meeting scheduled for November 25, 2013, to evaluate potential changes to scope and schedule for certain studies, resulting from the announcement regarding the closure of Vermont Yankee nuclear plant. The group concurred that this study scope would not be affected by the Vermont Yankee issue.

5. *Provisional Schedule*

   Mark stated that currently, FirstLight anticipates that the field data collection phase for the IFIM study would occur in early summer 2014. The study would have to be coordinated among other concurrent efforts to avoid conflicts and at times when flow control for each calibration flow set can be maintained. Model results would be made available in late summer so that results can be reviewed and discussed, and a subsequent Reach 1 flow demonstration can be scheduled. The study effort for Reaches 4 and 5 is dependent on completion of the freshwater mussel survey so that the locations of transects etc. can be better defined to account for that habitat assessment factor.

   There was some discussion about whether FERC should be cc'd on the study development process. Mark explained that the stakeholders will be informed on further developments or changes to any agreed-upon study plans, as well as those that don't have enough specifics in the existing study areas.

   The group agreed that FERC should be copied on some of the IFIM study plans as they are further developed. There may be some benefit to getting FERC onboard to help make the case why flows should be steady in the Connecticut River (and maybe the Deerfield) during the IFIM study collection.

SIGN-IN SHEET

11/12/13

Meeting in Northfield Visitors Center, Northfield, MA
Re: IF/M Study

Name	Affiliation	Email
Mark Wamser	Gomez + Sullivan	mwamser@gomezandsullivan.com
Jason George	"	
Gary Lemay	"	
Tom Sullivan	"	
BRANDON KULIK	KLEINSCHMIDT ASSOCIATES	brandon.kulik@kleinschmidtusa.c
John Howard	FirstLight	
Tom Christopher	NEFLOW	tom.christopher@comcast.net
Norm Sims	AMC	sims@honors.umass.edu
Andrea Donlon	CRWC	adonlon@ctriver.org
KARL MEYER	JOURNALIST	karlm@crocker.com
JESSE LEDDICK	MADFW-NHESP	jesse.leddick@state.ma.us
Bill McDavitt	NMFS	william.mcdavitt@noaa.gov
Bob Stira	FirstLight	
DON PUGH		don.pugh@yahoo.com
Bob Nasdor	AMERICAN WHITEWATER	BOB@AMERICANWHITEWATER.ORG
Katie Kennedy	TNC	kkennedy@tnc.org
Ken Sprankle	USFWS	Ken_sprankle@fws.gov
Melissa Grader	USFWS	Melissa_grader@fws.gov
John Warner	USFWS	john_warner@fws.gov
Caleb Slater	MADFW	Caleb.Slater@state.ma.us
Jess Pruden	NMFS - via phone	

MEMORANDUM

DATE: March 28, 2014

TO: Turners Falls Instream Flow Study Team

FROM: Brandon Kulik

RE: TURNERS FALLS IFIM STUDY BEDROCK SUBSTRATE CODING

The purpose of this memo is to recommend potential refinements to the classification of bedrock substrates and habitat suitability rating for use in the Turners Falls IFIM study.

The study team conducted a site visit to reaches 1, 2 and 3 (from Turners Falls Dam to Cabot tailrace) of the IFIM study on September 10-11, 2013. The focus of the site visit was study area orientation, to select transects, and refine study methods described in the Revised Study Plan (*see site visit summary notes*). During the site visit, the attendees observed that bedrock substrate is extensive, and dominates a significant portion of reaches 1 and 2. The bedrock substrate includes smooth as well as tilted and broken surfaces.

At the November 12, 2013 study team meeting, participants reviewed and discussed the results of the September 10-11, 2013 site visit; one issue that was identified for further development was suitability coding of bedrock substrates. Habitat Suitability Criteria (HSC) selected by the study team generally classifies bedrock as having low habitat suitability. This is because ordinary smooth bedrock lacks crevasses and pockets to shelter fish from high velocities, predators etc., prevents aquatic vegetation to anchor, or provides little opportunity for aquatic insects to anchor or burrow.

Variation in substrates

Photo Plate 1 illustrates a range of commonly occurring substrate conditions throughout reaches 1 and 2. Bedrock occurs in both complex forms, including folds, striations and crevasses (Photo 1) as well as in smooth, flat surfaces (Photo 2), sometimes overlain with boulder or cobble fragments, chiefly from broken or eroding rock materials (Photo 2a). In some instances these bedrock areas are extensive (Photo 3).

Other common substrates include boulder, cobble and gravel (Photos 4 through 6). In some locations, bedrock is overlain with patches of these other substrates (Photos 3a through 5).

Recommendation

A field coding and model application protocol for substrate suitability should be straightforward so that it can be efficiently and consistently interpreted by field technicians and objectively applied to the model analysis in the office. We recommend the following approach.

There appear to be four types of bedrock conditions that may provide differing levels of habitat suitability. These are smooth bedrock ("Type 1"), complex bedrock ("Type 2"), bedrock densely overlain with smaller substrates such as cobble/boulder ("Type 3"), and bedrock sparsely overlain with smaller substrates such as cobble/boulder ("Type 4").

Type 1. Smooth bedrock. This condition lacks sufficient cover, crevasses or other features that provide shelter or foraging opportunities for fish and is consistent with a low suitability rating. We do not recommend altering the suitability rating for this type of substrate.

Type 2. Complex Bedrock. This condition provides a degree of shelter; based on the size and geometry of the folds and striations, the variability appears to generally mimic boulder-sized substrates (See photos 1 and 1a). For that reason we suggest assigning the same suitability rating to this type of bedrock for a given species as would be assigned if it was boulder substrate.

Type 3. Bedrock densely overlain with smaller substrates. This condition provides shelter and foraging opportunity (see photos 3a and 4). In situations where overlying substrates are abundant (*i.e. greater than 50% of the stream bottom*) we recommend classifying the substrate as if it was the dominant smaller material and assigning the same suitability rating to this type of dominant smaller substrate present for a given species.

Type 4. Bedrock sparsely overlain with smaller substrates. This condition provides limited shelter and foraging opportunity (see photos 2a and 5). In situations where overlying substrates are sparse *(i.e. less than 50% of the stream bottom*) we recommend classifying the substrate as if it was the dominant bedrock material (type 1 or type 2) and assigning the same suitability rating to this type of dominant material present for a given species.

PHOTO PLATE 1. COMMON SUBSTRATES FOUND AT TURNERS FALLS

1. **Complex bedrock (reach 1)**

1a. Complex bedrock (reach 2)

2. **smooth bedrock**

2a. Smooth Broken bedrock (reach 1)

3. **Bedrock expanse**

3a. Bedrock expanse covered by boulder/cobble

TYPES OF BEDROCK SUBSTRATES FOUND AT TURNERS FALLS *(continued)*

4. Bedrock/Boulder/Cobble

4.a Cobble

5. Smooth bedrock overlain with cobble

5.a cobble

6. Gravel

Gravel

DRAFT Method for Conducting the Reach 1 Empirical Flow Habitat Assessment

March 28, 2014

The study area will include the fluvial channel portion of the bypassed reach of the Connecticut River that extends from the outlet of the plunge pool below the Turners Falls Dam downstream to the backwatered riverine pool (see Figure 1). Aquatic habitat in this area includes a complex braiding of shallow riffles and runs, defined by bedrock outcrops, rubble, and other smaller substrates.

1.0 PROPOSED METHODOLOGY

FirstLight proposes to conduct this study in a phased approach.

1.1 Phase 1. IFIM Flow Assessment

FirstLight will first perform the IFIM study in reaches 2 and 3, and the lowermost portion of Reach 1 as described in the Revised Study Plan. The study team will then evaluate these data to define a flow range of interest to evaluate in this study area, and propose a series of flow increments within that range for empirical observation.

1.2 Phase 2. Instream Flow Assessment

Prior to conducting field work, FirstLight will consult with the stakeholder team to select applicable aquatic species and lifestages for evaluation. This may include some or all of the same species and life stage Habitat Suitability Criteria (HSC)[1] applied to other study areas, and/or zone of passage considerations[2]. The flow assessment will be comprised of collecting empirical habitat suitability data in the study area at a series of flows at representative transects and/or locations selected in the field by the study team. FirstLight anticipates that approximately four flows may be evaluated; however the study team will make the final determination.

[1] The HSC ranks the suitability of depth, velocity and substrate/cover on a scale from 0.0 (unsuitable) to 1.0 (optimal).

[2] For purposes of this assessment FirstLight recommends zone of passage criteria cited by Bovee (1982) which provides for a minimum water depth of no less than 2/3 the body depth of the largest fish expected to pass the most limiting channel constriction.

Each flow will be provided by opening gates and /or the fishway, to introduce each targeted flow to the plunge pool. The range of flows to be provided has not been identified; however, FirstLight proposes to pass these flows through the fish ladder or Bascule Gate No. 1, which automatically adjusts its position to pass the same flow if the Turners Falls Impoundment elevation fluctuates. Note that the other bascule gates and the taintor gates are not "pond following" gates. To facilitate this, the study will occur at a time when project inflow is relatively stable, and within the range of the station's hydraulic capacity. To the extent that field conditions allow, the assessment will be conducted as a continuous sequential event over one or two consecutive days. Corresponding water surface elevations will be surveyed on transects or referenced by staff gage readings so that changes in wetted area can be documented.

Manual stream flow gaging in the study area will be difficult due to the channel characteristics. As an alternative, each study flow will be determined by gate setting calculations. More specifically, gate rating curves are available to calculate the discharge. The discharge contributed from Fall River will be manually gaged at the time of the study.

Once each evaluation flow is stabilized (verified by monitoring staff gages in Reach 1), the study participants will gather depth, velocity, and wetted substrate data along each pre-established transect and/or reference point(s) throughout the study area. These locations will be mapped and/or geo-referenced using GPS, so that the same location can be measured at each flow and the information transferred to GIS in reports.

During analysis, each resulting recorded HSC variable (depth, velocity and substrate/cover) will be determined for each selected species and lifestage by an index score value at each transect vertical or other reference point according to the following table:

HSI VALUE RANGE	NARRATIVE VALUE	INDEX SCORE
0.75 - 1.00	High	4
0.50 - 0.74	Good	3
0.25 - 0.49	Fair	2
0.0 – 0.24	Poor	1

The suitability of each vertical along each transect (or other loci selected) will be ranked according to how the prevailing depth, velocity, and substrate/cover measurements in the field relate to the HSC at each flow. The net habitat score for each transect will be the sum of the index score for each vertical, followed by summing all vertical scores across the transect.

For example, an optimal single vertical with perfect "High" suitability habitat would have a score of 12:

$$\text{Depth (4)} + \text{Velocity (4)} + \text{Substrate (4)} = 12.$$

Assuming that there were 25 verticals established across a transect, and if all criteria were theoretically ranked as "High" for the given flow, the resulting transect score would be $12_1 + 12_2 + \ldots 12_{25} = 300$. This would be performed for each agreed-upon species/life stage. Other potential non-transect loci such as non-linear patches of habitat (should they exist), would be similarly rated, but based on spot measurements rather than a linear transect. The rank scores resulting for each transect (or other site) at each flow will be provided in both tabular and graphic form, so that changes in habitat suitability across the flow range of interest can be readily compared and a suitability rating curve across the flow range established. Each transect at each flow will be photo-documented, with photos attached as a report appendix.

REFERENCES

Bovee, K.D. (1982). A guide to stream habitat analysis using the instream flow incremental methodology. (Office of Biol. Service FWS/OBS-82-26). Washington, DC: USFWS, U.S. Dept. of Interior.

Figure 1: Reach 1 Empirical Flow Habitat Assessment Study Area.

From:	Andrea Donlon
To:	"Jason George"; "Tom Christopher"; "Melissa Grader"; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; "Jesse Leddick"; "Bill McDavitt"; karlm@crocker.com; "Jessica Pruden"; don.pugh@yahoo.com; sims@honors.umass.edu; "Caleb Slater"; "Ken Sprankle"; brett_towler@fws.gov; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"
Cc:	"Howard, John"; Brandon.Kulik@KleinschmidtUSA.com; glemay@gomezandsullivan.com; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"
Subject:	RE: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting
Date:	Monday, April 14, 2014 2:35:20 PM

Brandon,

Here are comments from CRWC on the attachments sent out by Jason George on 3/28/14.

1. Meeting minutes from November 12, 2013.

The minutes mostly capture the key elements of our discussion. A couple of things I noted in my notes that aren't in the minutes are as follows:

- We discussed coordinating with upstream peaking operations, if possible. Nothing was specifically stated about whether that includes Northfield Mountain, but I guess that remains a question as to what that facility will be doing during some of the IFIM field work days.
- We also heard that water level loggers were going to be pulled out of the river just before Thanksgiving, and re-installed in March (not sure if that happened).

2. Bedrock substrate coding.

As long as the fisheries biologists feel that the complex bedrock in the bypass section of the CT River is functionally equivalent to boulder substrate, this approach seems reasonable. My only suggestion is that the 4 types of bedrock conditions listed in this memorandum be matched with the photos better, for clarity purposes. If Smooth Bedrock is Type 1, there should be a set of photos coded Type 1 with captions underneath. Type 2 photos should be organized together as well. Currently, it is confusing that photos labeled with a 1 are type 2 and vise-versa.

3. Draft method for conducting Reach 1 Empirical Flow Habitat Assessment (aka BOBSAR study plan, I think).

The last sentence says that "Each transect at each flow will be photo-documented, with photos attached as a report appendix." Please correct me if I'm wrong, but I think there are only two transects in Reach 1: T-11 in Cell M (which is going to be split into 2) and T-10 in Cell L. Photo documentation will be very important to document water levels in the braided riffle section of the river, and under this plan there will be no photo documentation because there are no transects. I would recommend that a future draft of this method include proposed photo points for this area. Ideally, it would be great to climb up the mill building brick smoke stack tower to get an aerial view of the entire area to document what the whole area looks like at specific flow points.

In general, I think more details are needed about what you plan to do during the four test flows in the Pool section just below the dam and the braided riffle section.

Andrea

____

Andrea Donlon, River Steward
CONNECTICUT RIVER WATERSHED COUNCIL, INC.
15 Bank Row
Greenfield MA 01301
Phone: (413)772-2020 x. 205
Fax: (413)772-2090
adonlon@ctriver.org
Become a member today! Join at www.ctriver.org.
CRWC is on Facebook—become a fan

From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, March 28, 2014 3:34 PM
To: 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; 'Jesse Leddick'; 'Bill McDavitt'; karlm@crocker.com; 'Jessica Pruden'; don.pugh@yahoo.com; sims@honors.umass.edu; 'Caleb Slater'; 'Ken Sprankle'; brett_towler@fws.gov; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'
Cc: 'Howard, John'; Brandon.Kulik@KleinschmidtUSA.com; glemay@gomezandsullivan.com; 'Stira, Robert'; 'Tom Sullivan'; 'Mark Wamser'
Subject: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting

Dear FirstLight IFIM Study Stakeholders,

Attached are the meeting notes from our last meeting on this study, held on November 12, 2013. As a follow-up to this meeting, we have developed two documents which detail methods proposed for the following specific elements of this study:

1. Method for coding bedrock substrates found in the study area
2. Draft method for conducting the reach 1 empirical flow habitat assessment (braided riffle area)

Please submit any comments you may have on the attached within two weeks, or by April 14, 2014. Please address technical comments to Brandon Kulik (Brandon.Kulik@KleinschmidtUSA.com).

Since the last meeting, FERC issued its Study Plan Determination Letter on February 21, 2014 in which the Instream Flow Study Plan was approved with modifications. FirstLight is currently investigating the modifications to the study plan which may require further consultation, including specific HSI criteria for sea lamprey and related HSI criteria for primary host fish of state-listed mussels of concern in the project-affected area. We anticipate distributing draft recommendations on these subjects for your review and input in the near future.

Additionally, in response to your comments and as directed by the FERC Study Plan Determination Letter, FirstLight plans to install over 20 water level loggers in Reach 1-3 in order to ensure the accuracy of modeled conditions. The specific locations of the logger deployment will be determined in the field, and your previous comments regarding logger placement will be considered. Once installed, a map showing the locations will be provided to you.

Finally, we anticipate that additional consultation will be required to conduct the work in the downstream reaches in 2015. We look forward to working with you to make this a successful study.

Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, PO Box 2179
Henniker, NH 03242
Office: (603) 428-4960
Cell: (603) 340-7666

From: Katie Kennedy
To: Brandon Kulik
Cc: "Howard, John"; glemay@gomezandsullivan.com; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"; Jason George; "Tom Christopher"; "Andrea Donlon"; "Melissa Grader"; peter.hazelton@state.ma.us; micah_kieffer@usgs.gov; "Jesse Leddick"; "Bill McDavitt"; karlm@crocker.com; "Jessica Pruden"; don.pugh@yahoo.com; sims@honors.umass.edu; "Caleb Slater"; "Ken Sprankle"; brett_towler@fws.gov; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"
Subject: RE: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting
Date: Monday, April 14, 2014 4:43:57 PM
Attachments: image004.png

Brandon – Here are my technical comments for the bedrock coding and the methods for Reach 1:

Bedrock coding: I think the description of the four bedrock types and the methods to classify them are thoughtful and sufficient. It may also be useful, as suggested by CRWC, to explicitly align the photos in the memo with these four classes.

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- The methods do not state the number of transects/locations, but as I understand it that is still TBD by the "Study Team." I suggest that this is made a bit more explicit.
- In terms of the results, I'm assuming that we will be able to see (in some form) not only the final score, but the individual habitat component measures for each transect/location under each flow. Would you also make this more explicit? I just want to be sure that I will be able to view the spatial relationships of the data if needed.

Thank you!
Katie Kennedy

Please consider the environment before printing this email.

Kathryn D. Mickett Kennedy
Applied River Scientist
kkennedy@tnc.org
(413) 586 2349 (Office)
(413) 588 1959 (Cell)

The Nature Conservancy
Connecticut River Program
136 West Street, Suite 5
Northampton MA 01060

The Nature Conservancy
Protecting nature. Preserving life.

nature.org/ctriver

From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, March 28, 2014 3:34 PM
To: 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; peter.hazelton@state.ma.us; Katie Kennedy; micah_kieffer@usgs.gov; 'Jesse Leddick'; 'Bill McDavitt'; karlm@crocker.com; 'Jessica Pruden'; don.pugh@yahoo.com; sims@honors.umass.edu; 'Caleb Slater'; 'Ken Sprankle'; brett_towler@fws.gov; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'
Cc: 'Howard, John'; Brandon.Kulik@KleinschmidtUSA.com; glemay@gomezandsullivan.com; 'Stira, Robert'; 'Tom Sullivan'; 'Mark Wamser'
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Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, PO Box 2179
Henniker, NH 03242
Office: (603) 428-4960
Cell: (603) 340-7666

From: Slater, Caleb (MISC)
To: Jason George
Subject: RE: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting
Date: Tuesday, April 22, 2014 10:02:53 AM
Attachments: 2013-11-12 Turners Falls IFIM agency meeting notes.pdf
Turners Falls IFIM Study - Bedrock Coding Memo.pdf
DRAFT Method for Conducting the Reach 1 Assessment - Stakeholder Copy.pdf

---

Jason,

Sorry about the delay- DFW is fine with the methods outlined here.

Caleb

Caleb Slater, PhD
Anadromous Fish Project Leader
Massachusetts Division of Fisheries and Wildlife
PLEASE NOTE NEW FIELD HEADQUARTERS ADDRESS (Phones and Emails have not changed.)
Mass. Division of Fisheries & Wildlife
100 Hartwell Street, Suite 230
West Boylston MA 01583
508-389-6331
www.mass.gov/masswildlife

From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, March 28, 2014 3:34 PM
To: 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; Hazelton, Peter (FWE); kkennedy@tnc.org; micah_kieffer@usgs.gov; Leddick, Jesse (FWE); 'Bill McDavitt'; karlm@crocker.com; 'Jessica Pruden'; don.pugh@yahoo.com; sims@honors.umass.edu; Slater, Caleb (FWE); 'Ken Sprankle'; brett_towler@fws.gov; 'John Warner'; Marold, Misty-Anne (FWE); 'Bob Nasdor'
Cc: 'Howard, John'; Brandon.Kulik@KleinschmidtUSA.com; glemay@gomezandsullivan.com; 'Stira, Robert'; 'Tom Sullivan'; 'Mark Wamser'
Subject: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting

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Additionally, in response to your comments and as directed by the FERC Study Plan Determination Letter, FirstLight plans to install over 20 water level loggers in Reach 1-3 in order to ensure the accuracy of modeled conditions. The specific locations of the logger deployment will be determined in the field, and your previous comments regarding logger placement will be considered. Once installed, a map showing the locations will be provided to you.

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From: Brandon Kulik
To: Katie Kennedy
Cc: "Howard, John"; glemay@gomezandsullivan.com; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"; Jason George; "Tom Christopher"; "Andrea Donlon"; "Melissa Grader"; peter.hazelton@state.ma.us; micah_kieffer@usgs.gov; "Jesse Leddick"; "Bill McDavitt"; karlm@crocker.com; "Jessica Pruden"; don.pugh@yahoo.com; sims@honors.umass.edu; "Caleb Slater"; "Ken Sprankle"; brett_towler@fws.gov; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"
Subject: RE: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting
Date: Monday, May 05, 2014 10:35:31 AM
Attachments: image002.png

Dear FirstLight IFIM Study Participants,

Pursuant to Jason George's email of March 28, 2014 , The Nature Conservancy and Connecticut River Watershed Council circulated comments pertaining to the following two documents from:

1. Method for coding bedrock substrates found in the study area
2. Draft method for conducting the reach 1 empirical flow habitat assessment (braided riffle area)

Thanks for your prompt review and input. Here are our responses:

Katie Kennedy (TNC) comments*:*

bedrock coding and the methods for Reach 1:

Bedrock coding: I think the description of the four bedrock types and the methods to classify them are thoughtful and sufficient. It may also be useful, as suggested by CRWC, to explicitly align the photos in the memo with these four classes. **We concur, and will re-organize the photos along with the narrative**

Reach 1 Methods: I think these generally look fine. A couple of minor points:

The methods do not state the number of transects/locations, but as I understand it that is still TBD by the "Study Team." I suggest that this is made a bit more explicit.

That is correct. The flow demonstration transects are strictly for empirical

measurements at points of interest and will be collectively selected by the study team attendees at the time of the flow demonstration. These transects are not part of the PHABSIM flow model and therefore have no computational relationship to the PHABSIM model transects.

> *In terms of the results, I'm assuming that we will be able to see (in some form) not only the final score, but the individual habitat component measures for each transect/location under each flow. Would you also make this more explicit? I just want to be sure that I will be able to view the spatial relationships of the data if needed.*

As noted in the study plan, the individual habitat suitability scores will be derived from empirical transect measurements (depth, velocity etc) that will recorded in the field at each demonstrated flow. We anticipate that the contributing raw data and resulting scoring for each locus along each transect will be included in tabular and graphic form in the ensuing report.

Andrea Donlon comments from CRWC:

1. Meeting minutes from November 12, 2013.
The minutes mostly capture the key elements of our discussion. A couple of things I noted in my notes that aren't in the minutes are as follows:

- *We discussed coordinating with upstream peaking operations, if possible. Nothing was specifically stated about whether that includes Northfield Mountain, but I guess that remains a question as to what that facility will be doing during some of the IFIM field work days.).* **FirstLight will notify TransCanada in advance of the field work, but they have no authority to limit TransCanada's peaking operations from Vernon. FirstLight will strive to manage operations so as to provide the stable flows needed during the IFIM data collection period.**
-
- *We also heard that water level loggers were going to be pulled out of the river just before Thanksgiving, and re-installed in March (not sure if that happened).* **Although not germane to the IFIM study, water level**

loggers in the Turners Falls Impoundment were installed before the spring runoff in March, with the exception of the water level logger near the French King Bridge—this one could not be installed due to safety concerns.

2. *Bedrock substrate coding.*

As long as the fisheries biologists feel that the complex bedrock in the bypass section of the CT River is functionally equivalent to boulder substrate, this approach seems reasonable. My only suggestion is that the 4 types of bedrock conditions listed in this memorandum be matched with the photos better, for clarity purposes. If Smooth Bedrock is Type 1, there should be a set of photos coded Type 1 with captions underneath. Type 2 photos should be organized together as well. Currently, it is confusing that photos labeled with a 1 are type 2 and vise-versa. **See comments above**

3. *Draft method for conducting Reach 1 Empirical Flow Habitat Assessment (aka BOBSAR study plan, I think).*

The last sentence says that "Each transect at each flow will be photo-documented, with photos attached as a report appendix." Please correct me if I'm wrong, but I think there are only two transects in Reach 1: T-11 in Cell M (which is going to be split into 2) and T-10 in Cell L. Photo documentation will be very important to document water levels in the braided riffle section of the river, and under this plan there will be no photo documentation because there are no transects. **The transects to which you are referring are part of the PHABSIM model; however, the flow demonstration transects are not, and they will be collectively selected by the study team attendees at the time of the flow demonstration. These flow demonstration transects have no direct computational relationship to the PHABSIM model. They are strictly for empirical measurements at points of interest specifically in the braided stream section below the large pool outlet that your comment refers to. The empirical flow demonstration approach was chosen for this braided channel area as an alternative to modeling, explicitly because it would be difficult to accurately model**.

I would recommend that a future draft of this method include proposed photo *points for this area. Ideally, it would be great to climb up the mill building brick smoke stack tower to get an aerial view of the entire area to document what the whole area looks like at specific flow points*

It is unlikely that we will photograph the flow demonstration study from the smoke stack tower due to safety concerns, and also because of its distance away from the stream channel. In our experience, the most revealing information from flow demonstration photos is invariably the changes in close-up microhabitat details such as micro chutes, eddies and other localized hydraulics that change at various flows. These would probably not be perceptible from a photo taken from the perspective of a distant tower.

In general, I think more details are needed about what you plan to do during the four test flows in the Pool section just below the dam and the braided riffle section.

The pool below the dam is wide shallow banked, and has complex outlets. As stated in the PHABSIM study plan, a bathymetric survey will be conducted in the pool immediately below the dam to characterize its volume, and the outlet bed elevations will be surveyed to provide insight as to how they control water elevations and also how water discharges from each outlet to the braided riffles.

The pool below the braided riffle section is relatively deep, with uniform banks and a straightforward hydraulic control. The study team concluded that it was unnecessary to model or analyze this pool because this pool is inherently insensitive to incremental flow changes. It was evident during the September 2013 site visit that the hydraulics are relatively static compared to riffles and runs. i.e pool depth and mean column velocities do not vary significantly at flows of interest. The chief value of the pool is to serve as refuge and resting area when fish elect to leave adjacent riffle/run habitat. It was evident to the biologists on the site visit that this habitat service will exist throughout the flow range of interest in the study and thus data collected in the pool would not likely yield useful decision data.

We appreciate you taking the time to review the materials and providing comments.

Sincerely,

Brandon Kulik

Brandon H. Kulik
Senior Fisheries Scientist
Kleinschmidt
Pittsfield, Maine
207-487-3328

From: Katie Kennedy [mailto:kkennedy@TNC.ORG]
Sent: Monday, April 14, 2014 4:44 PM
To: Brandon Kulik
Cc: 'Howard, John'; glemay@gomezandsullivan.com; 'Stira, Robert'; 'Tom Sullivan'; 'Mark Wamser'; Jason George; 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; peter.hazelton@state.ma.us; micah_kieffer@usgs.gov; 'Jesse Leddick'; 'Bill McDavitt'; karlm@crocker.com; 'Jessica Pruden'; don.pugh@yahoo.com; sims@honors.umass.edu; 'Caleb Slater'; 'Ken Sprankle'; brett_towler@fws.gov; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'
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Thank you!
Katie Kennedy

Please consider the environment before printing this email.

Kathryn D. Mickett Kennedy
Applied River Scientist
kkennedy@tnc.org

The Nature Conservancy
Connecticut River Program
136 West Street, Suite 5

(413) 586 2349 (Office)
(413) 588 1959 (Cell)

Northampton MA 01060

The Nature Conservancy
Protecting nature. Preserving life.

nature.org/ctriver

From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, March 28, 2014 3:34 PM
To: 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; peter.hazelton@state.ma.us; Katie Kennedy; micah_kieffer@usgs.gov; 'Jesse Leddick'; 'Bill McDavitt'; karlm@crocker.com; 'Jessica Pruden'; don.pugh@yahoo.com; sims@honors.umass.edu; 'Caleb Slater'; 'Ken Sprankle'; brett_towler@fws.gov; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'
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Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, PO Box 2179
Henniker, NH 03242
Office: (603) 428-4960
Cell: (603) 340-7666

From:	Jason George
To:	"Andrea Donlon"; "Melissa Grader"; "peter.hazelton@state.ma.us"; "kkennedy@tnc.org"; "micah_kieffer@usgs.gov"; "Jesse Leddick"; "Bill McDavitt"; "karlm@crocker.com"; "Jessica Pruden"; "don.pugh@yahoo.com"; "Caleb Slater"; "Ken Sprankle"; "brett_towler@fws.gov"; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"; "Tom Christopher"; "sims@honors.umass.edu"
Cc:	"Howard, John"; "Brandon Kulik"; "glemay@gomezandsullivan.com"; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"
Subject:	RE: FirstLight Turners Falls IFIM - HSI and status update
Date:	Friday, June 06, 2014 10:03:00 AM
Attachments:	WaterLevelLoggers - Reach 3 Upper1.pdf WaterLevelLoggers - Reach 3 Lower1.pdf 2014-06-06_Turners Falls HSI addendum.pdf

Dear FirstLight IFIM Study Stakeholders,

Attached is a memo describing our approach to the outstanding habitat suitability assessments for lamprey incubation and zone of passage and freshwater mussel host fish species. Also attached is a map showing the water level loggers installed in Reach 3. Additional water level loggers will be installed in Reaches 1 and 2 during the test flows to validate/calibrate the proposed models in this study.

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Please respond within two weeks, or by June 20, 2014, with any comments, questions or concerns regarding the attached materials. Thank you.

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From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, March 28, 2014 3:34 PM
To: 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; 'peter.hazelton@state.ma.us'; 'kkennedy@tnc.org'; 'micah_kieffer@usgs.gov'; 'Jesse Leddick'; 'Bill McDavitt'; 'karlm@crocker.com'; 'Jessica Pruden'; 'don.pugh@yahoo.com'; 'sims@honors.umass.edu'; 'Caleb Slater'; 'Ken Sprankle'; 'brett_towler@fws.gov'; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'
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MEMORANDUM

TO: Turners Falls Project Instream Flow Study Stakeholders

FROM: Brandon Kulik

DATE: June 6, 2014

RE: **INSTREAM FLOW STUDY: HABITAT SUITABILITY CRITERIA**

FirstLight met with study team members on May 8, 2013 to discuss and refine study-specific Habitat Suitability Criteria (HSC). Based on those discussions, FirstLight issued a memo on May 30, 2013, recommending additional HSC for the IFIM study at Turners Falls.

The purpose of this memo is to continue to resolve a few HSC details resulting from subsequent consultation, culminating in the FERC study plan determination letter (February 21, 2014). The two outstanding issues are:

1. further consultation regarding lamprey incubation and zone of passage
2. freshwater mussel host fish species criteria

HSI Development for Sea Lamprey (FERC SPD letter, B-7)

> *"The National Marine Fisheries Service (NMFS) requests that FirstLight add sea lamprey incubation criteria to reaches 1 and 2. Both NMFS and Donald Pugh suggests FirstLight add sea lamprey zone of passage criteria to reaches 1 and 2."*
>
> *" we do not recommend any specific changes to the HSI criteria or HSI application at this time. If the technical study team cannot reach consensus on specific HSI criteria for sea lamprey or other species, FirstLight should proceed with the study as described in the study plan and file the Initial Study Report as required by section 5.15(c) of the Commission's regulations. After comments and responses to comments on the Initial Study Report are received, we would make a determination regarding any outstanding issues including the need for additional data analysis based on alternative HSI criteria."*

Host Fish Habitat Modeling (FERC SPD letter, B-10)

> *"we recommend FirstLight evaluate project effects on the primary host fish of all state-listed mussels present in the project-affected area in addition to the proposed evaluation of tessellated darter. Previous mussel surveys and proposed surveys in study 3.3.16 - Habitat Assessment, Surveys and Modeling of Suitable Habitat for State listed Mussel Species would determine which state-listed mussel species are present in the project-affected area. FirstLight should develop HSI curves for these host fishes in a collaborative manner as described above"*

Sea lamprey incubation. Adult lamprey ascend rivers as water temperature exceeds 4° C, and spawning commences when the temperature of the water is about 10° C and is completed by the time it has warmed to about 20°-21° C (Bigelow and Schroeder, 1953). HSC for the spawning lifestage of this species provided by NOAA on May 23, 2013 (Kynard and Hogan, 2013) are currently incorporated into the study. These HSC relate to the behavior of adults selecting nesting sites, and fertilizing and burying eggs. Because the incubation lifestage is non mobile and utilizes the same habitat, it follows that flows suitable for spawning should also be suitable for incubation, and thus the same criteria apply.

Sea lamprey zone of passage. "*Adults can manage rapids easily by alternatively swimming and attaching to stones. They can surmount nearly vertical barriers of 5 or 6 ft…by creeping up the face with the suctorial disc*" (Scott and Crossman, 1973). Mosier and Mesa (2009) note that "*When confronted with rapid current velocities, adult Pacific lampreys orient into the current and use their oral disk to attach to the substrate, presumably resting between bouts of burst swimming. This … is most pronounced in current velocities greater than 60 cm/s (2 ft/s)... Consequently, the best surfaces for lamprey attachment are probably smooth and nonporous.*"

This is consistent with empirical observations made by Maine Department of Marine Resources at numerous riverine locations (*Gail Wippelhauser, Maine DMR, personal communication*), and can also be observed in a movie clip of adult lamprey in the Millers River, MA (https://www.youtube.com/watch?v=TFH-CiuCEPQ) (*Mike Trainor, Massachusetts Division of Marine Fisheries, personal communication*) The conclusion is that depth and velocity are not likely limiting factors. Of greater importance is availability of suitable substrates (*i.e.* large cobble and boulder) for the fish to sequentially attach to. Given the nature of the geology in the bypass reach, suitable substrate is not likely a limiting factor. We also note that additional zone of passage analyses will be conducted in Reach 1 (see DRAFT Method for Conducting the Reach 1 Empirical Flow Habitat Assessment, March 28, 2014).

Freshwater mussel host fish. The state-listed mussel species include yellow lampmussel, eastern pondmussel and tidewater mucket. Their habitat preferences and potential host fish are shown below (excerpted from Table 3.3.1-3 of the Revised Study Plan). The Revised Study Plan proposes to develop Category I mussel habitat suitability criteria for state or federally-listed freshwater mussels through a combination of literature review and by convening a panel of credentialed mussel biology experts who will provide input to developing specific HSI criteria. FirstLight is presently pursuing this effort and expects this to provide the necessary HSC for the target mussel species. In the event that Category I HSC curves cannot be developed, FirstLight will pursue an alternative approach using host fish species habitat suitability as a surrogate.

State-listed Mussel Species	Preferred Habitat	Host Fish
Yellow Lampmussel	It has been found in shallow water and areas more than 30 feet deep, usually in slow to moderate flow conditions. Within its core range in Massachusetts, it exhibited a distinct preference for sand and fine gravel substrates, and it was proportionately more abundant in shallow sandbars than it was in nearby areas that were deeper and had a rocky or muddy substrate.	White perch; yellow perch; possibly striped bass; potential species include banded killifish, chain pickerel, white sucker, smallmouth bass, largemouth bass
Eastern Pondmussel	The eastern pondmussel inhabits a wide variety of habitats in the southern part of the watershed. It exhibits no distinct preference for substrate, depth or flow conditions.	Unknown: anadromous or coastal
Tidewater Mucket	Coastal freshwaters. Inhabits muddy, sandy and gravelly substrates. Prefer depositional areas with slow currents. Healthy populations exist in sandbar habitats near islands in the mainstem Connecticut River. Found in water depths of one to > 25 feet.	White perch; banded killifish; striped bass possible but not tested.

From Nedeau, 2008.

Certain known fish hosts (America shad, white sucker) (noted in RSP Table 3.3.1-3) for which standalone HSC are proposed will provide an index of habitat suitability. However some fish hosts do not have standalone HSC. At the May 8, 2013 consultation meeting, the study team discussed inclusion of four habitat use guilds to account for habitat use for various species for which no standalone HSC are available[1]. Table 1 below shows how this scheme can account for mussel fish host habitat suitability for all mussel species potentially found in the study area, inclusive of state listed and non-listed species.

[1] These follow the classic "s*hallow slow", "shallow fast", "deep slow"* and *"deep fast"* categories.

Table 1. Turners Falls Instream Flow Study. Proposed habitat use guilds for common mussel host fish species (after Nedeau, 2008), and other fish species (*from Revised Study Plan Table 3.3.1-3*).

Deep Slow Guild		
Host Species	**Life stage**	**related mussel species**
White perch	J,A	YL*, EE, EF, TF, TM*
Yellow perch	J,A	YL*, EE
Brook trout[2]	J,A	EE
carp	J,A	EF
bluegill	J,A	EF

Shallow Fast Guild		
Host Species	**Life Stage**	**related mussel species**
Mottled sculpin	J,A	EE
Slimy sculpin	J,A	TF
Brook trout[1]	J,A	EE
Shiner and dace spp.	J,A	TF

Deep Fast Guild		
Host Species	**Life stage**	
Striped bass[1]	A	YL*, AF, TM*
carp	J,A	EF

Shallow Slow Guild		
Host Species	**Life stage**	
Banded killifish	J,A	YL*
Chain pickerel	J,A	YL*
Smallmouth bass	J,A	YL*, EE
Largemouth bass	J,A	YL*, EE, TF
Three spine stickleback	J,A	EE, EF
pumpkinseed	J,A	EE, EF, TF
redbreast	J,A	EE
Black crappie	J,A	EE
Brook trout[1]	J,A	EE
carp	J,A	EF
bluegill	J,A	EF

LEGEND: YL =yellow lampmussel; EE =eastern elliptio; TF = triangle floater; AF = alewife floater; EF = eastern floater, TM = tidewater mucket. An asterisk (*) indicates state listed status. J = juvenile lifestage; A = adult lifestage

[2] Not known to reside in the study area

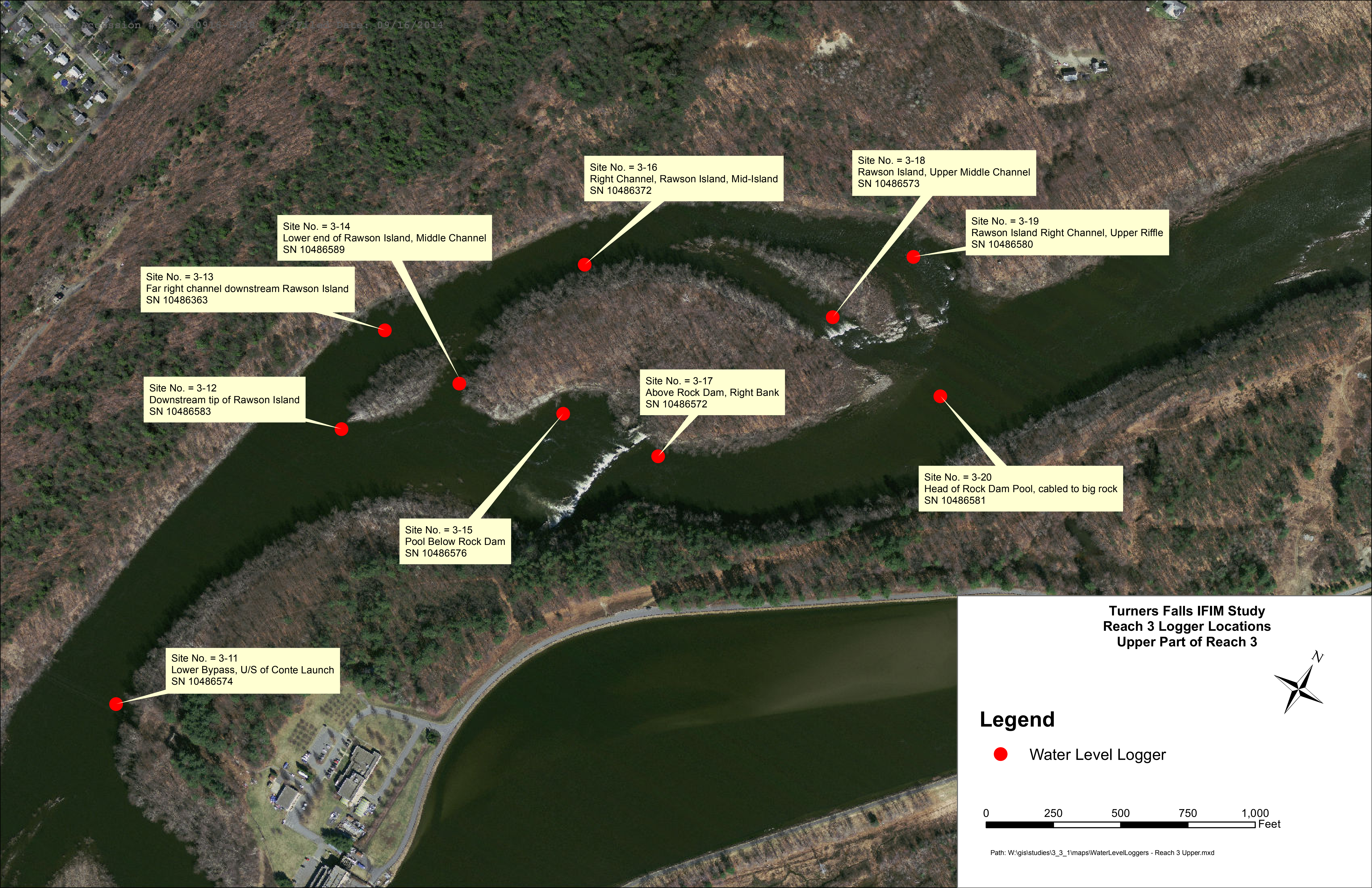
LITERATURE CITED

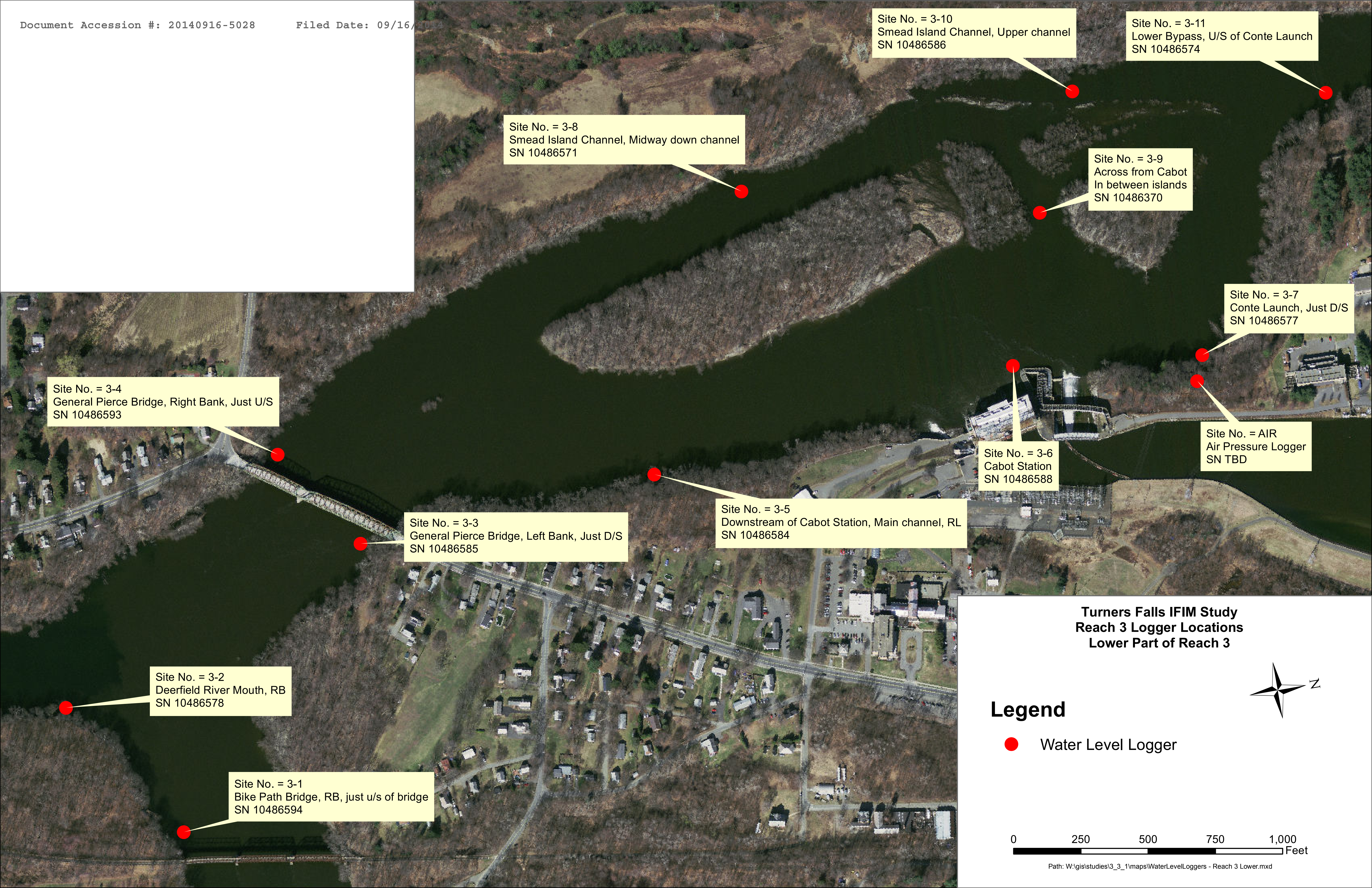
Bigelow, HB. and W.C. Schroeder, 1953. Fishes of the Gulf of Maine. Fishery Bulletin 74F of the Fish And Wildlife Service, Vol.53, Contribution No. 592, Woods Hole Oceanographic Inst., U. S. Gov. Printing Office – Washington. 577 p.

Kynard B. and M. Horgan. 2013. Habitat suitability index for sea lamprey redds. Unpublished manuscript. 5 pp.

Mosier, M.L. and M.G. Mesa, 2009. Passage considerations for anadromous lampreys. pp. 1-10. Am. Fish. Soc. Symposium 72:000–000, 2009. American Fisheries Society, Bethesda, MD.

Scott, W.B. and E.J Crossman, 1973. Freshwater fishes of Canada. Bulletin 184. Fish. Res. Bd. Can. Ottawa. 966 p.


Site No. = 3-16
Right Channel, Rawson Island, Mid-Island
SN 10486372
Site No. = 3-18
Rawson Island, Upper Middle Channel
SN 10486573
Site No. = 3-14
Lower end of Rawson Island, Middle Channel
SN 10486589
Site No. = 3-19
Rawson Island Right Channel, Upper Riffle
SN 10486580
Site No. = 3-13
Far right channel downstream Rawson Island
SN 10486363
Site No. = 3-12
Downstream tip of Rawson Island
SN 10486583
Site No. = 3-17
Above Rock Dam, Right Bank
SN 10486572
Site No. = 3-20
Head of Rock Dam Pool, cabled to big rock
SN 10486581
Site No. = 3-15
Pool Below Rock Dam
SN 10486576
Site No. = 3-11
Lower Bypass, U/S of Conte Launch
SN 10486574
Turners Falls IFIM Study
Reach 3 Logger Locations
Upper Part of Reach 3
N
Legend
Water Level Logger
0
250
500
750
1,000
Feet
Path: W:\gis\studies\3_3_1\maps\WaterLevelLoggers - Reach 3 Upper.mxd


Site No. = 3-10
Smead Island Channel, Upper channel
SN 10486586
Site No. = 3-11
Lower Bypass, U/S of Conte Launch
SN 10486574
Site No. = 3-8
Smead Island Channel, Midway down channel
SN 10486571
Site No. = 3-9
Across from Cabot
In between islands
SN 10486370
Site No. = 3-7
Conte Launch, Just D/S
SN 10486577
Site No. = 3-4
General Pierce Bridge, Right Bank, Just U/S
SN 10486593
Site No. = AIR
Air Pressure Logger
SN TBD
Site No. = 3-6
Cabot Station
SN 10486588
Site No. = 3-5
Downstream of Cabot Station, Main channel, RL
SN 10486584
Site No. = 3-3
General Pierce Bridge, Left Bank, Just D/S
SN 10486585
Site No. = 3-2
Deerfield River Mouth, RB
SN 10486578
Site No. = 3-1
Bike Path Bridge, RB, just u/s of bridge
SN 10486594
Turners Falls IFIM Study
Reach 3 Logger Locations
Lower Part of Reach 3
N
Legend
Water Level Logger
0
250
500
750
1,000
Feet
Path: W:\gis\studies\3_3_1\maps\WaterLevelLoggers - Reach 3 Lower.mxd

From:	Karl Meyer
To:	"Jason George"; "Andrea Donlon"; "Melissa Grader"; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; "Jesse Leddick"; "Bill McDavitt"; "Jessica Pruden"; don.pugh@yahoo.com; "Caleb Slater"; "Ken Sprankle"; brett_towler@fws.gov; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"; "Tom Christopher"; sims@honors.umass.edu
Cc:	"Howard, John"; "Brandon Kulik"; glemay@gomezandsullivan.com; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"
Subject:	RE: FirstLight Turners Falls IFIM - HSI and status update
Date:	Thursday, June 19, 2014 8:22:22 PM
Attachments:	2009 BelowCNTERockdm.JPG 2010 FshgRockDm.JPG

Dear Jason and Brandon,

Please find my formal comments below, as well as two attached photos. Thank you.

Best,
Karl Meyer

Karl Meyer, M.S., Environmental Science
85 School Street, # 3
Greenfield, MA 01301
June 19, 2014

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
88 First Street, N.E.
Washington, DC 20426

Stakeholder reply to: Jason George; Brandon Kulik
Gomez and Sullivan Engineers, PC

Stakeholder Comments RE: FERC P-1889-081 and P-2485-063:

These comments pertain to my input as a Stakeholder and participant in FirstLight IFIM Study Team in helping determine Habitat Study Criteria for target species in the By Pass Reach of the Connecticut River—Reaches 1 – 4 in the SPD.

They are specific to a memo from Brandon Kulik to Instream Flow Study Team Stakeholders dated June 6, 2014; as well as a request for Stakeholder Comments sent out by Jason George on June 6, 2014 regarding:

1. further consultation regarding lamprey incubation and zone of passage
2. freshwater mussel host fish species criteria

My comments:

Expand Water Level Logger Coverage in the pool below the Rock Dam, or move the currently proposed WLL to the east side of the pool to capture the essential zone of passage and incubation habitat that is unique to this section of the pool below Rock Dam.

In the PDF sent for Water Level Loggers—Reach 3 Upper1, Site No. = 3-15 Pool Below Rock Dam BN 10486576, the WLL placement is on the far west side of the pool. Anyone who has spent time examining the site understands that this unique pool and it essential habitat characteristics are to be found on the eastern side of this pool. Looking at the aerial shot, it is the area closest to Conte Lab, where the whitewater spreads furthest downstream through natural notches in the rock. This is the area that is most often fished, and likely offers best passage in this section during times of high—as well as low, flows.

Most visitors and fishermen will have witnessed sea lamprey using this cleft area of Rock Dam as water levels fall. I have seen many attached to the rock face, awaiting the impulse for their next burst toward the top. The fishermen are here because this is where the fish find passage. Please see attached photos from 2009 and 2010.

In the 2010 photo the gentlemen with the net has landed a shad.

The 2009 photo shows the sandy, cobbled, lower end of the pool below Rock Dam, which essential habitat for state-listed Yellow Lamp Mussel, as well as being critical spawning habitat for the federally endangered Shortnose sturgeon. (If you look closely, you might notice that one fisherman is a Conte Lab Researcher.)

Thus, Water Level Logger placement at this site, as opposed to the far western end of the pool, is the critical factor.

Further, through snorkeling and shoreline observation I have personally witnessed yellow perch, smallmouth bass and American shad using this habitat—all either host species, or potential host species for Massachusetts' endangered Yellow Lamp Mussel.

Thus, by placing a new Water Level Logger at this site, you are capturing essential information on which to base critical decisions for the survival of at least two endangered species.

End of Formal Comments

Thank you for this opportunity to participate in improving license requirements and protecting the Connecticut River ecosystem for future generations.

Sincerely,
Karl Meyer, M.S.

Please note: photos could not be included with FERC E-Comment. They were sent directly to Mr. George and Mr. Kulik along with these comments. Made available upon request.

From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, June 06, 2014 10:03 AM
To: 'Andrea Donlon'; 'Melissa Grader'; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; 'Jesse Leddick'; 'Bill McDavitt'; karlm@crocker.com; 'Jessica Pruden'; don.pugh@yahoo.com; 'Caleb Slater'; 'Ken Sprankle'; brett_towler@fws.gov; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'; 'Tom Christopher'; sims@honors.umass.edu
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'Mark Wamser'
Subject: RE: FirstLight Turners Falls IFIM - HSI and status update

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Cc: 'Howard, John'; 'Brandon.Kulik@KleinschmidtUSA.com'; 'glemay@gomezandsullivan.com'; 'Stira, Robert'; 'Tom Sullivan'; 'Mark Wamser'
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No virus found in this message.
Checked by AVG - www.avg.com
Version: 2014.0.4570 / Virus Database: 3955/7644 - Release Date: 06/08/14

From: Andrea Donlon
To: "Jason George"; "Melissa Grader"; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; "Jesse Leddick"; "Bill McDavitt"; karlm@crocker.com; "Jessica Pruden"; don.pugh@yahoo.com; "Caleb Slater"; "Ken Sprankle"; brett_towler@fws.gov; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"; "Tom Christopher"; sims@honors.umass.edu
Cc: "Howard, John"; "Brandon Kulik"; glemay@gomezandsullivan.com; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"
Subject: RE: FirstLight Turners Falls IFIM - HSI and status update
Date: Friday, June 20, 2014 3:20:25 PM

Jason,

Here are CRWC's comments on your June 6 mailing.

Habitat Suitability Criteria memo dated 6/6/14. CRWC has no comment on this memo, and will look to fisheries agencies to more closely review the material.

Logger locations: The FERC study plan determination said to determine number and location of loggers AFTER consultation with technical study team. It sounds from your email that the loggers have already been installed. Here are my comments on the locations:

Upper part of reach 3 logger locations:

- Site No. 3-11 could potentially be moved upstream 500-750 feet to get a better sense of the backfilling of this section when Cabot is releasing.
- I see Karl's comments regarding sites No. 3-15 and 3-17. I am guessing that you went for the other side because loggers on the side closest to the canal are likely to be visually spotted and torn out by visitors to the area. If so, then I wonder if you could do actual field measurements on scattered days to make comparison curves that would allow the data at 3-15 and 3-17 be used to approximate the water levels in the more interesting spots in these areas.

Lower part of reach 3 logger locations:

- Site No. 3-5 could be moved upstream about 250 feet to capture the middle between Cabot and the General Pierce bridge. I don't have a map of the sturgeon spawning areas, but certainly those areas should be targeted.
- Or possibly add a logger on the eastern bank of Smead Island in the middle of the island.

Will we have an opportunity to comment on the loggers in reaches 1 and 2 before they are installed?

Andrea

____
Andrea Donlon, River Steward
CONNECTICUT RIVER WATERSHED COUNCIL, INC.
15 Bank Row
Greenfield MA 01301
Phone: (413)772-2020 x. 205
Fax: (413)772-2090
adonlon@ctriver.org

Become a member today! Join at www.ctriver.org.
CRWC is on Facebook—become a fan

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Sent: Friday, June 06, 2014 10:03 AM
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Subject: RE: FirstLight Turners Falls IFIM - HSI and status update

Dear FirstLight IFIM Study Stakeholders,

Attached is a memo describing our approach to the outstanding habitat suitability assessments for lamprey incubation and zone of passage and freshwater mussel host fish species. Also attached is a map showing the water level loggers installed in Reach 3. Additional water level loggers will be installed in Reaches 1 and 2 during the test flows to validate/calibrate the proposed models in this study.

The field data collection for this study is in the final planning stages and we anticipate being in the field throughout the summer, with most of the data collected after the fishways close in mid-July.

Please respond within two weeks, or by June 20, 2014, with any comments, questions or concerns regarding the attached materials. Thank you.

Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, PO Box 2179
Henniker, NH 03242
Office: (603) 428-4960
Cell: (603) 340-7666

From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, March 28, 2014 3:34 PM
To: 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; 'peter.hazelton@state.ma.us'; 'kkennedy@tnc.org'; 'micah_kieffer@usgs.gov'; 'Jesse Leddick'; 'Bill McDavitt'; 'karlm@crocker.com'; 'Jessica Pruden'; 'don.pugh@yahoo.com'; 'sims@honors.umass.edu'; 'Caleb Slater'; 'Ken Sprankle'; 'brett_towler@fws.gov'; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'
Cc: 'Howard, John'; 'Brandon.Kulik@KleinschmidtUSA.com'; 'glemay@gomezandsullivan.com'; 'Stira, Robert'; 'Tom Sullivan'; 'Mark Wamser'
Subject: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting

Dear FirstLight IFIM Study Stakeholders,

Attached are the meeting notes from our last meeting on this study, held on November 12, 2013.

As a follow-up to this meeting, we have developed two documents which detail methods proposed for the following specific elements of this study:

1. Method for coding bedrock substrates found in the study area
2. Draft method for conducting the reach 1 empirical flow habitat assessment (braided riffle area)

Please submit any comments you may have on the attached within two weeks, or by April 14, 2014. Please address technical comments to Brandon Kulik (Brandon.Kulik@KleinschmidtUSA.com).

Since the last meeting, FERC issued its Study Plan Determination Letter on February 21, 2014 in which the Instream Flow Study Plan was approved with modifications. FirstLight is currently investigating the modifications to the study plan which may require further consultation, including specific HSI criteria for sea lamprey and related HSI criteria for primary host fish of state-listed mussels of concern in the project-affected area. We anticipate distributing draft recommendations on these subjects for your review and input in the near future.

Additionally, in response to your comments and as directed by the FERC Study Plan Determination Letter, FirstLight plans to install over 20 water level loggers in Reach 1-3 in order to ensure the accuracy of modeled conditions. The specific locations of the logger deployment will be determined in the field, and your previous comments regarding logger placement will be considered. Once installed, a map showing the locations will be provided to you.

Finally, we anticipate that additional consultation will be required to conduct the work in the downstream reaches in 2015. We look forward to working with you to make this a successful study.

Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, PO Box 2179
Henniker, NH 03242
Office: (603) 428-4960
Cell: (603) 340-7666

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

In Reply Refer To: FERC No. 1889
FirstLight Power Resources/GDF Suez
Connecticut River
COMMENTS ON INSTREAM FLOW STUDY PLAN

July 3, 2014

Mr. Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, P.O. Box 2179
Henniker, NH 03242

Dear Mr. George:

This responds to your email correspondence submitted on behalf of FirstLight Power Resources (FirstLight), dated March 28, 2014 and June 6, 2014, regarding resolution of a few outstanding details of the Instream Flow Habitat Assessment for the relicensing of the Tuners Falls Project, located on the Connecticut River in Massachusetts. We have reviewed the submitted materials and offer the following comments.

Coding Bedrock Substrates

The proposed bedrock coding is acceptable.

Reach 1 Empirical Assessment Methodology

The U.S. Fish and Wildlife Service (Service) has concerns with FirstLight's proposed methodology for Reach 1. As proposed, it appears there will be no way to translate the results to an overall Weighted Usable Area (WUA) to flow relationship because the assessment will be at discrete transects and/or non-linear areas that are not related to the rest of Reach 1. Typically, transects are located in a representative mesohabitat type and the linear extent of that type would be measured so the Service would be able to translate the transect data to a spatial area covering the entire mesohabitat. In this case, we will only have data on the suitability of a particular spot or transect.

Although Reach 1 is very heterogeneous with respect to mesohabitats as well as hydraulically complex, we believe it should still be possible to identify polygons that could represent the different habitats and then locate a transect in each of those polygons. This would allow us to extrapolate and calculate a WUA for that habitat at a given flow.

Without this quantitative measure, the study results for Reach 1 would only let us know how flow affects a particular transect, with no context for what that means for the reach as a whole or for use in the evaluation of flow needs throughout the bypass reach. For example, in the attached Powerpoint, on Slide 2 we have identified some hypothetical transect locations. If study results were to show that a flow of 200 cfs maximized the suitability of T6 and a flow of 600 cfs maximized suitability of T1, there would be no context as to how much habitat each transect represented and therefore, the relative value represented by either transect.

In Slide 3, we have suggested a first cut attempt to identify different habitat polygons which then theoretically would each have a transect placed in them. This would allow for an approximate calculation of area for each habitat and therefore a WUA-to-flow relationship.

Sea Lamprey Habitat Suitability Index Criteria

Spawning Curves

As we stated in our August 29, 2013 comments on the August 14, 2013 Revised Study Plan (RSP), the RSP correctly indicated that FirstLight has initiated consultation on the Habitat Suitability Index (HSI) curves, but that this consultation had not concluded. We had previously noted on a conference call that we would recommend changes to the lamprey spawning curves based on review of other lamprey data. However, discussion of HSI criteria was suspended, as FirstLight and the other parties addressed other study issues, and the lamprey spawning criteria was never resolved.

The HSI criteria proposed in the RSP is based on data from Kynard and Horgan (2013).[1] We reviewed those data and consulted directly with Dr. Boyd Kynard regarding the data they had collected. We also reviewed the Master's Thesis: Population demography, riverine movement and spawning habitat of the sea lamprey, *Petromyzon marinus*, in the Connecticut River (Yergeau 1983).[2]

Yergeau (1983) identified different substrates, velocities and depths utilized by spawning sea lamprey in the Fort River and Deerfield River. Larger substrates and higher depths and velocities were utilized in the Deerfield River (which has a much larger watershed than the Fort River). Given the size of the Connecticut River, the spawning data from the Deerfield River would be

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1 Kynard, B. and M. Horgan. 2013. Habitat suitability index for sea lamprey redds. Unpublished manuscript. 5 pp

2 Yergeau, K.M. 1983. Population demography, riverine movement and spawning habitat of the sea lamprey, *Petromyzon marinus*, in the Connecticut River. M.Sc. thesis. University of Massachusetts, Amherst, Massachusetts. 634 pp.

more representative of the Connecticut River and should be considered in establishing HSI criteria for lamprey spawning for use in this study.

Lamprey redds on the Deerfield River had depths ranging from 8 inches to 26 inches, with the greatest frequency of redds occurring at depths between 12 and 16 inches. Extrapolating the depth curves from Yergeau (1983), we recommend modifying the HSI criteria as follows:

Depth	SI Value
0.0	0.00
0.13	0.00
0.46	0.50
0.79	1.00
1.12	1.00
1.44	0.60
1.77	0.40
2.20	0.20
2.30	0.00

For substrate, Yergeau (1983) found spawning in the Deerfield River on substrates from 2 inches to 7 inches in diameter. Though less frequently used than gravel, significant spawning was observed on larger substrates. The 4-to-7-inch sizes observed at Deerfield River redds correspond to Substrate Code 6–Cobble/Rubble. Extrapolating from Yergeau (1983), we recommend that the HSI for Cobble/Rubble be changed to 0.50.

We recommend using the proposed HSI criteria with our recommended modifications as the initial criteria for use in this study. However, after the lamprey spawning study has been completed, the HSI criteria for lamprey spawning should be revisited and updated, as appropriate, based on collected redd data on the mainstem Connecticut River, for use in the Instream Flow Habitat Assessment.

Incubation Curves

The National Marine Fisheries Service requested that the HSI criteria for lamprey include incubation curves. FirstLight is not proposing incubation HSI curves, arguing that the spawning curves should cover/be protective of incubating eggs. The Service believes this is a reasonable assumption and would support characterizing the spawning curves as a spawning and incubation curve.

Zone of Passage

Some stakeholders requested that FirstLight include Zone of Passage (ZOP) curves. FirstLight is not proposing to add ZOP curves, arguing that lamprey are not depth or velocity constrained in movement so long as there is suitable substrate to latch onto; FirstLight's position is that suitable substrate is likely not a limiting factor in Reaches 1 and 2.

We do not necessarily agree that lamprey can move through any reach regardless of depth or velocity. Clearly, there needs to be some water, and velocity cannot exceed their burst swimming speed capability. That being said, since Reaches 1 and 2 already have shad as a target species for ZOP, lamprey should be covered as well, as the passage seasons essentially overlap (i.e., if a defined flow provides suitable ZOP for shad, it should offer ZOP to lamprey as well).

Thank you for the opportunity to comment. If you have any questions regarding these comments, please contact John Warner of this office at 603-223-2541.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

Attachments

cc: John Howard
FirstLight Power Resources
CRC, Ken Sprankle
NMFS, Bill McDavitt
NMFS, Jess Pruden
MA DFW, Caleb Slater
MA DEP, Bob Kubit
TU, Don Pugh
CRWC, Andrea Donlon
TNC, Katie Kennedy
Reading File
ES: JWarner:7-3-14:(603)223-2541


Turners Falls
T1
T2
T3
T4
T5
T6
Lines represent theoretical transect locations
and ovals represent Zone of Passage locations


Turners Falls
Hypothetical habitat polygons

of redds, proximity to available overhead cover and spatial relationship to pools or riffles.

Since sea lamprey redds were measured at several locations in 2 different streams, a one-way analysis of variance (SPSS Program, Nie et al. 1975) was utilized to determine if there were significant differences between the means of parameters sampled at different locations and years. This program computed the mean of each parameter for each study area and calculated an F-value, which was used to determine if a significant difference existed between the means. Analysis of covariance was also performed for the Fort River and Deerfield River data with water temperature as the covariate. This is because temperature has been reported as a decisive factor in determining the onset of spawning with sea lamprey.

RESULTS

Sea lamprey spawning was first observed in the Fort River during both years. In 1981, spawning was observed from June 3 to June 25. Redd characterization was conducted from June 4 to June 25, 1981 on the Fort River and from June 23 to June 26, 1981, on the Deerfield

Yergeau, L.M. 1983. UMass M.Sc. Thesis Population Demographics, Riverine Movement and Spawning Habitat of the Sea Lamprey in the CT River.

River. Spawning in 1982 was observed from June 23 to June 29. Nest sampling was limited to June 24-27 on the Fort River and June 28 on the Deerfield River. A period of heavy rain followed on June 29, which increased river flow and depth significantly. Many nests were abandoned or washed away and dead lampreys were observed throughout the study sites. The high water lasted approximately one week and no lampreys were observed on redds after the flooding subsided.

Sea lampreys commenced building redds in 1981 on June 4 when water temperatures increased to 19.0°C. Thermograph records for 1981 in the Fort River indicated sea lampreys spawned over a temperature range of 15-23°C (June 3 to June 25). In 1982, sea lamprey in the Fort River commenced spawning at 14.0°C but at a later date, June 22. Maximum spawning activity occurred during decreasing flows (1300-30 cfs, 36.8-0.85 m^3/s) and increasing water temperatures (16.5-18.5°C). No spawning was observed at water temperatures exceeding 24.5°C. In 1981, spawning activity decreased when river flow dropped in the Fort River below 21 cfs (0.59 m^3/s). In 1982 on the Deerfield River, spawning a^tivity ceased when flow increased to 2,670 cfs (75.61 m^3/s).

The location of concentrations of redds in all study areas was similar. The majority of nests in both rivers were located slightly upstream from a riffle area and downstream from a pool section, e.g., in the transition zone between riffle and pool.

One hundred-seventy two redds were sampled from the Fort River and 72 redds from the Deerfield River. Completed redds varied in size from 12 cm to 155 cm in length and from 13 cm to 175 cm in width (Figure 14). The average length and width of redds sampled from the Fort River and Deerfield River were very similar (Table 2). Mean substrate size sampled from the Deerfield River (9.4 cm) was significantly larger than the Fort River samples (6.9 cm) ($p < 0.05$, Figure 14).

Comparisons of the mean velocity and depth measured 1m above the redd, at the upper-edge and tailspill area presented in Table 2. The Deerfield River study site was generally deeper than the Fort River sites although the tailspill depths were similar due to the larger size of available gravel on the Deerfield river. The velocity and depth of the Deerfield River were variable due to the sudden fluctuation of river discharge regulated by the upstream hydropower facilities. When river discharge changed abruptly, lampreys would often abandon redds or construct new redds in an area that would later be exposed or washed away.

The location of redds within an area depended on the

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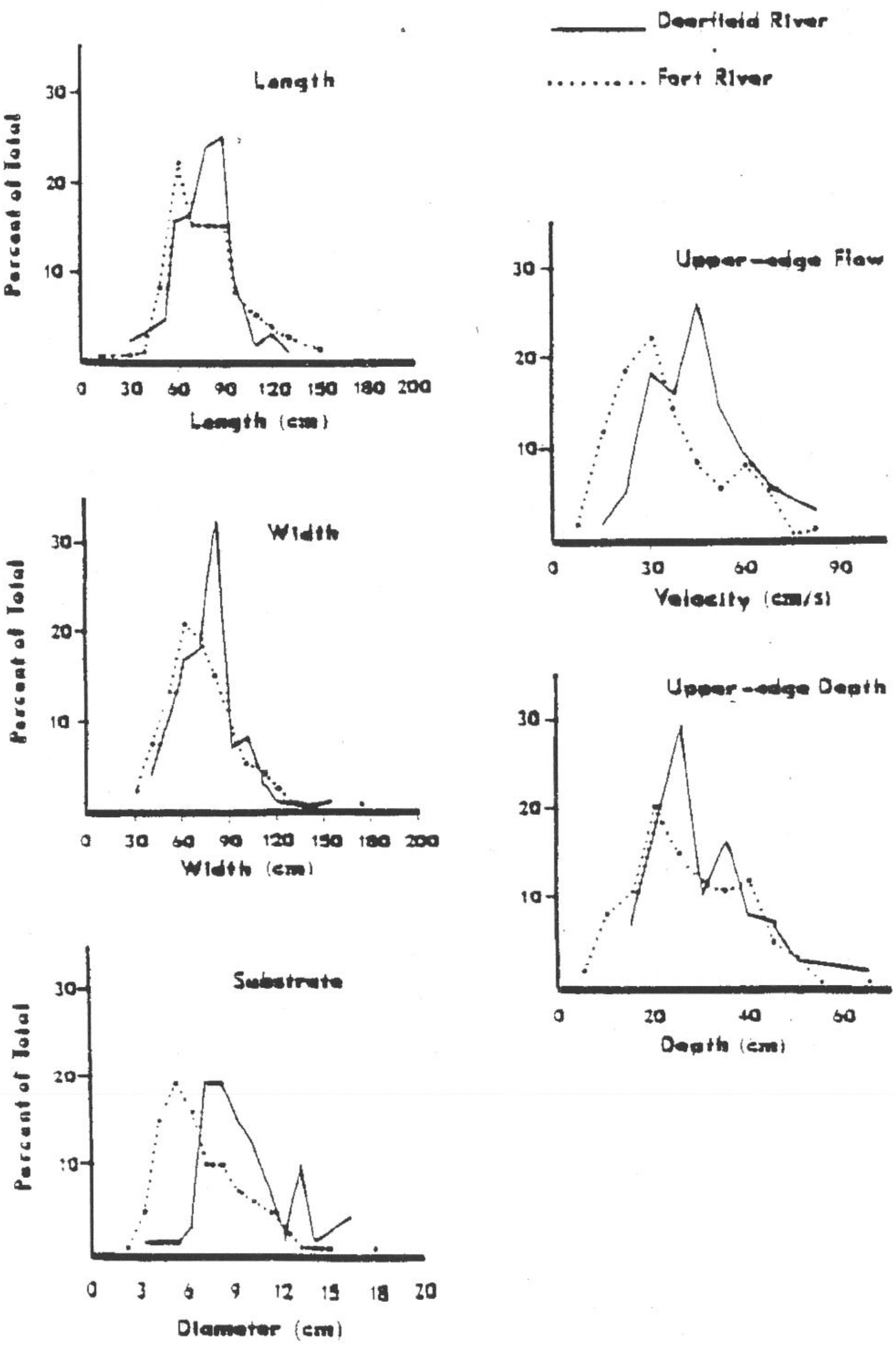

Table 2. Comparison of means of variables from nest surveying between the Fort River (n=172) and Deerfield Rivers (n=72).

Variable	Fort River (± s.error)	Deerfield River (± s.error)	Significance
Length of redd	84.4 ± 1.84 cm	84.5 ± 2.79 cm	ns
Width of redd	76.1 ± 1.84 cm	78.4 ± 2.70 cm	ns
Average substrate	6.8 ± 0.21 cm	9.4 ± 0.44 cm	s ($p < .05$)
Upper-edge depth	28.9 ± 0.88 cm	31.2 ± 1.50 cm	ns
Pit depth	36.4 ± 0.82 cm	37.4 ± 1.42 cm	ns
Tailspill depth	19.9 ± 0.78 cm	21.1 ± 1.27 cm	ns
Above redd flow	1.13 ± 0.46 ft/s	1.40 ± 0.05 ft/s	ns
Upper-edge flow	1.18 ± 0.42 ft/s	1.46 ± 0.07 ft/s	ns
Tailspill flow	1.54 ± 0.50 ft/s	1.77 ± 0.07 ft/s	ns

1 ft/s = 0.3048 m/s

velocity of the current. Circular or oval redds were constructed parallel in length to the river current, usually upstream from a riffle. A gradient of velocity existed going downstream from the measurement taken 1m above the redd to the tailspill section (Table 2). The slowest current was present 1m above the redd which was closest to a pool section. Current at the upper-edge of the redd most closely represented conditions actually present before spawning activity commenced, because depths and velocities were modified due to the construction of the pit and deposition of substrate at the tailspill area. For these reasons, the upper-edge depths and velocities were chosen to best characterize depth and water velocity of redds (Figure 14).

Analysis of variance revealed a highly-significant difference ($p<0.01$) between upper-edge depth for years and zones with the Fort River data (Table 3). Although these differences between zones for depth are significant, the zones are not significantly different for upper-edge flow (Table 3) and can be combined to compare with the upper-edge flow at redds in the Deerfield River. A non-significant difference was calculated for upper-edge flow between years for the Deerfield River data (Table 4). This may be primarily due to the variable flow, regulated by upstream hydropower facilities.

From:	Brandon Kulik
To:	Jason George; "Tom Christopher"; "Andrea Donlon"; "Melissa Grader"; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; "Jesse Leddick"; "Bill McDavitt"; karlm@crocker.com; "Jessica Pruden"; don.pugh@yahoo.com; sims@honors.umass.edu; "Caleb Slater"; "Ken Sprankle"; brett_towler@fws.gov; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"
Cc:	"Howard, John"; glemay@gomezandsullivan.com; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"
Subject:	FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting
Date:	Friday, July 11, 2014 2:46:51 PM
Attachments:	response to stakeholder comments on FirstLight IFIM study materials July 2014.docx

Dear FirstLight IFIM Study Stakeholders,

Thank you for your providing comments pertaining to the FirstLight IFIM study materials distributed on June 6, 2014.

Attached is a table summarizing comments provided by you, matched with FirstLight's responses to each comment received on the materials provided, and other outstanding issues raised in your comments.
As a general matter, all of this correspondence will ultimately be filed with FERC as an appendix to the study report.

As you may be aware, FirstLight will be conducting a whitewater boating evaluation in the bypass reach on July 19, 20 and 21. The field data collection for the instream flow study in reaches 1 through 3 is scheduled to begin on July 22 and last approximately 5-6 days, weather permitting.

Thank you

Brandon H. Kulik
Senior Fisheries Scientist
Kleinschmidt
Pittsfield, Maine
207-487-3328

Stakeholder Comment Summary	FirstLight Response
Karl Meyer, M.S., Environmental Science: June 19, 2014	
Expand Water Level Logger Coverage in the pool below the Rock Dam, or move the currently proposed WLL (Site 3-15) to the east side of the pool to capture the essential zone of passage and incubation habitat that is unique to this section of the pool below Rock Dam.	The water level logger at Site 3-15 (Pool Below Rock Dam) was placed to avoid the high recreation use on the western side of the river, which is easily accessible from Cabot Woods trail. We wanted to avoid having any fishermen getting their gear snagged on the logger, which could move the logger or cause someone to purposefully move out it of the way. Any water level loggers that are moved must be re-surveyed, and any data collected after the unit is moved is unusable. The purpose of logger 3-15 is to document the water surface elevation in the pool. Because the pool surfaces are flat, the logger as it currently sits will capture fluctuations representative of the entire pool. Coupled with the other data such as bed substrates, bathymetry and velocity collected throughout Reach 3, the western end of the pool below Rock Dam will be completely represented in the study area. The hydraulic model being developed for Reach 3 will cover the entire reach.
Andrea Donlon, Connecticut River Watershed Council: June 20, 2014	
Logger locations: The FERC study plan determination said to determine number and location of loggers AFTER consultation with technical study team. It sounds from your email that the loggers have already been installed. Will we have an opportunity to comment on the loggers in reaches 1 and 2 before they are installed?	The water level loggers have been installed in reach 3 to capture a wide range of flow conditions. The locations were selected by the hydraulic modeling team and installed in places that would best facilitate model calibration. Reach 2 water loggers will be installed prior to the 1-D data collection at the direction of the hydraulic modeling team. No loggers have been explicitly placed for reach 1 work. As part of study plan 3.3.8 (CFD modeling), however, five water level loggers have been placed throughout the plunge pool area. The purpose of these loggers is to assess CFD boundary condition water surface elevations. The data from the CFD loggers, however, may also serve the function of the proposed reach 1 water level loggers, pending stakeholder review of the logger placement. Please review and provide comment if the currently deployed loggers will not provide sufficient coverage for the purpose of the IFIM reach 1 study. Additional loggers may be placed prior to or during any reach 1 field work, whenever that occurs.
Upper part of reach 3 logger locations: • Site No. 3-11 could potentially be moved upstream 500-750 feet to get a better sense of the backfilling of this section when Cabot is releasing. • I see Karl's comments regarding sites No. 3-15 and 3-17. I am guessing that you went for the other side because loggers on the side closest to the canal are likely to be visually spotted and torn out by visitors to the area. If so, then I wonder if you could do actual field measurements on scattered days to make comparison curves that would allow the data at 3-15 and 3-17 be used to approximate the water levels in the more interesting spots in these areas.	Site 3-11 was moved further upstream on June 13, 2014 because the initial installation was damaged due to high debris load at this site. See above comment regarding placement of logger 3-15. Given the flat water surface profile of the pool, we anticipate little to no difference in water surface elevation between the eastern and western edges of the pool below rock dam. Again, the hydraulic model being developed for Reach 3 will cover the entire reach. Additionally, we will be collecting water surface elevations during the velocity calibration and validation collection that should serve this purpose.
Lower part of reach 3 logger locations: • Site No. 3-5 could be moved upstream about 250 feet to capture the middle between Cabot and the General Pierce bridge. I don't have a map of the sturgeon spawning areas, but certainly those areas should be targeted. • Or possibly add a logger on the eastern bank of Smead Island in the middle of the island.	The hydraulic model being developed for Reach 3 will cover the entire reach. Reach 3, including the sturgeon spawning area, will be evaluated using the 2-D model. In addition to the water level loggers we have already placed, the velocity calibration and validation data collection efforts will result in water surface elevation information throughout the reach.
Thomas Chapman, USFWS: July 3, 2014	
Coding Bedrock Substrates - The proposed bedrock coding is acceptable.	FirstLight concurs.
Reach 1 Empirical Assessment Methodology The Service has concerns with FirstLight's proposed methodology for Reach 1 and recommends identifying polygons to represent the different habitats in that reach and then locating a transect in each of those polygons, thus allowing calculation of a Weighted Usable Area (WUA) for that habitat at a given flow. Slides were provided to suggest a method to identify different habitat polygons which then theoretically would each have a transect placed in them, allowing for an approximate calculation of area for each habitat and therefore a WUA-to-flow relationship.	First Light is open to the USFWS's more quantitative approach as an option. However, keeping in mind that the goal of the flow demonstration is to empirically evaluate potential flow recommendations based on outcomes from the PHABSIM model conducted further downstream, a consequence would be that the requested quantitative results would not be available to flow demonstration participants until well after the flow demonstration. This is because WUA data will need to be computed and processed and reported (an office exercise). Thus, this type of decision information would not be available at the time that the participants are observing the demonstration flow. However the decision whether or not to adopt this approach can be collaboratively determined by consensus of the assessment team at the time of the flow demonstration.

Stakeholder Comment Summary	**FirstLight Response**
Sea Lamprey Habitat Suitability Index Criteria – Spawning Curves The Service provided modifications to the depth and substrate suitability criteria for sea lamprey spawning and recommend using their proposed modifications as the initial criteria for use in this study. However, after the lamprey spawning study has been completed, the HSI criteria for lamprey spawning should be revisited and updated, as appropriate, based on collected redd data on the mainstem Connecticut River, for use in the Instream Flow Habitat Assessment.	The sea lamprey habitat suitability criteria provided in the Revised Study Plan has been revised, as recommended. These criteria will be revisited and updated, as appropriate after completion of relicensing study no. 3.3.15 *Assessment of Adult Sea Lamprey Spawning within the Turners Falls Project and Northfield Mountain Project Area.*
Sea Lamprey Habitat Suitability Index Criteria - Incubation Curves The National Marine Fisheries Service requested that the HSI criteria for lamprey include incubation curves. FirstLight is not proposing incubation HSI curves, arguing that the spawning curves should cover/be protective of incubating eggs. The Service believes this is a reasonable assumption and would support characterizing the spawning curves as a spawning and incubation curve.	FirstLight concurs.
Sea Lamprey Habitat Suitability Index Criteria – Zone of Passage Some stakeholders requested that FirstLight include Zone of Passage (ZOP) curves. FirstLight is not proposing to add ZOP curves, arguing that lamprey are not depth or velocity constrained in movement so long as there is suitable substrate to latch onto; FirstLight's position is that suitable substrate is likely not a limiting factor in Reaches 1 and 2. We do not necessarily agree that lamprey can move through any reach regardless of depth or velocity. Clearly, there needs to be some water, and velocity cannot exceed their burst swimming speed capability. That being said, since Reaches I and 2 already have shad as a target species for ZOP, lamprey should be covered as well, as the passage seasons essentially overlap (i.e., if a defined flow provides suitable ZOP for shad, it should offer ZOP to lamprey as well).	FirstLight agrees that a ZOP critieria for shad can serve as a surrogate for ZOP to lamprey

From: Karl Meyer
To: "Jason George"; "Andrea Donlon"; "Melissa Grader"; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; "Jesse Leddick"; "Bill McDavitt"; "Jessica Pruden"; don.pugh@yahoo.com; "Caleb Slater"; "Ken Sprankle"; brett_towler@fws.gov; "John Warner"; "Misty-Anne Marold"; "Bob Nasdor"; "Tom Christopher"; sims@honors.umass.edu
Cc: "Howard, John"; "Brandon Kulik"; glemay@gomezandsullivan.com; "Stira, Robert"; "Tom Sullivan"; "Mark Wamser"; "Ken Hogan"
Subject: RE: FirstLight Turners Falls IFIM - HSI and status update
Date: Monday, July 14, 2014 10:39:37 AM

Dear Jason,

I note in your response to having a Water Level Logger placed on the east side of the pool below Rock Dam that there is some potential for small variation in pool levels between the west side and the east. This comes from your reply to Andrea Donlon, who also suggested further adjustments could be made to accommodate gathering important information in these habitats, including suggestions for WLLs 3-15 and 3-17.

Given that the EAST side of this pool has been long verified as a known gathering, spawning and incubation site for the state- and federally-endangered Connecticut River shortnose sturgeon (see Dr. Boyd Kynard's book, **Life History and Behaviour of the Connecticut River Shortnose and other sturgeons,** as well as USGS Researcher Micah Kieffer's presentation to Stakeholders during site visits in 2013), I want to reiterate—along with Andrea Donlon, that these areas need special coverage.

This is the only documented natural spawning pool used by the Connecticut River's only federally endangered migratory fish for millennia. That spawning/gathering/incubation site has been studied for decades, but without the benefit of detailed, real-time flow calibrations and information being collected for the current FERC relicensing process. It would be irresponsible not to gather this information to protect a public resource. I'm sure that NMFS, USFWS, and Mass. Div. of FW would agree. Many stakeholders have witnessed the inundation and rapid de-pauperization of this habitat during ramping and cut-off operation of the TF dam.

Therefore, I'd like to suggest a simple, collectable solution that might provide key, relevant information:

Simply take a series of time-stamped photos, calibrated with flows taken at the nearby WLLs at 3-15 and 3-17, as well as 3-14 and 3-20:

1. from below the east side of Rock Dam pool documenting the flows over the Rock Dam and its cleft ridge, across to the island.

2. standing above the east side of the Rock Dam looking downstream to the east-side sand-becomes-cobble end of the SNS spawning pool—as this is critical spawning and incubation habitat identified by Kynard, Kieffer et al.

Cost: minimal to nil. Time expended: very little.

These real time exposures will lend to a better understanding of this critical habitat, and address data gaps that have been inaccessible during the long-term studies of SNS at this site.

Thank you. And please update my contact information to: karlmeyer1809@verizon.net

Best,
Karl Meyer
M.S. Environmental Science

From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, June 06, 2014 10:03 AM
To: 'Andrea Donlon'; 'Melissa Grader'; peter.hazelton@state.ma.us; kkennedy@tnc.org; micah_kieffer@usgs.gov; 'Jesse Leddick'; 'Bill McDavitt'; karlm@crocker.com; 'Jessica Pruden'; don.pugh@yahoo.com; 'Caleb Slater'; 'Ken Sprankle'; brett_towler@fws.gov; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'; 'Tom Christopher'; sims@honors.umass.edu
Cc: 'Howard, John'; 'Brandon Kulik'; glemay@gomezandsullivan.com; 'Stira, Robert'; 'Tom Sullivan'; 'Mark Wamser'
Subject: RE: FirstLight Turners Falls IFIM - HSI and status update

Dear FirstLight IFIM Study Stakeholders,

Attached is a memo describing our approach to the outstanding habitat suitability assessments for lamprey incubation and zone of passage and freshwater mussel host fish species. Also attached is a map showing the water level loggers installed in Reach 3. Additional water level loggers will be installed in Reaches 1 and 2 during the test flows to validate/calibrate the proposed models in this study.

The field data collection for this study is in the final planning stages and we anticipate being in the field throughout the summer, with most of the data collected after the fishways close in mid-July.

Please respond within two weeks, or by June 20, 2014, with any comments, questions or concerns regarding the attached materials. Thank you.

Jason George
Gomez and Sullivan Engineers, PC
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Henniker, NH 03242
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From: Jason George [mailto:jgeorge@gomezandsullivan.com]
Sent: Friday, March 28, 2014 3:34 PM
To: 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; 'peter.hazelton@state.ma.us'; 'kkennedy@tnc.org'; 'micah_kieffer@usgs.gov'; 'Jesse Leddick'; 'Bill McDavitt'; 'karlm@crocker.com'; 'Jessica Pruden'; 'don.pugh@yahoo.com'; 'sims@honors.umass.edu'; 'Caleb Slater'; 'Ken Sprankle'; 'brett_towler@fws.gov'; 'John Warner'; 'Misty-Anne Marold'; 'Bob Nasdor'
Cc: 'Howard, John'; 'Brandon.Kulik@KleinschmidtUSA.com'; 'glemay@gomezandsullivan.com'; 'Stira,

Robert'; 'Tom Sullivan'; 'Mark Wamser'
Subject: FirstLight Turners Falls IFIM - follow-up to November 2013 study team meeting

Dear FirstLight IFIM Study Stakeholders,

Attached are the meeting notes from our last meeting on this study, held on November 12, 2013. As a follow-up to this meeting, we have developed two documents which detail methods proposed for the following specific elements of this study:

1. Method for coding bedrock substrates found in the study area
2. Draft method for conducting the reach 1 empirical flow habitat assessment (braided riffle area)

Please submit any comments you may have on the attached within two weeks, or by April 14, 2014. Please address technical comments to Brandon Kulik (Brandon.Kulik@KleinschmidtUSA.com).

Since the last meeting, FERC issued its Study Plan Determination Letter on February 21, 2014 in which the Instream Flow Study Plan was approved with modifications. FirstLight is currently investigating the modifications to the study plan which may require further consultation, including specific HSI criteria for sea lamprey and related HSI criteria for primary host fish of state-listed mussels of concern in the project-affected area. We anticipate distributing draft recommendations on these subjects for your review and input in the near future.

Additionally, in response to your comments and as directed by the FERC Study Plan Determination Letter, FirstLight plans to install over 20 water level loggers in Reach 1-3 in order to ensure the accuracy of modeled conditions. The specific locations of the logger deployment will be determined in the field, and your previous comments regarding logger placement will be considered. Once installed, a map showing the locations will be provided to you.

Finally, we anticipate that additional consultation will be required to conduct the work in the downstream reaches in 2015. We look forward to working with you to make this a successful study.

Jason George
Gomez and Sullivan Engineers, PC
41 Liberty Hill Road, PO Box 2179
Henniker, NH 03242
Office: (603) 428-4960
Cell: (603) 340-7666

No virus found in this message.

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

MassWildlife

Wayne F. MacCallum, *Director*

March 13, 2014

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

ADDITIONAL INFORMATION & COMMENTS
Northfield Mountain Pumped Storage Project No. 2485
Turners Falls Hydroelectric Project No. 1889
Additional Information Regarding Documented Presence of State-listed Mussel Species in the Project Area

Dear Secretary Bose,

The Massachusetts Division of Fisheries and Wildlife (the "Division") is the agency responsible for the protection and management of the fish and wildlife resources of the Commonwealth of Massachusetts. The Natural Heritage & Endangered Species Program of the Division is responsible for the regulatory protection of imperiled species and their habitats, as codified under the Massachusetts Endangered Species Act (M.G.L. c.131A) and its implementing regulations (321 CMR 10.00), and collects and manages information on the occurrence, abundance, distribution and conservation needs of rare species and significant natural communities in Massachusetts. This information is collected through field surveys, reviews of the scientific literature and research by staff biologists and cooperators around the state.

The Division would like to offer the following, additional information regarding the presence of state-listed mussel species within the Connecticut River, which is relevant to the "Study Plan Determination for Aquatic Studies - Turners Falls Hydroelectric Project and Northfield Mountain Pumped Storage Project" issued by the Federal Energy Regulatory Commission (FERC) on February 21, 2014 (the "Study Plan Determination").

Additional Information:

The Division's database includes a recent occupancy record of Yellow lampmussel (*Lampsilis cariosa*) within the Bypass Reach (Reach 3) of the project area, which was not detected in recent surveys conducted by the applicant. This is based on a record of observation, submitted to the Division and verified by Division biologists, as further described below:

Species Observed:	Yellow lampmussel (*Lampsilis cariosa*), state-listed as Endangered
Date Observed:	August 4, 2007
Location:	Eastern shoreline of Rawson's Island, near Rock Dam
Coordinates:	72.5806◦ W, 42.5954◦ N

Division of Fisheries and Wildlife
100 Hartwell Street, Suite 230, West Boylston, MA 01583 (508) 389-6300 Fax (508) 389-7890
An Agency of the Department of Fish and Game

Action Requested:

The Division requests that the additional occurrence of Yellow lampmussel supplement data collected during recent surveys conducted by the applicant in Reaches 1 through 3, future surveys to be conducted by the applicant in Reach 4 pursuant to Study Plan 3.3.16, and recent surveys conducted in Reach 5 by Holyoke Gas and Electric (FERC Project No. 2004).

In particular, the Division requests that the additional occurrence of Yellow lampmussel inform study elements of Study Plan 3.3.1 as required by FERC in the Study Plan Determination, as summarized below.

Study Plan	Study Element	Summary of Study Plan Determination	Action Requested
3.3.1	Evaluation of all State-listed Mussels	Model habitat persistence in reaches with documented occurrences of state-listed mussel species.	Add habitat persistence modeling for yellow lampmussel within Reach 3.
3.3.1	1D vs. 2D Modeling for Mussels	Conduct 1D modeling in reaches with documented occurrences of state-listed mussel species, for use in modeling habitat persistence.	2D data will be collected within Reach 3 pursuant to Study Plan 3.3.1. We recommend 2D modeling of habitat persistence for Yellow lampmussel in Reach 3, given that 2D modeling would not require additional data collection and would provide a better assessment of habitat persistence.
3.3.1	Velocity Profiles	Collect mean column and benthic velocity data at representative transects at three calibration flows in Reaches 4 and 5 to validate mean column velocities and simulated benthic velocities.	Amend study to collect data at representative transects (or at locations as otherwise appropriate to 2D data collection methodologies) to validate mean column and simulated benthic velocities in Reach 3. Given that data collection for Reach 3 will occur in 2014, we recommend timely reassessment of field methods, as appropriate, to collect this data.
3.3.1	Host Fish Habitat Modeling	Persistent habitat should be modeled for primary hosts of all state-listed mussels present in project area.	Amend study to include modeling of habitat persistence for primary host fishes within Reach 3.

Thank you for this opportunity to provide additional information and comments. If we can be of further assistance or provide any additional information on this matter, please contact Jesse Leddick, Endangered Species Review Biologist, at jesse.leddick@state.ma.us or (508) 389-6386.

Sincerely,

Thomas W. French

Thomas W. French, Ph.D.
Assistant Director for the Natural Heritage & Endangered Species Program
Massachusetts Division of Fisheries and Wildlife

MEETING MINUTES

Nick Ettema
Fisheries Biologist
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20246
202-502-6565

Meeting Location: Telephone Conference
Meeting Date: May 15, 2014, 2:00-3:00 pm
Participants: John Howard, FirstLight Hydro Generating Company (FirstLight)
Mark Wamser, Gomez and Sullivan Engineers (consultant to FirstLight)
Peter Hazelton, Massachusetts Division and Fish and Wildlife (MADFW)
Misty-Anne Marold (MADFW)
Jesse Leddick (MADFW)
Ken Hogan, Federal Energy Regulatory Commission (FERC or Commission)
Nick Ettema, (FERC)

Re: Meeting minutes for the telephone conference between Commission Staff, Massachusetts Division of Fisheries and Wildlife, and FirstLight Hydro Generating Company, regarding yellow lampmussel in Reach 3.

On May 15, 2014, Ken Hogan and Nick Ettema of the Commission's staff participated in a telephone conference with representatives of Massachusetts Division of Fisheries and Wildlife (MADFW) and FirstLight Hydro Generating Company (FirstLight) to discuss the new information pertaining to the discovery of a state-listed mussel in study reach 3 in 2007, a segment of the Turners Falls Project's bypassed reach. The mussel was located just below Rock Dam, a natural feature located in the Turners Falls bypass channel. This new information was outlined in Fisheries and Wildlife's filing on March 13, 2014. The parties above participated in an initial telephone conference regarding this information on May 6th (Memo filed on May 7, 2014). Commission staff hosted this meeting to facilitate a discussion on how the discovery of a state-listed mussel in the bypassed reach may affect FirstLight's study plan implementation, specifically, Study 3.3.1 – *Instream Flow Habitat Assessment*. A summary of the meeting was filed on July 8, 2014.

<u>Background</u>
In its March 13, 2014 filing, Fisheries and Wildlife submitted four requests for additional data collection and/or analysis for yellow lampmussel in reach 3[1] of the bypass: (1) model habitat persistence for yellow lampmussel in reach 3; (2) utilize the 2-dimensional (2-D) model instead of a 1-D model in reach 3 to model habitat persistence for yellow lampmussel; (3) directly collect representative data to validate mean column and benthic velocity measurements at different flows; and (4) model habitat persistence for primary host fish in reach 3.

[1] The physical limits of Reach 3 are defined in Study No. 3.3.1. Reach 3 starts just above Rock Dam, a natural rock feature in the bypass channel, to just below the Deerfield River confluence on the Connecticut River.

FirstLight's Response
In light of the new information, FirstLight intends to model habitat persistence for yellow lampmussel in reach 3 (item 1 above) and use the 2-D model (item 2) to accomplish this task. FirstLight also plans to model habitat for primary host fish of state-listed mussels in all study reaches as required by the study plan determination (item 4).

In order to model suitable habitat for mussels or other species in reach 3, FirstLight intends to collect hydraulic data including velocity measurements at two (2) flows[2] per Study 3.3.1 – *Conduct Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station*. FirstLight explained that it plans to use an Acoustic Doppler Current Profiler (ADCP) to measure water velocity at 2 different flows in reach 3. The ADCP would collect velocity data at different depths and then calculate the mean column velocity at each data collection point. These mean column velocity data would be used to help calibrate the 2-D model. Relative to item 3, once the model is calibrated, FirstLight indicated that benthic velocity, shear stress and other important hydraulic variables could then be calculated and modeled from the mean column velocity values at each point. In short, FirstLight's approach involves calculating benthic velocity and other hydraulic variables using a modeled mean column velocity. This approach is different from Fisheries and Wildlife's request to directly collect benthic velocity at different flows in reach 3 and to use that data to specifically model benthic velocities in reach 3 under various flows.

FirstLight noted that while the ADCP automatically calculates a mean column velocity, the device does record discrete measurements of velocity for the entire vertical profile, including a benthic velocity. As such, direct measurements of benthic velocity at two different flows would be available.

Discussion
Provided that FirstLight furnishes a copy of all ADCP velocity data collected in reach 3, with suitable explanatory information to allow the use of the data (i.e., column headers names, explanations, time intervals of collection, linking files to link velocity point data with location data, etc.), to Fisheries and Wildlife, Fisheries and Wildlife found FirstLight's intended approach to calculate benthic velocities and other hydraulic variables using the modeled mean column velocity, would be acceptable. Fisheries and Wildlife indicated that it would use the ADCP data to verify FirstLight's calculated modeled results of benthic velocity in reach 3.

During the conference call Fisheries and Wildlife also requested that the benthic velocity data collected in reaches 4 and 5 (required by the study plan determination), be made available to the DELPHI team tasked with developing habitat suitability criteria in study 3.3.16 – *Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-Listed Mussel Species in the CT River below Cabot Station*. Fisheries and Wildlife stated that this data may be useful to refine the suitability criteria the DELPHI is charged to develop. FirstLight noted this data would not be available until after field data collection occurs in 2015, but it did not object to providing the data or applying it to the suitability criteria. Thus, an assessment of yellow lampmussel habitat in Reach 3 will not be possible in 2014 as habitat suitability criteria will not be available until 2015.

[2] Per Study Plan 3.3.1 (page 3-107), the approximate calibration flow is listed as 2,500 cfs to 9,000 cfs. The two calibration flows will be collected under approximately steady flow conditions, as safety and hydrologic conditions allow.

Summary

FirstLight will collect hydraulic data and evaluate project effects on yellow lampmussel and its host fish in reach 3 using methodology described in the approved study plan. FirstLight will apply any DELPHI-developed habitat suitability criteria (pursuant to study 3.3.16) for yellow lampmussel to reach 3 and conduct 2-D modeling of habitat persistence based on these suitability criteria in 2015 after the criteria is established. All velocity data will be made available to Fisheries and Wildlife and/or the DELPHI team for their use.

Given the provisions of section 5.15 of the Commission's regulations, Fisheries and Wildlife found this approach for evaluating suitable habitat in reach 3 for yellow lampmussel to be acceptable.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.2

EVALUATE UPSTREAM AND DOWNSTREAM PASSAGE OF ADULT AMERICAN SHAD

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The goal of this study is to identify the effects of the Turners Falls and Northfield Mountain Projects on adult shad migration. Telemetric techniques will be utilized to assess the potential impacts of project operations on the behavior, approach routes, passage success, survival, and delay of adult American shad during both upstream and downstream migrations.

The fieldwork portion of this study will primarily be conducted in 2015 as the Federal Energy Regulatory Commission (FERC) recommended a one-year delay in schedule due to the timing of the decommissioning of the Vermont Yankee Nuclear Power Plant located upstream of the Northfield Mountain Pumped Storage Project.

1.2 Study Progress Summary

Task 1: Review Existing Information

FirstLight has been tasked with assessing the upstream and downstream migration of adult and juvenile American shad through the project. Between 2011 and 2012, the United States Fish and Wildlife Service (USFWS) in consultation with the United States Geological Service (USGS), conducted the Whole River (WR) telemetry study, which radio-tagged 364 fish and collected data at 28 receivers from Enfield, CT to Vernon Dam. Initial data reduction was performed by the USGS and upon receipt; the dataset (aggregation of 2011 and 2012) contained nearly 12 million records. Following the initial receipt of the WR dataset, it was apparent that false positives were still included in the information.

The USGS performed primary data reduction by removing detections from the recordset that did not match a list of released tags, had too low of a power, or that were detected before the tag was activated. Following the initial data reduction, FirstLight employed Beeman and Perry's (2012) Method C, which required two simultaneous detections within series to be considered a true detection, otherwise they were deemed false positive and removed from record. The initial data reduction record set was reviewed by USFWS and USGS; however, they believed that too much data was removed (Appendix A). Therefore, a new data reduction method based on a Naïve Bayes Classifier will be developed that will remove false positive detections probabilistically rather than making arbitrary distinctions. Once a dataset is reviewed by USGS and USFWS, analysis of existing information will continue.

Task 2: Study Design and Methods

The study will be conducted in 2015 as required in the SPDL. Preliminary evaluations and range testing of proposed monitoring locations was conducted on July 15 and 16, 2014. The objective of the preliminary evaluations was to investigate the feasibility of using radio telemetry methods to monitor strategic locations as identified in the RSP. The evaluation included those proposed monitoring locations spanning large distances (i.e. wide sections of the river) to ensure that the proposed monitoring regime is adequate to document tagged study fish as they migrate through the study area. The range testing was conducted using a Lotek SRX 400 receiver and 4-element yagi antenna and a test tag with the following parameters:

- Frequency 149.320
- Width - 12mm
- Length - 40mm
- Mass - 8g
- Apparent mass in water - 3.5g

The test tag was deployed using a fishing pole and float to set the depth of the tag at approximately 5 feet (ft). Water quality data were collected at the time of the testing including temperature, dissolved oxygen (DO), pH and conductivity. Conductivity in particular affects the radio signal transmitted by the tag and will affect the range of the monitoring system. The conductivity of the Connecticut River was 139 µS/L at the time of testing (July 15) and 88 µS/L within the Deerfield River confluence (July 16).

Range testing was conducted at the following locations:

- Shearer Farms (RM 127.5),
- NMPS Intake (RM 127),
- NMPS Gill Bank (RM 126.5),
- Turners Falls Impoundment (RM 122),
- Station No. 1 Tailrace (RM 121),
- Rawson Island (RM 120.5),
- Cabot Station Tailrace (RM 120)
- Deerfield River Confluence (RM 119.5), and
- Montague Wastewater (RM 119.5)

The analysis of the range testing is ongoing, but a preliminary review revealed that the monitoring stations as proposed in the RSP will be adequate to monitor shad movement through the study area with one exception. An additional monitoring station at the Shearer Farms location will be necessary to monitor the full width of the river. This location will be monitored with two Lotek SRX 400 receivers and yagi antennas.

Though the monitoring location proposed at the Red Cliffe Canoe Club (RM 86.5, upstream of Holyoke Dam) was not tested in the evaluation, given the width of the river at the location (~1200 ft), it is anticipated that an additional receiver station, one on each side of the river, will be required to monitor the full width of the river. This area will be monitored using two Lotek SRX 400 receivers and yagi antennas.

Radio noise information is being collected in 2014 at Cabot Station to help determine which frequencies are best suited for use in the study. The exact frequencies used in the study will be based on availability and the results of the noise testing, and in cooperation with the TransCanada studies. Data collection for this effort is ongoing and it is anticipated that analysis of the data will be completed prior to purchasing tags.

<u>Task 3: Evaluation of Mortality</u>

Mortality data will be collected at all fixed telemetry stations and during mobile tracking. Mobile surveys to assess mortality will be conducted twice per week in the riverine section from Turners Falls dam (RM 122) to RM 93.

<u>Task 4: Reporting</u>

A final report will be completed in March 2016 per FERC's SPDL.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the study plan or schedule.

1.4 Remaining Activities

- Conduct field study component in 2015.
- File Final Report.

Appendix A
Correspondence Log

From: Sprankle, Ken [ken_sprankle@fws.gov]
Sent: Friday, February 21, 2014 10:50 AM
To: Kevin Nebiolo
Subject: Re: Telemety Data
Attachments: 2012 RKM designations for RX Sites.xlsx

Hi Kevin,

I have not accessed the drop box but expect Ted could easily share if necessary. The database that has the attached table in is 434 megs - so can not email. Give me some site, and direction, and I will upload the dbase.

I don't know when/how much time in coming week I have for this given other work, but, will try and maintain some amount of effort.

Ken

On Fri, Feb 21, 2014 at 10:40 AM, Kevin Nebiolo <Kevin.Nebiolo@kleinschmidtusa.com> wrote:
Ken,

You should be able to respond to this email address. Do you have access to the dropbox account that was set up by Ted? I am planning on uploading the script, data and report after I have run through the data reduction algorithms.

Looking forward to future collaboration,

Kevin Nebiolo
Staff Scientist
Kleinschmidt Associates
P: 860-767-5069
F: 860-767-5097
35 Pratt St. Suite 201
Essex, CT 06426

--
Kenneth Sprankle
Connecticut River Coordinator
U. S. Fish and Wildlife Service
103 East Plumtree Road
Sunderland, MA 01375-9480
http://www.fws.gov/r5crc/

phone (413) 548-9138 ext 121
fax (413) 548-9622

From: Sprankle, Ken [ken_sprankle@fws.gov]
Sent: Wednesday, March 05, 2014 9:01 AM
To: Kevin Nebiolo
Cc: Robert.Stira@gdfsuezna.com; tcastrosantos@usgs.gov; Chris Tomichek
Subject: Re: Preliminary Data Reduction

Hi Kevin,

Thanks for sharing this and for undertaking this work. It will be helpful as another approach to the more labor intensive screening process we are undertaking as you and discussed. I hope that we will be able to share the results of our effort with you soon and we can compare. In a quick review, many of the reductions seem intuitively logical relative to what fish are capable of doing for movement rates. Does not appear you were able to include mobile tracking data records - which if identified are 100% positive detections - and of course are at mostly between fixed receiver sites. We have yet to include that in Ted's plots, hope to crack into that this Friday. I think those data have important value to this screening effort.

One question, the X axis time series is hard for me to follow and sometime includes large spans when the fish is tagged "early" and in some cases shows only one date, making it hard to compare among a time scale pattern as you scroll through. Does that make sense? Ted's plots all have the same time scale for X axis.

Thanks again,

Ken

On Tue, Mar 4, 2014 at 6:26 PM, Kevin Nebiolo <Kevin.Nebiolo@kleinschmidtusa.com> wrote:
Good evening,

Over the past few weeks I was able to run a preliminary data reduction script across the 2011 lower river fish. You can find methods in the attached memo, if anyone has any questions please feel free to respond. While talking with Bob today, we realized that I was still missing a chunk of the data. I was able to convert the remaining SAS data files to csv and am running through the script now.

- Kevin

--
Kenneth Sprankle
Connecticut River Coordinator
U. S. Fish and Wildlife Service
103 East Plumtree Road
Sunderland, MA 01375-9480
http://www.fws.gov/r5crc/

phone (413) 548-9138 ext 121
fax (413) 548-9622

From: Sprankle, Ken [ken_sprankle@fws.gov]
Sent: Wednesday, March 05, 2014 10:03 AM
To: Kevin Nebiolo
Cc: Robert.Stira@gdfsuezna.com; tcastrosantos@usgs.gov; Chris Tomichek
Subject: Re: Preliminary Data Reduction

Ok, thanks for the dates adjustment.

Your data file questions must be answered by Ted, I simply do not have that knowledge.

You say " Also, what was the file name for the mobile tracking data records, I do not want to import those into the data reduction script."

Ted has not included mobile tracking data in any of the files he sent you in ACCESS. These data are still in Excel spreadsheet files. You may have them, maybe not, Ted would not have sent them but I may have sent them to Kris. You say you do not want to import them into the "scripts" but are you not interested in having them included in the plots? I guess I am unclear on what exactly this means, I don't read this as a mutually exclusive thing statement, relative to using the data. Let me know.

Ken

On Wed, Mar 5, 2014 at 9:49 AM, Kevin Nebiolo <Kevin.Nebiolo@kleinschmidtusa.com>
wrote:
Ken,

I'll adjust the x-axis. Currently it is drawn to match the temporal extent of the record, but I can standardize so that it is drawn between a min and max season date.

I would love to share the results, I've done a lot to streamline the data, especially how it's handled in Access and the resultant database is robust. Just to make sure I am working with the correct data, I am currently only analyzing the whole river dataset(s). The gatehouse data will be a separate analysis. On the DVD provided there were three files:

* (1) a cleanradio.SAS7BDAT in 2011/Lower River,
* (2) a cleanradio.SAS7BDAT in 2012/Lower River,
* (3) a cleanradio.SAS7BDAT in 2012/Upper River.

I'm assuming that there is no "cleanradio" file for 2011 Upper River.

Were there any other files from the fixed receivers that could contain false positives?

Also, what was the file name for the mobile tracking data records, I do not want to import those into the data reduction script.

- Kevin

From: Sprankle, Ken [mailto:ken_sprankle@fws.gov]
Sent: Wednesday, March 05, 2014 9:01 AM
To: Kevin Nebiolo
Cc: Robert.Stira@gdfsuezna.com; tcastrosantos@usgs.gov; Chris Tomichek
Subject: Re: Preliminary Data Reduction

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Ken

On Tue, Mar 4, 2014 at 6:26 PM, Kevin Nebiolo <Kevin.Nebiolo@kleinschmidtusa.com> wrote:
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- Kevin

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Kenneth Sprankle
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Sunderland, MA 01375-9480
http://www.fws.gov/r5crc/

phone (413) 548-9138 ext 121
fax (413) 548-9622

--
Kenneth Sprankle
Connecticut River Coordinator
U. S. Fish and Wildlife Service
103 East Plumtree Road
Sunderland, MA 01375-9480
http://www.fws.gov/r5crc/

phone (413) 548-9138 ext 121
fax (413) 548-9622

From: Castro-Santos, Theodore [tcastrosantos@usgs.gov]
Sent: Friday, March 07, 2014 8:44 AM
To: Kevin Nebiolo
Cc: Robert.Stira@gdfsuezna.com; ken_sprankle@fws.gov; Chris Tomichek
Subject: Re: Preliminary Data Reduction

All:

I've had a quick look at the rationale, methods and output. Great to see progress on this. I do have some concerns, notably that the method is discarding some points that weight of evidence approach might retain. This has important effects on duration of exposure etc. It's field season now, so I can't meet anytime soon, but I do think we should try to find a time (June?) to go over some of the methods and/or compare different approaches to the data. Again, not terribly concerned at this point, and I do like the approach of plotting original and cleaned data.

One quick thought is to use a broader criteria, e.g. 3 detections out of 10 possible to denote viable data. The other thing to be careful of is receivers with CRTO enabled, which will tend to discard data (and not allow for identification of sequential detections).

Ted

Theodore Castro-Santos, PhD
Research Ecologist
USGS-S.O. Conte Anadromous Fish Research Center
P.O. Box 796; One Migratory Way
Turners Falls, MA 01376
413-863-3838
tcastrosantos@usgs.gov

On Tue, Mar 4, 2014 at 6:26 PM, Kevin Nebiolo <Kevin.Nebiolo@kleinschmidtusa.com> wrote:
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- Kevin

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Relicensing Study 3.3.3

EVALUATE DOWNSTREAM PASSAGE OF JUVENILE AMERICAN SHAD

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The objective of this study is to obtain information to assess the effects of the Projects on downstream passage of juvenile American shad. The potential impact of project operations on juvenile shad outmigrants will be studied using a combination of approaches, including hydroacoustics, radio telemetry, and the use of HI-Z Turb'N tags (balloon tags). Hydroacoustics will be utilized to monitor the timing, duration, and magnitude of the juvenile shad migration at the forebay area of Cabot Station, downstream of the Gatehouse in the canal, and Northfield Mountain Project intake from August through October 2015. Radio telemetry techniques will be employed to assess downstream passage routes (i.e., past the Northfield Mountain Project, over the Turners Falls Dam, into the Turners Falls power canal, through Station No. 1 and Cabot Station powerhouses, and through the downstream fish bypass adjacent to Cabot Station) and occurrence of delays. Placement of the radio telemetry receivers and antennas will be tested prior to initiation of field studies to ensure that adequate and reliable data are collected. Finally, balloon tags will be used to empirically determine rates of survival for fish entrained through representative turbines at Station No. 1 (one of the larger turbines and the smaller turbine) and Cabot Station (one turbine- all turbines are identical), and for those that pass over the dam via the bascule gates and tainter gates. The turbine survival study will be conducted under near best efficiency conditions.

The radio telemetry and balloon tag components of the study will be conducted utilizing hatchery raised juvenile shad grown to at least 120 mm at the North Attleboro National Fish Hatchery under the care of the United States Fish and Wildlife Service (USFWS). As of August 9, 2014, USFWS reported that there is an abundance of shad growing in the hatchery tanks and pools, and a grab sample indicated a mean length of 47 mm, which represents a growth rate of approximately 1 mm per day.

As recommended by the Federal Energy Regulatory Commission (FERC) in its February 21, 2014 Study Plan Determination Letter (SPDL), a radio telemetry receiver and antenna will also be deployed in the Northfield Mountain Upper Reservoir to assess entrainment of tagged fish at the Northfield Mountain intake. Data collected from at this location will allow for a more accurate determination of entrainment and complement hydroacoustic and telemetry data collected at the intake/tailrace.

As requested by FERC, fieldwork will be conducted in 2015 following decommissioning of the Vermont Yankee Nuclear Power Plant located upstream of the Northfield Mountain Project.

In FERC's SPDL it states "*To ensure data collected through the turbine juvenile shad survival study are representative of typical turbine operating conditions during the juvenile shad outmigration season, we recommend that FirstLight consult with the FWS, MADFW, and the NMFS and establish the typical operating condition of each test turbine evaluated during the juvenile shad out-migration season. FirstLight should make recommendations regarding how these operating conditions would be incorporated into the study and file them for Commission approval with the Initial Study Report in September 2014. FirstLight should consider comments received, and if recommendations are not adopted, the filing should provide FirstLight's reasons based on project-specific information.*"

On September 3, 2014 (Appendix A) FirstLight sent consultation correspondence to the agencies and stakeholders describing best efficiency conditions and verified that the Cabot units and Station No. 1 units are typically operated at or near best efficiency.

On September 4, 2014 (Appendix A) National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS) and Trout Unlimited (TU) replied and requested graphical depiction of the past 5 years of operational data during the study period (August 15 through October). Data was requested in MW and cfs.

1.2 Study Progress Summary

Task 1: Evaluation of Timing, Duration and Magnitude of Migration

In order to optimize the split beam transducers spatial coverage of the targeted areas, field testing was preliminarily performed in August 2014.

Task 2: Evaluate Route of Passage

Field testing of the telemetry monitoring locations was performed on July 15 and 16, 2014. The objective of the preliminary evaluations was to confirm the feasibility of using radiotelemetry methods to monitor locations identified in the Revised Study Plan (RSP). The evaluations included those proposed monitoring locations that span large distances (i.e., wide sections of the river) to ensure that the proposed telemetry gear will detect tagged fish as they migrate through those areas. The range testing was conducted using a Lotek SRX 400 receiver and 4-element yagi antenna and a test tag with the following parameters:

- Frequency 149.320
- Width - 12mm
- Length - 40mm
- Mass - 8g
- Apparent mass in water - 3.5g

The test tag was deployed using a fishing pole and float to set the depth of the tag at approximately 5 ft. Water quality data were collected at the time of the testing including temperature, dissolved oxygen (DO), pH and conductivity. Conductivity in particular affects the radio signal transmitted by the tag and will affect the range of the monitoring system. The conductivity of the Connecticut River was 139 µS/L at the time of testing (July 15, 2014) and 88 µS/L within the Deerfield confluence (July 16, 2014).

Range testing was conducted at the following locations:

- Shearer Farms (RM 127.5),
- Northfield Mountain Project Intake (RM 127),
- Northfield Mountain Project Gill Bank (RM 126.5),
- Turners Falls Impoundment (RM 122),
- Station No. 1 Tailrace (RM 121),
- Rawson Island (RM 120.5),
- Cabot Station Tailrace (RM 120)
- Deerfield River Confluence (RM 119.5), and
- Montague Wastewater (RM 119.5)

The analysis of the range testing is ongoing but a preliminary review revealed that the monitoring stations as proposed in the RSP will be adequate to monitor fish movement through the study area, with one exception. An additional monitoring station at the Shearer Farms location will be necessary to monitor the full width of the river. This location will be monitored with two Lotek SRX 400 receivers and yagi antennas.

Though the monitoring location proposed at the Red Cliffe Canoe Club (RM 86.5, upstream of Holyoke Dam) was not tested in the evaluation, given the width of the river at the location (~1200 ft), it is anticipated that an additional receiver station, one on each side of the river, may be required to monitor the full width of the river. This area will be monitored using two Lotek SRX 400 receivers and yagi antennas.

Radio noise information is being collected in 2014 at Cabot Station to help determine which frequencies are best suited for use in the study. The frequencies used in the study (between 148 and 152 Mhz) will be selected to avoid high-noise frequencies, and to coordinate with the TransCanada studies. Noise data collection is ongoing and analysis of the data will be completed prior to purchasing tags.

Task 3: Turbine and Dam Passage Survival

FirstLight has confirmed that near best efficiency conditions are representative of typical operating conditions during the juvenile shad outmigration season (mid-August-October). Turbine conditions on the dates of testing will be recorded and included in the Final Study Report.

Task 4: Reporting

A final report will be completed in March 2016 per FERC's SPDL.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the RSP.

1.4 Remaining Activities

- Conduct field studies in 2015.

Appendix A
Consultation Record

Consultation Correspondence

Appendix A

September 3, 2014

To: John Warner, Melissa Grader, Ken Sprankle, William McDavitt, Jessica Pruden, Don Pugh, Andrea Donlon, Katie Kennedy, Ken Hogan, Mark Wamser, John Howard, Robert Stira

From: Chris Tomichek

Subject: Operational Conditions During Turbine Survival Testing

Study Plans 3.3.3, *Evaluate Downstream Passage of Juvenile American Shad* and 3.3.5 *Evaluate Downstream Passage of American Eels* both include turbine survival testing. FirstLight proposed to conduct this study "at or near best efficiency conditions." FERC's February 21, 2014 Study Plan Determination Letter points out that FirstLight did not indicate that this is the typical operational scenario for the turbines during the outmigration season (August 15 through October). FERC indicated to ensure data collected through the turbine juvenile shad/adult eel survival study are representative of typical turbine operating conditions during the outmigration that FirstLight consult with the FWS, MADFW, and the NMFS and establish the typical operating condition of each test turbine evaluated during the out-migration season. FERC required FirstLight to provide the results of the consultation and file them for FERC approval with its Initial Study Report on September 15, 2014.

FirstLight typically runs the Cabot units (all 6 units are identical) at an output of 10.3 Mw. There are some exceptions when units could be run at less than 10.3 Mw, but they are uncommon. One exception would be at times of low river flow just before the minimum flow releases are switched to Station No. 1. At times like this, operators may decide to run one unit at Cabot at less than 10.3 Mw rather than put No. 1 units online, depending on other factors.

At No.1 Station, the units are run either fully on or off. At times when available flow exceeds Cabot's capacity, if the units at No. 1 are run, they are run at full output. Individual units are not run at intermediate outputs. Individual units may be turned off at extremely low river flow, when inflow to the Turners Project is less than the required minimum flow.

This email is to confirm that FirstLight typically operates their Units at <u>or near</u> best efficiency conditions. We would greatly appreciate your feedback by September 9, 2014. Please let me know if you have any comments or questions.

September, 4, 2014

To: John Warner, Melissa Grader, Ken Sprankle, Jessica Pruden, Don Pugh, Andrea Donlon, Katie Kennedy, Ken Hogan, Mark Wamser, John Howard, Robert Stira, Chris Tomichek

From William McDavitt

Subject: Re: Operational Conditions During Turbine Survival Testing

Chris,

It would be good to present “typical turbine operating conditions” during the outmigration season with some graphs and a narrative and then some sort of graphical depiction and narrative of the operating conditions during the study would be quite helpful. Being able to understand the operating conditions during the study and how far off of ‘typical’ these conditions are is information that I would find helpful in my evaluation. Being able to discern bias in the results, positively or negatively, is information that I think would be helpful for all stakeholders.

-Bill

September, 4, 2014

To: John Warner, William McDavitt, Ken Sprankle, Jessica Pruden, Don Pugh, Andrea Donlon, Katie Kennedy, Ken Hogan, Mark Wamser, John Howard, Robert Stira, Chris Tomichek

From Melissa Grader

Subject: Re: Operational Conditions During Turbine Survival Testing

To be a little more specific, we would either like to have actual operational data for Cabot Station for the past 5 years (hourly) for the outmigration season (Aug. through November) so that we can evaluate how often the station is operating at 10.3 MW versus other generation levels - or, if you want to crunch the numbers, then just provide us with graphical representations of those data.

This would be to better understand what you mean by "typically."

Thanks!

September, 4, 2014

To: John Warner, William McDavitt, Ken Sprankle, Jessica Pruden, Melissa Grader, Andrea Donlon, Katie Kennedy, Ken Hogan, Mark Wamser, John Howard, Robert Stira, Chris Tomichek

From Don Pugh

Subject: Re: Operational Conditions During Turbine Survival Testing

Data in cfs and MW, please.

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Relicensing Study 3.3.4

EVALUATE UPSTREAM PASSAGE OF AMERICAN EEL AT THE TURNERS FALLS

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to assess upstream passage of juvenile American eel at the Turners Falls Project (FERC No. 1889). Eels visual surveys and trapping with the objectives of identifying concentrations of eels staging in pools or are currently able to pass the Turners Falls Dam complex (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass Turners Falls and the proportion successfully passing the Turners Falls Project are unknown [letter from the National Marine Fisheries Service (NMFS)], Comments on FirstLight Power Resources Notice of Intent to File License Application, February 27, 2013). The assessment employs attempting to ascend wetted structures; and assessing whether eels can be passed in substantial numbers and whether sites are viable for permanent passage structures.

The locations where eel stage in attempts to pass upstream of the Turners Falls Project are being investigated through systematic surveys of eel presence and relative abundance. Surveys are in progress and will be conducted 10-12 times during the 2014 eel upstream migratory season. The surveys consist of visual inspection on foot in areas where eels are likely to concentrate as they attempt to climb structures wetted by spill or leakage flow in the Turners Falls Dam complex area and are being conducted in accordance with the RSP unless otherwise stated in Sections 1.3 *Variances from Study Plan and Schedule*. Survey locations, as identified in the RSP, include:

- Cabot Station spillway (emergency water control gates).
- Cabot fishway.
- Cabot log sluice.
- United States Geological Survey (USGS) Conte Lab flume outfall.
- Station No. 1 outfall.
- Small turbine and process water outfalls from the Cabot Canal.
- Spillway fishway attraction water stilling basin.
- Leakage points along the downstream face of Turners Falls Dam (as site safety conditions allow).

Further, as stipulated in Section 3.9 *Matrix of Comments and Reponses* of the RSP, FirstLight adopted recommendations to include the spillway fishway entrance and lower pools.

In addition to those listed above, other potential eel staging locations were identified during field surveys including:

- Cabot Station lower gate sluice.
- Station No. 1 canal drain gate sluice.
- City of Montague combine sewer outfall (CSO) No.1.
- The Spillway fishway

These areas have been incorporated into the nighttime surveys.

In year two of study (2015), areas identified as having eels present in sufficient numbers will be targeted as potential areas for permanent eel trap/passes and will be initially assessed using temporary/portable traps. The temporary trap/passes will be designed and built for each location, and operated throughout the eel upstream migratory season, beginning within one week of eels being recorded at the Holyoke eel pass and continuing through October. Ramp-type traps with supplementary attraction flow will be provided. Traps will operate daily (24 hours per day) and will be checked every two to three days or after rain events to quantify the catch.

No consultation for implementing this study was required. The RSP for this study was approved by FERC in its February 21, 2014 Study Plan Determination Letter (SPDL) with no modifications.

1.2 Study Progress Summary

Task 1: Systematic Surveys

Holyoke Gas & Electric (HG&E) operates the first dam on the Connecticut River, the Holyoke Hydroelectric Project, and maintains upstream eel passage facilities. FirstLight consulted with HG&E to determine the beginning of the upstream eel migration within the Connecticut River main stem. The passage of a significant numbers of eel (>100/day) at Holyoke began on June 9, 2014 and prompted the first systematic surveys of the Turners Falls Dam Complex on the evening of June 11, 2014, during which no eel were observed. Additional surveys were conducted on the evenings of June 26, July 2, 10, 17, 21, 31, August 7, 21 and September 4, 2014. Eels were first observed on June 26 and have been observed in each subsequent survey with varying abundance.

Task 2: Trap Collections

Trap collections have not yet begun and will be conducted during the second year of study (2015).

Task 3: Data Analysis

Upon completion of field surveys data were/will be reviewed to assure quality and archived. Data analysis has not yet begun but will include tabular and graphic summaries of eel abundance by location.

Task 4: Reporting

A report will be prepared detailing the methods and results of the study and is anticipated to be completed by the 1st quarter of 2015.

1.3 Variances from Study Plan and Schedule

The surveys are proceeding in accordance with the methods described in the RSP. On the evening of June 26, 2014 the Turners Falls Dam was spilling and Station No. 1 was in operation; on that day these areas were not surveyed for safety reasons. No eel were observed in the small turbine and process water outfalls from the Cabot Canal and the survey of these areas was abandoned beginning on July 17 as these areas are particularly difficult to access at night and were deemed a safety hazard.

1.4 Remaining Activities

Additional (1-3) surveys will be conducted during the months of September and October 2014. Remaining tasks will be conducted in 2015.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.5

EVALUATE DOWNSTREAM PASSAGE OF AMERICAN EEL

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

Kleinschmidt
Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The primary goals of this study are to (1) obtain a better understanding of the timing and magnitude of adult, silver-phase American eel migration as it relates to environmental factors and operation of the Turners Falls and Northfield Mountain Projects; and (2) to characterize the potential impacts of the Turners Falls and Northfield Mountain Projects on the outmigration of silver eels. The potential impact of project operations on silver eel outmigrants will be studied using a combination of approaches, including hydroacoustics, radio telemetry, and HI-Z Turb'N tags (balloon tags).

Hydroacoustics will be utilized to monitor the timing, duration, and magnitude of adult eel outmigration at the forebay area of Cabot Station, the Gatehouse, and the Northfield Mountain Project intake (tailrace) from August 1 through October 31 2015 and 2016. As recommended by the Federal Energy Regulatory Commission (FERC) in its February 21, 2014 Study Plan Determination Letter (SPDL), conducting two seasons of hydroacoustic monitoring will allow for year-to-year variability to be addressed and provide more reliable information to understand presence, migration timing, passage route utilization, and entrainment at the Northfield Mountain Project. The proper number, location, and orientation of the split-beam transducers to optimize spatial coverage, as described below under Task 1, was determined in August 2014.

Radio telemetry techniques will be employed to assess downstream passage and migration delays at the Turners Falls and Northfield Mountain Projects. For the Turners Falls Project, the study will determine the proportion of tagged eel passing via spillways, gates, turbines, and the existing fish bypass at Cabot Station and/or Station No. 1. For the Northfield Mountain Project, the study will determine the proportion of tagged eel entrained into the intake. As recommended by FERC in its SPDL, a radio telemetry receiver and antenna will also be deployed in the Northfield Mountain Upper Reservoir to assess entrainment of tagged fish at the Northfield Mountain intake. Data collected at this antenna site will allow for a more accurate determination of entrainment and compliment hydroacoustic and telemetry data collected at the intake/tailrace.

In addition, a radio antenna will be located upstream of the Gatehouse to assess potential passage delay and milling near the Gatehouse. Field testing to ensure the adequacy and reliability of antenna coverage in this area was conducted in August 2014 and is described below under Task 2.

Tagged fish will be tracked from a boat or from shore in river reaches between release sites and 5 km downstream of Cabot Station at least twice per week during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up. Tracking will continue until the tagged eels leave the study area or water temperatures reach 5°C. Movement rates (time between release and passage) of eels passing the projects by various routes will also be quantified. Eels will be collected at the Cabot or Holyoke Canal bypass sampler during the migratory season (late-August to mid-October) and affixed with 90-day battery life transmitters.

Balloon tags will be used to determine rates of survival for fish entrained through representative turbines at Station No. 1 (one of the larger and the smaller turbine) and Cabot Station (one turbine; the turbines are identical), and for those that pass over the dam via the bascule gates and tainter gates. The turbine survival study will be conducted under near best efficiency conditions, which are representative of the typical turbine operating conditions during the August through October 2015 period.

This fieldwork portion of this study will commence in 2015 as FERC requested a one-year delay in schedule due to the timing of the decommissioning of the Vermont Yankee Nuclear Power Plant located upstream of the Northfield Mountain Project.

In FERC's February 21, 2014 SPDL it states: *"Therefore, as discussed in study 3.3.3 above, we recommend that FirstLight consult with the FWS, MADFW, and the NMFS and establish the typical operating condition of each test turbine evaluated during this study. FirstLight should provide the results of this consultation and file them for Commission approval with the Initial Study Report in September 2014. FirstLight should consider comments received and if recommendations are not adopted, the filing should provide FirstLight's reasons based on project-specific information. Upon filing of the Initial Study Report, stakeholders are provided an opportunity for comment pursuant to section 5.15(c) of the Commission's regulations."*

On September 3, 2014 (Appendix A) FirstLight sent consultation correspondence to the agencies and stakeholders describing best efficiency conditions and verified that the Cabot units and No. 1 are typically operated at or near best efficiency.

On September 4, 2014 (Appendix A) National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS) and Trout Unlimited (TU) replied and requested graphical depiction of the past 5 years of operational data during the study period (August 15 through October). Data was requested in MW and cfs.

A modified study plan is included in Appendix B.

1.2 Study Progress Summary

Task 1: Evaluate Timing of Downstream Migratory Movements

In order to optimize the split beam transducers spatial coverage of the targeted areas, field testing and calibration was preliminarily performed in August 2014.

Task 2: Assessment of Downstream Passage of American Eel

Field testing of the telemetry arrays was performed on July 15 and 16, 2014. The objective of the preliminary evaluations was to investigate the feasibility of using radiotelemetry methods to monitor locations identified in the Revised Study Plan (RSP). The evaluation included those proposed monitoring locations that span large distances (i.e., wide sections of the river) to ensure that the proposed equipment will detect tagged study fish as they migrate through the study area. The range testing was conducted using a Lotek SRX 400 receiver and 4-element yagi antenna and a test tag with the following parameters:

- Frequency 149.320
- Width - 12mm
- Length - 40mm
- Mass - 8g
- Apparent mass in water - 3.5g

The test tag was deployed using a fishing pole and float to set the depth of the tag at approximately 5 ft. Water quality data were collected at the time of the testing including temperature, dissolved oxygen (DO), pH and conductivity. Conductivity in particular affects the radio signal transmitted by the tag and will affect the range of the monitoring system. The conductivity of the Connecticut River was 139 µS/L at the time of testing (July 15, 2014) and 88 µS/L within the Deerfield confluence (July 16, 2014).

Range testing was conducted at the following location:

- Shearer Farms (RM 127.5),
- Northfield Mountain Project Intake (RM 127),

- Northfield Mountain Project Gill Bank (RM 126.5),
- Turners Falls Impoundment (RM 122),
- Station No. 1 Tailrace (RM 121),
- Rawson Island (RM 120.5),
- Cabot Station Tailrace (RM 120)
- Deerfield River Confluence (RM 119.5), and
- Montague Wastewater (RM 119.5)

The analysis of the range testing is ongoing but a preliminary review revealed that the monitoring stations as proposed in the RSP will be adequate to monitor fish movement through the study area with one exception. An additional monitoring station at the Shearer Farms location will be necessary to monitor the full width of the river. This location will be monitored with two Lotek SRX 400 receivers and yagi antennas.

Though the monitoring location proposed at the Red Cliffe Canoe Club (RM 86.5, upstream of Holyoke Dam) was not tested in the evaluation, given the width of the river at the location (~1200 ft), it is anticipated that an additional receiver station, one on each side of the river, may be required to monitor the full width of the river. This area will be monitored using two Lotek SRX 400 receivers and yagi antennas.

Radio noise information is being collected in 2014 at Cabot Station to help determine which frequencies are best suited for use in the study. The frequencies used in the study (between 148 and 152 Mhz) will be selected to avoid high-noise frequencies, and to coordinate with the TransCanada studies. Noise data collection for this effort is ongoing and it is anticipated that analysis of the data will be completed prior to purchasing tags.

<u>Task 2a: Northfield Mountain Route Selection Study</u>

Range testing was completed as described above.

<u>Task 2b: Turners Falls Dam Route Selection Study</u>

Range testing was completed as described above.

<u>Task 2c: Mobile Tracking</u>

Mobile tracking will occur as part of the field studies, which will commence in 2015.

<u>Task 3: Data Management and Analysis</u>

Data will be collected from the field and analyzed following the completion of field studies.

<u>Task 4: Turbine and Dam Passage Survival</u>

FirstLight has confirmed that near best efficiency conditions are representative of typical operating conditions during the silver eel outmigration season (August-October). Turbine conditions on the dates of testing will be recorded and included in the Final Study Report.

<u>Task 5: Reporting</u>

A final report will be completed in March 2017 per the Federal Energy Regulatory Commission’s Study Plan Determination Letter.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

1.3 Variances from Study Plan and Schedule

To date there are no variances from the RSP.

1.4 Remaining Activities

- Conduct field studies in 2015 and repeat hydroacoustic monitoring (Task 1) and analysis of data in 2016.
- File Final Study Report.

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Appendix A
Consultation Record

Consultation Correspondence

Appendix A

September 3, 2014

To: John Warner, Melissa Grader, Ken Sprankle, William McDavitt, Jessica Pruden, Don Pugh, Andrea Donlon, Katie Kennedy, Ken Hogan, Mark Wamser, John Howard, Robert Stira

From: Chris Tomichek

Subject: Operational Conditions During Turbine Survival Testing

Study Plans 3.3.3, *Evaluate Downstream Passage of Juvenile American Shad* and 3.3.5 *Evaluate Downstream Passage of American Eels* both include turbine survival testing. FirstLight proposed to conduct this study "at or near best efficiency conditions." FERC's February 21, 2014 Study Plan Determination Letter points out that FirstLight did not indicate that this is the typical operational scenario for the turbines during the outmigration season (August 15 through October). FERC indicated to ensure data collected through the turbine juvenile shad/adult eel survival study are representative of typical turbine operating conditions during the outmigration that FirstLight consult with the FWS, MADFW, and the NMFS and establish the typical operating condition of each test turbine evaluated during the out-migration season. FERC required FirstLight to provide the results of the consultation and file them for FERC approval with its Initial Study Report on September 15, 2014.

FirstLight typically runs the Cabot units (all 6 units are identical) at an output of 10.3 Mw. There are some exceptions when units could be run at less than 10.3 Mw, but they are uncommon. One exception would be at times of low river flow just before the minimum flow releases are switched to Station No. 1. At times like this, operators may decide to run one unit at Cabot at less than 10.3 Mw rather than put No. 1 units online, depending on other factors.

At No.1 Station, the units are run either fully on or off. At times when available flow exceeds Cabot's capacity, if the units at No. 1 are run, they are run at full output. Individual units are not run at intermediate outputs. Individual units may be turned off at extremely low river flow, when inflow to the Turners Project is less than the required minimum flow.

This email is to confirm that FirstLight typically operates their Units at <u>or near</u> best efficiency conditions. We would greatly appreciate your feedback by September 9, 2014. Please let me know if you have any comments or questions.

September, 4, 2014

To: John Warner, Melissa Grader, Ken Sprankle, Jessica Pruden, Don Pugh, Andrea Donlon, Katie Kennedy, Ken Hogan, Mark Wamser, John Howard, Robert Stira, Chris Tomichek

From William McDavitt

Subject: Re: Operational Conditions During Turbine Survival Testing

Chris,

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-Bill

September, 4, 2014

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From Melissa Grader

Subject: Re: Operational Conditions During Turbine Survival Testing

To be a little more specific, we would either like to have actual operational data for Cabot Station for the past 5 years (hourly) for the outmigration season (Aug. through November) so that we can evaluate how often the station is operating at 10.3 MW versus other generation levels - or, if you want to crunch the numbers, then just provide us with graphical representations of those data.

This would be to better understand what you mean by "typically."

Thanks!

September, 4, 2014

To: John Warner, William McDavitt, Ken Sprankle, Jessica Pruden, Melissa Grader, Andrea Donlon, Katie Kennedy, Ken Hogan, Mark Wamser, John Howard, Robert Stira, Chris Tomichek

From Don Pugh

Subject: Re: Operational Conditions During Turbine Survival Testing

Data in cfs and MW, please.

Appendix B
Modified Study Plan

3.3.5 Evaluate Downstream Passage of American Eel

General Description of Proposed Studies

The USFWS, NHFG, MDFW, NOAA, VTDEC, TU, and CRWC have requested two specific studies regarding downstream passage of adult American eel. The first study request was for a timing evaluation of downstream migratory movements of American eel on the mainstem Connecticut River. The second study request was for an assessment of downstream American eel passage at the Turners Falls Project and Northfield Mountain Projects. The study proposed herein will use radiotelemetry and hydroacoustic methods to investigate the timing of silver phase eel outmigration in the Connecticut River in the Project area and routes of passage through the Projects. Additionally, HI-Z Turb'N tags will be used to empirically determine rates of survival for eels entrained at Station No. 1 and Cabot Station and to determine spill survival over the dam.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goals of these studies are to:

1. Better understand migration timing of adult, silver-phase American eel as it relates to environmental factors and operations of the Turners Falls Project and Northfield Mountain Project.

2. Collect information to determine the impact of the Turners Falls Project and Northfield Mountain Project on the outmigration of silver eel in the Connecticut River.

Specific objectives of these studies are to:

1. Characterize the general migratory timing and presence of adult, silver-phase American eel migrating past the Turners Falls Project and Northfield Mountain Project relative to environmental factors and operations.

2. Quantify movement rates and proportion of eel passing downstream via various passage routes at the Turners Falls and Northfield Mountain Projects. For the Northfield Mountain Project, the study will evaluate the proportion of eel entrained into the intake. For the Turners Falls Project, the study will evaluate the proportion of eel passing via the available routes of passage.

3. Evaluate survival of adult silver eel passed at the available routes of passage at the Turners Falls complex.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

Based on management plans developed by the ASMFC and the CRASC, the resource management goals identified by the commenting agencies are to:

- Ensure PME measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

- Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific goals with respect to downstream passage of American eel are to:

- Minimize current and potential negative project operation effects that could hinder management goals and objectives.
- Minimize project-related sources of downstream passage injury, stress, and mortality in order to maximize the number of silver eel migrating to the spawning grounds.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

According to the commenting agencies, data on the timing of downstream migratory movements and rates of American eel in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on the presence of "eel-sized" acoustic targets have been collected (Haro et al., 1999) within the Cabot Station forebay, supported by video monitoring at the Cabot Station downstream fish bypass. This was a short-term study, with acoustic monitoring performed between 17 September and 5 October and video monitoring conducted between 18 September and 22 October. Some daily monitoring of the downstream fish bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt Associates, 2005; 2006; Normandeau Associates, 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was only operated at night

As discussed in the PAD, 2-D and 3-D telemetry studies were conducted at Cabot Station in 1996, 1997, 2002 and 2003. Results of those studies indicate that a significant proportion of eel entering the Cabot forebay become entrained through the Station turbines (90% in 2002, 100% in 2003; Brown, 2005; Brown et al., 2009). The PAD notes that the study done in 2003 determined that 15 of the 29 test eel were detected at the Hadley Falls Station. However, that study was not designed to assess turbine mortality. The approach velocity at the Cabot Station racks is approximately 2.0 feet per second at maximum hydraulic capacity. At Station No. 1, the racks have 2.6-inch clear spacing and an approach velocity of 1.2 feet per second. The intake at the Northfield Mountain Project has 48-foot-deep trash racks with six-inch clear spacing over the intake and an approach velocity of 3.5 feet per second at full pumping capacity (15,000 cfs).

To date, no directed studies of eel mortality at Cabot Station or eel entrainment or mortality at either Station No. 1 or the Northfield Mountain facility have been conducted.

Existing research and literature on the American eel relevant to these proceedings includes the following:

Brown, L.S. (2005). Characterizing the downstream passage behavior of silver phase American eel at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts. Amherst, Massachusetts: University of Massachusetts.

Brown, L., A. Haro, and T. Castro-Santos. (2009). Three-dimensional movement of silverphase American eel in the forebay of a small hydroelectric facility. In J. Casselman et al. (Eds.), *Eel at the Edge: Science, Status, and Conservation Concerns* (pages 277-291). Bethesda, MD: American Fisheries Society.

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Project Nexus (18 CFR § 5.11(d)(4))

Project operations may directly or indirectly affect eel outmigration in the fall through entrainment, rate of movement, injury, or mortality. Baseline information related to the timing and passage of outmigrating eel will allow stakeholders to assess project-related effects on eel migratory success and survival.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Information will be collected to assess potential impacts to adult eel outmigrants by project operations by a combination of approaches including hydroacoustic and radio telemetry, and the use of HI-Z Turb'N tags. The study objectives will be met by a tasked approach and are anticipated to occur in 2014.

Task 1: Evaluate Timing of Downstream Migratory Movements

The timing, duration, and magnitude of adult eel migration at the Turners Fall Project will be evaluated over a range of existing and operational conditions. Hydroacoustics will be deployed in the forebay area at Cabot Station, at the Gatehouse and the Northfield Mountain Project intake (August through October). An array of split beam transducers will be deployed to provide sufficient coverage of the cross-sectional targeted areas. The exact location and number of transducers, and orientation will be determined prior to the commencement of the survey during reconnaissance and test deployment, but will be established to optimize spatial coverage. To the extent possible, transducers will be mounted in areas of limited turbulence and ambient noise and away from eddies or other hydraulics where fish "milling" would occur. Ideally transducers would be mounted as close to the target area as possible. A summary of the telemetry array range testing and calibration will be included in the ISR.

Data will be recorded and archived continuously; however at the Northfield Mountain intake, only data recorded during 1 hour before and during pumpback mode will be analyzed. Depending on the configuration of the system and the target area, fish moving in the direction of the target area, fish size, or other sampled parameters can potentially be used to identify acoustic targets corresponding to adult eels. Acoustic targets can be filtered by size and supporting data used to apportion the number of fish by size class. Current plans are to have the hydroacoustic expert on site on August 13, 2013.

Data will be recorded by an onsite data logger. Transducers will be inspected and serviced by a qualified technician on a weekly basis, and data will be remotely downloaded and reviewed at least once per week during sampling to qualitatively view trends, and to ensure the system is functioning properly. During analysis, echo data will be analyzed using standard analytical tools such as Echoview ® software, and temporally related to concurrent station operation, water temperature, climatic conditions and Connecticut River flow. Data will be displayed in both tabular and graphic form, and include hourly daily, monthly and full season estimates. To the extent possible data output will also show patterns of spatial distribution of targets in the intake area. Data from the hydroacoustics will provide information on the timing, frequency and magnitude of the migration, as well as estimates of adult eel entering to and existing in the Canal and estimates of the numbers entrained at the Northfield Mountain Project. Eel outmigration through the downstream bypass will be sampled concurrently. Concurrent bypass sampling will be conducted over several discreet events (12 to 18) to ground truth the hydroacoustic data and compare the percent of eels passing via the Cabot sampler and Cabot Station. To address the potential year-to-year variability of downstream silver eel migrations, Task 1 will be conducted for two consecutive study seasons between August 1 and October 31.

<u>Task 2: Assessment of Downstream Passage of American Eel</u>

FirstLight will assess downstream passage and entrainment survival of adult American eel through use of radio-telemetry techniques.

FirstLight will use radio telemetry techniques to monitor adult downstream eel passage at the Turners Falls Project and Northfield Mountain Project. For the Northfield Mountain Project, the study will evaluate the proportion of tagged eel entrained into the intake, as well as in the upper reservoir. For the Turners Falls Project, the study will evaluate the proportion of eel passing via spillways, gates, turbines, and the existing fish bypass at Cabot Station and/or Station No. 1. The route of passage study will be designed with the use of motion sensor telemetry tags that will give researchers an indication of passage-induced mortality.[1] This phase of the study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest to assess general routes of passage (i.e., via spill, fish passageways, or turbines).

Radio transmitters will transmit on several frequencies and are anticipated to range between 2 and 4 frequencies within the 150 to 151 megahertz band and will be uniquely coded to allow for individual fish identification. Transmitters will be supplied by Sigma Eight Inc. and will allow for in-field coding should ambient radio noise preclude the use of any particular frequency and code combination. The transmitters will employ a motion sensor and be configured such that the 2 second burst interval shifts randomly to minimize repeated collision of tags on the same frequency. FirstLight and TransCanada will consult before purchasing tags to ensure all radio telemetry receivers at the Projects can detect them

Emigrating silver phase eels will be collected at the Cabot bypass sampler or the Holyoke Canal bypass sampler. Eels selected for tagging will meet morphometric (e.g., eye diameter relative to body size - Pankhurst Index of approximately 6.5 or greater) criteria to ensure they are migrant silver phased eels. Collections will be made within the migratory season (late August to mid-October), and eels will be tagged and released within 21 days of collection.[2] In addition, project operation (flows, levels, gate

[1]For example, if an eel goes into an immobile state for a period of 36 hours, the tag's code will be programmed to switch signal transmission patterns (e.g., to a different code or different burst rate).

[2] The timing of collection, tagging, and release will be entirely dependent on migratory patterns and weather/river conditions. All tagged eel will be released at night during inclement weather or with inclement weather pending to increase the likelihood that eel will move soon after release. Though FirstLight will target a seven-day hold period, riverine conditions may not be adequate for release, and therefore hold times may last longer than seven days.

openings, number of units operating and operation level) and environmental conditions (river flow, water temperature, air temperature, and moon phase and precipitation amounts) will be recorded throughout the duration of the studies.

Task 2a: Northfield Mountain Route Selection Study

Groups of eels will be tagged and released approximately 5 km upstream of the Northfield Mountain tailrace. Tagged eels (n = 72) will be released on 8 nights (4 nights at 3 unit operation and 4 nights at 4 unit operation) with three releases per night (at dusk, two hours later and two hours after that) and 3 tagged fish per release. The proposed telemetry receiver locations and equipment are listed on Table 3.3.5-1. An adaptive release strategy will be used to target eels passing Northfield when pumps are running.

Task 2b: Turners Falls Dam Route Selection Study

Groups of eels will be tagged and released approximately 3 km upstream of the Turners Falls Dam. Groups of eels will be released over various spill conditions including no spill and will be determined based on results of the instream flow study (Study No. 3.3.1). A total of 30 tagged eels will be released at dusk on the day prior to target flow conditions in small multiple batches. The proposed telemetry receiver locations and equipment are listed on Table 3.3.5-1. An additional 30 eels will be released in the canal.

Table 3.3.5.-1: Location and types of telemetry receivers proposed for the silver eel emigration study.

Location	RM	Receiver Station
Montague Wastewater	119.5	A Lotek SRX receiver with yagi antenna will monitor the full width of the River
Cabot Station Tailrace	120	Lotek SRX with yagi antenna–to monitor the full river width
Cabot Station Forebay	120	Two radio receivers will monitor the Forebay area; 1) Lotek or Orion with yagi antenna will monitor the full width of the canal immediately upstream of the Cabot station 2) Orion with dipole antenna will monitor the entrance to the Cabot downstream bypass.
Station 1 Forebay	121	A Lotek SRX or Orion with yagi antenna will monitor the full width of the intake canal
Station 1 Tailrace	121	A Lotek SRX or Orion with yagi antenna will monitor the tailrace area. Detection zone will monitor the full width of the bypass reach. A detection power analysis will differentiate those test fish that are attracted to the tailwater from those that continue upstream
Below Turners Falls Dam	122	Two Orion or Lotek SRX receivers with yagi antennas will

Migratory movements of silver eel have been noted after hold periods longer than seven days during several recent radio-telemetry studies at hydroelectric facilities in the northeast [(see FERC projects P-2364 (Abenaki), P-2365 (Anson), P-2325 (Weston)].

		monitor the area below the dam, one on either side of the river bank such that approach to the dam can be differentiated from either the right or left sides of the River
Upstream of Gatehouse	122	One or two Orion receivers with aerial Yagi or dropper antennas to assess migratory delays and milling
Upstream End of the Canal	122	A Lotek or Orion with a yagi antenna will monitor the full width of the canal at a location downstream of the Gatehouse in the upper canal to monitor fish entering the canal from upstream
Turners Falls Impoundment	122	A Lotek with a yagi antenna will monitor the full width of the impoundment
NMPS Gill Bank	126.5	A Lotek with a yagi antenna will monitor the full width of the impoundment
NMPS Intake	127	A Lotek or Orion with a yagi antenna will monitor the intake area
NMPS Upper Reservoir	127	One or two Orion receivers with aerial Yagi or dropper antennas to assess entrainment
Shearer Farms	127.5	A Lotek with a yagi antenna will monitor the full width of the impoundment

Task 2c: Mobile Tracking

Mobile tracking (i.e., via boat, vehicle, or by foot) in river reaches between release sites and 5 km downstream of Cabot Station will be performed at least twice per week and after releases to confirm routes and fates of passed fish, or fish lost to follow-up. Tracking will occur until the tagged eels leave the study area or water temperatures reach 5^{o}C. Movement rates (time between release and passage) of eels passing the projects by various routes will also be quantified.

Tag pulse will likely be programmed at 2 second intervals with a battery life of at least 90 days. Prior to release of tagged eel, FirstLight will perform testing and range verification to minimize overlap of detection fields while maximizing detection range. As needed, beacon transmitters will be employed at strategic locations to provide a repeated data stamp during the study to verify receiver functionality.

Task 3: Data Management and Analysis

Data from hydroacoustic timing studies (Task 1) will be collected in the field and transferred to an electronic format. All data entry will be assured for quality. These data will be processed with Myriax Echoview or similar software. The data will be reduced by applying an intensity threshold that is representative of the target size and analyzed with an α, β-tracking algorithm, which identifies the series of echoes that were returned by an individual fish over successive pings. The tracking results will be reviewed on the echogram and exported as a database containing time, target strength, and 3-D positional information for each fish detected. An expansion factor will be calculated for each individual eel as a function of its effective beam width at the range it was observed. This effective beam width depends on the acoustic beam pattern and the size of the target. The expansion factor compensates for this differential detection probability.

Data from the adult eel telemetry study (Task 2) will be collected regularly from the field during the study periods (i.e., at 2 to 3 day intervals). Data will be archived and entered into an MS Access or MS Excel database for sorting and post-processing. All data entry will be reviewed for quality assurance. To the extent possible, routes of passage will be determined. Route determinations will be based on the sequence of individual eel detections at the antenna arrays. Additionally, route-specific survival will be determined by analysis of the sensor tag data, which will indicate whether an eel has resumed typical migratory behavior after passing downstream or has not survived passage.

Task 4: Turbine and Dam Passage Survival

HI-Z Turb'N tags will be used to empirically determine rates of survival for eels entrained at Station No. 1 and Cabot Station and spill survival over the dam. As currently envisioned, a total of 150 tagged (Hi-Z and radio tagged) eels will be released into turbines. The tagged eels will be proportionally allocated by the number of different turbine types at Station No. 1 and Cabot Station. All six turbines at Cabot Station are similar type and hydraulic capacity so testing will be conducted at one turbine at Cabot Station as a representative unit. Data for that unit will be extrapolated to calculate a total station survival rate. Station No. 1 has five Francis style turbines. Four of the five turbines are similar in speed, hydraulic capacity (490 to 560 cfs) and one is smaller (140 cfs). Testing will be conducted at two turbines at Station No. 1 (at one to represent the four larger units and at the smaller capacity unit). Like Cabot, the data for the representative unit will be extrapolated to calculate a total survival rate for all four units and combined with the data for the smaller unit for a total station survival rate. Tests will be conducted by injecting tagged eel into the selected turbines at Cabot and No. 1 Stations at or near best efficiency hydraulic capacity conditions for each test unit which are representative of the typical turbine operating conditions during the August-October period. Fish will be recovered from the tailrace, examined for injuries and held for 48 hours to determine latent mortality. An additional 125 fish will be released above the dam to determine mortality due to passage at the bascule and tainter gates.

Task 5: Reporting

The hydroacoustic, radio telemetry and HI-Z Turb'N tag data will be analyzed relative to passage route(s) timing, frequency, magnitude and survival. Telemetry data from each fish will be portrayed graphically including movement and timing through the project area with passage route selection identified. Movements will be analyzed relative to environmental and operational parameters. For the entrainment task, survival through each turbine or spill gate tested will be calculated based on the number of tagged fish injected into a turbine or gate that are alive. All injuries will be reported. Total through-project survival will be calculated based on study results of the survival study, other related studies as well as operations data. This information will be compiled into a report and will include the methods used, results, a discussion and conclusions. It will include release numbers, locations and dates, fish length, weight, and morphometric criteria, river temperature at NMPS, canal, bypass and below Cabot Station,

Data use to develop the report will be made available to stakeholders upon request in digital form.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of the Projects on downstream passage and timing of adult eel in the investigation area. The estimated cost for this study is approximately between $400,000 and $500,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

This fieldwork portion of this study will commence in 2015 as FERC requested a one-year delay in schedule due to the timing of the decommissioning of the Vermont Yankee Nuclear Power Plant located upstream of the NFMPS Project. FirstLight proposes to provide Stakeholders with a study report supplement to summarize downstream adult eel monitoring results in February 2016. Task 1, or the hydroacoustic component of this study, will be repeated from August 1 to October 31, 2016. FirstLight will file the Final Report on or before March 1, 2017 as indicated in the SPDL.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.6

IMPACT OF PROJECT OPERATIONS ON SHAD SPAWNING, SPAWNING HABITAT AND EGG DEPOSITION IN THE AREA OF THE NORTHFIELD MOUNTAIN AND TURNERS FALLS PROJECTS

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight™
GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The purpose of Study No. 3.3.6 is to gather data to determine whether project operations affect shad spawning in the Project area. American shad (shad), migrate into the Connecticut River to spawn, reaching Project waters in late April or early to mid- May. Much of the river downstream of Cabot Station is suitable for shad spawning, and the reach of the Connecticut River including the Deerfield River confluence is thought to be particularly productive spawning habitat.

Specifically, the shad spawning study will:

- Determine areas utilized by shad for spawning by conducting night-time visual and aural observation of spawning activity;
- Identify and define those areas geospatially, and obtain data on physical habitat conditions affected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Collect information in order to assess project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity; and
- Verify spawning activity as measured by night-time spawning/splash surveys in areas of spawning activity, and downstream of these areas, to gather data to determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

On August 14, 2013 FirstLight filed its Revised Study Plan (RSP) with the Federal Energy Regulatory Commission (FERC).

On December 2, 2013, NMFS filed a letter (Appendix A) with FERC expressing concern about the study's potential to adversely affect shortnose sturgeon, an endangered species under the Endangered Species Act (ESA). The NMFS letter stated that if possible, the study *"should be designed or modified to avoid effects to shortnose sturgeon; however, if such modification is not possible, Section 7 consultation is necessary"*.

On January 28, 2014, FirstLight filed a letter (Appendix A) with FERC responding to NMFS's concern. FirstLight proposed to replace the shad collection efforts with enhanced visual observations and splash counts of shad spawning to avoid adverse effects to shortnose sturgeon

On February 21, 2014, the Federal Energy Regulatory Commission's (FERC) issued its Study Plan Determination Letter (SPDL). In it, FirstLight was required to *"consult with NMFS, FWS, MADFW and Commission staff on an amendment to the revised study plan that would seek to avoid all effects to shortnose sturgeon and provide sufficient information. Following consultation, FirstLight should file with the Commission for approval, an amended study plan for study 3.3.6 when it files its Initial Study Report in September 2014"*. (page B-45 of February 21, 2014 SPDL).

On June 3, 2014, FirstLight met with FERC (via phone), National Marine Fisheries Service (NMFS) (via phone), United States Fish and Wildlife Service (USFWS), Massachusetts Division of Fish and Wildlife (MADFW), The Nature Conservancy (TNC), and Connecticut River Watershed Council (CRWC) to discuss the study. At this meeting, USFWS provided FirstLight with four potential modifications to

Study Nos. 3.3.6 study plan with the goal of not adversely affecting endangered shortnose sturgeon. The four modifications were:

1. Avoid towing nets within 2-km of the Montague reach between Rock Dam (river km 194) and the railroad bridge (rkm 192; now a bike path, located immediately downstream of the Deerfield River mouth- see Figure 1), a hydrographically turbulent reach where the greatest concentration of larval migrants would occur within;
2. Avoid sampling in shallower water (< 2 m);
3. Use floats attached to nets to make sure towed nets remain at the chosen depths near the surface.
4. Require that egg samples be screened for the presence of shortnose sturgeon before the next sampling effort is made. If shortnose sturgeon eggs, embryos, or larvae, are detected during screening of ichthyoplankton tows, all sampling should cease and NMFS will be contacted immediately. NMFS will then work with First Light to determine how to proceed.

On July 3, 2014, FirstLight sent NMFS a letter (Appendix A) with proposed modifications to Study No. 3.3.6.

On July 14, 2014, NMFS provided an email (Appendix A) to FirstLight recommending that FirstLight submit a letter describing the final proposed study, analyzing the effects of the proposed study on shortnose sturgeon, and determining whether the proposal would ill adversely affect shortnose sturgeon. If FirstLight determined that the proposed study is not likely to adversely affect shortnose sturgeon (i.e., that all effects will be insignificant and discountable and FirstLight does not anticipate any capture or collection), NMFS advised FirstLight to request NMFS's concurrence with that determination.

On August 6, 2014 FirstLight discussed the study further with NMFS. On August 25, 2014, FirstLight sent NMFS and other agencies a letter (Appendix A) indicating that, after thorough consideration of the proposed study modifications, it was unable to make a determination that the study is not likely to adversely affect shortnose sturgeon. In its letter, FirstLight stated that based on past studies, it expects to capture sturgeon egg larvae if ichthyoplankton nets are deployed. As such, FirstLight proposed to conduct the study as set forth in its January 28, 2014 letter, with no shad egg collection efforts. Instead, FirstLight proposed (see Appendix B) to replace shad collection efforts with enhanced visual observations and splash counts below Turners Falls Dam. Ross (1993) has quantified spawning of adult American shad by counting spawning splashes over 5-min intervals. Splashing events were verified to be spawning American shad through direct observations. Ross (1993) concluded that that this technique was valid and useful to quantify spawning activity for this species. Collection of eggs downstream of the spawning sites will not confirm that spawning occurred, as eggs drift downstream and there is no assurance that the collected eggs were just spawned. However, FirstLight has agreed to collect eggs as described upstream in the Impoundment as this area is beyond the range of the shortnose sturgeon. FirstLight therefore believes that visual observations and splash counts of shad spawning, which will have no impact to shortnose sturgeon, will fulfill the goals and objectives of the study.

1.2 Study Progress Summary

Task 1: Development of a Detailed Study Design

An amended study plan was developed based on the consultation described above. See Appendix B.

Task 2: Examination of Known Spawning Areas Downstream of Turners Falls Dam

To be conducted in 2015.

Task 3: Identification of Spawning Areas Upstream of Turners Falls Dam

To be conducted in 2015.

Task 4: Examination of Identified Spawning Areas Upstream of Turners Falls Dam

To be conducted in 2015.

Task 5: Data Analysis and Reporting

A final report will be completed in March 2016 per FERC's SPDL.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the study plan

1.4 Remaining Activities

The study will be conducted in 2015 and the report will be completed by March 2016.

Appendix A
Correspondence Log

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

ORIGINAL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

FILED
SECRETARY OF THE COMMISSION
2013 DEC -2 A 10: 09
FEDERAL ENERGY REGULATORY COMMISSION

NOV 22 2013

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

P-2485

RE: Supplemental Comments on Firstlight's Proposed Study Plan dated June 28, 2013 for Turners Falls (P-1889) and Northfield Mountain Pumped Storage (P-2485)

Dear Ms. Bose:

We submitted comments on Firstlight's June 28, 2013, Study Plan in letters filed with you on July 15, 2013 and August 28, 2013. In our July 15 letter, we indicated that a consultation, pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, may be necessary to consider effects of the *Fish Assemblage Assessment* (P-1889 Study 3.3.11) on endangered shortnose sturgeon. We recommended that the study be modified to eliminate the potential for effects or that FERC initiate formal consultation pursuant to section 7 with us. In recent conversations with Firstlight, we have become aware of the potential for additional studies to adversely affect shortnose sturgeon including study 3.3.6 *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects* and study 3.6.3 *Whitewater Boating Evaluation* (Revised Study Plan for the Turners Falls Hydroelectric Project (P-1889) and Northfield Mountain Pumped Storage Project (P-2485)). If possible, these studies should be designed or modified to avoid effects to shortnose sturgeon; however, if such modification is not possible, section 7 consultation is necessary.

Section 7(a)(2) of the ESA, states that each Federal agency shall, in consultation with the Secretary, insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Any discretionary federal action that may affect a listed species must undergo Section 7 consultation. It is our understanding that the approval of study plans is a discretionary action taken by FERC that is subject to section 7 consultation. As the lead Federal agency, you must initiate section 7 consultation with us on any action that may affect listed species. If you determine that the studies are "not likely to adversely affect" any listed species (i.e., when direct or indirect effects of the proposed project or its interdependent and/or interrelated actions on listed species are expected to be discountable, insignificant or completely beneficial), you should submit this determination to us in writing, along with a justification, and request our concurrence. If we concur with this determination, we will reply in a letter that will convey the concurrence, thus completing Section 7 consultation. If you determine that a study or studies are "likely to adversely affect" any listed species (i.e., if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effects are not: discountable, insignificant, or beneficial) or we do not concur with your "not likely to adversely affect" determination, formal Section 7 consultation, resulting in the issuance of a Biological Opinion with an appropriate Incidental Take Statement, may be required. Any effects that amount to the take of a listed species (defined by the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct") are not discountable, insignificant or entirely beneficial. Therefore, if any take, including non-lethal capture and release and/or exposure to electric current during electrofishing, is anticipated, formal consultation is required. My staff is available to discuss the effects of the proposed studies on shortnose sturgeon and assist you and Firstlight in determining the likely effects of the proposed studies. If you have designated Firstlight as your non-Federal representative for purposes of informal section 7 consultation, you must indicate this in writing to us. In that event, Firstlight, representing FERC, would be able to request our concurrence for any "not likely to adversely affect" determinations. However, if formal consultation is necessary, the request must come from FERC.

This letter supplements the comments filed by us in July and August 2013; the comments presented in those letters regarding our Federal Power Act authorities as well as impacts to other NMFS trust resources remain valid. If you have any questions or need additional information, please contact Jessica Pruden in our Protected Resources Division (Jessica.Pruden@noaa.gov or 978-282-8482).

Sincerely,

Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

EC: Crocker, F/NER3
McDavitt, F/NER4

File Code: Sec 7 FERC Turners Falls Relicensing

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 422-5900
Internet: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

January 28, 2014

VIA ELECTRONIC FILING

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: FirstLight Hydro Generating Company, FERC Project Nos. 2485-063 and 1889-081
Response to National Marine Fisheries Service Supplemental Comments on Study Plan

Dear Secretary Bose:

On December 2, 2013, the National Marine Fisheries Service (NMFS) filed a letter with the Federal Energy Regulatory Commission (FERC or Commission) containing supplemental comments on FirstLight Hydro Generating Company's (FirstLight) study plan for relicensing the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485). NMFS's comments expressed concern that three of FirstLight's study plans; Study Plan 3.3.6, *Impact of Project Operations on Shad Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects*; Study Plan 3.3.11, *Fish Assemblage Assessment*, and Study Plan 3.6.3; *Whitewater Boating Evaluation*—had the potential to adversely affect shortnose sturgeon, an endangered species under the Endangered Species Act. NMFS therefore suggested that these studies should be designed or modified to avoid effects to shortnose sturgeon. The purpose of this letter is to respond to NMFS's comments on two of these study plans, Study Plans 3.3.6 and 3.3.11, to enable the Commission's Director of the Office of Energy Projects to issue a study plan determination that directs FirstLight to implement studies that will avoid potential effects to shortnose sturgeon.[1]

Study Plan 3.3.6, *Impact of Project Operations on Shad Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects*

Study Plan 3.3.6 addresses requests by resource agencies to determine if Turners Falls Project operations affect shad spawning, by conducting night time surveys to document shad spawning. The agencies requested that following this documentation, FirstLight observe spawning activity under a range of

[1] FirstLight has already addressed NMFS's concerns on the third study plan, Study Plan 3.6.3, *Whitewater Boating Evaluation*, in its modified revised study plan filed on January 13, 2014, by proposing to conduct the evaluation outside of the April 15 – June 22 shortnose sturgeon spawning and rearing period.

operating conditions. FirstLight's revised study plan for Study Plan 3.3.6 includes these parts of the study as requested, during the May – June shad spawning time period.

The agencies also requested that shad egg collections be conducted in areas of spawning activity to further determine if spawning has occurred. It has been documented that shortnose sturgeon spawn in the vicinity of the Cabot Station tailrace (Kieffer and Kynard 2012). Kieffer and Kynard (2012) have documented a spawning period of 5-17 days during the same 26 day period each year (April 27-May 22). Early life history stages (eggs and larvae) are present in the project area for 20 to 30 days after spawning (Kynard et al. 2012a). So the period when shortnose sturgeon eggs and larvae are present overlaps with the proposed sampling period for shad egg collection. Consequently, the collection of shad eggs may have the potential to impact shortnose sturgeon, and NMFS recommended in its December 2 letter that the study be revised.

To address this potential concern, FirstLight proposes to replace shad egg collection efforts, which studies have shown are duplicative of visual observations of shad spawning, with enhanced visual observations and splash counts. Ross (1993) has quantified spawning of adult American shad by counting spawning splashes over 5-min intervals. Splashing events were verified to be spawning American shad through direct observations. Ross (1993) concluded that that this technique was valid and useful to quantify spawning activity for this species. FirstLight therefore believes that visual observations and splash counts of shad spawning, which will have no impact to shortnose sturgeon, will fulfill the goals and objectives of the study.

Study Plan 3.3.11, *Fish Assemblage Assessment*

Study Plan 3.3.11 addresses regulatory agency requests to characterize the fish assemblage above and below the Turners Falls Dam. Although the study is not targeting shortnose sturgeon, NMFS has pointed out that non-targeted sampling in certain areas may have the potential to affect shortnose sturgeon, whose historic upstream range on the Connecticut River is Turners Falls. While sampling as proposed can occur in the Turners Falls impoundment because this is beyond the range of shortnose sturgeon, sampling efforts below Turners Falls Dam may need to be modified to avoid potential impacts to shortnose sturgeon.

In its comments dated July 15 on proposed Study Plan 3.3.11, NMFS recommended the study be modified to eliminate the potential for effects on shortnose sturgeon. Specifically, NMFS recommended that: (1) no electrofishing occur in the reach of the Connecticut River below the Deerfield River (which NMFS refers to as Transect 6); and (2) a seasonal restriction be placed on sampling in the bypass reach (which NMFS refers to as Transect 5) to ensure that no electrofishing is carried out when shortnose sturgeon may be present (April 15 – June 30).

In its revised study plan, FirstLight noted that the geographic scope of the study was being reviewed by NMFS, and that the potential impact on shortnose sturgeon may result in modifying the geographic area. FirstLight therefore agreed not to perform any electrofishing in the bypass reach from April 15 – June 30.

While NMFS did not provide any additional comments on FirstLight's revised study plan for Study 3.3.11, FirstLight believes that additional modifications to the plan may be necessary to avoid potential impacts to shortnose sturgeon in both the bypass reach and the reach of the river below the Turners Falls Dam. To avoid any potential impacts to sturgeon, FirstLight proposes to conduct all sampling in the bypass reach after June 30, and in the reach below the Deerfield River, FirstLight proposes to use both existing data and the data it obtains in the Turners Falls Impoundment.

A 2009 electrofishing survey of the area below Turners Falls Dam downstream to the Route 116 Bridge was conducted as part of a larger Environmental Protection Agency effort to sample the entire Connecticut River from Lake Francis to the freshwater extent of the tidal estuary. Sampling occurred at three 1-km stations in the bypass reach and eight 1-km stations between the bypass reach and the Route 116 Bridge in Sunderland (Figure 1). The species composition and relative abundance (Table 1) is typical of fish assemblages described for inland fishes of Massachusetts (Hartel et al. 2002). FirstLight believes that these recent data, coupled with the data FirstLight will obtain in the Turners Falls Impoundment will provide sufficient information on species composition and relative abundance in the Project area to accomplish the study's goals and objectives.

If you have any questions regarding this filing, please feel free to contact me.

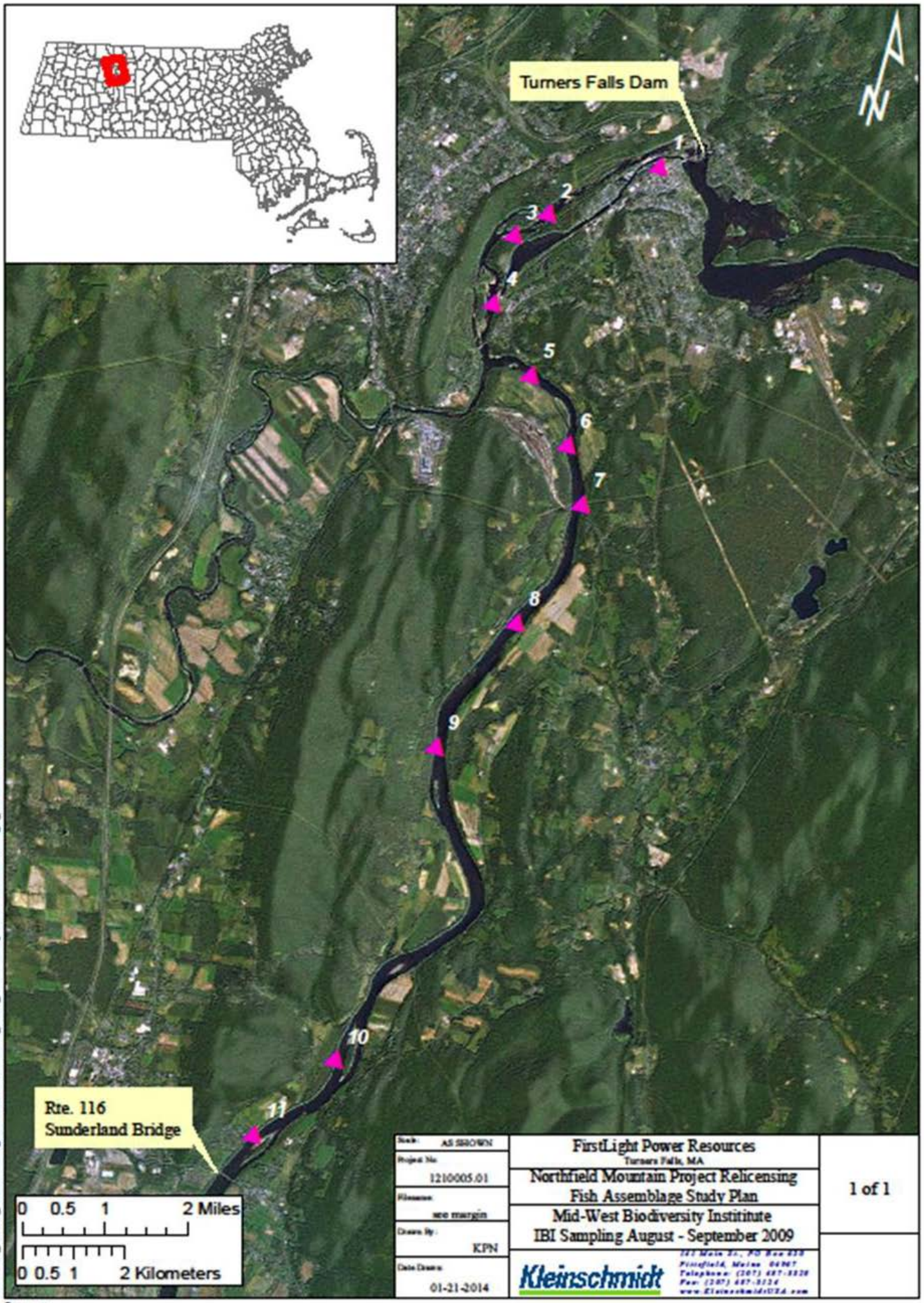
Sincerely,

John Howard

Table 1. Fish collected at eleven 1 km sample sites on the Connecticut River below the Turners Falls Dam to the Route 116 Bridge in Sunderland MA by electrofishing (2009).

	Stations											
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
Date Sampled (2009)	**8/31**	**9/28**	**8/15**	**8/16**	**8/16**	**9/2**	**8/16**	**10/5**	**8/17**	**8/17**	**8/17**	
American eel	13	12	5	14	0	0	3	2	29	0	0	**78**
American shad	0	0	0	7	7	6	0	0	0	1	25	**46**
Atlantic salmon	0	8	0	1	0	0	0	0	0	0	1	**10**
Black crappie	0	0	0	0	1	0	0	0	0	0	0	**1**
Bluegill	15	0	3	5	7	8	8	0	12	14	9	**81**
Brown trout	1	0	0	0	0	0	2	0	0	0	0	**3**
Chain pickerel	0	0	0	0	0	1	0	1	0	0	0	**2**
Channel catfish	0	0	0	0	0	0	1	0	0	0	0	**1**
Common carp	1	0	0	2	0	0	0	0	0	0	0	**3**
Common shiner	0	0	0	4	0	0	0	0	0	0	0	**4**
Fallfish	0	0	14	4	29	150	10	10	99	128	8	**452**
Largemouth bass	0	0	0	0	2	0	0	0	0	4	0	**6**
Longnose dace	11	0	1	0	0	0	0	0	0	0	0	**12**
Northern pike	0	0	1	0	1	0	0	1	0	2	0	**5**
Pumpkinseed	0	0	1	0	0	0	0	0	2	0	0	**3**
Rock bass	2	3	8	1	3	3	4	0	12	0	0	**36**
Sea lamprey	14	1	1	0	0	0	0	2	3	0	2	**23**
Smallmouth bass	85	56	70	42	45	46	81	19	12	33	25	**514**
Spottail shiner	13	0	133	0	9	354	0	8	53	10	0	**580**
Tessellated darter	17	0	8	3	1	2	1	4	1	0	0	**37**
Walleye	0	0	0	0	0	0	1	0	0	0	0	**1**
White sucker	6	5	9	5	4	23	9	3	1	4	2	**71**
Yellow perch	1	1	3	0	0	2	1	2	1	7	5	**23**
Total	**179**	**86**	**257**	**88**	**109**	**595**	**121**	**52**	**225**	**203**	**77**	**1992**
Sampling effort (Seconds)	**9272**	**3356**	**4856**	**3298**	**3495**	**6360**	**4415**	**6578**	**3708**	**3595**	**3441**	**52374**

Figure 1: Locations of fish collection sites on the Connecticut River below the Turners Falls Dam to the Route 116 Bridge in Sunderland MA by electrofishing (2009).



Source:

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July 3, 2014

Ms. Jessica Pruden
Northeast Regional Shortnose Sturgeon Recovery Coordinator
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930

Re: FirstLight, Relicensing of the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485), Study No. 3.3.6- *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Project*.

Dear Ms. Pruden

FirstLight Hydro Generating Company (FirstLight) is currently in the process of relicensing its Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485) with the Federal Energy Regulatory Commission (FERC). On August 14, 2013 FirstLight filed its Revised Study Plan (RSP). The purpose of this letter is to submit proposed modifications to Study No. 3.3.6 *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Project* so as to avoid potential effects to federally endangered shortnose sturgeon known to occur in the area below Cabot Station[1].

Background

Study No. 3.3.6 addressed requests by resource agencies to evaluate any potential impacts of the Turners Falls Hydroelectric Project on shad spawning. As part of the study, FirstLight proposed to conduct shad egg collections in areas of spawning activity to further determine if spawning had occurred. One of these areas is in the vicinity of Cabot Station where shortnose sturgeon are documented to spawn at the same time when shad egg collection would occur. Consequently, the collection of shad eggs may have the potential to impact federally listed shortnose sturgeon due to potentially collecting shortnose sturgeon larvae.

John S. Howard
Director FERC Compliance
Chief Dam Safety Engineer

FirstLight Power Resources, Inc.
99 Millers Falls Road
Northfield, MA 01360
Tel. (413) 659-4489/ Fax (413) 422-5900/
E-mail: john.howard@gdfsuezna.com

[1] Cabot Station and Station No. 1 are two developments that comprise the Turners Falls Hydroelectric Project.

On December 2, 2013, the National Marine Fisheries Service (NMFS) filed a letter with FERC stating "*In recent conversations with FirstLight, we have come aware of the potential for additional studies to adversely affect shortnose sturgeon including study 3.3.6 Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Project and study 3.6.3 Whitewater Boating Evaluation. If possible, these studies should be designed or modified to avoid effects to shortnose sturgeon; however, if such modification is not possible, section 7 consultation is necessary.*

On January 28, 2014, FirstLight filed a letter with FERC responding to the NMFS's December 2, 2013 letter. To address NMFS's concern regarding potential impacts to shortnose sturgeon due to shad egg collection, FirstLight proposed to replace shad egg collection efforts with enhanced visual observations and splash counts.

On February 21, 2014 FERC issued its second Study Plan Determination Letter (SPDL) which addressed Study No. 3.3.6. In the SPDL, FERC stated the following relative to Study No. 3.3.6 "*consult with NMFS, FWS, MADFW and Commission staff on an amendment to the revised study plan that would seek to avoid all effects to shortnose sturgeon and provide sufficient information. Following consultation, FirstLight should file with the Commission for approval, an amended study plan for study 3.3.6 when it files its Initial Study Report in September 2014*" (page B-45 of February 21, 2014 SPDL).

As requested by FERC, on June 3, 2014, FirstLight held a meeting[2] with FERC, NMFS, United States Fish and Wildlife Service (USFWS), Massachusetts Division of Fisheries and Wildlife (MADFW), Connecticut River Watershed Council (CRWC) and The Nature Conservancy (TNC) to discuss Study No. 3.3.6 and other studies.

<u>Proposed Modifications to Study No. 3.3.6</u>

At the June 3, 2014 meeting, the regulatory agencies indicated that in addition to splash counts, they would like shad eggs to be collected. The regulatory agencies had discussed the issue with Micah Kieffer of the United States Geological Survey's (USGS) Conte Lab, who has spent decades studying shortnose sturgeon spawning in the vicinity of Cabot Station. Mr. Kieffer provided the regulatory agencies with suggested modifications to the field data collection work that he felt would limit potential impacts to shortnose sturgeon. Those proposed modifications were provided to FirstLight at the June 3, 2014 meeting and included the following:

1. Avoid towing nets within 2-km of the Montague reach between Rock Dam (river km 194) and the railroad bridge (rkm 192; now a bike path, located immediately downstream of the Deerfield River mouth- see Figure 1) where the greatest concentration of larval migrates would occur within a hydrographically turbulent reach;
2. Avoid sampling in shallower water (< 2 m);
3. Use floats attached to nets to make sure towed nets remain at the chosen depths near the surface.
4. Require that egg samples be screened for the presence of shortnose sturgeon before the next sampling effort is made.

FirstLight is willing to incorporate modifications 1-3 above in the study plan to be filed in September 2014. Processing eggs samples, as proposed by modification 4, is time consuming; May and June are periods of high detritus and dense plankton concentrations in the Connecticut River, and ichthyoplankton

[2] FERC and NMFS participated via telephone.

samples must be examined with the aid of a dissecting microscope. Accordingly, obtaining and screening egg samples is not possible while FirstLight conducts the initial night time reconnaissance surveys to document shad spawning. FirstLight is willing, however, to conduct limited plankton sampling following this documentation, as part of its observations of spawning activity under a range of operating conditions. Specifically, FirstLight proposes to conduct two plankton samples per week, before and after a flow change, to evaluate whether shad spawning is occurring. FirstLight believes that this sampling and screening will fulfill the goals and objectives of the shad spawning study, while also addressing concerns about potential impacts to shortnose sturgeon.

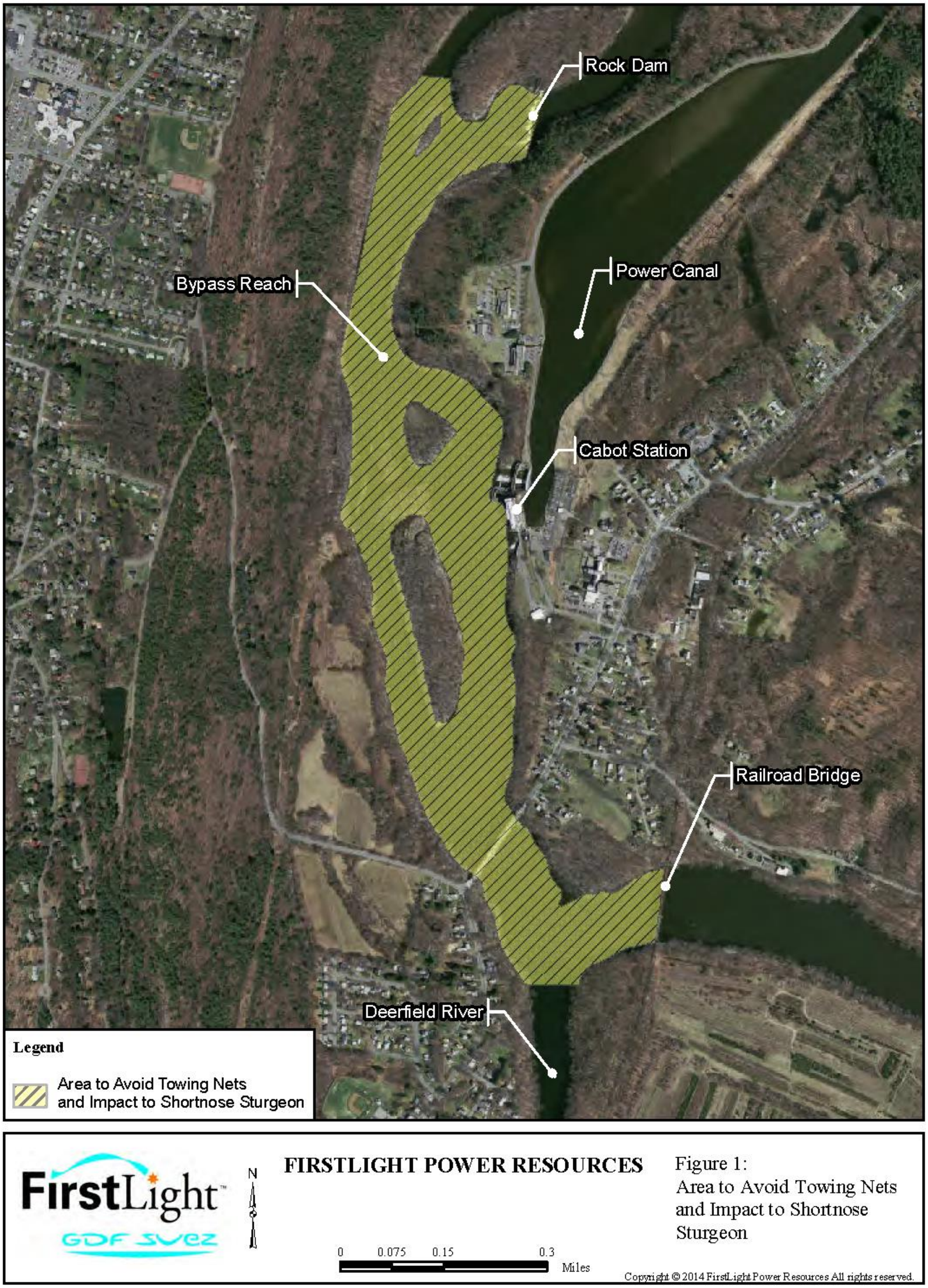
Thank you for your consideration of this proposed modification. Please respond to confirm that these proposed modifications to the shad spawning study will address your concerns about the study's potential impacts to shortnose sturgeon.

Sincerely,

John Howard

Cc: John Warner, USFWS (via email)
Melissa Grader, USFWS (via email)
Ken Hogan, FERC (via email)
Caleb Slater, MADFW (via email)

Attachment: Figure 1



FIRSTLIGHT POWER RESOURCES

Figure 1:
Area to Avoid Towing Nets and Impact to Shortnose Sturgeon

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Path: W:\gis\maps
o_towing_net_location.mxd

Mark Wamser

From: Howard, John <John.Howard@gdfsuezna.com>
Sent: Monday, July 14, 2014 10:55 AM
To: 'Julia Wood'
Cc: Mark Wamser - Gomez and Sullivan Engineers, P.C. (mwamser@gomezandsullivan.com)
Subject: FW: Re:

Julia, FYI, John

From: Jessica Pruden - NOAA Federal [mailto:jessica.pruden@noaa.gov]
Sent: Monday, July 14, 2014 10:52 AM
To: Howard, John
Cc: Chris Tomichek; Kimberly Damon-Randall - NOAA Federal; Kenneth Hogan; Julie Crocker - NOAA Federal; Mark Wamser
Subject: Re:

John,
Thank you for your letter outlining the proposed modifications that will be incorporated into study *3.3.6 Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of Northfield Mountain and Turners Falls Project.* We are comfortable with modifications 1-3 being incorporated into the final study plan. We also understand the difficultly of screening every sample and are comfortable with the proposed screening approach outlined in your letter. However, the following requirement should also be incorporated into the proposed sampling and screening approach: *If shortnose sturgeon eggs, embroys, or larvae, are detected during screening of ickthyo-plankton tows, all sampling should cease and NMFS should be contacted immediately. NMFS will then work with First Light to determine how to proceed.*

Once First Light is confident that the proposed study, with the modifications and requirements outlined above, are acceptable to the other agencies, we would recommend ESA section 7 consultation. Given that First Light has been designated as the non-federal representative by FERC, you may submit a letter, as FERC's representative, describing the final proposed study, an analysis of the effects of the proposed action on shortnose sturgeon, and determination as to whether the proposed action will adversely affect shortnose sturgeon. If you determine that the proposed study is not likely to adversely affect shortnose sturgeon (i.e., that all effects will be insignificant and discountable and you do not anticipate any capture or collection), you should request our concurrence with that determination. Once we receive this letter, NMFS will make a determination as to whether we concur with First Lights determination.

We understand that a separate working group is developing an alternative proposed approach for study *3.3.11 Fish Assemblage Assessment.* We would strongly recommend that if possible, First Light include a description of the final proposed approach, an analysis of the effects on shortnose sturgeon, and determination on whether the action will adversely affect shortnose sturgeon in the same letter we reference above. This will likely ensure greater efficiency in terms of a timely response from NMFS.

We are comfortable engaging in early consultation, which would allow First Light and NMFS to consult as soon as First Light is confident that both studies are acceptable to all of the interested agencies. Consultation does not need to wait until the Final Study Plan Determination has been made by FERC. Please let us know if you have any questions about any of this information.

Thank you,

Jessica Pruden

On Thu, Jul 3, 2014 at 10:56 AM, Chris Tomichek <Chris.Tomichek@kleinschmidtgroup.com> wrote:

Good Morning

Attached is a letter that FirstLight put in the mail to NMFS this morning that includes proposed modifications to Study Plan 3.3.6 - *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Project* to avoid potential impacts to shortnose sturgeon larvae as discussed at the June 3, 2014 meeting.

Regards,

Chris

Chris Tomichek

Senior Manager

Fisheries and Aquatic Resources

Office: 860.767.5069

www.KleinschmidtGroup.com

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Jessica Pruden
Shortnose Sturgeon Recovery Coordinator and Tribal Liaison for the Greater Atlantic Region
NOAA Fisheries
55 Great Republic Drive
Gloucester, MA 01930
Work 978-282-8482
E-Mail Jessica.Pruden@noaa.gov
Cell: 978-992-1014

August 25, 2014

VIA EMAIL

Jessica Pruden, National Marine Fisheries Service
John Warner, US Fish & Wildlife Service
Melissa Grader, US Fish & Wildlife Service
Caleb Slater, Massachusetts Department of Fish & Wildlife
Ken Hogan, Federal Energy Regulatory Commission

Re: FirstLight Hydro Generating Company, Relicensing of the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485), Study No. 3.3.6 - *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Project*.

Dear All:

FirstLight is preparing a revision to relicensing Study No. 3.3.6, *Impact of Project Operations on Shad Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects*. After FirstLight filed its Revised Study Plan (RSP) on August 14, 2013, the National Marine Fisheries Service (NMFS) expressed concern that the shad egg collection efforts proposed in the study had the potential to adversely affect shortnose sturgeon. FirstLight responded to NMFS's concerns in a January 28, 2014 letter in which FirstLight proposed to replace the shad collection efforts with enhanced visual observations and splash counts of shad spawning, which would have no impact to shortnose sturgeon. The United States Fish and Wildlife Service (USFWS) subsequently indicated that alternative study plan modifications may be feasible to allow for shad egg collection while minimizing effects to shortnose sturgeon. The Federal Energy Regulatory Commission (FERC) therefore recommended, in its study plan determination issued on February 21, 2014, that FirstLight consult with NMFS, USFWS, Massachusetts Division of Fish and Wildlife (MDFW), and FERC staff on an amendment to the RSP that "would seek to avoid all effects to shortnose sturgeon."

At FirstLight's June 3, 2014 consultation meeting, USFWS and NMFS offered suggested modifications to FirstLight's field data collection that they felt would limit potential impacts to shortnose sturgeon. These included:

1. Avoiding towing nets within 2-km of the Montague reach between Rock Dam (river km 194) and the railroad bridge (rkm 192; located immediately downstream of the Deerfield River mouth),

John S. Howard
Director FERC Compliance
Chief Dam Safety Engineer

FirstLight Power Resources, Inc.
99 Millers Falls Road
Northfield, MA 01360
Tel. (413) 659-4489/ Fax (413) 422-5900/
E-mail: john.howard@gdfsuezna.com

where the greatest concentration of larval migrates would occur within a hydrographically turbulent reach;

2. Avoiding sampling in shallower water (< 2 m);
3. Using floats attached to nets to make sure towed nets remain at the chosen depths near the surface; and
4. Screening egg samples for the presence of shortnose sturgeon before the next sampling effort is made, and if shortnose sturgeon eggs, embryos, or larvae, are detected during screening of ichthyoplankton tows, ceasing all sampling and contacting NMFS immediately.

FirstLight initially felt such modifications could minimize potential impacts to shortnose sturgeon. However, in a July 14, 2014 email, NMFS indicated that FirstLight should conduct an analysis of the study, and in particular the sampling effort with the suggested modifications, on shortnose sturgeon. NMFS stated that "if [FirstLight] determine[s] that the proposed study is not likely to adversely affect shortnose sturgeon (i.e., that all effects will be insignificant and discountable and you do not anticipate any capture or collection), you should request our concurrence with that determination."

After careful consideration of the proposed study modifications, FirstLight is unable to make a determination that the study is not likely to adversely affect shortnose sturgeon. In fact, for the reasons discussed below, FirstLight anticipates that it would capture and collect shortnose sturgeon larvae if it conducts shad egg sampling below Cabot Station, with or without the suggested modifications to the egg sampling effort.

Shortnose sturgeon spawning is well documented in the Connecticut River. The United States Geological Survey's (USGS) Conte Lab researchers have conducted studies concluding that there is only one spawning site in the Connecticut River, at Montague below Cabot Station and at the Rock Dam at approximately river km 192 (Kynard et al. 2012). The Montague site was verified as a spawning area based on successful capture of sturgeon eggs and larvae in 1993, 1994, and 1995, that were 190 times the number of fertilized eggs and 10 times the number of embryos found at the downstream Holyoke site (Vinogradov 1997). Based on available information, shortnose sturgeon larvae generally rear at, or just downstream from, spawning grounds (Kieffer and Kynard 2012).

However, shortnose sturgeon larvae have been collected much farther downstream, including at river km 120 on May 25, 2005 (Kleinschmidt 2008) and at river km 68 on May 3, 2006 (Kleinschmidt 2006). These shortnose sturgeon larvae were collected as part of general ichthyoplankton studies that filtered 100 m^3 of water (6 minute tow). The larvae collected at river km 120 occurred where river depths averaged about 2-m and 0.6-m diameter plankton nets were towed close to the surface. The two larvae captured at river km 68 occurred where river depths averaged about 3-m and a 1-m diameter plankton net was towed close to the surface.

NMFS has prohibited sampling much further downstream of the Montague spawning site, without appropriate take protections in place, because of potential adverse impacts to shortnose sturgeon. In 2007, the United States Environmental Protection Agency (USEPA) requested that FirstLight sample ichthyoplankton at river km 148 as part of an assessment of the Mt. Tom Generating Station. NMFS was concerned that some shortnose sturgeon larvae may drift downstream from the Montague spawning grounds and be captured in ichthyoplankton nets in May and June. Thus, FirstLight did not conduct the requested sampling.

Based on the past collections of shortnose sturgeon larvae at river kms 120 and 68, as well as NMFS's previous analysis that shortnose sturgeon larvae may be collected 44 river kilometers downstream of the Montague spawning and rearing grounds, FirstLight expects that capture and collection of shortnose sturgeon larvae may be likely to occur if it deploys ichthyoplankton nets as requested for Study No. 3.3.6

just downstream of river km 192 in May and June. For these reasons, FirstLight proposes to conduct the study as set forth in its January 28, 2014 letter, with no shad egg collection efforts. Instead, FirstLight will propose in its modified study plan, to be filed with the upcoming Initial Study Report, to replace shad collection efforts—which studies have shown are duplicative of visual observations of shad spawning—with enhanced visual observations and splash counts. FirstLight believes that this will fulfill the goals and objectives of the study without impacting shortnose sturgeon.

If you have any questions, please feel free to call me.

Sincerely,

John Howard

cc: Andrea Donlon, Connecticut River Watershed Council, via email
Katie Kennedy, The Nature Conservancy, via email
Karl Meyer, Environmental Scientist, via email
Don Pugh, Trout Unlimited, via email

Attachment: Literature Cited

Literature Cited

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Appendix B
Modified Study Plan

3.3.6 Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects (Updated)

General Description of Proposed Study

The following stakeholders requested studies to investigate the impact of project operations on shad spawning, spawning habitat and egg deposition within the project boundary: USFWS, MADFW, NHFGD, NHDES, CTRWC, NOAA, the Town of Gill, TU, and VTDEC. Section 4.4.5 of the PAD identifies several migratory species of fish that seasonally occur in the aquatic habitat within the Project boundary. One such species, the American shad (shad), migrate into the Connecticut River to spawn, reaching Project waters in late April or early to mid- May. Much of the river downstream of Cabot Station is suitable for shad spawning, and the reach of the Connecticut River including the Deerfield River confluence is thought to be particularly productive spawning habitat. The study described herein will gather data to determine the effects of operational changes and subsequent flow/water level fluctuations on spawning shad in the project area.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

Determine if project operations (under the permitted and proposed operational ranges) affect shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches that extends from the base of Vernon Dam to the Route 116 Bridge in Sunderland.

Specifically, the shad spawning study will:

- Determine areas utilized by shad for spawning by conducting night-time visual and aural observation of spawning activity;
- Identify and define those areas geospatially, and obtain data on physical habitat conditions affected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Collect information in order to assess project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity; and
- Verify spawning activity as measured by night-time spawning/splash surveys in areas of spawning activity, and downstream of these areas, to gather data to determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The CRASC was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138).

CRASC developed *A Management Plan for American Shad in the Connecticut River Basin* in 1992. Management Objectives in the plan include the following:

- Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
- Achieve annual passage of 40% to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, aims to maximize the number of juvenile recruits emigrating from freshwater stock complexes through the following objectives:

- To mitigate hydrological changes from dams, consider operational changes such as turbine venting, aerating reservoirs upstream of hydroelectric plants, aerating flows downstream, and adjusting in-stream flows.
- Natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation) because river flow plays an important role in the migration of diadromous fish.
- Ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account instream flow needs for American shad migration, spawning, and nursery use, and minimize deviation from natural flow regimes.
- When considering options for restoring alosine habitat, include study of impacts and possible alteration of dam-related operations, to enhance river habitat.

The resource agencies' goals related to aquatic natural resources include:

- Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
- Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
- Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.
- Conserve, enhance, and restore natural communities, habitats, and species and the ecological processes that sustain them.
- Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.
- Ensure that PME measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
- Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Turners Falls Project.

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The resource agencies' goal specific to American shad is:

- Minimize current and potential negative project operation effects on American shad spawning and recruitment.

The agency requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and PME measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R.794), the Federal Power Act (16 U.S.C. §791a, *et seq*.), the Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time. The number of shad lifted at Holyoke reached 721,764 in 1992 and the overall Connecticut River shad population exceeded 1.6 million shad in that year (CRASC 1992). In most years, however, the shad population has not reached CRASC management plan objectives. Likewise the number of shad passing Turners Falls Dam has not met the CRASC objective.

In preparation of the PAD, fisheries data were compiled on the shad resources in the Connecticut River; the data can be found in section 4.4.5 of the PAD. American shad seasonally migrate into the Connecticut River in the spring, late March or April, to spawn; typically reaching Project waters by late April to mid-May when river flow is generally declining from the spring peak. Shad passage has been monitored at the Holyoke Dam (Figure 4.4.5-1 of the PAD) and these counts provide a comprehensive record of the number of shad that have access to Project waters. Population number and passage numbers past Holyoke have declined from the 1992 peak described above, with average Holyoke passage numbers over the last ten years of 211,850. However, shad numbers have been on the rise since 2005 with over 490,000 shad passing Holyoke Dam in 2012.

American shad typically spawn in water ranging from 3 to 18 ft in depth, in run or glide habitat (FirstLight, 2012). Shad typically spawn at night, with males reaching spawning areas prior to females (Greene et al., 2009). Daytime spawning has been documented on overcast days or in turbid water when light intensity is somewhat diminished (Greene et al., 2009). Females are broadcast spawners, preferring to release their eggs in the water column over coarse substrates including cobble, gravel and sand (Greene et al., 2009 and FirstLight, 2012). American shad are highly fecund and spawn repeatedly as they move up river (Greene et al., 2009). The act of spawning can be conspicuous and vigorous, with spawning individuals breaking the surface.

Most (~77%) of the 30 mile reach below Cabot Station consists of *run* mesohabitat type with coarse substrates; presence of glide habitat areas are negligible (FirstLight, 2012a). Though habitat suitable for shad spawning is abundant in the 30 mile reach downstream of Cabot Station, the area of the Connecticut River, in the vicinity of the Deerfield River confluence, is thought to be particularly productive. The location of American shad spawning in the Connecticut River between Holyoke Dam and Turners Falls Dam was identified in previous studies by Layzer (1974) and Kuzmeskus (1977). The documented spawning locations from Cabot Station downstream to the Route 116 Bridge are shown in Figure 3.3.1-4.

The upstream extent of this range is in close proximity to Cabot Station and experiences flow changes resulting from Station operation.

In 2012, FirstLight conducted studies in the late spring and summer to examine habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, MA (PAD).

Project Nexus (18 CFR § 5.11(d)(4))

For the purposes of this study plan the Study Area includes the Connecticut River: downstream from Cabot Station to the upper extent of the Holyoke impoundment (specifically, the Route 116 Bridge in Sunderland); in the bypass reach between Turners Falls Dam and Cabot Station, and in the Turners Falls impoundment.

Shad spawning is likely influenced by river flow, among other environmental factors such as water temperature. Flow fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While several shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. There are no known studies of the relationship between spawning behavior, habitat use, and egg deposition and Turners Falls and Northfield Project operations Continued Project operation and maintenance activities could, through the manipulation of flow, affect American shad that utilize the project area for spawning. The Agencies are concerned that peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet management targets. This study will provide information regarding the availability and location of shad spawning habitat and the effect on spawning activity of flow changes caused by Project operation.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

FirstLight will investigate shad spawning within the study area to determine how operations at Cabot Station and Northfield may affect shad spawning behavior. The investigation will include a review of existing information relative to shad spawning in the Connecticut River and a visual and aural survey of the study area to locate spawning areas and evaluate the effect of Project operations on spawning.

The field studies will examine known spawning areas downstream of the Turners Falls Project (to the Route 116 Bridge), although the plankton-net sampling of eggs will be restricted to above Turners Falls Dam where the sampling will not affect shortnose sturgeon eggs and larvae. No previous studies have attempted to locate spawning areas upstream of Turners Falls Dam. Additionally, the field effort will include surveying the impoundment (up to the Vernon Dam) for evidence of shad spawning.

Field study locations will be determined by review of existing information, results of the IFIM study (Study No. 3.3.1) and hydraulic modeling; therefore, FirstLight will consult with Stakeholders to review results of Task 1, as outlined under the Study Schedule section below.

Task 1: Development of a Detailed Study Design

As a first step, historic data pertaining to Cabot Station discharge and flow data was collected to provide the basis for determining typical flow regimes during the study period. Operational data from the previous eight years of generation was reviewed to determine how the station has historically operated during the shad spawning season. Historical data from the USGS gage located on the Connecticut River in the City of Montague (USGS 01170500) and the Deerfield River (USGS 01170000) near the town of West Deerfield, Massachusetts was reviewed in conjunction with station operation data. It is important to determine the magnitude of flow and corresponding water level fluctuation in the Connecticut River below Cabot Station when flows exceed the hydraulic capacity of the Turners Falls Project. Similarly, it will be important to determine the same when flows are within the hydraulic capacity of the Turners Falls Project. The frequency of changes and rate of flow changes will also be reviewed.

FirstLight is developing a hydraulic model of the Connecticut River from the Turners Falls Dam to the Holyoke Dam- see Study No. 3.2.2 *Hydraulic Studies of Turners Falls Impoundment, Bypass Reach, and below Cabot Station*. The hydraulic model developed for the reach between Turners Falls Dam and Holyoke Dam will be used to further inform this study. More specifically, the hydraulic model will simulate water elevations in this reach under the historic flow ranges during the spawning season. Flow data will be obtained from the Montague USGS gage. The model will be run in an unsteady mode to simulate the peaking operations of the Turners Falls Project during the spawning season. The intent of the modeling is to understand the relationship between the magnitudes of water level fluctuations due to peaking operations. The hydraulic model and previous water level data collected at Route 116 Bridge and at Rainbow Beach may also place bounds on the geographic extent of the study. For example, peaking operations may have a greater impact on the magnitude of water level fluctuations closer to Cabot Station than further downstream. Based on the water level monitoring conducted at the USGS gage in Montague, Route 116 Bridge and at Rainbow Beach, the magnitude of water level fluctuation decreases and attenuates further downstream. The results of the hydraulic model will also provide an indication of areas that potentially become dewatered under certain operational scenarios.

Further, counts of shad passed at the Holyoke Dam and Turners Falls will be tracked to pinpoint the most effective timing of field surveys. Concurrent adult shad telemetry studies may also provide insight as to the location of spawning shad.

Task 2: Examination of Known Spawning Areas Downstream of Turners Falls Dam

Field surveys will be conducted in two phases at night primarily by boat or from shore during periods of anticipated spawning; timing and flow regimes will be based on information collected in Task 1; Phase 1 will identify locations where shad are actively spawning, and information will be collected to evaluate project effects in Phase 2. In the study area, spawning typically occurs between early May to mid-June, when water temperatures reach 13-18ºC (Collette and Klein-MacPhee, 2002). Field surveys of spawning activity will commence during this period (approximately early May) or after a minimum of 10,000 shad have passed the Holyoke Project. The level of effort will be dependent on the density of spawning shad within the study area, with initial surveys to be conducted twice weekly and will be increased to three times per week during peak spawning..

Surveys conducted below Turners Falls Dam will investigate all the historical spawning locations downstream to the Route 116 Bridge (Layzer, 1974; Kuzmeskus, 1977). However since this work was conducted over 35 years ago, it is probable that spawning sites have changed so we will also survey the area, down to the Route 116 Bridge, for radio tagged fish that may be spawning as well as previously undocumented spawning sites.

Phase 1 of the surveys will employ methods described by Ross et al. (1993). Adult spawning shad will be observed and quantified by counting spawning splashes over 15-minute intervals between sunset and 01:00 hours. Once splashes have been observed for a 15-minute interval, the survey crew will progress to the next known spawning area for observations. The amount of time spent at each spawning area will be subjectively determined by the field survey crew, but will be such that all of the known spawning areas are observed between sunset and 01:00 hrs. Sampling will be conducted to ensure the results are not bias by visiting the same site at the same time of day every time.

Spot lights will be used to verify that such splashes were made by spawning American shad. The species and number of fish observed and their behavior will be recorded. We assume that, though every splash may not represent actual spawning and every spawning may not be accompanied by a splash, the level of surface activity is strongly correlated with actual spawning (Ross et al., 1993). Other parameters to be measured during observed spawning events include; spawn timing and location (GPS); water temperature, dissolved oxygen (DO), pH, conductivity, turbidity, depth and surface velocity; and predominant substrate type. All data will be recorded on a dedicated data sheet. The data sheet will include aerial reference images and/or maps of the study area to document the relative position of observed spawning shad and provide the information necessary to estimate the total area used for spawning as well as an index of spawning activity. The data collected in the field will be correlated to Cabot Station discharge and river flow as a function of time.

In Phase 2, the impacts of flow fluctuation on spawning shad will be investigated during the peak spawning period at locations identified in Phase 1 These areas will be targeted for observations during periods of discharge fluctuation at Cabot Station. Prior to, during, and after flow changes, data (including splash observations, water quality parameters, depth, surface velocity, predominant substrate type, and location) will be collected to provide a baseline of shad spawning rate. FirstLight will then manipulate discharge at Cabot Station to investigate impacts to spawning. Shad spawning rate will be investigated over a range of expected seasonal flow fluctuations based on historic discharge data at Cabot Station. Several discharge manipulations will be investigated but will begin with the most extreme fluctuations scenarios. Baseline spawning rate and behavior will be compared to those observed during periods of flow manipulation to investigate potential impacts to spawning.

Task 3: Identification of Spawning Areas Upstream of Turners Falls Dam

Less is known about spawning locations upstream of the Turners Falls Dam; and the study described herein should provide insight on spawning locations upstream within the study area (to the Vernon Dam). As such, upstream surveys will target areas of suitable aquatic habitat for shad spawning based on HSI curves. The methodology for these surveys will focus on identifying spawning areas via splash surveys consistent with Phase 1 of Task 1. Sampling will begin after 2,500 shad pass the Gatehouse ladder.

Task 4: Examination of Identified Spawning Areas Upstream of Turners Falls Dam

Further investigation of spawning areas identified upstream of the Turners Falls Dam (to the Vernon Dam) in Task 3 will be performed with methodology consistent to that utilized for Phase 2 of Task 2. As discussed above, a review of the previous ten years of Project operational data will allow for the determination of appropriate operating scenarios for which sampling will occur. In addition, based on the results of Phase 1 of the spawning survey, ichthyoplankton nets will be deployed downstream of spawning areas during operational changes to determine if shad eggs are present and viable above the Turners Falls Dam. A 1-meter -long ichthyoplankton net 500 micron mesh or smaller will be towed for 10 minutes, the net will be retrieved and the contents preserved for subsequent analysis and identification of shad eggs. Identification of shad eggs will be in accordance with existing literature and will rely on methods of Ross and Bennet (1993) for distinction from white sucker eggs.

Task 5: Data Analysis and Reporting

Information collected during this study will be compiled and presented in a report, which will include a map of the study area depicting the locations of observed spawning shad; materials and methods; results; a discussion of observed spawning behaviors; and, if applicable, impacts due to operational changes.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort will adequately assess the potential effects of continued Projects operations on spawning shad and their habitat within the study area. One year of the study is anticipated to cost between $70,000 and $90,000. Should a second year of study be required, year two cost is anticipated to be between $50,000 and $60,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

Due to the iterative nature of the study tasks that need to occur prior to field investigations, FirstLight proposes to utilize an ongoing consultation process with Stakeholders. This will provide Stakeholders with an opportunity to review results of Task 1 and to provide input on specific known and likely spawning locations to be visited in the field. The following study and consultation steps/estimated timeframes will be the following:

- FirstLight to conduct Task 1 – October 2014 through December 2014 (it is anticipated that results of hydraulic modeling and IFIM study will be compiled in the fall 2014 timeframe sufficient to be considered under this task to identify operating regimes under which field studies will be conducted)
- Distribute results of Task 1 and proposed locations for field investigation of known and anticipated spawning locations – January 2015
- Hold meeting with Stakeholders to review desktop analysis and reach consensus on field study locations – February – March 2015

Conduct field studies of spawning locations during the 2015 spawning season, May through June. The exact timing of the field survey will depend on a variety of seasonal and site specific factors but water temperature is the primary factor that triggers spawning. Other factors include photoperiod, water flow and velocity, and turbidity. The timing of the survey will be further refined using information obtained from shad passage data collected downstream at the Holyoke Project fish lift and Turners Falls Project fish ladders. Further, information collected during concurrent shad migration investigations may also provide insight to the locations and timing of spawning.

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Relicensing Study 3.3.7

FISH ENTRAINMENT AND TURBINE PASSAGE MORTALITY STUDY

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to assess fish entrainment and turbine mortality at the Turners Falls and Northfield Mountain Projects. This study will include both qualitative and quantitative approaches to characterize the risk of impingement and turbine entrainment and mortality of fish species in the vicinity of the Projects. The qualitative approach will utilize a desktop analysis to assess the potential for turbine entrainment and mortality and impingement of resident species, which will be based on the results of Study No. 3.3.11 (Fish Assemblage Assessment- slated for 2015). Entrainment and turbine mortality will be quantitatively estimated for juvenile and adult American shad and adult American eel based on data collected in hydroacoustic and radio telemetry monitoring that will be conducted as part of Study Nos. 3.3.2, 3.3.3, and 3.3.5.

This study will be initiated in 2015 as the Federal Energy Regulatory Commission (FERC) requested a one-year delay in schedule due to the timing of the decommissioning of the Vermont Yankee Nuclear Power Plant located upstream of the Turners Falls and Northfield Mountain Projects. Results from the Fish Assemblage Assessment (Study No. 3.3.11) will be necessary to complete the desktop analyses for resident species, and results from the hydroacoustic and radio telemetry monitoring of juvenile and adult American shad and adult American eel will be necessary to complete Tasks 2 and 3 herein.

In FERC's February 21, 2014 Study Plan Determination Letter it states "*We recommend that FirstLight consult with FWS, NMFS, MADFW, and the Watershed Council after the 2014 results of the Evaluate Downstream Passage of Juvenile American Shad study (study 3.3.3) are available to assess the need for a second year study to further evaluate American shad egg and larval (or juvenile) entrainment at the Northfield Mountain Project*." Given that FirstLight is required to submit a study plan to evaluate ichthyoplankton entrainment at the Northfield Mountain Pumped Storage Project (resulting from the United States Fish and Wildlife Service study dispute); it is assumed that this recommendation is not necessary as FirstLight is currently consulting with the stakeholders to finalize a study plan.

1.2 Study Progress Summary

Task 1: Qualitative Assessment of Entrainment and Impingement

A preliminary assessment of entrainment risk was performed for resident species documented in the Turners Falls Impoundment by the Massachusetts Department of Fish and Game between 1971 and 1975 (MDF&G 1978) and the Midwest Biodiversity Institute in 2008 (Yoder et al. 2010). A Traits Based Assessment was performed to qualitatively assess the potential risk of entrainment/impingement for species based on habitat preference, life history strategies, behavior, morphology and demography. Based on these factors, species and lifestages of resident fishes were indexed across a range from the most to least prone to entrainment. For the susceptible species, the assessment assumed that the degree to which individuals become entrained depends on their physical swimming abilities, such that if the darting speed is greater than the intake velocity, the fish would escape entrainment; and conversely, if the darting speed is less than the intake velocity, then the fish is at risk for being entrained. For impingement, body lengths and widths of species in the area of the intakes were assessed to determine which fish would likely be physically excluded by the bar rack spacing at each intake structure and if these species would be able to overcome the influence of the intake velocity.

Preliminary results indicate that most of the common resident fish are unlikely to be in the area of the intakes due to their habitat preferences, and therefore, unlikely to be entrained or impinged. Two species, walleye and fallfish, prefer habitat that is found in front of the Northfield Mountain Project intake/tailrace and may be more susceptible to entrainment or impingement depending on length. Most of the common resident fish are likely to sustain their populations even if individuals of the population are entrained

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because with the exception of largemouth bass, white suckers, walleye, white perch, and fallfish can double their numbers every 1.4 to 4.4 years (species summaries accessed at www.fishbase.org, 2012) and are not isolated populations due to the presence of upstream and downstream fish passage facilities.

Task 2: Quantification of Shad and Eel Entrainment

A preliminary desktop analysis of the potential for entrainment was performed for juvenile and adult American shad and adult American eel similar to the method described above for resident species. As these species are diadromous, the potential for entrainment is restricted to the seasons when they may be present in the vicinity of the Northfield Mountain Project intake/tailrace. The quantification of entrainment rates will be refined once results from Study Nos. 3.3.2, 3.3.3, and 3.3.5 are available.

Task 3: Estimation of Turbine Mortality Rate

A preliminary assessment of turbine mortality was performed for species susceptible to entrainment based on a turbine strike model and the consideration of fish lengths, turbine specifications, and station hydraulics. This preliminary assessment was performed using available literature; however, site-specific data collected during Study Nos. 3.3.2, 3.3.3, and 3.3.5 will be utilized to more accurately predict fish losses due to entrainment and turbine mortality.

Task 4: Reporting

A final report will be completed in March 2016 per FERC's SPDL.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances.

1.4 Remaining Activities

- Continue desktop analysis and incorporate species identified during the Fish Assemblage Assessment that will be conducted in 2015.
- Estimate turbine entrainment and mortality once data from the hydroacoustic and radio telemetry monitoring of juvenile and adult American shad and adult American eel are available in 2015.
- File Final Study Report.

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Relicensing Study 3.3.8

COMPUTATIONAL FLUID DYNAMICS MODELING IN THE VICINITY OF THE FISHWAY ENTRANCES AND POWERHOUSE FOREBAYS

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers

SEPTEMBER 2014

TABLE OF CONTENTS

1.1 Study Summary 1
1.2 Study Progress Summary 1
1.3 Variances from Study Plan and Schedule 3
1.4 Remaining Activities 3

LIST OF TABLES

Table 1: RSP-Proposed flow scenarios for CFD Model 1 and CFD Model 2. 4
Table 2: RSP-Proposed flow scenarios for CFD Model 3 and CFD Model 4. 4
Table 3: Refined flow scenarios for CFD Model 1 and CFD Model 2. 4
Table 4: Refined flow scenarios for CFD Model 3 and CFD Model 4. 4
Table 5: RSP-proposed flow scenarios for CFD Model 5. 5
Table 6: RSP-proposed flow scenarios for CFD Model 6. 5

LIST OF FIGURES

Figure 1: Station No. 1 Forebay Bathymetry 6
Figure 2: Cabot Forebay Bathymetry 7
Figure 3: Cabot Fishway Bathymetry and Velocity Measurement Coverage 8
Figure 4: Planned Bathymetry and Velocity CFD Transects at the Spillway Fishway. 9
Figure 5: Station No. 1 Forebay three-dimensional rendering. 10
Figure 6: Cabot Forebay three-dimensional rendering. 10
Figure 7: Cabot fishway three-dimensional rendering. 11
Figure 8: Turners Falls Dam spillway fishway three-dimensional rendering. 11

1.1 Study Summary

The purpose of this study is to obtain information to determine the flow field conditions that exist at various locations at the Turners Falls Project. Per the Revised Study Plan (RSP), FirstLight is required to conduct Computational Fluid Dynamics (CFD) Modeling in the vicinity of the fishway entrances and powerhouse forebays. The Turners Falls Project consists of two hydroelectric facilities, Station No. 1 and Cabot Station, which utilize flow from the power canal to generate power. Upstream fish passage at the Project consists of three passage structures: the "Spillway Fish Ladder" (located at the Turners Falls spillway), the "Gatehouse Fish Ladder" (located at the Turners Falls Dam gatehouse), and the "Cabot Fish Ladder" (located at Cabot Station). Downstream passage routes at the Turners Falls Project include over the dam, through the powerhouses, or through the downstream fish passage sluice adjacent to Cabot Station. The objective of this study is to evaluate the flow field conditions in the vicinity of the fishway entrances and powerhouse forebays. Note that per the RSP, this study does not include CFD modeling of the Gatehouse Fish Ladder as this was previously conducted and the findings filed with FERC.

This study includes 6 CFD model production runs. Model 1 will cover the power canal and forebay in front of Station No. 1. Model 2 will cover the Station No. 1 intake rack, and will be run for similar flow conditions as Model 1. Model 3 will cover the Cabot Station forebay. Model 4 will cover the Cabot Station intake rack, and will be run for similar flow conditions as Model 3. Model 5 will cover the Cabot Fish Ladder entrance area, and Model 6 will cover the Spillway Fish Ladder entrance area.

1.2 Study Progress Summary

<u>Task 1: Bathymetric Survey of the Study Areas</u>

Bathymetric surveys at the Cabot Fish Ladder, Station No. 1 Forebay and the Cabot Forebay have been completed. The bathymetric survey data was collected using an Acoustic Doppler Channel Profiler (ADCP) linked to a GPS unit, and included the collection of both bathymetry and velocity data. Additional survey was collected using a real time kinematic (RTK) GPS to locate the edge of water and important structural features in the study area (e.g. top of wall elevations). All information was collected in the North American Vertical Datum of 1988 (NAVD88).

The bathymetry and velocity profile data was collected under the following scenarios:

- **Station No. 1 Forebay** – The bathymetric survey for the Station No. 1 Forebay was collected on March 28, 2014. When collecting bathymetry and velocity data at Station No. 1, all units were on at Station No. 1 (2,210 cfs) and Cabot was operating at its approximate minimum generation flow (2,288 cfs).

- **Cabot Forebay** - The bathymetric survey for the Cabot Forebay was collected on March 29, 2014. When collecting bathymetry and velocity data at Cabot, Cabot Units 1, 5 and 6 were generating (~6,864 cfs), and the log sluice was open approximately 10 feet (~1,288 cfs). Station No. 1 was not generating when the bathymetry at Cabot was being collected.

- **Spillway Fish Ladder** – These data have not yet been collected. We anticipate collecting them in early fall 2014. The flow conditions during data collection will be approximately 120 cfs from the fish ladder.

- **Cabot Fish Ladder** – Velocity and bathymetry data were collected in the vicinity of the Cabot Fish Ladder on August 6, 2014. The bypass reach flow was approximately 700 cfs, while the Cabot flow through the turbines was approximately 4,500 cfs. The Cabot Fisk Ladder was passing normal operating flows during data collection as well. The log sluice was also discharging water that day, but the flow passing that structure has not been determined yet.

During post-processing, the bathymetric elevation data was converted from NAVD88 to the Turners Falls project datum which is the National Geodetic Vertical Datum of 1929 (NGVD29). A horizontal shift was also applied to the ADCP data for the Station No. 1 Forebay and the Cabot Forebay based on the survey collected with the higher accuracy RTK GPS unit. The Cabot Fish Ladder bathymetry has not been post-processed at this time.

Figure 1, Figure 2 and Figure 3 show a plan view of the bathymetry and survey data collected at the Station No. 1 Forebay, Cabot Forebay and the Cabot Fish Ladder, respectively. Figure 4 shows the planned survey transect locations at the Spillway Fish Ladder.

It is anticipated that supplemental bathymetric survey will be collected at Station No. 1 during the 2014 Fall canal drawdown.

Task 2: Compile Model Input Datasets in CAD

The bathymetry data for the Cabot Forebay and the Station No. 1 Forebay have been post-processed and a three-dimensional (3D) surface generated. The 3D surface was generated in ArcGIS as a Triangulated Irregular Network (TIN) and converted to a stereolithography (STL) file as required for the CFD model. 3D surfaces have not yet been generated for the Cabot Fish Ladder and Spillway Fish Ladder bathymetry.

Project drawings and field survey were used to develop 3D CAD drawings of the pertinent project facilities (e.g. fish ladders, log sluice, intake racks, canal walls, etc.). The 3D CAD work was exported to an STL file as required for the CFD model.

Figure 5 and Figure 6 show 3D renderings of the STL files generated for the Station No. 1 Forebay and Cabot Forebay CFD models, respectively. These figures show both the processed bathymetry and the 3D CAD structural drawings. Figure 7 and Figure 8 show the 3D CAD work that has been completed at the Spillway Fish Ladder and the Cabot Fish Ladder.

Task 3: Construct Three-Dimensional Model

The Station No. 1 Forebay CFD model is currently (August 15, 2014) being set-up and initial runs made.

Task 4: Conduct Model Production Runs

The model production runs have not been started at this time, however, the flow scenarios for the Cabot Forebay and Station No. 1 Forebay model runs have been refined to reflect current operating procedures. These refinements are not considered a variance from the project plan. Table 1 and Table 2 show the scenarios outlined in the RSP for Models 1 through 4, while Table 3 and Table 4 show operational details relating to the refinements developed as part of this task (e.g. which turbines will be used).

No refinements to the Cabot Fish Ladder model scenario (Model 5) or the Spillway Fish Ladder model scenario (Model 6) have been required at this time. The flow scenarios proposed in the RSP for Model 5 and Model 6 are shown in Table 5 and Table 6, for reference, respectively.

Task 5: Report

A final report will be completed in the 2nd quarter of 2015.

1.3 Variances from Study Plan and Schedule

The only variances from the RSP are schedule related, as described below.

Assuming field efforts are completed by the end of September 2014, data post processing should be completed by late November 2014. CFD model development, testing and production runs will occur from Q3 2014 throughout Q1 2015. It is anticipated that study report will be completed by Q2 2015.

1.4 Remaining Activities

Under Task 1, field data collection at the Spillway Fish Ladder and supplemental field data collection for the Station No. 1 Forebay still need to be completed.

The development of CAD work described in Task 2 is effectively complete with minor edits anticipated as the 3D CFD models are developed, and 3D bathymetry surfaces at the Cabot Fish Ladder and Spillway Fish Ladder still need to be developed.

Tasks 3 and 4 are being actively worked on and Task 5 has not been started at this time.

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Table 1: RSP-Proposed flow scenarios for CFD Model 1 and CFD Model 2.

Scenario Number	Models Run	Station No. 1 Flow (cfs)	Canal Pass-Through Flow (cfs)	Total Power Canal Flow (cfs)
1-1, 2-1	1 and 2	1,433 (current min flow)	200	1,633
1-2, 2-2	1 and 2	2,210 (Station No. 1 capacity)	200	2,410
1-3	1	2,210	13,928 (Cabot capacity of 13,728 cfs plus 200 cfs for log sluice)	16,138

Table 2: RSP-Proposed flow scenarios for CFD Model 3 and CFD Model 4.

Scenario Number	Models Run	Cabot Station Flow (cfs)	Log Sluice Flow (cfs)	Total Power Canal Flow (cfs)
3-1, 4-1	3 and 4	1,700	200	1,900
3-2, 4-2	3 and 4	7,500	200	7,700
3-3, 4-3	3 and 4	13,728 (Cabot capacity)	200	13,928

Table 3: Refined flow scenarios for CFD Model 1 and CFD Model 2.

Scenario Number	Units Generating	Flow Through Units (cfs)	Cabot Station Flow (cfs)	Log Sluice Flow (cfs)	Total Power Canal Flow (cfs)
1-1, 2-1	3, 5 ,7	475, 465, 493	1,433	200	1,633
1-2, 2-2	1, 2, 3, 5, 7	560, 140, 500, 490, 520	2,210	200	2,410
1-3	1, 2, 3, 5, 7	560, 140, 500, 490, 520	2,210	13,928	16,138

Table 4: Refined flow scenarios for CFD Model 3 and CFD Model 4.

Scenario Number	Units Generating	Flow Through Units (cfs)	Cabot Station Flow (cfs)	Log Sluice Flow (cfs)	Total Power Canal Flow (cfs)
3-1, 4-1	1	1,700	1,700	200	1,900
3-2, 4-2	1, 2, 3	2,288 each	6,864	200	7,064
3-3, 4-3	All Units	2,288 each	13,728	200	13,928

Table 5: RSP-proposed flow scenarios for CFD Model 5.

Scenario Number	Cabot Flow (cfs)	Bypass Reach Flow (cfs)	Cabot Fishway Flow (cfs)	Total Flow (cfs)
5-1	1,700	400	368	2,468
5-2	7,500	400	368	8,268
5-3	13,728	400	368	14,496
5-4	13,728	6,501	368	20,597 (April 75% exc.)
5-5	13,728	16,240	368	30,336 (April 50% exc.)

Table 6: RSP-proposed flow scenarios for CFD Model 6.

Scenario Number	Power Canal Flow[1] (cfs)	Spillway Ladder Flow (cfs)	Bascule Gate No. 1 Flow (cfs)	Other Bascule Gate Spill[2] (cfs)	Tainter Gate Spill[3] (cfs)	Total Turners Falls Flow (cfs)
6-1	7,282	318	400	0	0	8,000
6-2	15,938	318	4,341	0	0	20,597
6-3	15,938	318	7,500	6,580	0	30,336
6-4	15,938	318	7,500	12,460	10,000	46,216

[1] The power canal is not included in CFD model 6, but is included in this table to show the flow distribution.
[2] The bascule gates are typically operated in a set order of no. 1, no. 2, no. 4 and no.3, with gate no. 1 being opened first and closed last, and gate no. 3 being opened last and closed first. The bascule gates can be throttled as desired.
[3] The tainter gates are typically opened to maintain some flexibility in the bascule gates' available capacity. Since the bascule gates do not require manual operation like the tainter gates, station personnel generally prefer to not max out the bascule gate capacity. The tainter gates can be throttled as necessary, but the adjustments cannot be done remotely like it can for the bascule gates.

FirstLight GDF SUEZ

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)
INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.3.8

Figure 1 - Station No. 1 Forebay Bathymetry

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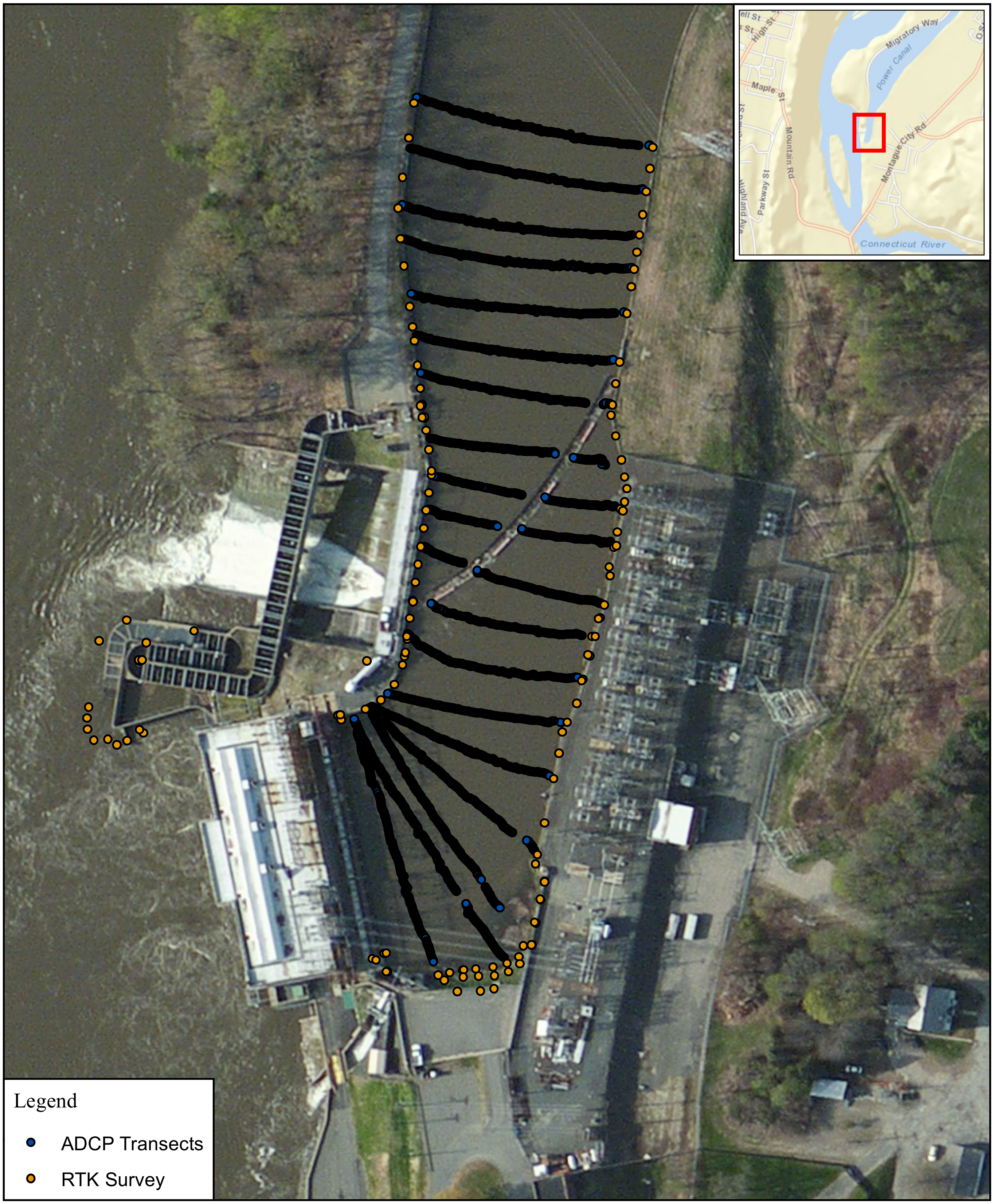

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Figure 2 - Cabot Forebay Bathymetry

N

0 62.5 125 250 Feet

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Path: W:\gis\studies\3_3_08\maps\Figure 2.mxd

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0 250 500 1,000 Feet

Figure 3 - Cabot Fishway Bathymetry and Velocity Measurement Coverage

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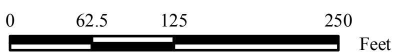

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RELICENSING STUDY 3.3.8

Figure 4 - Planned Bathymetry and Velocity CFD Transects at the Spillway Fishway.

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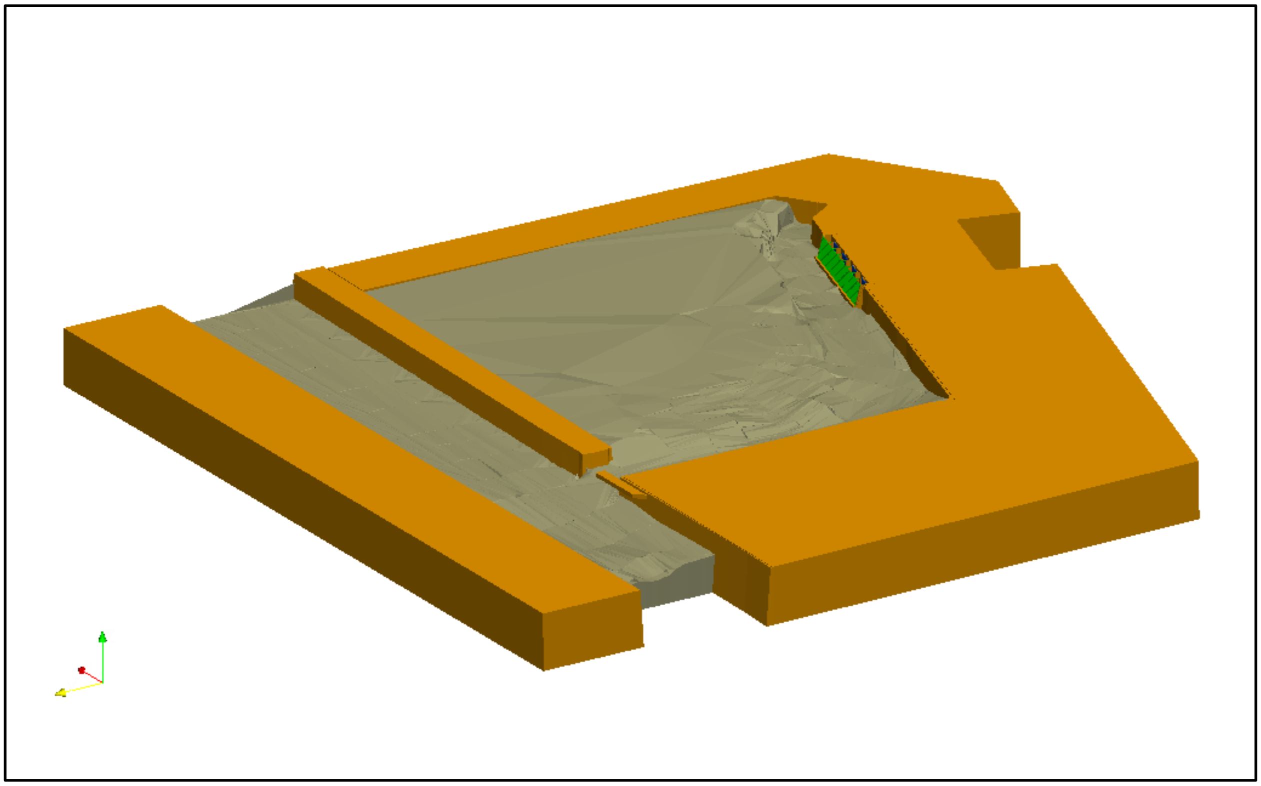

Figure 5: Station No. 1 Forebay three-dimensional rendering.

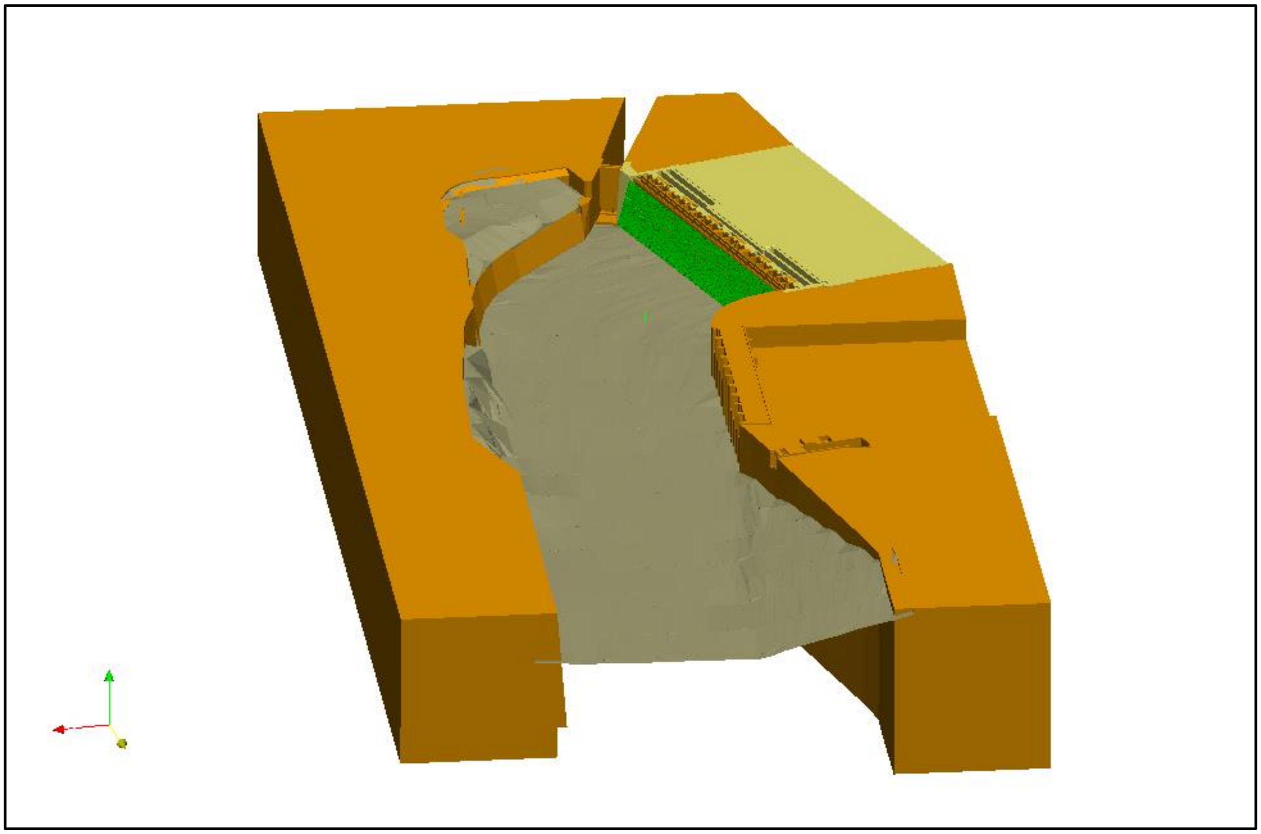

Figure 6: Cabot Forebay three-dimensional rendering.

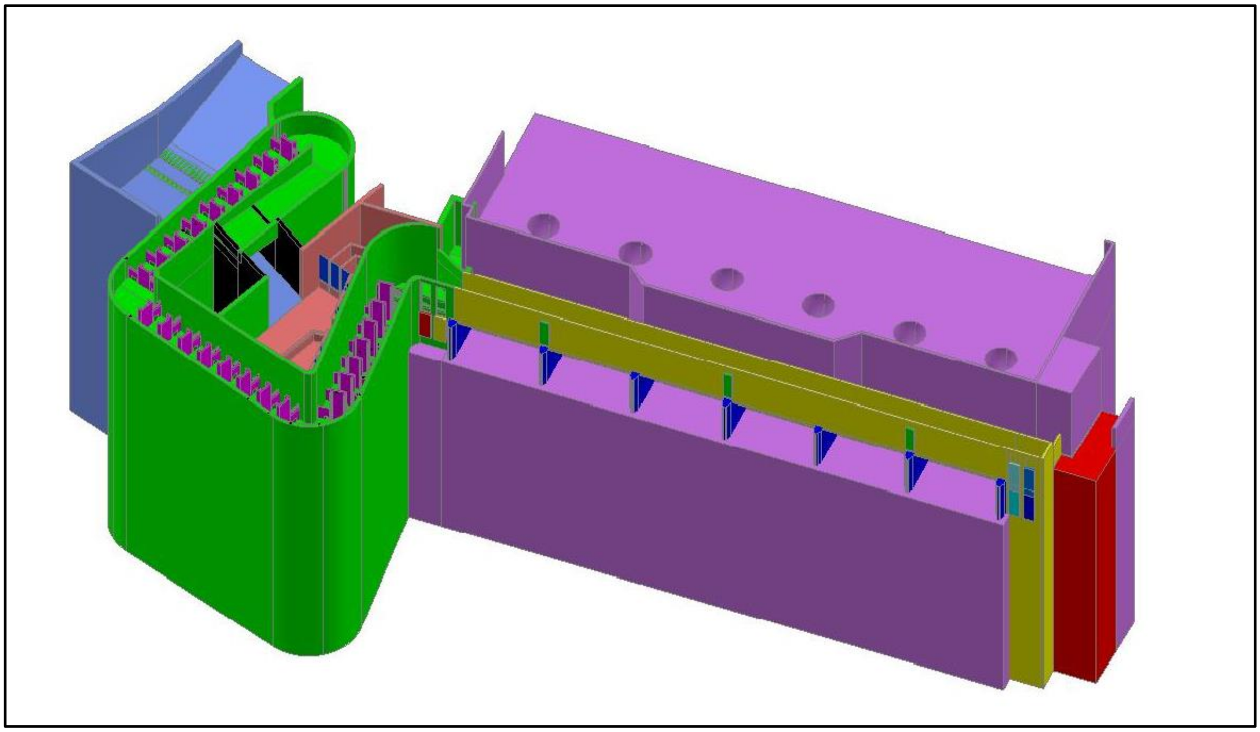

Figure 7: Cabot fishway three-dimensional rendering.

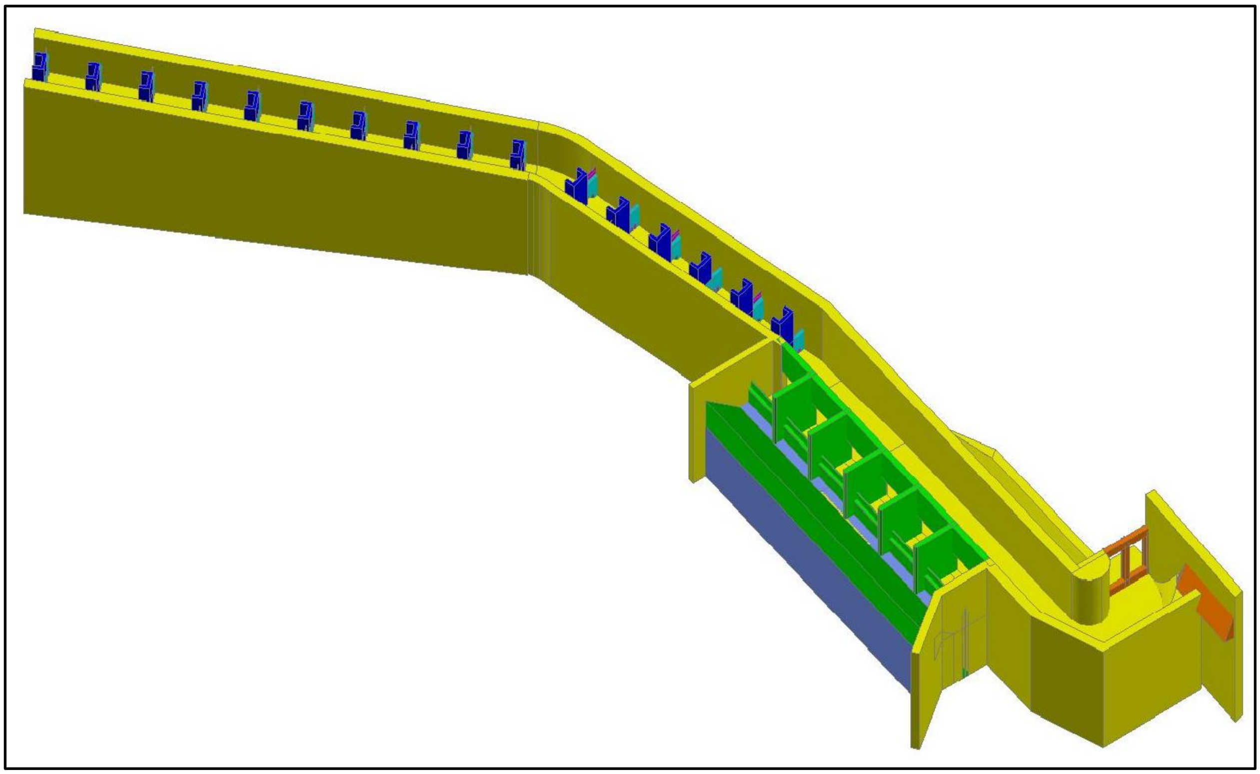

Figure 8: Turners Falls Dam spillway fishway three-dimensional rendering.

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Relicensing Study 3.3.9

TWO-DIMENSIONAL MODELING OF THE NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT INTAKE/TAILRACE CHANNEL AND CONNECTICUT RIVER UPSTREAM AND DOWNSTREAM OF THE INTAKE/TAILRACE

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

GOMEZ AND SULLIVAN ENGINEERS

SEPTEMBER 2014

1.1 Study Summary

This study models flow characteristics upstream and downstream of the Northfield Mountain Project tailrace under a variety of operating conditions to assess the potential for velocities and flow fields to interfere with migratory fish due to Northfield Mountain Project operations. The flow field conditions in the immediate vicinity of the Northfield Mountain Project intake/discharge structure (i.e. within the Northfield Mountain Project tailrace) will be assessed using field data collected under both pumping and generating conditions. Per the Federal Energy Regulatory Commission's (FERC) Study Plan Determination Letter (SPDL) dated September 13, 2013, the field data is to be collected at four transect locations. Flow field conditions in the vicinity of the tailrace are to be assessed with a two-dimensional model. The model extents include a 10 kilometer portion of the Turners Falls Impoundment (Impoundment) surrounding the Northfield Mountain Project tailrace (5 km upstream, 5 km downstream). A series of "production runs" with the two-dimensional model will be performed to evaluate velocity and water level fluctuations in the vicinity of the Northfield Mountain Project tailrace. The production runs will vary three model variables: a) Impoundment elevation; b) Northfield Mountain Project flow; c) main stem Connecticut River flow (base flow). The Impoundment elevation will be evaluated at 2 different levels (i.e. maximum and minimum Impoundment elevations permitted under the current FERC License, and four (4) different flow scenarios are to be evaluated for the Northfield Mountain Project flow (i.e. 4 pumps, 2 pumps, 4 generators, 2 generators). Per the FERC's SPDL, the base flow is to be evaluated at five different flows (i.e. the 5%, 25%, 50%, 75%, and 95% exceedance flow at Turners Falls Dam), for a total of 40 productions runs.

1.2 Study Progress Summary

Task 1: Review Existing Data and Identify Data Gaps

Review of the existing data is complete. Updated bathymetric data of the Impoundment was collected 5 km upstream and 5 km downstream of the Northfield Mountain Project tailrace. During this task it was also determined that two new water level loggers, in addition to the those approved in the RSP, should be installed as part of Task 2. The first new logger was located in the Impoundment along the bank across from the Northfield Mountain Project tailrace. This logger will be beneficial during model calibration for representation of the water level drawdown due to pumping and generating operations. The second new logger was installed on the concrete intake structure above the water level to correct all of the other loggers for atmospheric pressure.

Task 2: Bathymetric Survey Update & Post Processing

Bathymetric survey of the 10 km reach of the Impoundment was completed over the course of four days (May 27, 2014, and June 2, 2014 through June 4, 2014). The bathymetric survey was collected using an Acoustic Doppler Channel Profiler (ADCP) linked to a GPS unit, and included the collection of both bathymetry and velocity data. All information was collected in the North American Vertical Datum of 1988 (NAVD88). A thorough review of the data was performed during post-processing to remove outliers from the dataset due to loss of satellite communication (this is often caused by overhead obstructions such as the French King Gorge Bridge and trees along the bank). Post-processing has been completed, and the bathymetric data is available in both NAVD88 and the Northfield Mountain Project vertical datum (National Geodetic Vertical Datum of 1929, NGVD29). Figure 1 provides an overview of the bathymetric terrain developed from this dataset. Per the RSP, seven (7) water level loggers were installed, and data is periodically offloaded for analysis. Only six of these loggers record water pressure, while the seventh is used to correct for atmospheric pressure. Figure 2 indicates the location of the water level loggers, while Figure 3 shows the water level information collected to date.

Task 3: Develop and Graph Water Column Velocity Profiles

Bathymetric and water column velocity data has been collected at three transects within the Northfield Mountain Project tailrace under four different operating scenarios. Data for two units generating and pumping was collected on April 6, 2014 and April 7, 2014 respectively, while data for four units was collected on July 12, 2014. An Acoustic Doppler Channel Profiler (ADCP) linked to a GPS unit was utilized for the collection of this data. Similar to the bathymetric survey, this data was collected in NAVD88, and converted to NGVD29 during post-processing. Figures 4 – 7 show the average velocity with direction for each of the four operating scenarios.

Task 4: Build and Calibrate 2D Model

This task has not been started at this time, but is scheduled to start at the beginning of the 4th quarter of 2014.

Task 5: Conduct and Analyze Production Runs

This task has not been started at this time. As part of the 2015 study year, the initial results will be presented to the stakeholders, and additional runs may be requested.

Task 6: Report

A final report will be completed in the 2nd quarter of 2015.

1.3 Variances from Study Plan and Schedule

The RSP indicated that field data within the Northfield Mountain Project tailrace would be collected at three transects. FERC's SPDL modified the RSP to include an additional transect located equidistant from the intake and the closest proposed transect. It should be noted that the face of the intake structure is not located at the concrete structure as seen in aerial imagery. The upper half of Figure 8 indicates the approximate face of the intake structure (red dashed line) in comparison to the proposed location of transects (green lines) while the face of the intake structure is faintly visible in the aerial imagery (dated 9/18/2011) provided in the lower half of Figure 8. The distance from the face of the intake structure to the closest transect is approximately 25 feet. As such a fourth transect was not collected as it would sit atop the intake structure, and only the three originally proposed transects were collected.

1.4 Remaining Activities

Minor fieldwork remains as the water level loggers will remain in place throughout the summer. The data will be offloaded from these loggers periodically, and processed in the office. Additional processing of the field data for the development of the water column velocity profile graphs need to be performed for final report figures. Additionally the two-dimensional model must be developed using River 2D software, and calibrated to existing water surface elevation data. The initial 40 "production runs" are expected to be completed by the 1st quarter of 2015.

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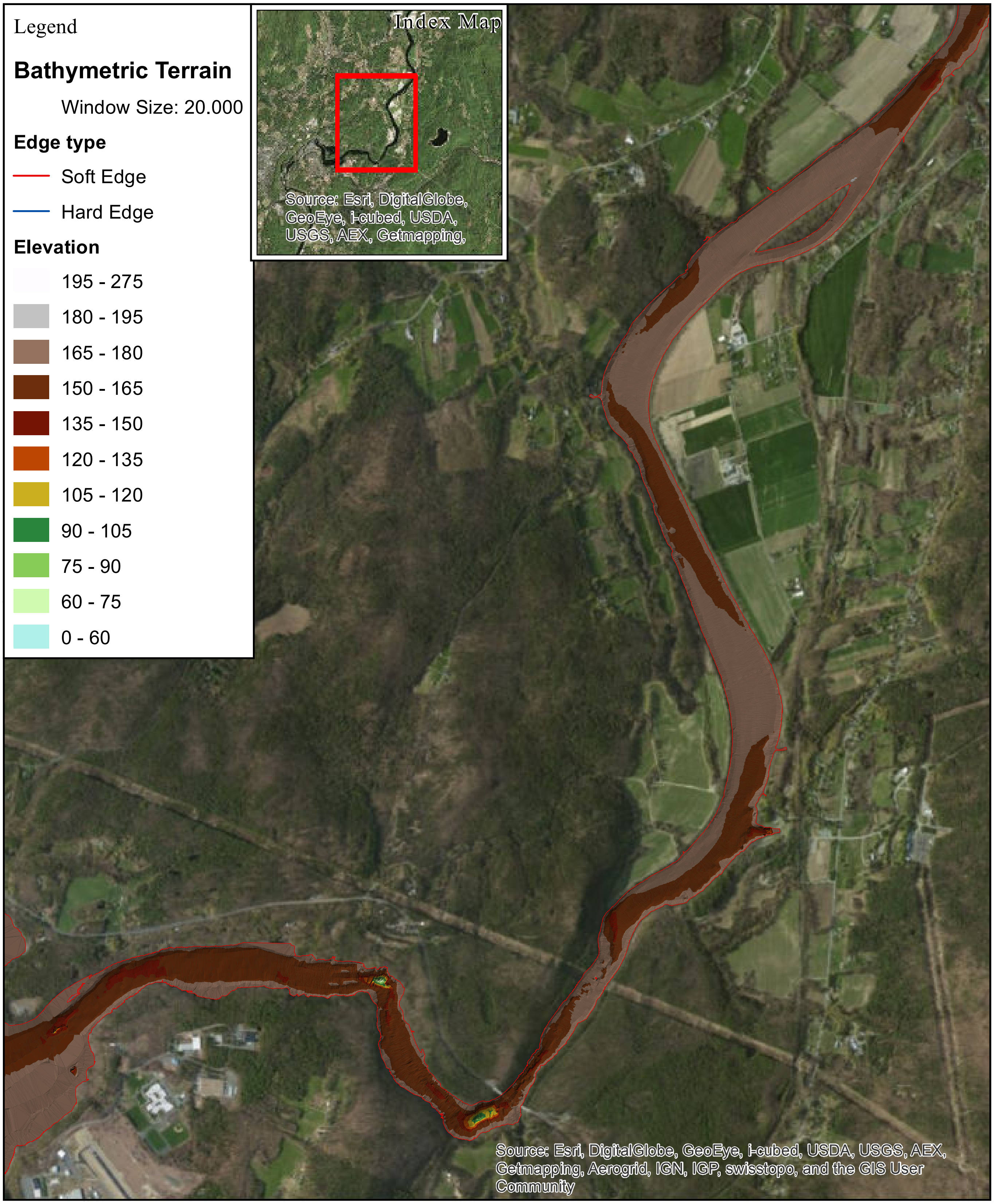

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Figure #1
Bathymetric Terrain

N

0 0.25 0.5 1 Miles

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Figure #2
Pressure Logger Locations

N

0 0.25 0.5 1 Miles

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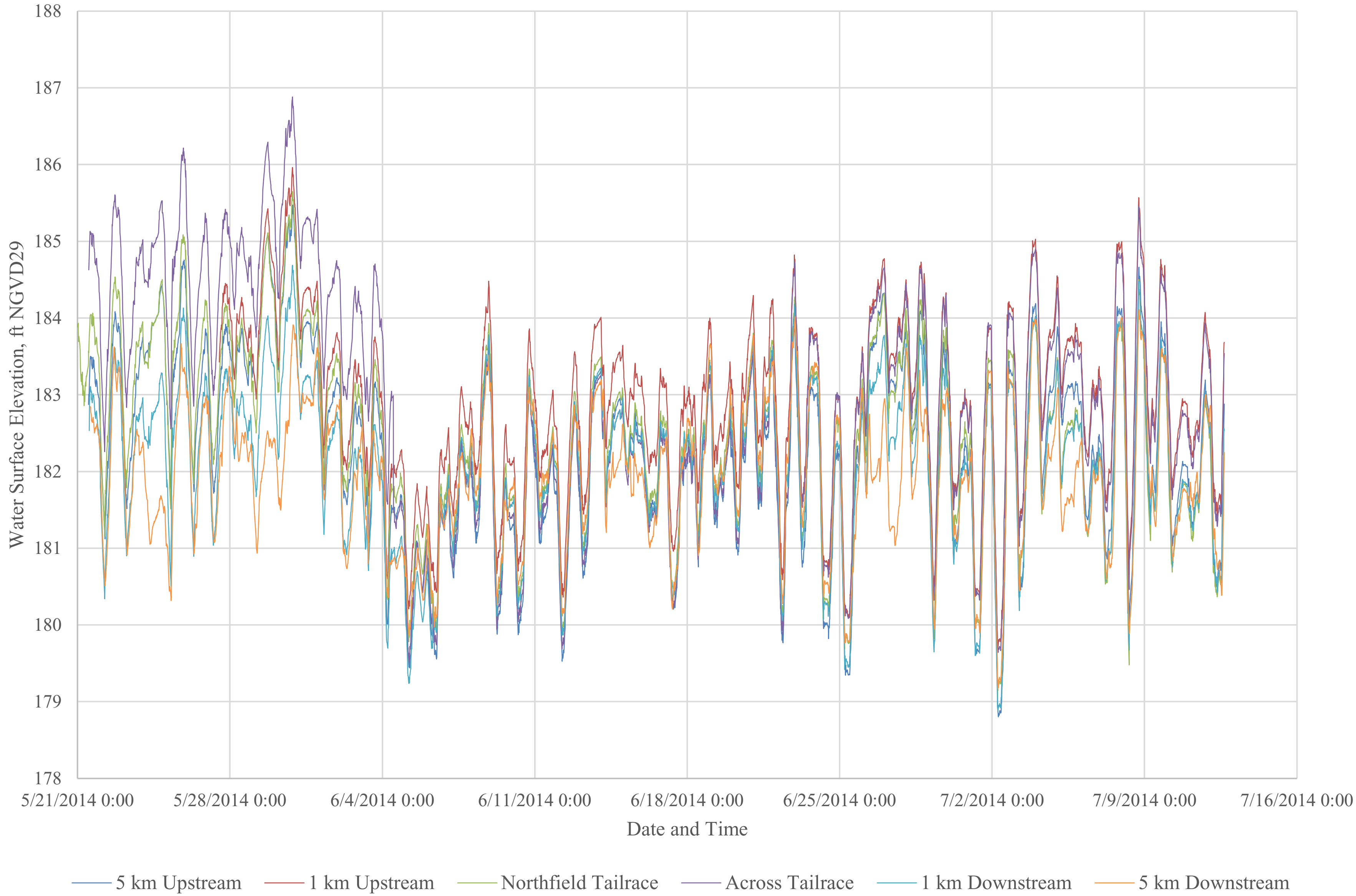
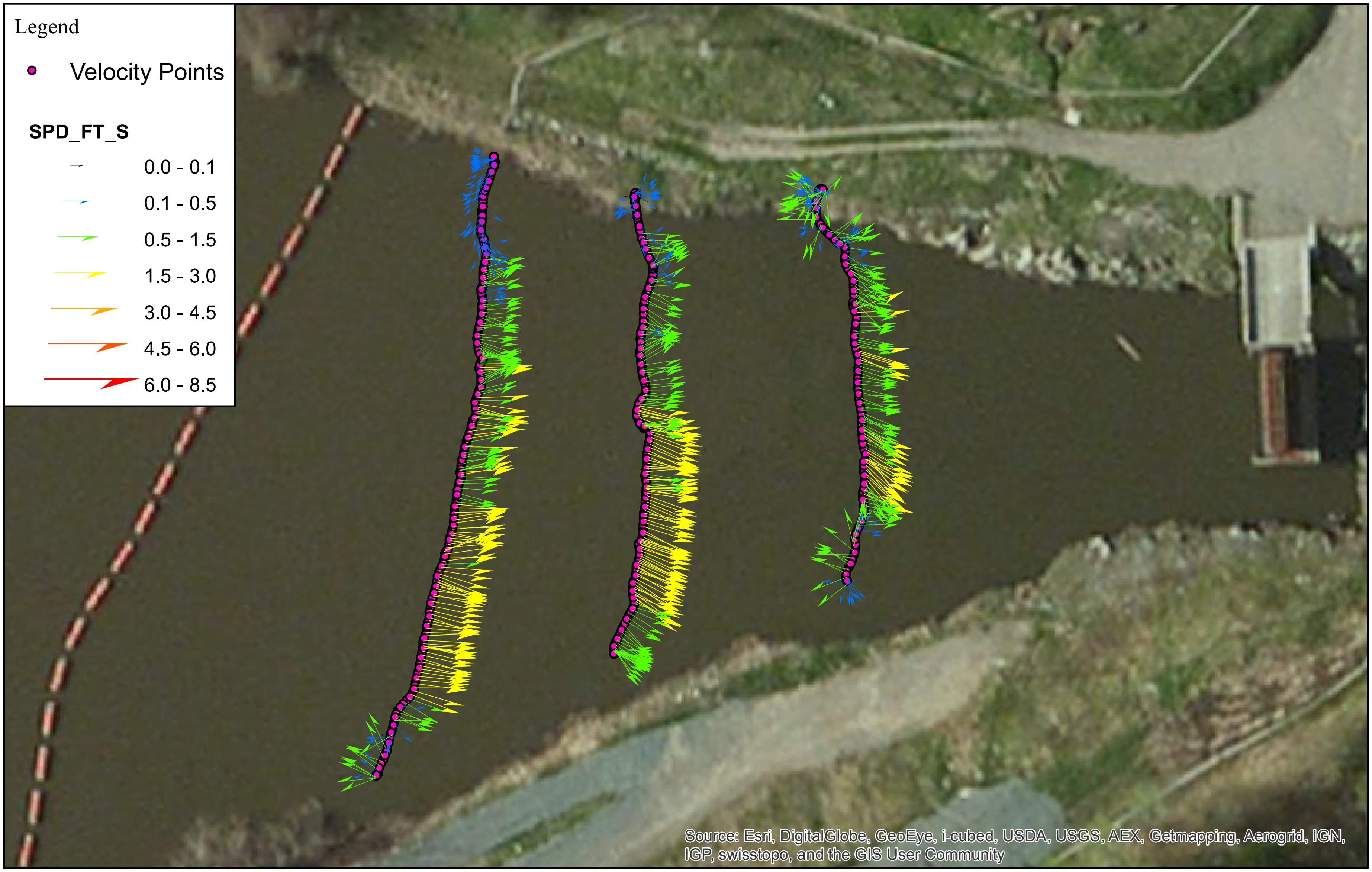
Figure #3: Water Level Logger Data





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INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.3.9

0 0.005 0.01 0.02 Miles

Figure #4
Average Water Column Velocities
2 Units Pumping

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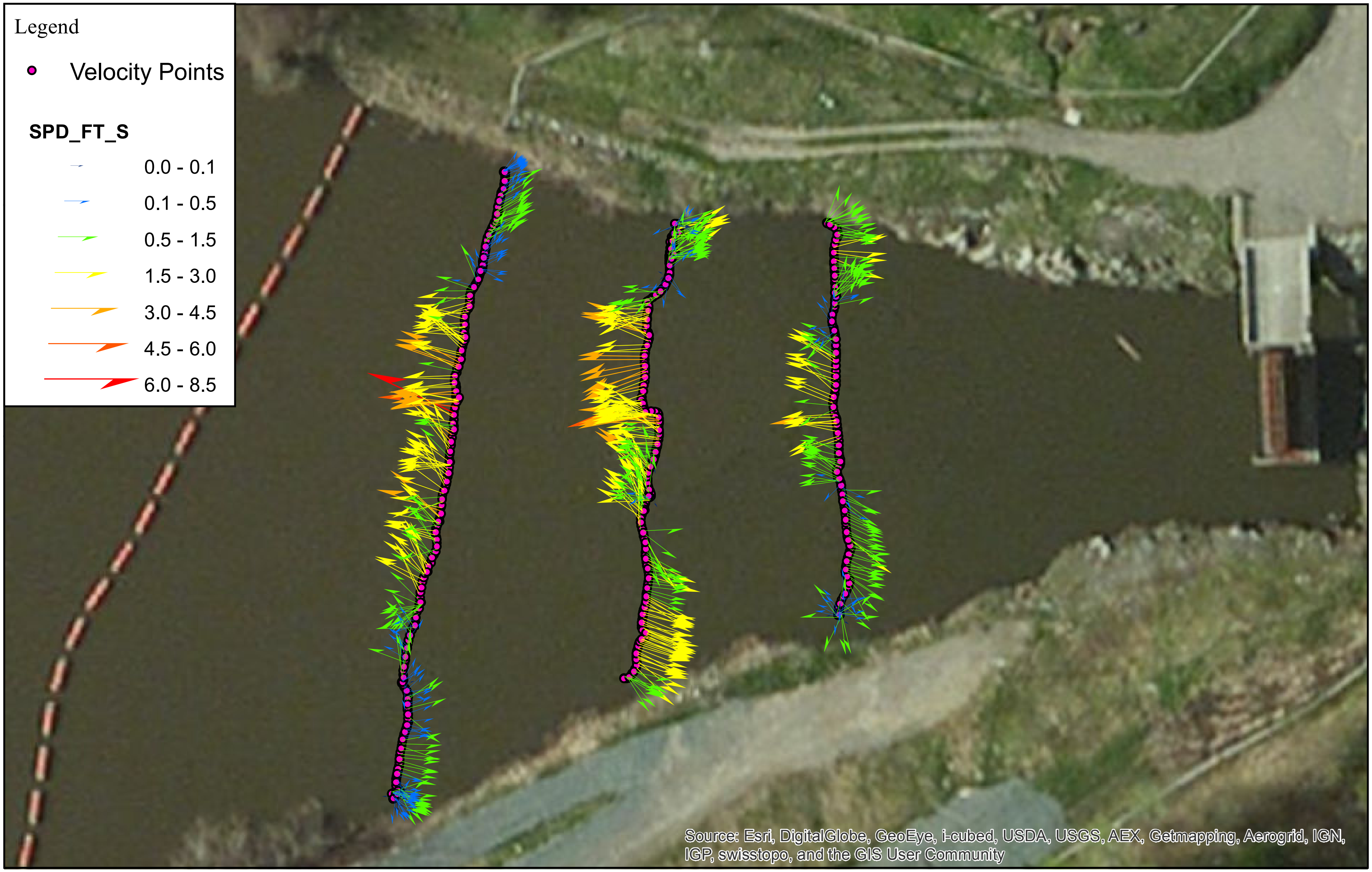

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Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)
INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.3.9

0 0.005 0.01 0.02 Miles

Figure #5
Average Water Column Velocities
2 Units Generating

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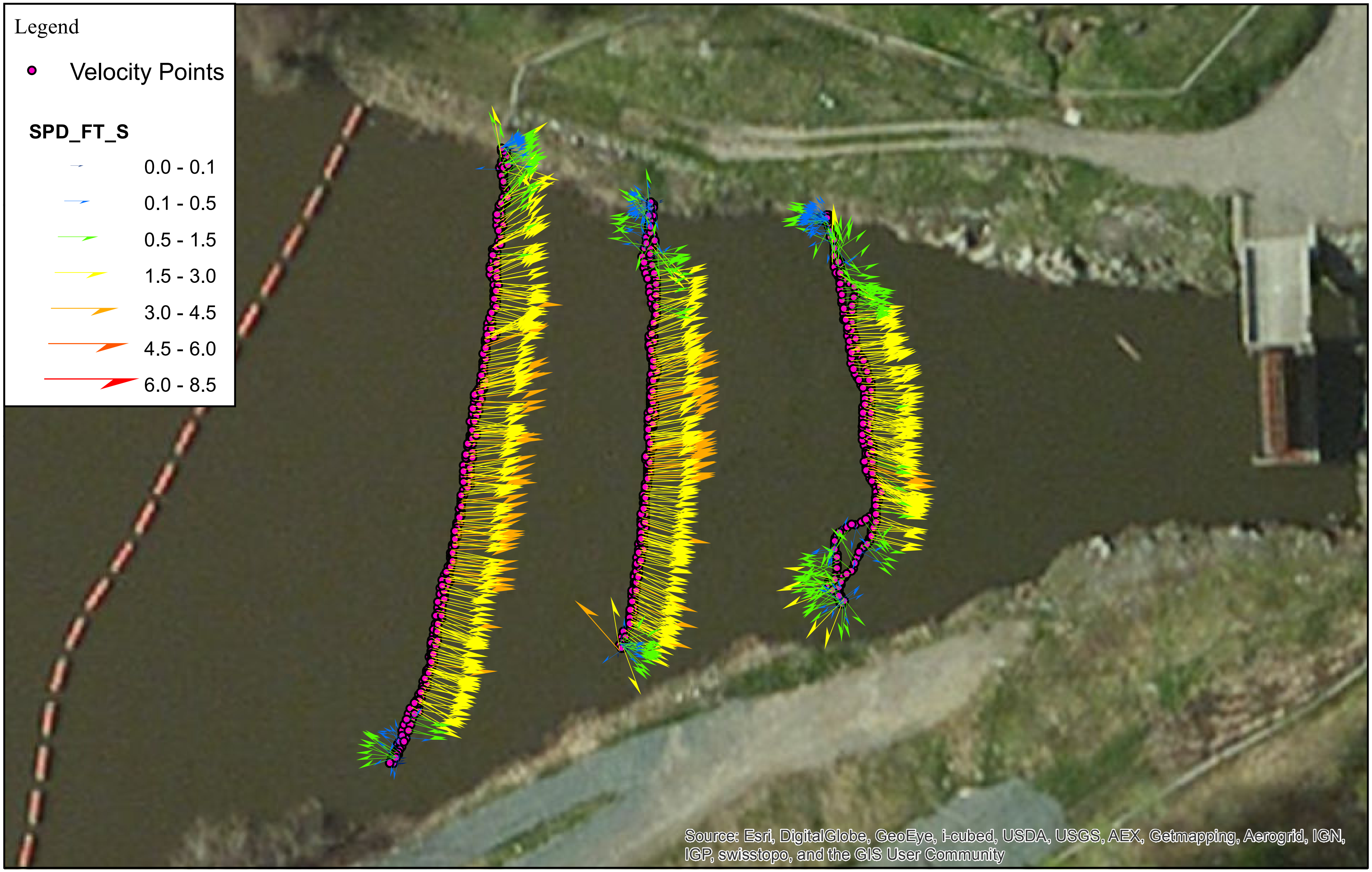

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Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.3.9

Figure #6
Average Water Column Velocities
4 Units Pumping

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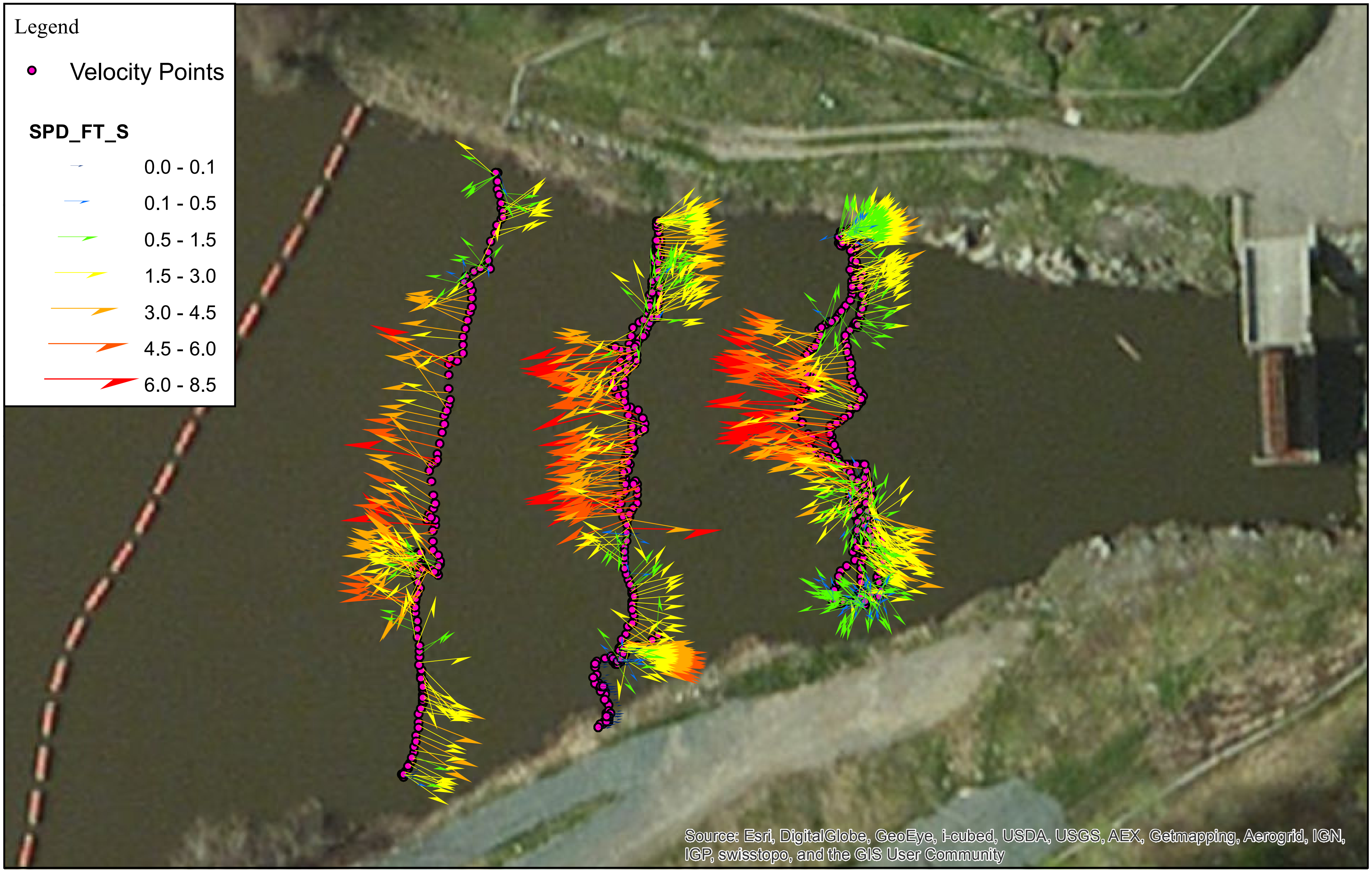

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Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.3.9

0 0.005 0.01 0.02 Miles

Figure #7
Average Water Column Velocities
4 Units Generating

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INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.3.9

N

0 0.0075 0.015 0.03 Miles

Figure #8
Location of Proposed Transects with Respect to Face of Intake Structure

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Relicensing Study 3.3.10

ASSESS OPERATIONAL IMPACTS ON EMERGENCE OF STATE-LISTED ODONATES IN THE CONNECTICUT RIVER

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

biodrawversity

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

This study has two objectives: (1) synthesis of existing data, supplemented with field surveys, to characterize the assemblage structure and emergence/eclosure behavior of odonates in the project area, and (2) determine if project operations affect the emergence and eclosure success of state-listed odonates, and the potential implications for the odonate assemblage in affected areas, particularly state-listed species. This is a two-year study, with qualitative odonate surveys in 2014 and quantitative studies in 2015, followed by analysis and reporting.

In 2014, odonate larvae and exuviae were surveyed between the Turners Falls Dam and the Route 116 Bridge in Sunderland, and in the Turners Falls Impoundment (Impoundment) near Barton's Cove, to establish a qualitative baseline for the odonate assemblage in these areas. Preceding the fieldwork, a study plan and scientific collection permit application was submitted to the Massachusetts Natural Heritage and Endangered Species Program (NHESP), and NHESP issued the permit on May 15, 2014.

1.2 Study Progress Summary

<u>Task 1: Review of Existing Information</u>

Existing information (peer-reviewed articles, books, relevant case studies, unpublished reports, etc.) on the life history and ecology of target odonate species will be reviewed in the fall and winter of 2014-2015.

<u>Task 2: Finalize Study Plan and Attain Collection Permit</u>

The study plan for the 2014 fieldwork was completed in April 2014, a collection permit application was submitted to NHESP in early May 2014, and NHESP issued the permit on May 15, 2014.

<u>Task 3: Qualitative Surveys for Larvae and Exuviae to Determine Species Presence</u>

Fieldwork for this task was completed in May and June of 2014. All the survey sites that NHESP requested were surveyed. These included:

- In the Impoundment - Representative shoreline habitat in Barton's Cove, totaling approximately 200 meters.
- In the Turners Falls Bypass Reach - Representative shoreline habitat in Reach 3 [as defined in the Revised Study Plan (RSP) - Study No. 3.3.1] totaling approximately 200 meters.
- In the Connecticut River below Cabot Station - Representative habitats within two (2) reaches in the area between the Railroad Bridge and Third Island (Montague/Deerfield), totaling approximately 400 meters.
- In the Connecticut River below Cabot Station - Approximately 200 meters of shoreline near the Route 116 Bridge in Sunderland was surveyed to compare species composition here to areas farther upstream (i.e., the two sites between the Railroad Bridge and Third Island). This was added to assess whether more intensive quantitative surveys planned for 2015, especially studies of emergence behavior could be done in an area that was more accessible.

<u>Task 4: Quantitative Surveys of Emergence/Enclosures Behavior</u>

This work will be completed in 2015. FirstLight will use results of Tasks 1 and 3 to inform discussions of additional data collection, replication, stratification by habitat, and to finalize its emergence speed study methods with stakeholders prior to data collection. FirstLight will convene a meeting with interested stakeholders to determine adequate number of survey transects and replicates for this effort.

Task 5: Water Fluctuation Impact Assessment

This work will be completed in 2015. The Federal Energy Regulatory Commission (FERC) in its February 21, 2014 Study Plan Determination Letter (SPDL) recommended that FirstLight deploy a water level logger (with the capability to record temperature) set to record data at 15-minute intervals, in each quantitative survey reach to accurately evaluate water levels, standardize field measurements, and describe temperature in relation to odonate emergence behavior. FirstLight has a permanent water level logger in the vicinity of Barton's Cove, which should provide information on impoundment water levels to support this task. Below the dam, in addition to the permanent United States Geological Survey (USGS) staff gauge on the Connecticut River at Montague City, FirstLight will install temporary water level/water temperature loggers in each reach (total of two loggers) for the duration of the quantitative surveys.

Task 6: Report

A final report will be completed in March 2016 per FERC's SPDL.

1.3 Variances from Study Plan and Schedule

To date, the only variance from the study plan and schedule was to include one additional survey site near the Route 116 Bridge in Sunderland. This was surveyed to compare species composition here to areas farther upstream (i.e., the two sites between the Railroad Bridge and Third Island). FirstLight added this site in order to assess whether more intensive quantitative surveys planned for 2015, especially studies of emergence behavior could be done in an area that was more accessible.

1.4 Remaining Activities

Odonate larvae and exuviae collected in 2014 will be identified, field data will be entered and analyzed, and a study plan for the 2015 fieldwork will be submitted for review. Review of existing information (relevant publications, case studies, etc.) will occur in fall and winter of 2014-2015. FirstLight will convene a meeting with interested stakeholders to finalize the quantitative survey methods and level of effort under Task 4.

Quantitative surveys will occur in 2015. A final report, which will include an assessment of effects of water fluctuations, will be prepared following the 2015 field season.

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Relicensing Study 3.3.11

FISH ASSEMBLAGE ASSESSMENT

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The purpose of this study is to characterize the fish assemblage above and below the Turners Falls Project. The National Marine Fisheries Service (NMFS) has pointed out that sampling in certain areas may have the potential to affect shortnose sturgeon, whose historic upstream range on the Connecticut River is Turners Falls. While sampling as proposed in the RSP can occur in the Turners Falls Impoundment because this is beyond the range of shortnose sturgeon, sampling efforts below Turners Falls Dam will be modified from the RSP, as discussed below, to avoid potential impacts to shortnose sturgeon.

Correspondence

On June 28, 2013, FirstLight filed its *Updated* Proposed Study Plan (PSP) with the Federal Energy Regulatory Commission (FERC).

On July 15, 2013, NMFS filed a letter with the FERC commenting on the *Update*d PSP. In NMFS's letter, it recommended that Study No. 3.3.11 be modified to eliminate the potential for effects on shortnose sturgeon. Specifically, NMFS recommended that: (1) no electrofishing occur in the reach of the Connecticut River below the Deerfield River (which NMFS refers to as Transect 6); and (2) a seasonal restriction be placed on sampling in the bypass reach (which NMFS refers to as Transect 5) to ensure that no electrofishing is carried out when shortnose sturgeon may be present (April 15 – June 30).

On August 14, 2013, FirstLight filed its Revised Study Plan (RSP) with FERC incorporating NMFS's recommendations.

On January 28, 2014, FirstLight filed a letter (Appendix A) with FERC noting that additional modifications to the plan may be necessary to avoid potential impacts to shortnose sturgeon in both the bypass reach and the reach of the river below Turners Falls Dam. To avoid any potential impacts to sturgeon, FirstLight proposed to conduct all sampling in the bypass reach after June 30, and in the reach below the Deerfield River, FirstLight proposed to use both existing data and the data it obtains in the Turners Falls Impoundment.

On February 21, 2014, FERC in its second Study Plan Determination Letter (SPDL) stated the following: "*The revised study plan, as proposed [in August 2013] may result in effects on shortnose sturgeon. FirstLight's proposal to amend the revised study plan would eliminate this concern. However, we recognize that the resource management agencies with jurisdictional responsibilities have not had an opportunity to consult with FirstLight or comment on the proposed amendment to this study. As a result, we recommend that FirstLight consult with the NMFS, FWS, MADFW, and Commission staff on an amendment to the revised study plan that would seek to avoid all effects to shortnose sturgeon and provide sufficient information needed by the jurisdictional agencies and the Commission for their needs. Following consultation, FirstLight should file with the Commission for approval, an amended study plan for study 3.3.11 when it files its Initial Study Report in September 2014. The amended study plan should document FirstLight's consultation efforts, consider comments received, and if recommendations are not adopted, provide FirstLight's reasons based on project-specific information*".

On June 3, 2014, FirstLight had a meeting with FERC, NMFS, United States Fish and Wildlife Service (USFWS). Massachusetts Division of Fish and Wildlife (MADFW), The Nature Conservancy (TNC), and Connecticut River Watershed Council (CRWC) to discuss potential alternatives to the study revisions proposed by FirstLight on January 28.

On July 14, 2014, NMFS emailed FirstLight (Appendix A) recommending that FirstLight determine whether the final study it proposes will adversely affect shortnose sturgeon.

On September 9, 2014, USFWS emailed FirstLight and NMFS (Appendix A) its understanding of the status of Study 3.3.11 and attached a revised fish assemblage study plan. Note that FirstLight is filing a modified study plan (Appendix B) but does not address the USFWS's revised study plan (attached to the September 9, 2014 email).

At this juncture, FirstLight proposes to adopt the changes to the RSP it set forth in its January 28, 2014 letter, which will avoid potential impacts to the species. Specifically, FirstLight will conduct all sampling in the bypass reach after June 30, and in the reach below the Deerfield River, FirstLight will use both existing data and the data it obtains in the Turners Falls Impoundment to characterize the fish assemblage in this reach.

Reporting

A final report will be completed in March 2016 per FERC's SPDL.

1.2 Study Progress Summary

An amended study plan was developed based on the consultation described above (see Appendix B). Note that FirstLight's amended study plan does not address the modified study plan provided to FirstLight by the USFWS on September 9, 2014.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances from this study.

1.4 Remaining Activities

- Conduct the field study in 2015.
- Complete report.

Appendix A
Correspondence Log

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

ORIGINAL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

FILED
SECRETARY OF THE
COMMISSION
2013 DEC -2 A 10: 09
FEDERAL ENERGY
REGULATORY COMMISSION

NOV 22 2013

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

P-2485

RE: Supplemental Comments on Firstlight's Proposed Study Plan dated June 28, 2013 for Turners Falls (P-1889) and Northfield Mountain Pumped Storage (P-2485)

Dear Ms. Bose:

We submitted comments on Firstlight's June 28, 2013, Study Plan in letters filed with you on July 15, 2013 and August 28, 2013. In our July 15 letter, we indicated that a consultation, pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, may be necessary to consider effects of the *Fish Assemblage Assessment* (P-1889 Study 3.3.11) on endangered shortnose sturgeon. We recommended that the study be modified to eliminate the potential for effects or that FERC initiate formal consultation pursuant to section 7 with us. In recent conversations with Firstlight, we have become aware of the potential for additional studies to adversely affect shortnose sturgeon including study 3.3.6 *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects* and study 3.6.3 *Whitewater Boating Evaluation* (Revised Study Plan for the Turners Falls Hydroelectric Project (P-1889) and Northfield Mountain Pumped Storage Project (P-2485)). If possible, these studies should be designed or modified to avoid effects to shortnose sturgeon; however, if such modification is not possible, section 7 consultation is necessary.

Section 7(a)(2) of the ESA, states that each Federal agency shall, in consultation with the Secretary, insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Any discretionary federal action that may affect a listed species must undergo Section 7 consultation. It is our understanding that the approval of study plans is a discretionary action taken by FERC that is subject to section 7 consultation. As the lead Federal agency, you must initiate section 7 consultation with us on any action that may affect listed species. If you determine that the studies are "not likely to adversely affect" any listed species (i.e., when direct or indirect effects of the proposed project or its interdependent and/or interrelated actions on listed species are expected to be discountable, insignificant or completely beneficial), you should submit this determination to us in writing, along with a justification, and request our concurrence. If we concur with this determination, we will reply in a letter that will convey the concurrence, thus completing Section 7 consultation. If you determine that a study or studies are "likely to adversely affect" any listed species (i.e., if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effects are not: discountable, insignificant, or beneficial) or we do not concur with your "not likely to adversely affect" determination, formal Section 7 consultation, resulting in the issuance of a Biological Opinion with an appropriate Incidental Take Statement, may be required. Any effects that amount to the take of a listed species (defined by the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct") are not discountable, insignificant or entirely beneficial. Therefore, if any take, including non-lethal capture and release and/or exposure to electric current during electrofishing, is anticipated, formal consultation is required. My staff is available to discuss the effects of the proposed studies on shortnose sturgeon and assist you and Firstlight in determining the likely effects of the proposed studies. If you have designated Firstlight as your non-Federal representative for purposes of informal section 7 consultation, you must indicate this in writing to us. In that event, Firstlight, representing FERC, would be able to request our concurrence for any "not likely to adversely affect" determinations. However, if formal consultation is necessary, the request must come from FERC.

This letter supplements the comments filed by us in July and August 2013; the comments presented in those letters regarding our Federal Power Act authorities as well as impacts to other NMFS trust resources remain valid. If you have any questions or need additional information, please contact Jessica Pruden in our Protected Resources Division (Jessica.Pruden@noaa.gov or 978-282-8482).

Sincerely,

Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

EC: Crocker, F/NER3
McDavitt, F/NER4

File Code: Sec 7 FERC Turners Falls Relicensing

FirstLight Power Resources
GDF SUEZ

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 422-5900
Internet: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

January 28, 2014

VIA ELECTRONIC FILING

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: FirstLight Hydro Generating Company, FERC Project Nos. 2485-063 and 1889-081
Response to National Marine Fisheries Service Supplemental Comments on Study Plan

Dear Secretary Bose:

On December 2, 2013, the National Marine Fisheries Service (NMFS) filed a letter with the Federal Energy Regulatory Commission (FERC or Commission) containing supplemental comments on FirstLight Hydro Generating Company's (FirstLight) study plan for relicensing the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485). NMFS's comments expressed concern that three of FirstLight's study plans; Study Plan 3.3.6, *Impact of Project Operations on Shad Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects*; Study Plan 3.3.11, *Fish Assemblage Assessment*, and Study Plan 3.6.3; *Whitewater Boating Evaluation*—had the potential to adversely affect shortnose sturgeon, an endangered species under the Endangered Species Act. NMFS therefore suggested that these studies should be designed or modified to avoid effects to shortnose sturgeon. The purpose of this letter is to respond to NMFS's comments on two of these study plans, Study Plans 3.3.6 and 3.3.11, to enable the Commission's Director of the Office of Energy Projects to issue a study plan determination that directs FirstLight to implement studies that will avoid potential effects to shortnose sturgeon.[1]

Study Plan 3.3.6, *Impact of Project Operations on Shad Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects*

Study Plan 3.3.6 addresses requests by resource agencies to determine if Turners Falls Project operations affect shad spawning, by conducting night time surveys to document shad spawning. The agencies requested that following this documentation, FirstLight observe spawning activity under a range of

[1] FirstLight has already addressed NMFS's concerns on the third study plan, Study Plan 3.6.3, *Whitewater Boating Evaluation*, in its modified revised study plan filed on January 13, 2014, by proposing to conduct the evaluation outside of the April 15 – June 22 shortnose sturgeon spawning and rearing period.

operating conditions. FirstLight's revised study plan for Study Plan 3.3.6 includes these parts of the study as requested, during the May – June shad spawning time period.

The agencies also requested that shad egg collections be conducted in areas of spawning activity to further determine if spawning has occurred. It has been documented that shortnose sturgeon spawn in the vicinity of the Cabot Station tailrace (Kieffer and Kynard 2012). Kieffer and Kynard (2012) have documented a spawning period of 5-17 days during the same 26 day period each year (April 27-May 22). Early life history stages (eggs and larvae) are present in the project area for 20 to 30 days after spawning (Kynard et al. 2012a). So the period when shortnose sturgeon eggs and larvae are present overlaps with the proposed sampling period for shad egg collection. Consequently, the collection of shad eggs may have the potential to impact shortnose sturgeon, and NMFS recommended in its December 2 letter that the study be revised.

To address this potential concern, FirstLight proposes to replace shad egg collection efforts, which studies have shown are duplicative of visual observations of shad spawning, with enhanced visual observations and splash counts. Ross (1993) has quantified spawning of adult American shad by counting spawning splashes over 5-min intervals. Splashing events were verified to be spawning American shad through direct observations. Ross (1993) concluded that that this technique was valid and useful to quantify spawning activity for this species. FirstLight therefore believes that visual observations and splash counts of shad spawning, which will have no impact to shortnose sturgeon, will fulfill the goals and objectives of the study.

Study Plan 3.3.11, *Fish Assemblage Assessment*

Study Plan 3.3.11 addresses regulatory agency requests to characterize the fish assemblage above and below the Turners Falls Dam. Although the study is not targeting shortnose sturgeon, NMFS has pointed out that non-targeted sampling in certain areas may have the potential to affect shortnose sturgeon, whose historic upstream range on the Connecticut River is Turners Falls. While sampling as proposed can occur in the Turners Falls impoundment because this is beyond the range of shortnose sturgeon, sampling efforts below Turners Falls Dam may need to be modified to avoid potential impacts to shortnose sturgeon.

In its comments dated July 15 on proposed Study Plan 3.3.11, NMFS recommended the study be modified to eliminate the potential for effects on shortnose sturgeon. Specifically, NMFS recommended that: (1) no electrofishing occur in the reach of the Connecticut River below the Deerfield River (which NMFS refers to as Transect 6); and (2) a seasonal restriction be placed on sampling in the bypass reach (which NMFS refers to as Transect 5) to ensure that no electrofishing is carried out when shortnose sturgeon may be present (April 15 – June 30).

In its revised study plan, FirstLight noted that the geographic scope of the study was being reviewed by NMFS, and that the potential impact on shortnose sturgeon may result in modifying the geographic area. FirstLight therefore agreed not to perform any electrofishing in the bypass reach from April 15 – June 30.

While NMFS did not provide any additional comments on FirstLight's revised study plan for Study 3.3.11, FirstLight believes that additional modifications to the plan may be necessary to avoid potential impacts to shortnose sturgeon in both the bypass reach and the reach of the river below the Turners Falls Dam. To avoid any potential impacts to sturgeon, FirstLight proposes to conduct all sampling in the bypass reach after June 30, and in the reach below the Deerfield River, FirstLight proposes to use both existing data and the data it obtains in the Turners Falls Impoundment.

A 2009 electrofishing survey of the area below Turners Falls Dam downstream to the Route 116 Bridge was conducted as part of a larger Environmental Protection Agency effort to sample the entire Connecticut River from Lake Francis to the freshwater extent of the tidal estuary. Sampling occurred at three 1-km stations in the bypass reach and eight 1-km stations between the bypass reach and the Route 116 Bridge in Sunderland (Figure 1). The species composition and relative abundance (Table 1) is typical of fish assemblages described for inland fishes of Massachusetts (Hartel et al. 2002). FirstLight believes that these recent data, coupled with the data FirstLight will obtain in the Turners Falls Impoundment will provide sufficient information on species composition and relative abundance in the Project area to accomplish the study's goals and objectives.

If you have any questions regarding this filing, please feel free to contact me.

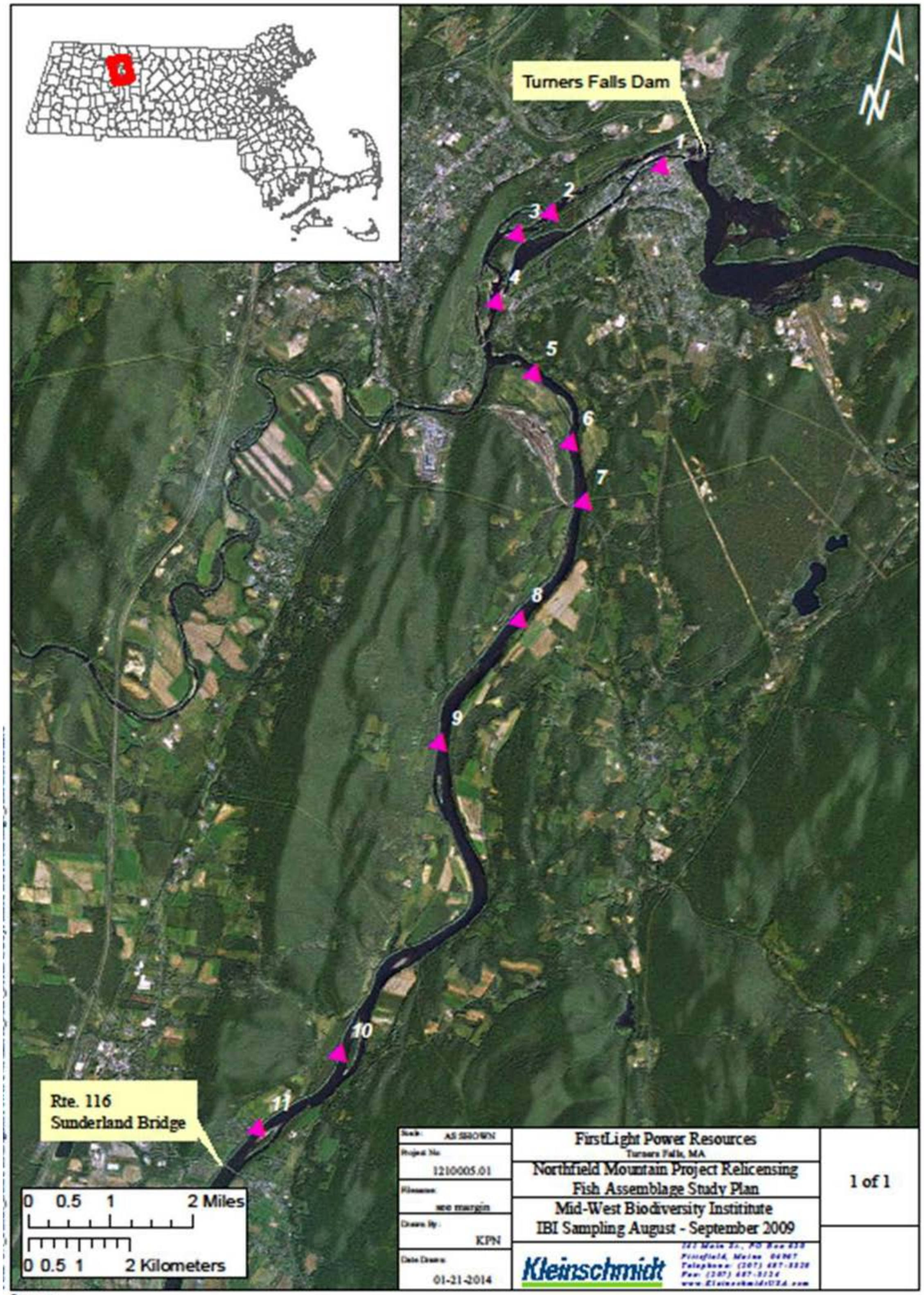
Sincerely,

John Howard

Table 1. Fish collected at eleven 1 km sample sites on the Connecticut River below the Turners Falls Dam to the Route 116 Bridge in Sunderland MA by electrofishing (2009).

	Stations											
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
Date Sampled (2009)	**8/31**	**9/28**	**8/15**	**8/16**	**8/16**	**9/2**	**8/16**	**10/5**	**8/17**	**8/17**	**8/17**	
American eel	13	12	5	14	0	0	3	2	29	0	0	**78**
American shad	0	0	0	7	7	6	0	0	0	1	25	**46**
Atlantic salmon	0	8	0	1	0	0	0	0	0	0	1	**10**
Black crappie	0	0	0	0	1	0	0	0	0	0	0	**1**
Bluegill	15	0	3	5	7	8	8	0	12	14	9	**81**
Brown trout	1	0	0	0	0	0	2	0	0	0	0	**3**
Chain pickerel	0	0	0	0	0	1	0	1	0	0	0	**2**
Channel catfish	0	0	0	0	0	0	1	0	0	0	0	**1**
Common carp	1	0	0	2	0	0	0	0	0	0	0	**3**
Common shiner	0	0	0	4	0	0	0	0	0	0	0	**4**
Fallfish	0	0	14	4	29	150	10	10	99	128	8	**452**
Largemouth bass	0	0	0	0	2	0	0	0	0	4	0	**6**
Longnose dace	11	0	1	0	0	0	0	0	0	0	0	**12**
Northern pike	0	0	1	0	1	0	0	1	0	2	0	**5**
Pumpkinseed	0	0	1	0	0	0	0	0	2	0	0	**3**
Rock bass	2	3	8	1	3	3	4	0	12	0	0	**36**
Sea lamprey	14	1	1	0	0	0	0	2	3	0	2	**23**
Smallmouth bass	85	56	70	42	45	46	81	19	12	33	25	**514**
Spottail shiner	13	0	133	0	9	354	0	8	53	10	0	**580**
Tessellated darter	17	0	8	3	1	2	1	4	1	0	0	**37**
Walleye	0	0	0	0	0	0	1	0	0	0	0	**1**
White sucker	6	5	9	5	4	23	9	3	1	4	2	**71**
Yellow perch	1	1	3	0	0	2	1	2	1	7	5	**23**
Total	**179**	**86**	**257**	**88**	**109**	**595**	**121**	**52**	**225**	**203**	**77**	**1992**
Sampling effort (Seconds)	**9272**	**3356**	**4856**	**3298**	**3495**	**6360**	**4415**	**6578**	**3708**	**3595**	**3441**	**52374**

Figure 1: Locations of fish collection sites on the Connecticut River below the Turners Falls Dam to the Route 116 Bridge in Sunderland MA by electrofishing (2009).



Source:

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Kynard, B., M. Kieffer, B.E. Kynard, M. Burlingame and P. Vinogradov. 2012a. Demography, Movements, Spawning habitat, and Spawning Success of Adult Connecticut River Shortnose Sturgeon Migrating to Holyoke Dam. Chapter 2 *in* Life history and behavior of Connecticut River shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

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Normandeau Associates, Inc. (NAI) 2009. Shortnose sturgeon emigration approach and downstream passage routes at the Holyoke Project, 2008. Final Report.

Ross, R.M., Backman, T.W.W. & Bennett, R.M. (1993). *Evaluation of habitat suitability index models for riverine life stages of American shad, with proposed models for pre-migratory juveniles* (Biological Report 14. U. S. DOI). Washington, D.C.: U. S. Fish and Wildlife Service.

Mark Wamser

From: Jessica Pruden - NOAA Federal <jessica.pruden@noaa.gov>
Sent: Monday, July 14, 2014 10:52 AM
To: Howard, John
Cc: Chris Tomichek; Kimberly Damon-Randall - NOAA Federal; Kenneth Hogan; Julie Crocker - NOAA Federal; Mark Wamser
Subject: Re:

John,
Thank you for your letter outlining the proposed modifications that will be incorporated into study *3.3.6 Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of Northfield Mountain and Turners Falls Project.* We are comfortable with modifications 1-3 being incorporated into the final study plan. We also understand the difficultly of screening every sample and are comfortable with the proposed screening approach outlined in your letter. However, the following requirement should also be incorporated into the proposed sampling and screening approach: *If shortnose sturgeon eggs, embroys, or larvae, are detected during screening of ickthyo-plankton tows, all sampling should cease and NMFS should be contacted immediately. NMFS will then work with First Light to determine how to proceed.*

Once First Light is confident that the proposed study, with the modifications and requirements outlined above, are acceptable to the other agencies, we would recommend ESA section 7 consultation. Given that First Light has been designated as the non-federal representative by FERC, you may submit a letter, as FERC's representative, describing the final proposed study, an analysis of the effects of the proposed action on shortnose sturgeon, and determination as to whether the proposed action will adversely affect shortnose sturgeon. If you determine that the proposed study is not likely to adversely affect shortnose sturgeon (i.e., that all effects will be insignificant and discountable and you do not anticipate any capture or collection), you should request our concurrence with that determination. Once we receive this letter, NMFS will make a determination as to whether we concur with First Lights determination.

We understand that a separate working group is developing an alternative proposed approach for study *3.3.11 Fish Assemblage Assessment.* We would strongly recommend that if possible, First Light include a description of the final proposed approach, an analysis of the effects on shortnose sturgeon, and determination on whether the action will adversely affect shortnose sturgeon in the same letter we reference above. This will likely ensure greater efficiency in terms of a timely response from NMFS.

We are comfortable engaging in early consultation, which would allow First Light and NMFS to consult as soon as First Light is confident that both studies are acceptable to all of the interested agencies. Consultation does not need to wait until the Final Study Plan Determination has been made by FERC. Please let us know if you have any questions about any of this information.

Thank you,
Jessica Pruden

On Thu, Jul 3, 2014 at 10:56 AM, Chris Tomichek <Chris.Tomichek@kleinschmidtgroup.com> wrote:

Good Morning

Attached is a letter that FirstLight put in the mail to NMFS this morning that includes proposed modifications to Study Plan 3.3.6 - *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Project* to avoid potential impacts to shortnose sturgeon larvae as discussed at the June 3, 2014 meeting.

Regards,

Chris

Chris Tomichek

Senior Manager

Fisheries and Aquatic Resources

Office: 860.767.5069

www.KleinschmidtGroup.com

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Jessica Pruden
Shortnose Sturgeon Recovery Coordinator and Tribal Liaison for the Greater Atlantic Region
NOAA Fisheries
55 Great Republic Drive
Gloucester, MA 01930
Work 978-282-8482
E-Mail Jessica.Pruden@noaa.gov
Cell: 978-992-1014

August 25, 2014

VIA EMAIL

Jessica Pruden, National Marine Fisheries Service
John Warner, US Fish & Wildlife Service
Melissa Grader, US Fish & Wildlife Service
Caleb Slater, Massachusetts Department of Fish & Wildlife
Ken Hogan, Federal Energy Regulatory Commission

Re: FirstLight Hydro Generating Company, Relicensing of the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485), Study No. 3.3.6 - *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Project*.

Dear All:

FirstLight is preparing a revision to relicensing Study No. 3.3.6, *Impact of Project Operations on Shad Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects*. After FirstLight filed its Revised Study Plan (RSP) on August 14, 2013, the National Marine Fisheries Service (NMFS) expressed concern that the shad egg collection efforts proposed in the study had the potential to adversely affect shortnose sturgeon. FirstLight responded to NMFS's concerns in a January 28, 2014 letter in which FirstLight proposed to replace the shad collection efforts with enhanced visual observations and splash counts of shad spawning, which would have no impact to shortnose sturgeon. The United States Fish and Wildlife Service (USFWS) subsequently indicated that alternative study plan modifications may be feasible to allow for shad egg collection while minimizing effects to shortnose sturgeon. The Federal Energy Regulatory Commission (FERC) therefore recommended, in its study plan determination issued on February 21, 2014, that FirstLight consult with NMFS, USFWS, Massachusetts Division of Fish and Wildlife (MDFW), and FERC staff on an amendment to the RSP that "would seek to avoid all effects to shortnose sturgeon."

At FirstLight's June 3, 2014 consultation meeting, USFWS and NMFS offered suggested modifications to FirstLight's field data collection that they felt would limit potential impacts to shortnose sturgeon. These included:

1. Avoiding towing nets within 2-km of the Montague reach between Rock Dam (river km 194) and the railroad bridge (rkm 192; located immediately downstream of the Deerfield River mouth),

John S. Howard
Director FERC Compliance
Chief Dam Safety Engineer

FirstLight Power Resources, Inc.
99 Millers Falls Road
Northfield, MA 01360
Tel. (413) 659-4489/ Fax (413) 422-5900/
E-mail: john.howard@gdfsuezna.com

where the greatest concentration of larval migrates would occur within a hydrographically turbulent reach;
2. Avoiding sampling in shallower water (< 2 m);
3. Using floats attached to nets to make sure towed nets remain at the chosen depths near the surface; and
4. Screening egg samples for the presence of shortnose sturgeon before the next sampling effort is made, and if shortnose sturgeon eggs, embryos, or larvae, are detected during screening of ichthyoplankton tows, ceasing all sampling and contacting NMFS immediately.

FirstLight initially felt such modifications could minimize potential impacts to shortnose sturgeon. However, in a July 14, 2014 email, NMFS indicated that FirstLight should conduct an analysis of the study, and in particular the sampling effort with the suggested modifications, on shortnose sturgeon. NMFS stated that "if [FirstLight] determine[s] that the proposed study is not likely to adversely affect shortnose sturgeon (i.e., that all effects will be insignificant and discountable and you do not anticipate any capture or collection), you should request our concurrence with that determination."

After careful consideration of the proposed study modifications, FirstLight is unable to make a determination that the study is not likely to adversely affect shortnose sturgeon. In fact, for the reasons discussed below, FirstLight anticipates that it would capture and collect shortnose sturgeon larvae if it conducts shad egg sampling below Cabot Station, with or without the suggested modifications to the egg sampling effort.

Shortnose sturgeon spawning is well documented in the Connecticut River. The United States Geological Survey's (USGS) Conte Lab researchers have conducted studies concluding that there is only one spawning site in the Connecticut River, at Montague below Cabot Station and at the Rock Dam at approximately river km 192 (Kynard et al. 2012). The Montague site was verified as a spawning area based on successful capture of sturgeon eggs and larvae in 1993, 1994, and 1995, that were 190 times the number of fertilized eggs and 10 times the number of embryos found at the downstream Holyoke site (Vinogradov 1997). Based on available information, shortnose sturgeon larvae generally rear at, or just downstream from, spawning grounds (Kieffer and Kynard 2012).

However, shortnose sturgeon larvae have been collected much farther downstream, including at river km 120 on May 25, 2005 (Kleinschmidt 2008) and at river km 68 on May 3, 2006 (Kleinschmidt 2006). These shortnose sturgeon larvae were collected as part of general ichthyoplankton studies that filtered 100 m^3 of water (6 minute tow). The larvae collected at river km 120 occurred where river depths averaged about 2-m and 0.6-m diameter plankton nets were towed close to the surface. The two larvae captured at river km 68 occurred where river depths averaged about 3-m and a 1-m diameter plankton net was towed close to the surface.

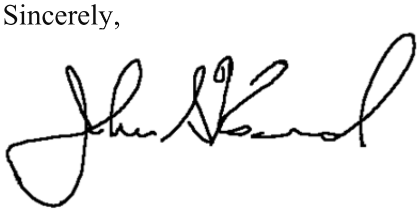
NMFS has prohibited sampling much further downstream of the Montague spawning site, without appropriate take protections in place, because of potential adverse impacts to shortnose sturgeon. In 2007, the United States Environmental Protection Agency (USEPA) requested that FirstLight sample ichthyoplankton at river km 148 as part of an assessment of the Mt. Tom Generating Station. NMFS was concerned that some shortnose sturgeon larvae may drift downstream from the Montague spawning grounds and be captured in ichthyoplankton nets in May and June. Thus, FirstLight did not conduct the requested sampling.

Based on the past collections of shortnose sturgeon larvae at river kms 120 and 68, as well as NMFS's previous analysis that shortnose sturgeon larvae may be collected 44 river kilometers downstream of the Montague spawning and rearing grounds, FirstLight expects that capture and collection of shortnose sturgeon larvae may be likely to occur if it deploys ichthyoplankton nets as requested for Study No. 3.3.6

just downstream of river km 192 in May and June. For these reasons, FirstLight proposes to conduct the study as set forth in its January 28, 2014 letter, with no shad egg collection efforts. Instead, FirstLight will propose in its modified study plan, to be filed with the upcoming Initial Study Report, to replace shad collection efforts—which studies have shown are duplicative of visual observations of shad spawning—with enhanced visual observations and splash counts. FirstLight believes that this will fulfill the goals and objectives of the study without impacting shortnose sturgeon.

If you have any questions, please feel free to call me.

Sincerely,



John Howard

cc: Andrea Donlon, Connecticut River Watershed Council, via email
Katie Kennedy, The Nature Conservancy, via email
Karl Meyer, Environmental Scientist, via email
Don Pugh, Trout Unlimited, via email

Attachment: Literature Cited

Literature Cited

Kieffer, M.. Kynard, B.2012. Spawning and Non-spawning Migrations, Spawning, and the Effect of River Regulation on Spawning Success of Connecticut River Shortnose Sturgeon Chapter 3 *in* Life history and behavior of Connecticut River Shortnose Sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

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Appendix A

Study Plan 3.3.11 Correspondence from USFWS

From: Grader, Melissa [mailto:melissa_grader@fws.gov]
Sent: Tuesday, September 09, 2014 3:35 PM
To: Howard, John; Pruden, Jessica
Cc: kkennedy@tnc.org; John Warner; Ken Sprankle; Andrea Donlon; Slater, Caleb (MISC); Mark Wamser; Stira, Robert; William McDavitt - NOAA Affiliate; John Baummer; william.connelly@ferc.gov; Stephen.Kartalia@ferc.gov; Nicholas Ettema; Don Pugh; Julie Crocker - NOAA Federal
Subject: Re: Northfield Turners Falls Study Plan Consultation 6 3 14 Meeting Minutes

Hi John and Jess,

This is to follow up on the issue of how to address fish assemblage sampling downstream of Turners Falls Dam. I believe this is how things were left:

1. FL in its RSP proposed to not sample downstream of Cabot, due to concerns with potentially capturing shortnose sturgeon (SNS).

2. In its February 21, 2014 Study Plan Determination, FERC required FirstLight to consult with the Service, NMFS, MA DFW and Commission staff on an amendment to the revised study plan that would "seek to avoid all effects to shortnose sturgeon and provide sufficient information needed by the jurisdictional agencies and the Commission for their needs."

3. On June 6, 2014 FL held a meeting with stakeholders to discuss possible ways to avoid interactions with SNS. With respect to the bypass reach, FL proposed to sample after June 30th. For the reach below Cabot Station, FL proposed to use existing data and data it obtains in the Turners Falls headpond to characterize the fish assemblage. Details of the full discussion are contained in the meeting minutes provided by FL.

4. A revised study plan was to have been sent to stakeholders for review and comment prior to filing it with the ISR this month. To date, FL has not submitted any revised plans to the stakeholders for review.

5. Subsequent to the June 6, 2014 meeting, the Service consulted with NMFS and reviewed relevant literature to determine if there were suitable non-invasive sampling techniques that could be used to characterize the fish assemblage in the reach below Cabot Station. Based on those consultations and deliberations, we herein provide proposed amendments to Study Plan 3.3.11 (attached). We believe the proposed changes will eliminate SNS concerns and provide the information needed by the agencies.

In short, the Service recommends that visual observations be used downstream of Cabot as well as in other riverine reaches. We believe that NMFS has stated this is an acceptable sampling method that would not require ESA consultation. Jess, would you please confirm/clarify what, if anything would be required at this point ? Based on our proposed amendments, would FL need to submit anything (informal or otherwise) to NMFS?

We are available to discuss the proposed changes if you think that would be beneficial.

Regards,

Melissa

USFWS Proposed Study Plan:

3.3.11 Fish Assemblage Assessment

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The study area includes the Connecticut River from Vernon Dam to the Route 116 Bridge in Sunderland. The study will employ a stratified-random sampling design. The study area will be divided into strata based on mesohabitat type. Proposed sampling methods include daytime boat electrofishing, nighttime boat electrofishing, gill nets, seine nets, and visual observation. Sampling will be performed during the early summer (June) and again in the fall (September).

The stratified random sampling design will randomly assign sampling stations within particular mesohabitat types in proportion to their linear habitat distance. Thus for mesohabitat types having a larger proportion of linear mesohabitat, more random sites will be assigned. A stratified random sample will capture key population characteristics that are proportional to the overall Connecticut River fish assemblage. Furthermore, stratified random sampling performs as well or better than simple random sampling and results in substantial improvement in precision when variation within strata (mesohabitat type) is less than variation among strata (Hansen, Beard and Hayes 2007). In stratified random sampling, an estimate for the whole population is obtained by weighting estimates from each stratum by the fraction of the whole population contained in each stratum. It is important to note that stratified random sampling requires that the entire sampling frame be divided into strata before sampling begins (Hanson, Beard and Hayes 2007). Multiple methods of fish capture will be used in each stratum, except in the riverine reach below Cabot Station where only visual observation methods will be used to avoid impacts to shortnose sturgeon. Selected locations within each station will be sampled either by day and night-time boat electrofishing (shoreline and littoral habitat), gill nets (deeper, benthic areas), seine net (wadeable shoreline and littoral habitat), and visual observation (shoreline, littoral, or benthic habitat) during the early summer and again in the fall. The exact number of sampling locations will be dependent on the weighted stratification of the study area by mesohabitat but it is anticipated that at least 18 stations will be sampled during each sampling event.

Stakeholders requested an additional spring sampling. FirstLight is not proposing to sample during the spring for the following reasons: 1) Anadromous fish will be available for capture during the proposed early summer collection. 2) The fall collection will occur when young-of-the-year (age-0+) fish had grown to sizes such that they were readily susceptible to capture using various sampling gears. 3) All species of fish that are found within the study area should be readily captured during the early summer and fall sampling events that FirstLight proposes. 4) FirstLight is proposing to conduct a comprehensive survey of the nesting fish in the littoral zone during the spring which will provide information on the occurrence, distribution, and relative abundance of these fish species.

Task 1: Sampling Location Selection

During this assessment, a stratified-random sampling design will be utilized to provide unbiased and precise fish assemblage data. The proposed design incorporates general river morphology along with mesohabitat through the use of strata and sub-strata. To accomplish this, the underlying strata allow for delineation of the study area spatially, based on locations where changes in river morphology occur. For all areas downstream of Cabot Station to the Route 116 Bridge, mesohabitat sub-strata were derived from surveys performed during 2012. Alternatively, the bypass reach contains the greatest diversity of mesohabitats, but each mesohabitat segment is relatively small; thus, random stations will be selected from shoreline, deep water, and tailwater habitats such that a representative sample from multiple habitats will be collected. Sub-strata in the Turners Falls Impoundment will be derived from bathymetry data, because the impoundment contains areas with relatively deep water.

Due to inherent variability of flows, water levels, and likely fish movements within the study area, different sampling locations will be selected for each sampling event; this statistically valid practice will avoid bias. Prior to field sampling, stations to be sampled will be selected to ensure all mesohabitat types are adequately represented. Mesohabitat types include:

- **Riffle:** shallow, moderate velocity, turbulent, high gradient, moderate to large substrates (cobble/gravel)
- **Rapid:** shallow, moderate to high velocity, turbulent, chutes and eddies present, high gradient, large substrates or bedrock
- **Run:** moderately deep to deep, well defined non-turbulent laminar flow, low to moderate velocity, well defined thalweg, typically concave stream geometry, varying substrates, gentle slope
- **Glide:** moderately shallow, well defined non-turbulent laminar flow, low velocity, well defined thalweg, typically flat stream geometry, typically finer substrates, transitional from pool
- **Pool:** deep, low velocity, well defined hydraulic control at outlet
- **Backwater:** varying depth, minimal or no velocity, long backwatered reaches
- **Impounded:** varying depth, low velocity influenced by the presence of a dam

- **Nearshore/Shallow**: less than 8ft in depth
- **Mid-Channel**
- **Deep water:** depths greater than 20ft

Alternative sampling locations will also be identified by mesohabitat in case a selected sampling station is inaccessible.

Task 2: Fish Capture

FirstLight anticipates using a variety of techniques to sample the various habitat types within the study area, including day and nighttime boat electrofishing, gill netting, seining, and visual observation as described below. The type of gear utilized will be largely dictated by habitat type, with visual observation methods used at riverine sampling stations. In addition to biological data, supporting data will also be collected for each sample site including: location (GPS), sampling gear type, sampling effort, mesohabitat type, average depth, average velocity, river flow, water temperature, turbidity, predominant substrate, time of day, day of year, presence of cover, and proportion of vegetation cover. All data will be recorded on dedicated data sheets. Upon return from the FGS, data sheets will be review for quality assurance and archived.

The MADFW has recommended that sampling include the use of eel pots. Boat electrofishing is effective at collecting eel within the littoral habitat and will therefore be adequately represented within the sampled fish assemblage. The sampling effectiveness of collecting eel in the Connecticut River was demonstrated by Yoder (unpublished data 2009) whom found that the American eel was the most abundant species collected using boat electrofishing methods in the Connecticut River below the Holyoke Dam. The VANR has recommended the use of a benthic trawl; however, FirstLight proposes to use gill nets to sample deeper sections of the river.

Boat Electrofishing

Due to the presence of spawning and juvenile surgeon in the bypass reach during the spring, no electrofishing will be performed in this stratum from April 15 – June 30 as suggested by the NMFS.

Boat electrofishing will occur during the daytime and night. All electrofishing transects will be standardized by time (500 seconds fished) such that a catch per unit effort (CPUE) may be calculated. Boat electrofishing can effectively sample fish from most near-shore littoral habitats present within the Connecticut River (typically 10 feet deep or less).

Electrofishing will be accomplished with the use of a 16-ft jonboat rigged with a pulsed-DC Smith-Root GPP 5.0 electrofisher with the capacity to adjust the pulse rates between 30 - 120 pulses/second and vary voltage to accommodate ambient conductivity. The electrode array includes an array of cathodes suspended from the bow to a depth of approximately six feet to project the electric field into both the shoreline epibenthic zone, as well as the upper water column. The anode array is suspended from the bow on an adjustable boom. Both anodes and cathodes will be configured to optimize the electric field under ambient low conductivity conditions. A smaller vessel capable of negotiating riffles and shoals, similarly rigged with a 2.5

GPP unit may be deployed for sampling in the shallower riverine habitats. This smaller boat will consist of a 14 ft inflatable Sea-Eagle raft with retractable anodes and side-mounted cathodes.

Electrofishing will be conducted in a downstream manner, following standardized methods developed specifically for large river quantitative electrofishing surveys (MBI, 2002, Yoder and Kulik, 2003). The start point, end point, and boat track for each sampling station will be geo-referenced using a handheld Garmin GPS (or similar device) and transposed to corresponding USGS topographic mapping software program (Terrain Navigator).

All stunned fish will be collected with ¼-inch mesh dip nets and deposited into a live-well filled with aerated ambient river water. At the conclusion of each sample, all captured fish will be identified to species, classified as adult, juvenile or Young-of-Year (YOY), enumerated, weighed, measured for total length, and then released. If large numbers (n > 25) of small fish (YOY fish or cyprinids less than 100 mm) are captured, they will be grouped by size class, enumerated, and batch-weighed with length measurements only taken from one large and one small representative specimen within each group. Fish that are not able to be identified in the FGS, such as small cyprinids, will be brought back to the lab for identification.

Gill Netting

For sampling deeper habitat sub-strata (Depth 12-25 feet; Depth 25-40 feet; Depth > 40 feet), where electrofishing will not be effective, sampling will be conducted with experimental gill nets consistent with standardized methods for fish capture from rivers (Bonar, Hubert, & Willis, 2009). The nets will be 12-foot feet high by 100-foot in length and will be constructed of 4 to 5 panels of increasing mesh size (e.g., 1.5, 2, 2.5, 3, 3.5-inch stretched mesh) to accommodate collection of the various sized fish in the project waters.

The nets will be deployed to maximize capture area where water depths are greater than net height. Nets will be set in selected locations and allowed to fish for 4 hours prior to retrieval.

The exact locations of each net set will be recorded using a handheld Garmin Vista HCx GPS (or similar device) and the time of deployment and retrieval will also be recorded. Fish processing will occur as described above for electrofishing.

Seining

In shallow shoreline locations where boat access may not be feasible sampling will be performed via seining with a 100-ft long, 6-ft deep, 1/4-inch mesh bag seine net.

Seine samples will be collected by extending the net parallel to shore and then pulling the upstream end of the net into the water and in a downstream direction for a 180 degree sweep while the opposite end of the net is held in place (Bonar, Hubert, & Willis, 2009). The start point and end point for each sweep will be geo-referenced using a handheld Garmin Vista HCx GPS (or similar device) and transposed to corresponding USGS topographic mapping software program (Terrain Navigator). Total fish catch will be processed following each haul in the same manner as described above for electrofishing and gill netting.

Visual Observation

Direct visual observation is a simple, versatile, cost-effective, and proven method for collecting fish assemblage data that is also nonintrusive, making it an ideal technique in rivers occupied by threatened or endangered species (e.g., shortnose sturgeon) that could be disturbed or injured by other methods such as electrofishing (Bonar et al. 2009; Thurow et al. 2013). Visual observation was used in the recently completed Maryland darter survey as part of the relicensing of the Conowingo Project on the Susquehanna River (RSP 3.10, 2013).Visual observation surveys will be conducted in the riverine portions of the study area. Below Cabot Station, this will be the only sampling method employed (due to the presence of the endangered shortnose sturgeon in this reach). In both the bypass reach and the riverine reach below Vernon Dam, visual observation will be used in addition to the other gear types, to validate the technique as well as collect data that could be used to calibrate the visual observation-only data collected below Cabot Station (i.e., to assess whether visual observations may have missed certain species and/or sizes of fish).

Methods should follow those described in Bonar et al. (2009) and Thurow et al. (2013). All visual observations will occur during daylight hours with optimum light conditions (e.g., 10:00 am to 5:00 pm). Visual observation is an effective fish sampling technique in a variety of habitats, but may be impeded by high velocities. If measured velocities are > 1.5 m/s, sampling should be delayed if possible; if not possible, an alternative sampling method should be employed. Visual observation is also highly dependent upon water transparency and turbidity. Before sampling, visibility distance will be measured using a Secchi disk or similar method (see Bonar et al. 2009:153). Visual observation methods should only be used when visibilities are 2 m or greater. If low visibilities are due to a recent rain event or other temporary disturbance, sampling should be postponed to a later date; if low visibilities are the result of chronic turbidity, an alternative sampling method should be employed.

Visual observation surveys will be conducted using snorkeling, SCUBA diving, or hookah diving (see Thurow et al. 2013 for detailed methods) along multiple transects (or lanes) parallel with the current, as described in Thurow et al. (2013). Snorkeling will be limited to the shallower areas of banks and bars, whereas SCUBA and hookah diving methods may be used at most depths. At greater depths, handheld underwater lights may be necessary to improve visibility. Because observers moving upstream are less likely to disturb fish, observers should enter the water downstream and proceed slowly upstream (using a supporting stick or rod if necessary). If conditions do not permit a downstream entry, observers will float downstream with the current while limiting motion as much as possible (Thurow et al. 2013). The location and time of beginning and end points will be recorded for each transect.

For each fish observed, species and estimated length should be recorded. If a large school of fish is encountered, all species observed should be recorded; average number and length of fish in the school should be estimated. Any uncertainty regarding species identification should also be noted. See Bonar et al. (2009) for methods to estimate fish length underwater and Thurow et al. (2013) for methods of underwater data recording.

Visual observation transects will be standardized by observation time and area sampled. Area sampled will be equivalent to (length of transect) * (2*visibility distance).

Task 3: Data Analysis and Reporting

All data will be standardized by effort expended (seconds of electrofishing, net-hours, observation hours, and number of seine hauls for electrofishing, gill netting, visual observation, and seining respectively). Catch per unit effort (CPUE) and standard errors will be calculated for each species, station, and sampling technique. Data will also be separated into groups by size and a CPUE per size group will be calculated. Values of CPUE for each segment and gear type will be calculated as the sum of catch from all samples within a station divided by the sum effort expended within that station. The Shannon-Weiner index of diversity, which is a function of species richness and evenness, will also be calculated.

Information collected during this study will be compiled and presented in a final report. The report will include tabular data summarizing length, weight, and size class of fish captured, a map of the study area to depict the location of sample stations, and overall results including occurrence, distribution and relative abundance. Comparisons will be made with historical records. Results will be described in relation to studies described in study plans 3.3.14 – *Aquatic Habitat Mapping of the Turners Falls Impoundment* and 3.3.13 – *Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Habitat and Spawning Habitat*. Raw data will be provided to stakeholders in digital format upon request.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort will adequately address the objectives by documenting fish species occurrence, distribution and abundance within the project area along spatial and temporal gradients. FirstLight estimates the cost of this study to be $75,000 to $85,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The study described herein is scheduled to be conducted in the early summer and fall of 2014, with Task 1 occurring prior to field studies. Because the study effort will be ongoing when the Initial Study Report is due to Stakeholders in September 2014, FirstLight proposes to provide Stakeholders with a study report supplement to summarize results in February 2015.

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Appendix B
Modified Study Plan

3.3.11 Fish Assemblage Assessment

General Description of Proposed Study

In the study request letter from the FERC, a baseline fisheries population study was requested. The request included sampling within the Turners Falls Impoundment, tailwater areas, the bypassed reach, and downstream riverine corridors via electrofishing surveys. The FERC also requested targeted eel sampling of upstream and downstream migrating American eel. Targeted eel sampling will be conducted as part of *Study No. 3.3.4 – Evaluate Upstream Passage of American Eel at the Turners Falls Project* and silver-phase eel abundance and migration will be evaluated in *Study No. 3.3.5– Evaluate Downstream Passage of Eel*; thus, additional targeted eel sampling is not being proposed for this study.

In their study request letters, USFWS, MADFW, NHFGD, CRWC, Town of Gill, TNC, TU, VANR each requested a fish assemblage assessment to determine the occurrence, distribution, and relative abundance of fish species within the project areas and to compare study results to historical records. They requested a comprehensive assessment of fish assemblages, employing multiple gear types to randomly sample a variety of habitats throughout the study area during spring, summer, and fall as part of a robust sampling design. The proposed study will include multiple sampling methods within a statistically rigorous and comprehensive stratified-random design similar to what has been used successfully on large rivers a high degree of spatial heterogeneity.

MADFW further requested that the study include state-listed fish species as well as host fish species of the dwarf wedgemussel (*Alasmidonta heterodon*), federally- and state-listed as "Endangered"; the yellow lampmussel (*Lampsilis cariosa)* state-listed as "Endangered"; and the Eastern pondmussel (*Ligumia nasuta*), state-listed as "Special Concern." MADFW requested that the study should assess the occurrence and abundance of mussel larvae on resident host fish. FirstLight is not proposing to evaluate mussel larvae on host fish because the relationships are already well understood (Table 3.3.11-1); the level of effort proposed will provide data on the distribution and relative abundance of state-listed fish species and host fish species.

The Pre-Application Document (PAD) for the Turners Falls Project and Northfield Mountain Projects identifies 22 species of fish that occur in the aquatic habitat within the Project boundary. The study described herein will document fish species occurrence, distribution and relative abundance within the Turners Falls Project and Northfield Mountain Project areas. FirstLight believes that the level of effort will provide baseline fish assemblage data and that the overall sampling design will provide useful data that can be used to inform other proposed studies.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to provide baseline information pertaining to the fish assemblage structure within the study area. Specific objectives include to:

- Document species occurrence, distribution, and relative abundance of resident and diadromous fish within the project area along spatial and temporal gradients.
- Describe the distribution of resident and diadromous fish species within reaches of the river and in relationship to habitat.
- Compare historical records of fish species occurrence in the project area to results of this study.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The MADFW, NHFGD and the VTFWD each have, as a mission, the protection and conservation of fish and their habitats. Riverine fish species are an important component of the river's ecology and are the basis for the sport fishery. Furthermore, several of the states' Species of Greatest Conservation Need (SGCN) have been documented in the project area.

The conservation and protection of species state-listed as Endangered, Threatened, or of Special Concern under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) is an important objective of the Natural Heritage & Endangered Species Program of the MADFW. State-listed species and their habitats are protected pursuant to the MESA and its implementing regulations (321 CMR 10.00), as well as the rare wildlife species provisions of the Massachusetts Wetlands Protection Act (WPA) (310 CMR 10.59). The Division seeks to accomplish the resource goals and regulatory requirements of the MESA in order to:

- Ensure that PME measures are commensurate with Turners Falls Project and Northfield Mountain Project affects and meet MESA requirements for the Turners Falls Projects and Northfield Mountain Project.
- Conserve, protect, and enhance the habitats for state-listed species that will be affected by Turners Falls Project and Northfield Mountain Project operations.

The agencies requests are intended to facilitate the collection of information necessary to conduct impact analyses and develop reasonable conservation, PME measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), the Clean Water Act (33 U.S.C. §1251 *et seq*.), the MESA, and the WPA. Specific to state-listed fish and mussel species, the Divisions goals are to:

- Protect, enhance, or restore diverse high quality aquatic habitats in the Connecticut River watershed and mitigate for the loss or degradation of these habitats.
- Minimize current and potentially negative effects of Turners Falls Project and Northfield Mountain Project operations on state-listed species and their habitats.

Determining species occurrence, distribution, and abundance of fish species will better clarify what species occur in the project area both spatially and temporally relative to habitats which may be affected by operation of the Turners Falls Project and Northfield Mountain Project. This information will better inform results from other study requests that will be examining the effects of operations of the Turners Falls Project and Northfield Mountain Project on various aquatic habitats, water quality, and other related concerns such as entrainment concerns at the Northfield Mountain Project. This information will be used to make recommendations and provide full consideration for all species, including those that might not otherwise be known to occur in the project area and impacts that may affect their population status through direct or indirect effects of the Turners Falls Project and Northfield Mountain Project.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

A study of resident fish species in the Turners Falls Impoundment was conducted by the Commonwealth of Massachusetts from 1971 to 1975. Eight stations in the impoundment were sampled every other week from April through October with electrofishing equipment (MDF&G, 1978). Because many changes have occurred throughout the watershed during the last four decades, these data may not be an accurate representation of the current fish assemblage.

In 2008 the impoundment was surveyed via electrofishing; this survey, conducted by Midwest Biodiversity Institute (MBI), was part of a larger United States Environmental Protection Agency (USEPA) effort to sample the entire Connecticut River from its headwaters at Lake Francis to the freshwater extent of the tidal estuary (Yoder et al., 2009). The 2008 survey did not have the same goals and objectives as this study; thus, data collected is not sufficient to assess the abundance, occurrence, or distribution of fish within the study area or in relation to project operations. Neither study employed the use of alternative gear types; while electrofishing is considered to an effective method for capturing fish in littoral areas of flowing water, capture probabilities are typically lower for small fish or those lacking swim bladders. It is also not effective at capturing fish from deep water unless modified. A total of 22 fish species was identified in the project area based on historical data, but several species reported to occur within the project area were not documented, including Northern pike, burbot, Eastern silvery minnow, and channel catfish.

As referenced in the PAD, Section 4.4, two state-listed fish species are known to occur in the Connecticut River, including the Eastern silvery minnow (*Hybognathus regius*) and burbot (*Lota lota*), both of which are state-listed as “Special Concern.” Currently, there are only two known populations of the Eastern silvery minnow in Massachusetts, both located in the Connecticut River. Burbot are also rare in Massachusetts, with only a few individuals having been collected in the Connecticut River watershed.

The tessellated darter is one of only three fish species in the Upper Connecticut River that serve as hosts for the glochidia of dwarf wedgemussel, the others being the slimy sculpin (*Cottus cognatus*) and the Atlantic salmon (*Salmo salar*) (Nedeau, 2008). Tessellated darters are a relatively sedentary benthic insectivorous fish with small home ranges and short, fast bursts of speed.

Based on data collected by Yoder (2009), sampling at 4-5 transects distributed throughout the Turners Falls Impoundment was sufficient to capture most but not all species detectable by electrofishing the shoreline of the impoundment (Figure 3.3.11-1).

A 2009 electrofishing survey of the area below Turners Falls Dam downstream to the end of the Project area was conducted as part of a larger EPA effort to sample the entire Connecticut River from Lake Francis to the freshwater extent of the tidal estuary. Sampling occurred at three 1-km stations in the bypass reach and eight 1-km stations between the bypass reach and the Route 116 Bridge in Sunderland (Figure 3.3.11-2). The species composition and relative abundance (Table 3.3.11-2) is typical of fish assemblages described for inland fishes of Massachusetts (Hartel et al. 2002).

Project Nexus (18 CFR § 5.11(d)(4))

Operation of the Turners Falls Project and Northfield Mountain Project has the potential to directly affect fish populations, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater spawning areas, which could limit the productivity of certain fish species through direct impacts to their spawning success, ultimately resulting in alterations to fish assemblage structure. An understanding of the current fish assemblage is needed in order to examine potential effects. Determining species distribution and abundance will clarify what species occur in the Turners Falls Project and Northfield Mountain Project areas, spatially and temporally, relative to habitats that may be affected.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The study area includes the Connecticut River from Vernon Dam to the Turners Falls Bypass Reach. The Bypass reach will not be sampled until after June 30 and the area below the Bypass reach to the Rt 116 Bridge in Sunderland will be evaluated using existing data (Table 3.3.11-2) and results from the

Impoundment survey. The study will employ a stratified-random sampling design. The study area will be divided into strata based on mesohabitat type. Proposed sampling methods include daytime boat electrofishing, nighttime boat electrofishing, gill nets, and seine nets. Sampling will be performed during the early summer (June) and again in the fall (September).

The stratified random sampling design will randomly assign sampling stations within particular mesohabitat types in proportion to their linear habitat distance. Thus for mesohabitat types having a larger proportion of linear mesohabitat, more random sites will be assigned. A stratified random sample will capture key population characteristics that are proportional to the overall Connecticut River fish assemblage. Furthermore, stratified random sampling performs as well or better than simple random sampling and results in substantial improvement in precision when variation within strata (mesohabitat type) is less than variation among strata (Hansen, Beard and Hayes 2007). In stratified random sampling, an estimate for the whole population is obtained by weighting estimates from each stratum by the fraction of the whole population contained in each stratum. It is important to note that stratified random sampling requires that the entire sampling frame be divided into strata before sampling begins (Hanson, Beard and Hayes 2007). Multiple methods of fish capture will be used in each stratum. Selected locations within each station will be sampled either by day and night-time boat electrofishing (shoreline and littoral habitat), gill nets (deeper, benthic areas), and seine net (wadeable shoreline and littoral habitat) during the early summer and again in the fall. The exact number of sampling locations will be dependent on the weighted stratification of the study area by mesohabitat but it is anticipated that at least 18 stations will be sampled during each sampling event.

Stakeholders requested an additional spring sampling. FirstLight is not proposing to sample during the spring for the following reasons: 1) Anadromous fish will be available for capture during the proposed early summer collection. 2) The fall collection will occur when young-of-the-year (age-0+) fish had grown to sizes such that they were readily susceptible to capture using various sampling gears. 3) All species of fish that are found within the study area should be readily captured during the early summer and fall sampling events that FirstLight proposes. 4) FirstLight is proposing to conduct a comprehensive survey of the nesting fish in the littoral zone during the spring which will provide information on the occurrence, distribution, and relative abundance of these fish species.

Task 1: Sampling Location Selection

During this assessment, a stratified-random sampling design will be utilized to provide unbiased and precise fish assemblage data. The proposed design incorporates general river morphology along with mesohabitat through the use of strata and sub-strata. To accomplish this, the underlying strata allow for delineation of the study area spatially, based on locations where changes in river morphology occur. The bypass reach contains the greatest diversity of mesohabitats, but each mesohabitat segment is relatively small; thus, random stations will be selected from shoreline, deep water, and tailwater habitats such that a representative sample from multiple habitats will be collected. Sub-strata in the Turners Falls Impoundment will be derived from bathymetry data, because the impoundment contains areas with relatively deep water.

Due to inherent variability of flows, water levels, and likely fish movements within the study area, different sampling locations will be selected for each sampling event; this statistically valid practice will avoid bias. Prior to field sampling, stations to be sampled will be selected to ensure all mesohabitat types are adequately represented. Mesohabitat types include;

- **Riffle:** shallow, moderate velocity, turbulent, high gradient, moderate to large substrates (cobble/gravel)

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

- **Rapid:** shallow, moderate to high velocity, turbulent, chutes and eddies present, high gradient, large substrates or bedrock
- **Run:** moderately deep to deep, well defined non-turbulent laminar flow, low to moderate velocity, well defined thalweg, typically concave stream geometry, varying substrates, gentle slope
- **Glide:** moderately shallow, well defined non-turbulent laminar flow, low velocity, well defined thalweg, typically flat stream geometry, typically finer substrates, transitional from pool
- **Pool:** deep, low velocity, well defined hydraulic control at outlet
- **Backwater:** varying depth, minimal or no velocity, long backwatered reaches
- **Impounded:** varying depth, low velocity influenced by the presence of a dam
    - **Nearshore/Shallow**: less than 8ft in depth
    - **Mid-Channel**
    - **Deep water:** depths greater than 20ft

Alternative sampling locations will also be identified by mesohabitat in case a selected sampling station is inaccessible.

<u>Task 2: Fish Capture</u>

FirstLight anticipates using a variety of techniques to sample the various habitat types within the study area, including day and nighttime boat electrofishing, gill netting, and seining as described below. The type of gear utilized will be dictated by habitat type. In addition to biological data, supporting data will also be collected for each sample site including: location (GPS), sampling gear type, sampling effort, mesohabitat type, average depth, average velocity, river flow, water temperature, turbidity, predominant substrate, time of day, day of year, presence of cover, and proportion of vegetation cover. All data will be recorded on dedicated data sheets. Upon return from the FGS, data sheets will be review for quality assurance and archived.

The MADFW has recommended that sampling include the use of eel pots. Boat electrofishing is effective at collecting eel within the littoral habitat and will therefore be adequately represented within the sampled fish assemblage. The sampling effectiveness of collecting eel in the Connecticut River was demonstrated by Yoder (unpublished data 2009) whom found that the American eel was the most abundant species collected using boat electrofishing methods in the Connecticut River below the Holyoke Dam. The VANR has recommended the use of a benthic trawl; however, FirstLight proposes to use gill nets to sample deeper sections of the river.

Boat Electrofishing

Due to the presence of spawning and juvenile surgeon in the bypass reach during the spring, no electrofishing will be performed in this stratum from April 15 – June 30 as recommended by the NMFS.

Boat electrofishing will occur during the daytime and night. All electrofishing transects will be standardized by time (500 seconds fished) such that a catch per unit effort (CPUE) may be calculated.

Boat electrofishing can effectively sample fish from most near-shore littoral habitats present within the Connecticut River (typically 10 feet deep or less).

Electrofishing will be accomplished with the use of a 16-ft jonboat rigged with a pulsed-DC Smith-Root GPP 5.0 electrofisher with the capacity to adjust the pulse rates between 30 - 120 pulses/second and vary voltage to accommodate ambient conductivity. The electrode array includes an array of cathodes suspended from the bow to a depth of approximately six feet to project the electric field into both the shoreline epibenthic zone, as well as the upper water column. The anode array is suspended from the bow on an adjustable boom. Both anodes and cathodes will be configured to optimize the electric field under ambient low conductivity conditions. A smaller vessel capable of negotiating riffles and shoals, similarly rigged with a 2.5 GPP unit may be deployed for sampling in the shallower riverine habitats. This smaller boat will consist of a 14 ft inflatable Sea-Eagle raft with retractable anodes and side-mounted cathodes.

Electrofishing will be conducted in a downstream manner, following standardized methods developed specifically for large river quantitative electrofishing surveys (MBI, 2002, Yoder and Kulik, 2003). The start point, end point, and boat track for each sampling station will be geo-referenced using a handheld Garmin GPS (or similar device) and transposed to corresponding USGS topographic mapping software program (Terrain Navigator).

All stunned fish will be collected with ¼-inch mesh dip nets and deposited into a live-well filled with aerated ambient river water. At the conclusion of each sample, all captured fish will be identified to species, classified as adult, juvenile or Young-of-Year (YOY), enumerated, weighed, measured for total length, and then released. If large numbers (n > 25) of small fish (YOY fish or cyprinids less than 100 mm) are captured, they will be grouped by size class, enumerated, and batch-weighed with length measurements only taken from one large and one small representative specimen within each group. Fish that are not able to be identified in the FGS, such as small cyprinids, will be brought back to the lab for identification.

Gill Netting

For sampling deeper habitat sub-strata (Depth 12-25 feet; Depth 25-40 feet; Depth > 40 feet), where electrofishing will not be effective, sampling will be conducted with experimental gill nets consistent with standardized methods for fish capture from rivers (Bonar, Hubert, & Willis, 2009). The nets will be 12-foot feet high by 100-foot in length and will be constructed of 4 to 5 panels of increasing mesh size (e.g., 1.5, 2, 2.5, 3, 3.5-inch stretched mesh) to accommodate collection of the various sized fish in the project waters.

The nets will be deployed to maximize capture area where water depths are greater than net height. Nets will be set in selected locations and allowed to fish for 4 hours prior to retrieval.

The exact locations of each net set will be recorded using a handheld Garmin Vista HCx GPS (or similar device) and the time of deployment and retrieval will also be recorded. Fish processing will occur as described above for electrofishing.

Seining

In shallow shoreline locations where boat access may not be feasible sampling will be performed via seining with a 100-ft long, 6-ft deep, 1/4-inch mesh bag seine net.

Seine samples will be collected by extending the net parallel to shore and then pulling the upstream end of the net into the water and in a downstream direction for a 180 degree sweep while the opposite end of the

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

net is held in place (Bonar, Hubert, & Willis, 2009). The start point and end point for each sweep will be geo-referenced using a handheld Garmin Vista HCx GPS (or similar device) and transposed to corresponding USGS topographic mapping software program (Terrain Navigator). Total fish catch will be processed following each haul in the same manner as described above for electrofishing and gill netting.

Task 3: Data Analysis and Reporting

All data will be standardized by effort expended (seconds of electrofishing, net-hours, and number of seine hauls for electrofishing, gill netting, and seining respectively). Catch per unit effort (CPUE) and standard errors will be calculated for each species, station, and sampling technique. Data will also be separated into groups by size and a CPUE per size group will be calculated. Values of CPUE for each segment and gear type will be calculated as the sum of catch from all samples within a station divided by the sum effort expended within that station. The Shannon-Weiner index of diversity, which is a function of species richness and evenness, will also be calculated.

Information collected during this study will be compiled and presented in a final report. The report will include tabular data summarizing length, weight, and size class of fish captured, a map of the study area to depict the location of sample stations, and overall results including occurrence, distribution and relative abundance. Comparisons will be made with historical records. Results will be described in relation to studies described in study plans *3.3.14 – Aquatic Habitat Mapping of the Turners Falls Impoundment* and *3.3.13 – Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Habitat and Spawning Habitat*. Raw data will be provided to stakeholders in digital format upon request.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort will adequately address the objectives by documenting fish species occurrence, distribution and abundance within the project area along spatial and temporal gradients. FirstLight estimates the cost of this study to be $75,000 to $85,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The study described herein is scheduled to be conducted in the early summer and fall of 2015, with Task 1 occurring prior to field studies. FirstLight proposes to provide Stakeholders with a study report supplement to summarize results in the first quarter of 2016.

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Table 3.3.11-1: Freshwater mussel and glochicial host fish relationships.

Freshwater Mussel	Connecticut River Glochidial Host Fish
Dwarf Wedgemussel	Tessellated darter, slimy sculpin, juvenile and parr Atlantic salmon
Yellow Lampmussel	White perch, yellow perch; banded killifish, chain pickerel, white sucker, smallmouth bass, and largemouth bass
Eastern Pondmussel	Unknown; reported to parasitize centrarchids (sunfishes and bass) as well as banded killifish

Table 3.3.11-2. Fish collected at eleven 1 km sample sites on the Connecticut River below the Turners Falls Dam to the Route 116 Bridge in Sunderland MA by electrofishing (2009).

	Stations											
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
Date Sampled (2009)	**8/31**	**9/28**	**8/15**	**8/16**	**8/16**	**9/2**	**8/16**	**10/5**	**8/17**	**8/17**	**8/17**	
American eel	13	12	5	14	0	0	3	2	29	0	0	**78**
American shad	0	0	0	7	7	6	0	0	0	1	25	**46**
Atlantic salmon	0	8	0	1	0	0	0	0	0	0	1	**10**
Black crappie	0	0	0	0	1	0	0	0	0	0	0	**1**
Bluegill	15	0	3	5	7	8	8	0	12	14	9	**81**
Brown trout	1	0	0	0	0	0	2	0	0	0	0	**3**
Chain pickerel	0	0	0	0	0	1	0	1	0	0	0	**2**
Channel catfish	0	0	0	0	0	0	1	0	0	0	0	**1**
Common carp	1	0	0	2	0	0	0	0	0	0	0	**3**
Common shiner	0	0	0	4	0	0	0	0	0	0	0	**4**
Fallfish	0	0	14	4	29	150	10	10	99	128	8	**452**
Largemouth bass	0	0	0	0	2	0	0	0	0	4	0	**6**
Longnose dace	11	0	1	0	0	0	0	0	0	0	0	**12**
Northern pike	0	0	1	0	1	0	0	1	0	2	0	**5**
Pumpkinseed	0	0	1	0	0	0	0	0	2	0	0	**3**
Rock bass	2	3	8	1	3	3	4	0	12	0	0	**36**
Sea lamprey	14	1	1	0	0	0	0	2	3	0	2	**23**
Smallmouth bass	85	56	70	42	45	46	81	19	12	33	25	**514**
Spottail shiner	13	0	133	0	9	354	0	8	53	10	0	**580**
Tessellated darter	17	0	8	3	1	2	1	4	1	0	0	**37**
Walleye	0	0	0	0	0	0	1	0	0	0	0	**1**

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

White sucker	6	5	9	5	4	23	9	3	1	4	2	**71**
Yellow perch	1	1	3	0	0	2	1	2	1	7	5	**23**
Total	**179**	**86**	**257**	**88**	**109**	**595**	**121**	**52**	**225**	**203**	**77**	**1992**
Sampling effort (Seconds)	**9272**	**3356**	**4856**	**3298**	**3495**	**6360**	**4415**	**6578**	**3708**	**3595**	**3441**	**52374**

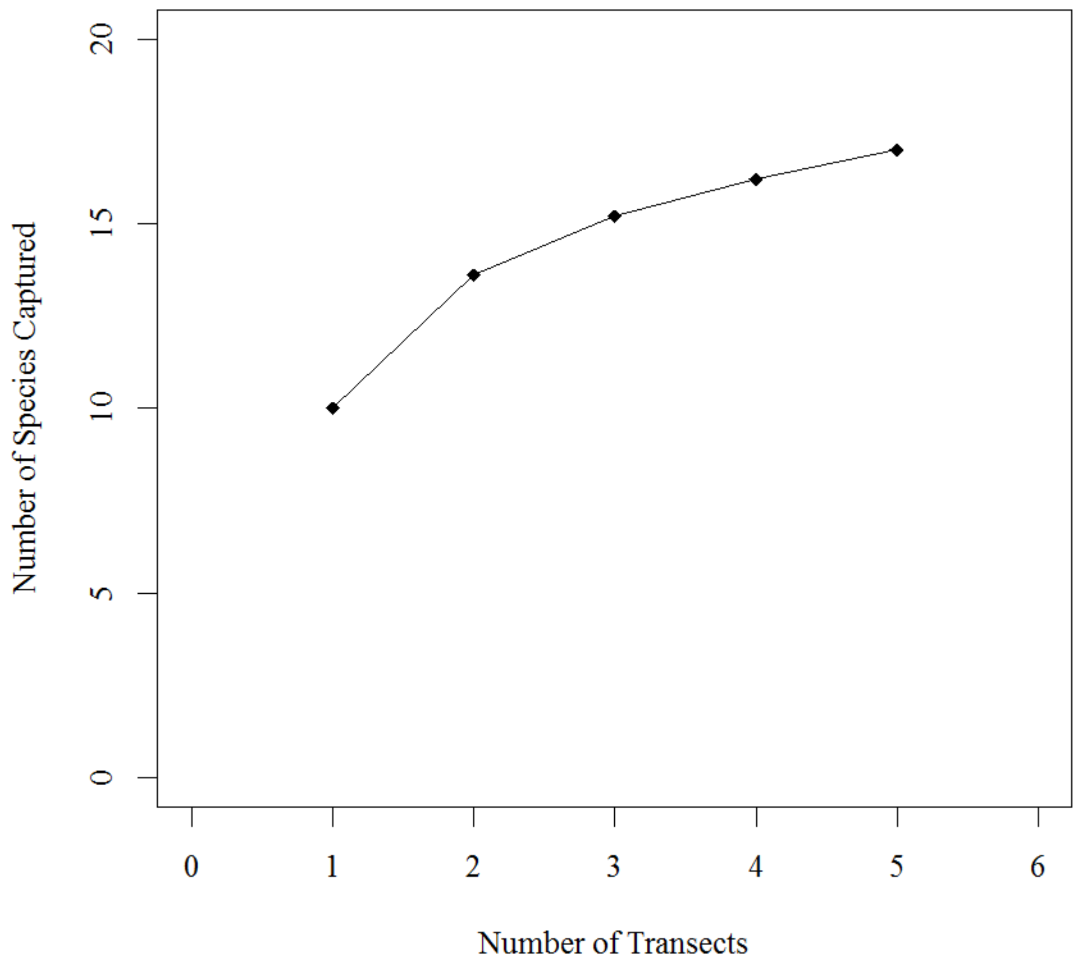

Figure 3.3.11-1: Species-accumulation curve derived from Yoder (2009) boat electrofishing data within the Turners Falls Impoundment

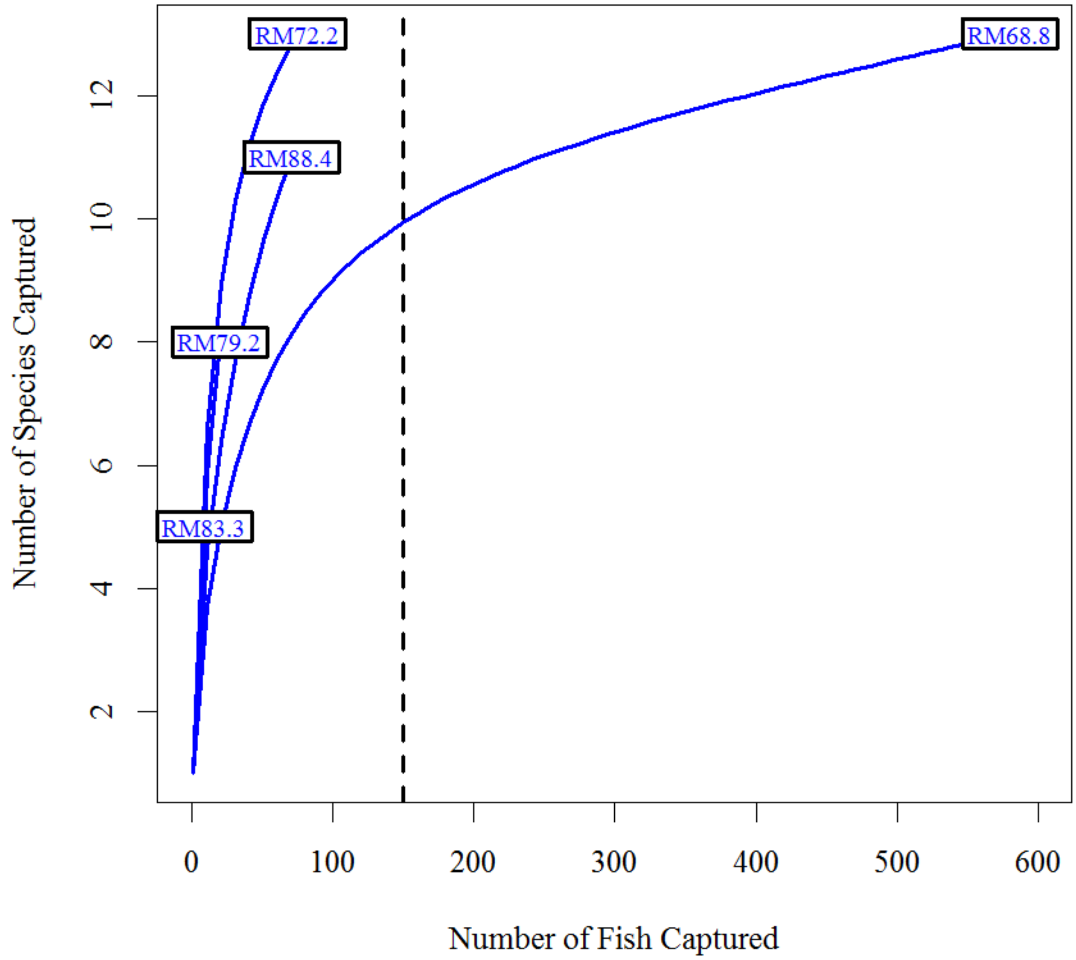

Figure 3.3.11-2: Rarefaction curves derived from each transect sampled by Yoder (2009). Labels indicate locations (River Mile) within the Turners Falls Impoundment where fish were sampled. The dashed vertical line indicates the proposed minimum sample size (n = 150 fish) per reach sampled.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.12

EVALUATE FREQUENCY AND IMPACT OF EMERGENCY WATER CONTROL GATE DISCHARGE EVENTS AND BYPASS FLUME EVENTS ON SHORTNOSE STURGEON SPAWNING AND REARING HABITAT IN THE TAILRACE AND DOWNSTREAM FROM CABOT STATION

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

GOMEZ AND SULLIVAN ENGINEERS

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to determine the frequency of spill events during shortnose sturgeon spawning duration and, if deemed necessary, determine appropriate protocols for sufficient protection of shortnose spawning and rearing. Federal Energy Regulatory Commission's (FERC) Study Plan Determination Letter (SPDL) dated February 21, 2014 approved the Revised Study Plan (RSP) for this study without modification. In the RSP, FirstLight proposed to conduct this study incrementally. The first step is a desktop exercise to obtain and analyze existing data in order to understand the operation of the emergency spill gates and bypass flume (Task 1). A report describing the results of this analysis is attached as Appendix A.

The results of the desktop analysis will be presented at the Initial Study Report (ISR) meeting.

There has been no stakeholder consultation required for this study since the RSP was filed.

1.2 Study Progress Summary

Task 1: Analysis of Existing Data

A report summarizing the analysis of existing data is attached to this Initial Study Report as Appendix A.

The summary report of existing data demonstrated the operation of the emergency spill gates and log sluice/bypass flume. The data show that 0.6% of the time, more than two spill gates were open to some degree. The reason appears to be related to operational procedures to keep debris off the log boom. Two short-duration events occurred during the period analyzed when the spill gates opened automatically in response to high canal forebay water levels.

With regard to the sluice gate releases, most of the time the gate is open is related to downstream fish passage requirements. Less than 4% of the time, the gate is opened to more than 7 feet for operational reasons (i.e., to pass trashrack debris downstream).

Task 2: Scenario Development

This task is contingent on whether additional field study is required.

Task 3: Field Verification of Conditions (if necessary)

If a field component of the study is necessary, field measurements will be collected in accordance with the methods detailed in the RSP, subject to modification based on agency consultation.

Task 4: Data Analysis and Reporting

This task is contingent on whether additional field study is required. As such, at this juncture, a reporting due date is not provided.

1.3 Variances from Study Plan and Schedule

The study schedule in the RSP targeted Spring 2014 for distribution of a summary report and a meeting with stakeholders to determine the need for field study and targeted Summer 2014 to perform field investigation outside of the sturgeon spawning season, if necessary. The summary report is attached to this ISR summary as Appendix A. The schedule was extended due to the unanticipated delay in receiving the SPDL for this study in February 2014.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

The potential next steps would occur in 2015, if necessary.

1.4 Remaining Activities

As demonstrated in the summary report, the emergency spillway/log sluice gate discharge events during the sturgeon spawning period are infrequent and generally of low intensity in relation to river flow. FirstLight's position is that the field data collection aspect of this study is not necessary. As stated in the RSP, a mutual agreement will be reached in consultation with interested stakeholders to determine whether additional study is necessary.

Appendix A
Data Summary Report: Evaluation of Emergency Gate and Bypass Flume Discharges

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.12

EVALUATION OF EMERGENCY GATE AND BYPASS FLUME DISCHARGES

Initial Study Report

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight Power Resources
GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers

SEPTEMBER 2014

TABLE OF CONTENTS

1 INTRODUCTION 1-1

2 DESCRIPTION OF GATES AND THEIR OPERATION 2-1

2.1 Turners Falls Power Canal Spillway Gates 2-1

2.2 Bypass Flume/Log Sluice Gate 2-1

3 DATA ANALYSIS METHODS 3-1

4 RESULTS AND DISCUSSION 4-1

LIST OF TABLES

Table 4-1: Frequency of Emergency Spill Gate Openings from April 1-June 30, 2005-2012. 4-4
Table 4-2: Periods When More Than Four Spill Gates Were Open From April 1-June 30, 2005-2012. 4-5
Table 4-3: Frequency of Sluice Gate Opening from April-June, 2005-2012. 4-8

LIST OF FIGURES

Figure 2-1: Overhead View of Gate Locations 2-3
Figure 2-2: Photographs of Cabot Station Emergency Spill Gates 2-4
Figure 2-3: Photographs of Cabot Station Sluice Gate 2-5
Figure 3-1: Location of FirstLight Operations Data Collection Points 3-3
Figure 4-1: Spill Gate Release and River Flow on April 19, 2005. 4-9
Figure 4-2: Spill Gate Release and River Flow on May 6, 2005. 4-10
Figure 4-3: Spill Gate Release and River Flow on April 26, 2006. 4-11
Figure 4-4: Spill Gate Release and River Flow on May 5, 2006. 4-12

LIST OF APPENDICES

APPENDIX A – BI-WEEKLY CHARTS OF SPILL GATE OPENING VS. CABOT STATION GENERATION
APPENDIX B – BI-WEEKLY CHARTS OF SPILL GATE DISCHARGE VS. RIVER DISCHARGE
APPENDIX C – BI-WEEKLY CHARTS OF SLUICE GATE OPENING VS. CABOT STATION GENERATION
APPENDIX D – BI-WEEKLY CHARTS OF SLUICE GATE DISCHARGE VS. RIVER DISCHARGE

LIST OF ABBREVIATIONS

cfs	cubic feet per second
Conte Lab	S.O. Conte Anadromous Fish Research Center
FERC	Federal Energy Regulatory Commission
FirstLight	FirstLight Hydro Generating Company
ILP	Integrated Licensing Process
PAD	Pre-Application Document
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SPDL	Study Plan Determination Letter
VY	Vermont Yankee Nuclear Power Plant

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

1 INTRODUCTION

FirstLight Hydro Generating Company (FirstLight), a subsidiary of GDF SUEZ North America, Inc., is the current licensee of the Northfield Mountain Pumped Storage Project (FERC No. 2485) and the Turners Falls Hydroelectric Project (FERC No. 1889). FirstLight has initiated with the Federal Energy Regulatory Commission (FERC, the Commission) the process of relicensing the two Projects using the FERC's Integrated Licensing Process (ILP). The current licenses for Northfield Mountain and Turners Falls Projects were issued on May 14, 1968 and May 5, 1980, respectively, with both set to expire on April 30, 2018.

As part of the ILP, FERC conducted a public scoping process during which various resource issues were identified. On October 31, 2012, FirstLight filed its Pre-Application Document (PAD) and Notice of Intent with the FERC. The PAD included FirstLight's preliminary list of proposed studies. On December 21, 2012, FERC issued Scoping Document 1 (SD1) and preliminarily identified resource issues and concerns. On January 30 and 31, 2013, FERC held scoping meetings for the two Projects. FERC issued Scoping Document 2 (SD2) on April 15, 2013.

FirstLight filed its Proposed Study Plan (PSP) on April 15, 2013 and, per the Commission regulations, held a PSP meeting at the Northfield Visitors Center on May 14, 2013. Thereafter, FirstLight held ten[1] resource-specific study plan meetings to allow for more detailed discussions on each PSP and on studies not being proposed. On June 28, 2013, FirstLight filed with the Commission an Updated PSP to reflect further changes to the PSP based on comments received at the meetings. On or before July 15, 2013, stakeholders filed written comments on the Updated PSP. FirstLight filed a Revised Study Plan (RSP) on August 14, 2013 with FERC addressing stakeholder comments.

On August 27, 2013 Entergy Corp. announced that the Vermont Yankee Nuclear Power Plant (VY), located on the downstream end of the Vernon Impoundment on the Connecticut River and upstream of the two Projects, will be closing no later than December 29, 2014. With the closure of VY, certain environmental baseline conditions will change during the relicensing study period. On September 13, 2013, FERC issued its first Study Plan Determination Letter (SPDL) in which many of the studies were approved or approved with FERC modification. However, due to the impending closure of VY, FERC did not act on 19 proposed or requested studies pertaining to aquatic resources. The SPDL for these 19 studies was deferred until after FERC held a technical meeting with stakeholders on November 25, 2013 regarding any necessary adjustments to the proposed and requested study designs and/or schedules due to the impending VY closure. FERC issued its second SPDL on the remaining 19 studies on February 21, 2014, approving the RSP with certain modifications.

The SPDL required FirstLight to conduct a study to evaluate the frequency and impact of water releases from the emergency spill gates and bypass flume on shortnose sturgeon spawning and rearing habitat in the tailrace and downstream from Cabot Station.

FirstLight is conducting this study incrementally, in accordance with the approved RSP. First, existing data are analyzed to understand the operation of the emergency spill gates and bypass flume which is the subject of this report. Then, the analysis is being shared with the resource agencies and a meeting will be held to discuss the results to determine if a field component of the study is necessary.

[1] The ten meetings were held on May 14, 15, 21, and 22, and June 4, 5, 11, 12, and 14 and August 8.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

The objectives of this report are to:

1. Determine the frequency with which the emergency water control gates are operated to discharge large quantities of water.

2. Describe the use of the bypass flume to pass water, fish, and any debris raked off the intake racks downstream.

The shortnose sturgeon is a federally listed endangered species under the Endangered Species Act. There is a population of shortnose sturgeon residing in the river reach between Turners Falls and Holyoke Dams. Spawning habitat for these fish occurs between a natural rock formation locally known as “Rock Dam” (within the Turners Falls bypassed reach) and a point approximately 650 feet downstream of the Cabot Station tailrace. Sturgeon spawning in this area typically occurs from April to mid-May and the egg incubation period is about two weeks when water temperatures are between 8 and 12 degrees Celsius (°C). Upon hatching, larval shortnose sturgeon hide for about 12 days under available cover at the spawning site while absorbing the yolk-sac, before migrating downstream to deeper water between the mouth of the Deerfield River and Holyoke Dam[2].

This report will provide data and analysis describing the use of the emergency water control gates and bypass flume during the last 8 years (2005-2012) to determine potential impacts on shortnose sturgeon spawning and rearing activities.

[2] National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

2 DESCRIPTION OF GATES AND THEIR OPERATION

The principal components of the Turners Falls Project include the Turners Falls Dam, gatehouse, power canal, Station No. 1 and Cabot Station, located at the downstream end of the power canal. Water can be released from the power canal via Station No. 1 and Cabot Station generation, through the Cabot spillway gates (upstream of Cabot Station), and from the log sluice just downstream from the Cabot Station intakes (see Figure 2-1). Emphasis of this study is on the spillway gates and log sluice. Water can also be released through the fishways at Cabot Station and Turners Falls Dam, as well as from other water users along the canal.

2.1 Turners Falls Power Canal Spillway Gates

The canal spillway adjacent to and upstream of Cabot Station contains 10 vertical, downward-opening slide gates that are 12 feet wide x 12 feet high with individually driven rack and pinion operators. Eight of the gates are used to discharge canal flows and two of the gates supply attraction water to the Cabot fish ladder. In this report, these eight gates are referred to as the "spill gates." The spill gates (shown in Figure 2-2) are used to rapidly draw down the power canal in the event of a Cabot Station load rejection or canal dike breach or to sluice ice and debris downstream.

The discharge capacity of these eight spill gates is approximately 12,000 cfs at the normal canal level of 173.5 feet above mean sea level (NGVD 1929 datum). The maximum Cabot fish ladder attraction water provided through the other two gates is approximately 335 cfs.

The canal level at Cabot Station is constantly monitored. For safety reasons, the spill gates automatically open and the gates at the Turners Falls Gatehouse automatically close in the event an abnormal high or low canal level is detected, or when there is a load rejection at Cabot Station. An abnormally low canal level could indicate a dike breach which is an emergency situation that could inundate houses along Montague City Road. A load rejection at Cabot Station could cause the canal level to rise and overflow, inundating surrounding areas. During such events, when the gates are operated automatically, the canal level will drop rapidly and the duration of excess water flowing through the spill gates will be short, just minutes.

The gates are used for operational reasons as well. During periods of high river flows, at least one spillway gate will be opened to allow river debris entering the canal to be discharged back to the river to prevent obstructions at the Cabot Station intake racks. Likewise in the winter and spring, when there is excess ice in the canal, gates will be opened to route ice down the spillway. Operators will also routinely open one or more gates when necessary to help remove debris from the trash boom. During these periods, operators may also temporarily reduce generation - the load reduction allows for debris to be moved off the log boom. The gates discharge back to the river just upstream of Cabot Station.

2.2 Bypass Flume/Log Sluice Gate

Past the Cabot Station intake and trashracks is a gated log sluice that has been enhanced to provide downstream fish passage past Cabot Station. In this report, the gate controlling water passage through this opening is referred to as the "sluice gate." The sluice has been resurfaced to provide a passage route, and above-water lighting and a fish sampling facility have been added. Although the sluice gate is approximately 16 feet wide, there is an 8 foot wide weir that is inserted in the sluice opening during downstream fish passage periods. The weir has an elliptical floor, and was developed specifically to enhance fish passage. The gate is downward-opening. The sluice discharges to the river just downstream of Cabot Station as shown in Figure 2-3.

The bypass flume is utilized as a downstream fish passage facility at Cabot Station and is generally open for fish passage from April through mid-November in accordance with a schedule provided by the Connecticut River Atlantic Salmon Commission (CRASC). The schedule for the downstream fish passage facility at the Turners Falls Project in 2014 is as follows:

- Atlantic salmon smolts — April 1 – June 15
- Atlantic salmon adults — October 15 – December 15[3]
- American shad adults — April 7 – July 31
- American shad juveniles — August 1 – November 15
- American eel adults — September 1 – November 15

During this time a continuous flow of approximately 200 cfs is maintained through the log sluice and the fish passage weir is in place, except for brief periods of sampler deployment or rack maintenance and longer periods when high river flow would pose an erosion threat at the sluice discharge if the gate were left open. This opening can also be used to pass debris downstream; the fish passage weir may be removed at times to facilitate clearing the intake racks of debris. Gate openings greater than 7 feet usually indicate a period of intake rack cleaning.

[3] Downstream passage operation for adult salmon will only be required if 50 or more adults are documented as passing upstream at this facility. For this study, the status of the salmon passage effort is not relevant, because the downstream fish passage facility will be open during the sturgeon spawning period for adult American shad.

FIRSTLIGHT POWER RESOURCES
RELICENSING STUDY 3.3.12
EVALUATION OF EMERGENCY GATE
AND BYPASS FLUME DISCHARGES

N

0 100 200 400 Feet

Figure 2-1:
Overhead View of
Gate Locations

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Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Figure 2-2: Photographs of Cabot Station Emergency Spill Gates

Upstream View of Spill Gate discharge location (no spill)

Figure 2-3: Photographs of Cabot Station Sluice Gate

View of Sluice Gate discharge (approximately 210 cfs) from top of downstream fishway

Upstream View of Sluice Gate discharge location

3 DATA ANALYSIS METHODS

Gate opening data from 2005 through 2012 were obtained from FirstLight's operations records on a 10-minute time step, April 1 – June 30 annually. In addition to the gate openings, additional operations data obtained from FirstLight included the canal forebay elevation, Cabot Station generation in megawatts - converted to discharge, and approximate bypass reach discharge calculated from Turners Falls Dam and Station No. 1 releases (Figure 3-1).

Emergency Spill Gates

The crest elevation of the eight spill gates varies between about 174.1 and 174.7 feet. FirstLight's system records the gate opening relative to its fully closed position. For example, if the gate crest is fully closed at elevation 174.2 feet and at a particular time the crest is at 170.2 feet, the system reports the gate level as 4.0 feet. The normal water surface elevation in the canal is 173.5 feet[4]. A gate was defined as open if the value was > 1.2 feet (this accounts for the difference between a gate crest elevation of 174.7 feet and normal canal level of 173.5 feet).

The number of Cabot spill gates open at each 10-min interval was computed, and then the frequency of times when 0 through 8 gates were open was calculated. The results were tabulated to show frequency of spill gate and sluice gate openings per year (during the period of interest). For the spill gates, duration analysis tabulation simply stated if the gates were open or closed and did not include magnitude (i.e., how open each gate was).

Sluice Gate

The sluice gate crest is at elevation 175.1 feet (approximately) when the gate is closed, and normal canal forebay elevation equals 173.5 feet, so no water would typically be flowing over the gate at gate openings up to about 1.6 feet. For this analysis, reported gate opening values < 1.5 feet open indicate the period when this gate was closed.

The frequency of sluice gate opening was separated into categories based on the magnitude of the opening.

Flow Calculations

Flow over each gate was calculated based on the head atop each gate using the standard weir equation:

$Q = C*L*H^{1.5}$ where,

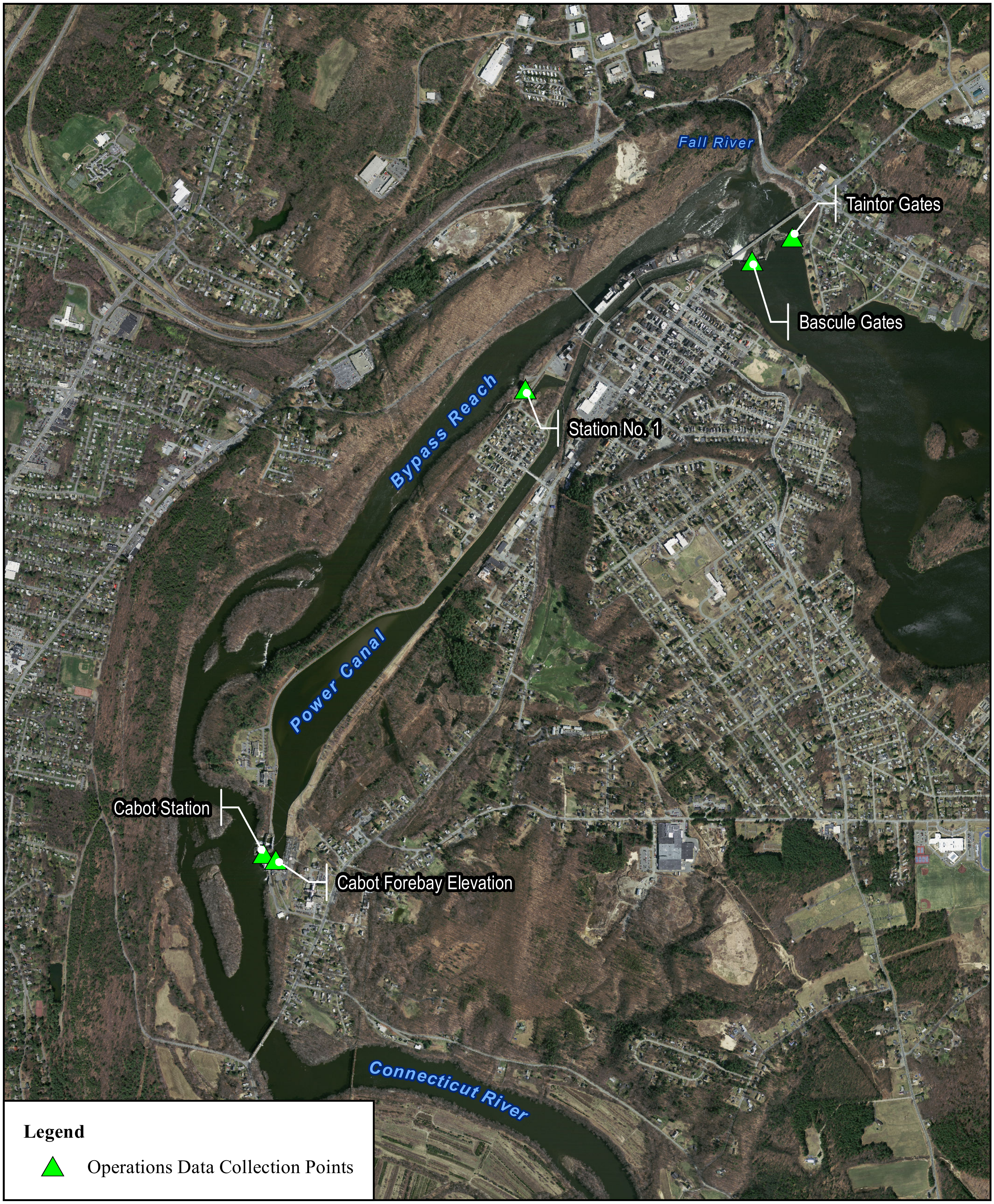
Q is discharge (in cfs)
C is the weir coefficient (unitless)
L is the length of each gate (in feet)
H is the head or depth of water atop the gate crest (in feet).

When calculating head over the spill gates, an average crest elevation of 174.4 feet was used for all the spill gates. A coefficient of 3.3 was used for the spill gates and a coefficient of 3.1 was used for the sluice gate.

[4] Note that all FirstLight gages which measure the water surface elevation are based on the same mean sea level datum (specifically NGVD 1929 datum).

Time-series plots were developed on a biweekly time step showing the magnitude of gate releases in cfs versus river flow. River flow was calculated by converting generation output at Cabot Station and Station No. 1 to cfs, and adding these values to flow releases at the Turners Falls Dam.

It should be noted that this river flow calculation does not include: inputs from Fall River (ungaged, 34 square mile drainage area); flows provided through the Cabot fishway (maximum attraction flow = 335 cfs) or Spillway fishway (maximum attraction flow = 300 cfs); or any inputs from the other water users along the canal (i.e., Southworth Paper Hydro (capacity = 113 cfs) and Turners Falls Hydro LLC (capacity =288 cfs), which operate only after Cabot and Station No. 1 are operating at full hydraulic capacity, and Conte Lab (capacity = 200 cfs)).



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FIRSTLIGHT POWER RESOURCES
RELICENSING STUDY 3.3.12
EVALUATION OF EMERGENCY GATE
AND BYPASS FLUME DISCHARGES

0 1,000 2,000 4,000
Feet

Figure 3-1:
Location of FirstLight
Operations
Data Collection Points

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Path: W:\gis\studies\3_3_12\Figure_3-1.mxd

4 RESULTS AND DISCUSSION

Cabot Emergency Spill Gates

As noted above, FirstLight provided spill gate opening data every 10 minutes from April 1 to June 30 for the years 2005 through 2012. Thus, the spill gate opening was recorded 144 times/day for 91 days (April 1 to June 30), which is equivalent to 13,104 records/year during the target period. All of the gates were in a closed position 40.5% of the time (Table 4.1). One gate is often left partially open to help route debris from the boom in the canal through the spill gate; one gate is open 57.4% of time (thus over 97.8% of the time, none or one gate is open to some degree). More than two gates were open at 0.6% of the intervals (Table 4-1).

Within the period of interest, there were a total of 26 occurrences when at least five gates were open to some degree (Table 4-2). These occurrences lasted for periods ranging from 10 minutes (the minimum interval examined) to 2 hours, when on April 26, 2006, 5 to 6 gates were open continuously from 7:20 am to 9:20 am. Table 4-2 depicts these events. The only interval when all gates were fully open occurred at 2:40 am on June 14th, 2010.

Periods when more than two gates are opened are generally related to high debris load in the river that accumulated on the log boom. Biweekly plots showing the spill gate opening compared to Cabot Station generation are shown in Appendix A. Periods of increased spill gate opening are usually concomitant with short-term reductions in generation. The load reduction allows for debris to be moved off the log boom. Once the gates are closed, generation levels resume.

Biweekly plots showing the magnitude of flow through the spill gates compared to river flow are shown in Appendix B. The flow inputs are plotted on the same scale to show the relative effect of the gate release in the context of the flow from Cabot Station and in the bypass reach.

The largest spill event occurred on June 14th, 2010 during which approximately 8,653 cfs of spill was recorded for one 10-minute interval (2:40); this event occurred during a time when bypass flows increased considerably (from 400 to 7,410 cfs during the hour) as a result of spill at Turners Falls Dam and when discharge through Cabot Station was reduced (9,077 to 3,764 cfs during the hour). Another large magnitude spill event occurred on June 4th, 2007 during which approximately 8,168 cfs of spill was recorded during a time when bypass flows were low (400 cfs) but discharge through Cabot Station was high (12,620 cfs). This event lasted for 20 minutes (two 10-minute intervals). Both of these events occurred as an automated response due to the canal forebay elevation being above the emergency threshold of 174.3 feet for a short period (<10 minutes).

Sluice Gate

Table 4-3 shows the frequency and magnitude that the sluice gate was open during the period April 1-June 30 from 2005-2012. 23% of the time, the gate was closed. Typically, the sluice gate is opened 5-7 feet when the fish sampler is deployed. This occurred 70% of the time over the period of interest. The gate was open > 7 feet less than 4% of the time. Gate openings >7 feet usually indicate a period of intake rack cleaning. Similar to the spill gates, periods of increased opening at the sluice gate are usually concomitant with short-term reductions in generation. The load reduction allows for debris to be moved off the trashracks and sluiced downstream.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Biweekly plots showing the sluice gate opening compared to Cabot Station generation are shown in Appendix C. The gate is closed briefly to put the downstream fish sampler into service (usually around 15:30-16:00) and to take it out (22:00).

Biweekly plots showing the magnitude of flow through the sluice gate compared to river flow are contained in Appendix D. The maximum capacity of the sluice gate is approximately 800 cfs, which is usually substantially lower than total river flow.

Previous Observations from Conte Lab

As stated in the RSP, sturgeon researchers at the S.O. Conte Anadromous Fish Research Center (Conte Lab) have observed spillage at the emergency water control gate and the bypass flume that appeared to increase velocity over the shortnose sturgeon spawning and rearing area downstream of Cabot Station and may have resulted in a debris plume.

To further understand the operational conditions related to these observations, the Conte Lab was contacted. Dates of the spillage observations were provided from Conte Lab (pers. com., M. Kieffer, March 21, 2013).

Four occurrences were noted within the date range parameters of this report (2005-2012), including:

- 04/19/05 10:04
- 05/06/05 13:00
- 04/26/06 9:10
- 05/05/06 13:00

In addition to the figures in the Appendices, the magnitude and duration of these events observed by Conte Lab are presented in Figures 4-1 through 4-4. Data from three out of four of these dates (5 gates open) is also included in Table 4-2 (during the occurrence noted on 4/19/05, only three spill gates were open).

In the context of the overall analysis, the conditions observed on 4/19/2005 (three spill gates open) occur 0.3% of the time, and the conditions observed on 5/6/2005, 4/26/2006, and 5/5/2006 (five spill gates open) occur 0.1% of the time (see Table 4-1). This suggests that if any impacts to the sturgeon spawning area occur as a result of the spill gate operation (e.g., increased velocities or sediment transport), any such impacts would be very infrequent. Furthermore, Kieffer and Kynard (2007)[5] also note that spill events at Cabot Station usually caused no identifiable increase in discharge at the USGS Montague City gage, because there was only a shift in release location, rather than a shift in discharge volume.

Summary

The data provided herein demonstrate the operation of the emergency spill gates and log sluice/bypass flume. The data show that 0.6% of the time, more than two spill gates were open to some degree. The reason appears to be related to operational procedures to keep debris of the log boom. Two short-duration events occurred during the period analyzed when the spill gates opened automatically in response to high canal forebay water levels.

[5] Kieffer, Micah & Kynard, Boyd. (2007). Effects of Water Manipulations by Turners Falls Dam Hydroelectric Complex on Rearing Conditions for Connecticut River Shortnose Sturgeon Early Life Stages. S.O. Conte Anadromous Fish Research Center. Turners Falls. MA.

With regard to the sluice gate releases, most of the time the gate is open is related to downstream fish passage requirements. Less than 4% of the time (Table 4-3), the gate is opened to more than 7 feet for operational reasons (i.e., to pass trashrack debris downstream).

The discharge events through the emergency spill gates during the sturgeon spawning period are infrequent and of low intensity in relation to river flow. FirstLight's position is that the field data collection aspect of this study is not necessary.

Consultation

As stated in the RSP, the results of these analyses are being presented to interested stakeholders before proceeding further with this study; a mutual agreement will be reached in consultation with interested stakeholders to determine whether additional study is necessary.

Table 4-1: Frequency of Emergency Spill Gate Openings from April 1-June 30, 2005-2012.

Number of gates open	Occurrences per year (10-minute intervals)									Frequency
	2005	2006	2007	2008	2009	2010	2011	2012	Total	
0 (no gates open)	4,742	4,121	5,437	6,057	2,320	6,145	4,001	9,589	42,412	40.5%
1	7,915	8,749	7,278	6,981	9,821	6,930	9,032	3,455	60,161	57.4%
2	190	80	302	31	951	16	41	13	1,624	1.5%
3	156	42	53	11	3	4	29	32	330	0.3%
4	55	80	30	16	7	0	1	15	204	0.2%
5	42	28	0	8	0	1	0	0	79	0.1%
6	4	4	2	0	0	4	0	0	14	0.0%
7	0	0	0	0	2	0	0	0	2	0.0%
8	0	0	2	0	0	4	0	0	6	0.0%
Total Readings	13,104	13,104	13,104	13,104	13,104	13,104	13,104	13,104	104,832	

Note: As an example of how to read the table, the value of 4,742 means that from April 1 to June 30, 2005, there were 4,742 readings (based on a 10-minute interval) out of 13,104 when no spill gates were open.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Table 4-2: Periods When More Than Four Spill Gates Were Open From April 1-June 30, 2005-2012.

Time	Gate Opening (feet)								Number of gates open	Spill Gate Discharge (cfs)
	SG03	SG04	SG05	SG06	SG07	SG08	SG09	SG10		
4/2/2005 19:10	0.00	9.31	0.38	0.40	6.12	9.90	10.00	8.50	5	4,473
4/2/2005 19:20	0.00	9.31	0.38	0.40	6.12	9.90	10.00	8.50	5	4,474
4/2/2005 19:30	0.00	9.32	0.38	0.40	6.12	9.90	10.00	8.50	5	4,474
4/2/2005 19:40	0.00	9.32	0.38	0.40	6.12	9.90	10.00	8.50	5	4,474
4/2/2005 19:50	0.00	9.32	0.38	0.40	6.12	9.91	10.00	8.50	5	4,475
4/2/2005 20:00	0.00	9.32	0.38	0.40	6.12	9.91	10.00	8.50	5	4,475
4/2/2005 20:10	0.00	9.32	0.38	0.40	6.13	9.91	10.00	8.50	5	4,476
4/2/2005 20:20	0.00	9.32	0.38	0.40	6.12	9.91	10.00	8.50	5	4,476
4/2/2005 20:30	0.00	9.32	0.38	0.40	6.12	9.91	10.00	8.50	5	4,475
4/3/2005 18:00	0.00	9.32	0.02	4.04	10.00	3.77	10.00	8.49	6	4,435
4/3/2005 18:10	0.00	9.33	0.02	5.21	9.04	2.98	10.00	8.49	6	4,329
4/5/2005 5:30	0.00	9.31	0.02	0.03	4.11	10.00	10.00	8.50	5	4,244
4/7/2005 13:50	0.00	9.34	0.33	7.01	10.00	10.00	10.00	0.09	5	4,881
4/7/2005 14:00	0.00	9.34	0.33	10.00	10.00	10.00	10.00	0.09	5	5,372
4/8/2005 12:40	0.00	9.35	2.64	0.04	10.00	10.00	10.00	0.09	5	4,371
4/8/2005 12:50	0.00	9.35	8.02	0.04	10.00	10.00	10.00	0.09	5	5,037
4/8/2005 13:00	0.00	9.35	6.02	0.04	10.00	10.00	10.00	0.09	5	4,742
4/8/2005 13:10	0.00	9.35	3.94	0.04	10.00	10.00	10.00	0.09	5	4,491
4/8/2005 13:20	0.00	9.35	3.94	0.04	10.00	10.00	10.00	0.09	5	4,492
4/8/2005 13:30	0.00	9.35	3.94	0.04	10.00	10.00	10.00	0.10	5	4,491
4/8/2005 13:40	0.00	9.35	3.94	0.04	10.00	10.00	10.00	0.09	5	4,492
4/17/2005 6:00	0.00	9.31	5.58	4.71	10.00	10.00	10.00	0.09	6	4,979
4/17/2005 6:10	0.00	9.31	5.58	4.71	10.00	10.00	10.00	0.09	6	4,979
4/26/2005 12:40	0.00	5.38	0.00	9.90	4.96	10.00	10.00	0.09	5	3,990
4/26/2005 12:50	0.00	5.38	0.00	9.91	7.01	10.00	10.00	0.09	5	4,266
4/26/2005 13:00	0.00	5.38	0.00	9.91	7.01	10.00	10.00	0.09	5	4,266
4/26/2005 13:10	0.00	5.38	0.00	9.91	7.01	10.00	10.00	0.09	5	4,266
4/26/2005 13:20	0.00	5.38	0.00	9.91	5.86	10.00	10.00	0.09	5	4,104
4/26/2005 13:30	0.00	5.38	0.00	9.91	5.86	10.00	10.00	0.09	5	4,104
4/26/2005 13:40	0.00	5.38	0.00	9.91	5.86	10.00	10.00	0.09	5	4,104
4/26/2005 13:50	0.00	5.38	0.00	9.91	3.88	10.00	10.00	0.09	5	3,869
5/6/2005 13:00	0.00	9.35	9.77	10.00	0.05	10.00	10.00	0.09	5	5,331
5/6/2005 13:10	0.00	9.35	9.77	10.00	0.05	10.00	10.00	0.09	5	5,332
5/6/2005 13:20	0.00	9.35	9.77	10.00	0.05	10.00	10.00	0.09	5	5,332
5/6/2005 13:30	0.00	9.35	9.77	10.00	0.05	10.00	10.00	0.09	5	5,332
5/6/2005 13:40	0.00	9.35	9.77	10.00	0.05	10.00	7.92	0.09	5	4,980
5/6/2005 13:50	0.00	9.35	9.77	10.00	0.05	10.00	7.92	0.09	5	4,980
5/6/2005 14:00	0.00	9.35	9.77	10.00	0.04	10.00	7.92	0.09	5	4,980
5/6/2005 14:10	0.00	9.35	9.77	10.00	0.04	10.00	7.01	0.09	5	4,841

Time	Gate Opening (feet)								Number of gates open	Spill Gate Discharge (cfs)
	SG03	SG04	SG05	SG06	SG07	SG08	SG09	SG10		
6/2/2005 12:40	0.00	9.37	4.86	10.00	0.05	10.00	10.00	0.09	5	4,598
6/2/2005 12:50	0.00	9.37	4.86	10.00	0.05	10.00	10.00	0.09	5	4,598
6/2/2005 13:00	0.00	9.37	4.86	10.00	0.05	10.00	10.00	0.09	5	4,598
6/2/2005 13:10	0.00	9.37	4.86	10.00	0.05	10.00	10.00	0.09	5	4,599
6/2/2005 13:20	0.00	9.37	4.86	10.00	0.05	10.00	10.00	0.09	5	4,599
6/2/2005 13:30	0.00	9.37	4.86	10.00	0.05	10.00	10.00	0.09	5	4,599
6/2/2005 13:40	0.00	9.37	4.86	10.00	0.05	10.00	10.00	0.09	5	4,599
4/1/2006 13:30	4.26	2.42	2.23	0.26	0.23	0.18	2.23	2.48	5	539
4/26/2006 7:20	0.00	9.31	9.74	0.04	0.04	2.97	8.77	8.47	5	3,863
4/26/2006 7:30	0.00	9.31	9.74	0.04	0.04	7.09	8.77	8.48	5	4,360
4/26/2006 7:40	0.00	9.31	9.74	0.04	0.04	10.00	8.77	8.48	5	4,840
4/26/2006 7:50	0.00	9.31	9.74	0.04	5.09	10.00	8.80	8.48	6	5,193
4/26/2006 8:00	0.00	9.31	9.74	0.04	5.09	10.00	8.79	8.48	6	5,191
4/26/2006 8:10	0.00	9.31	9.75	0.04	5.09	10.00	8.79	8.48	6	5,192
4/26/2006 8:20	0.00	9.31	9.75	0.04	5.09	10.00	8.80	8.49	6	5,194
4/26/2006 9:00	0.00	9.31	9.75	0.04	0.04	10.00	9.50	8.49	5	4,968
4/26/2006 9:10	0.00	9.31	9.75	0.04	0.04	10.00	9.49	8.49	5	4,968
4/26/2006 9:20	0.00	4.86	9.75	0.04	0.04	10.00	9.49	8.49	5	4,312
5/5/2006 12:50	0.00	8.06	0.03	0.04	5.09	7.71	9.58	8.52	5	3,690
5/5/2006 13:00	0.00	8.06	0.03	0.04	5.09	7.72	9.57	8.52	5	3,690
5/14/2006 11:40	0.00	9.32	0.01	0.04	3.97	10.00	9.60	8.50	5	4,158
5/14/2006 11:50	0.00	9.33	0.01	0.04	3.97	10.00	9.60	8.50	5	4,159
5/14/2006 12:00	0.00	9.33	0.01	0.04	3.97	10.00	9.60	8.50	5	4,159
5/14/2006 12:10	0.00	9.33	0.01	0.04	3.97	10.00	9.60	8.50	5	4,159
5/14/2006 12:20	0.00	9.33	0.01	0.04	3.97	10.00	9.60	8.50	5	4,159
5/14/2006 12:30	0.00	9.33	0.01	0.04	3.97	10.00	9.60	8.50	5	4,159
5/14/2006 12:40	0.00	9.33	0.01	0.04	3.97	10.00	9.60	8.50	5	4,158
5/14/2006 12:50	0.00	9.33	0.01	0.04	3.97	10.00	9.60	8.50	5	4,158
6/11/2006 7:50	0.00	9.13	3.84	0.04	0.00	10.00	9.86	8.51	5	4,158
6/11/2006 8:00	0.00	9.33	2.91	0.04	0.00	10.00	9.86	8.51	5	4,104
6/11/2006 8:10	0.00	9.33	2.91	0.04	0.00	10.00	9.86	8.51	5	4,105
6/11/2006 8:20	0.00	9.33	2.91	0.04	0.00	10.00	9.86	8.51	5	4,105
6/12/2006 3:40	0.00	9.17	9.76	0.04	5.14	10.00	0.00	8.51	5	4,294
6/29/2006 15:20	0.00	9.36	9.79	4.98	0.00	0.02	10.00	8.53	5	4,316
6/29/2006 15:30	0.00	9.36	9.79	7.28	0.00	0.02	10.00	8.53	5	4,630
6/29/2006 15:40	0.00	9.36	9.79	10.00	0.00	0.02	10.00	8.53	5	5,080
6/29/2006 15:50	0.00	9.36	9.79	10.00	0.00	0.02	10.00	8.53	5	5,080
6/29/2006 16:00	0.00	9.36	9.79	10.00	0.00	0.02	10.00	8.53	5	5,079
6/29/2006 16:10	0.00	9.36	9.79	10.00	0.00	0.02	10.00	8.53	5	5,079
6/4/2007 8:00	9.81	9.92	9.74	9.99	10.00	10.00	8.70	8.44	8	8,168
6/4/2007 8:10	9.81	9.87	9.74	10.00	10.00	10.00	0.00	0.09	6	6,465

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Time	Gate Opening (feet)								Number of gates open	Spill Gate Discharge (cfs)
	SG03	SG04	SG05	SG06	SG07	SG08	SG09	SG10		
6/27/2007 18:20	9.81	9.89	9.76	10.00	10.00	10.00	7.48	6.56	8	7,686
6/27/2007 18:30	3.86	7.03	7.41	10.00	4.86	2.73	0.00	0.09	6	2,992
5/7/2008 4:20	0.0	9.2	1.1	0.0	4.1	10.0	10.0	8.4	5	4,179
5/7/2008 4:30	0.0	9.2	1.1	0.0	4.1	10.0	10.0	8.4	5	4,184
5/7/2008 4:40	0.0	9.3	1.1	0.0	4.1	10.0	10.0	8.4	5	4,193
5/7/2008 4:50	0.0	9.4	1.1	0.0	4.1	10.0	10.0	8.4	5	4,210
5/7/2008 5:00	0.0	9.5	1.1	0.0	4.1	10.0	10.0	8.4	5	4,223
5/7/2008 5:10	0.0	9.3	1.1	0.0	4.1	10.0	10.0	8.4	5	4,195
5/7/2008 5:20	0.0	9.3	1.1	0.0	4.1	10.0	10.0	8.4	5	4,198
6/8/2008 23:40	4.1	2.5	1.1	3.8	3.3	3.4	0.0	0.1	5	827
6/2/2009 23:00	5.90	7.03	0.01	5.83	5.51	5.83	4.82	5.03	7	2,950
6/15/2009 4:30	5.89	6.19	0.01	5.81	5.49	5.80	4.84	1.92	7	2,531
5/4/2010 2:40	6.57	10.00	6.42	6.46	6.38	6.94	6.14	6.80	8	4,850
5/4/2010 2:50	0.00	4.49	0.00	4.54	5.47	10.00	10.00	3.98	6	3,359
5/4/2010 4:00	2.76	7.58	3.08	3.30	3.20	3.62	3.13	3.87	8	1,746
5/4/2010 4:10	2.76	10.00	5.97	3.30	3.20	3.62	3.13	3.96	8	2,487
5/26/2010 23:20	5.57	5.85	5.42	0.30	5.02	0.27	4.39	3.16	6	1,974
5/26/2010 23:30	9.79	10.00	3.75	0.31	9.83	0.27	9.99	9.81	6	5,571
5/26/2010 23:40	9.79	10.00	3.75	0.31	9.83	0.27	9.99	9.81	6	5,568
5/26/2010 23:50	9.79	10.00	3.75	0.31	9.83	0.27	4.11	0.19	5	3,648
6/14/2010 2:40	9.78	10.00	9.88	10.00	9.88	10.00	10.00	9.83	8	8,653

Note: There were no occurrences when >4 spill gates were open during the period April 1-June 30, in 2011 or 2012.

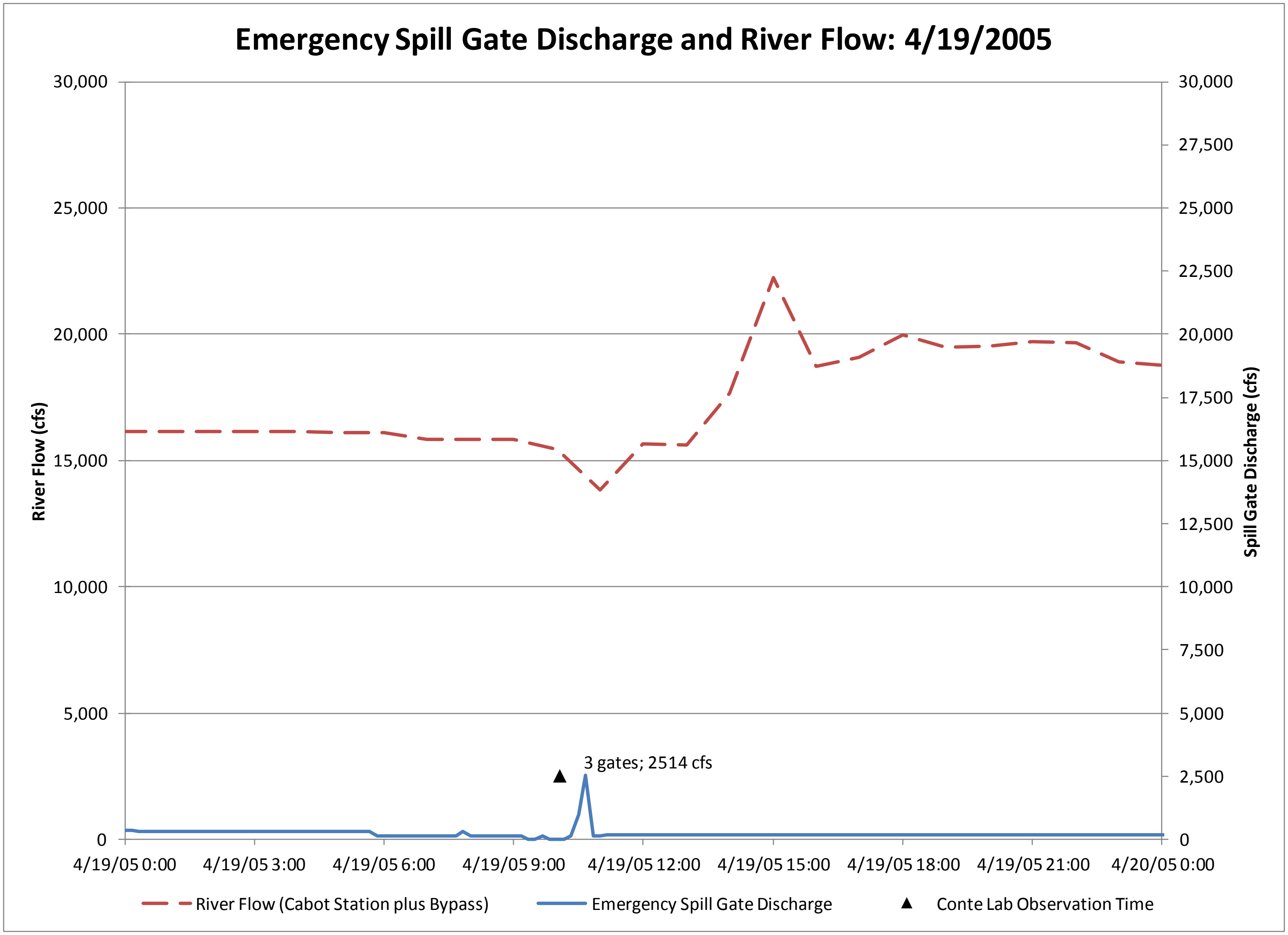
Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Table 4-3: Frequency of Sluice Gate Opening from April-June, 2005-2012.

Gate Opening (feet)	Intervals	Percent
<1.50 (closed)	24,131	23.0%
1.50-4.99	2,948	2.8%
5.00-7.00	73,367	70.0%
7.01-12.00	4,041	3.9%
Data records	104,487	99.7%
No data (null)	345	0.3%
Total readings	104,832	100%

Note: Gate openings >7 feet usually indicate a period of intake rack cleaning.

Figure 4-1: Spill Gate Release and River Flow on April 19, 2005.



Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Figure 4-2: Spill Gate Release and River Flow on May 6, 2005.

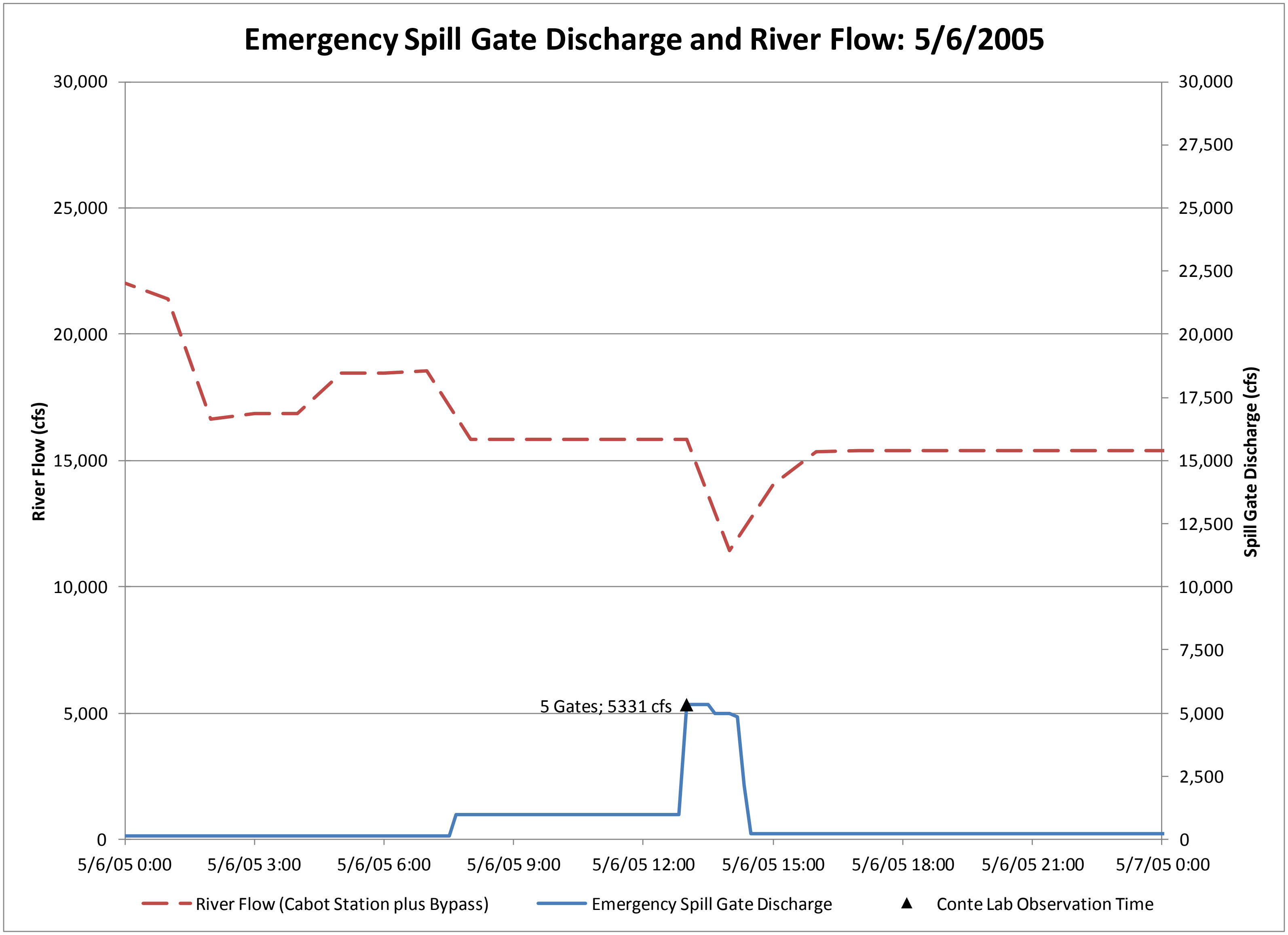


Figure 4-3: Spill Gate Release and River Flow on April 26, 2006.

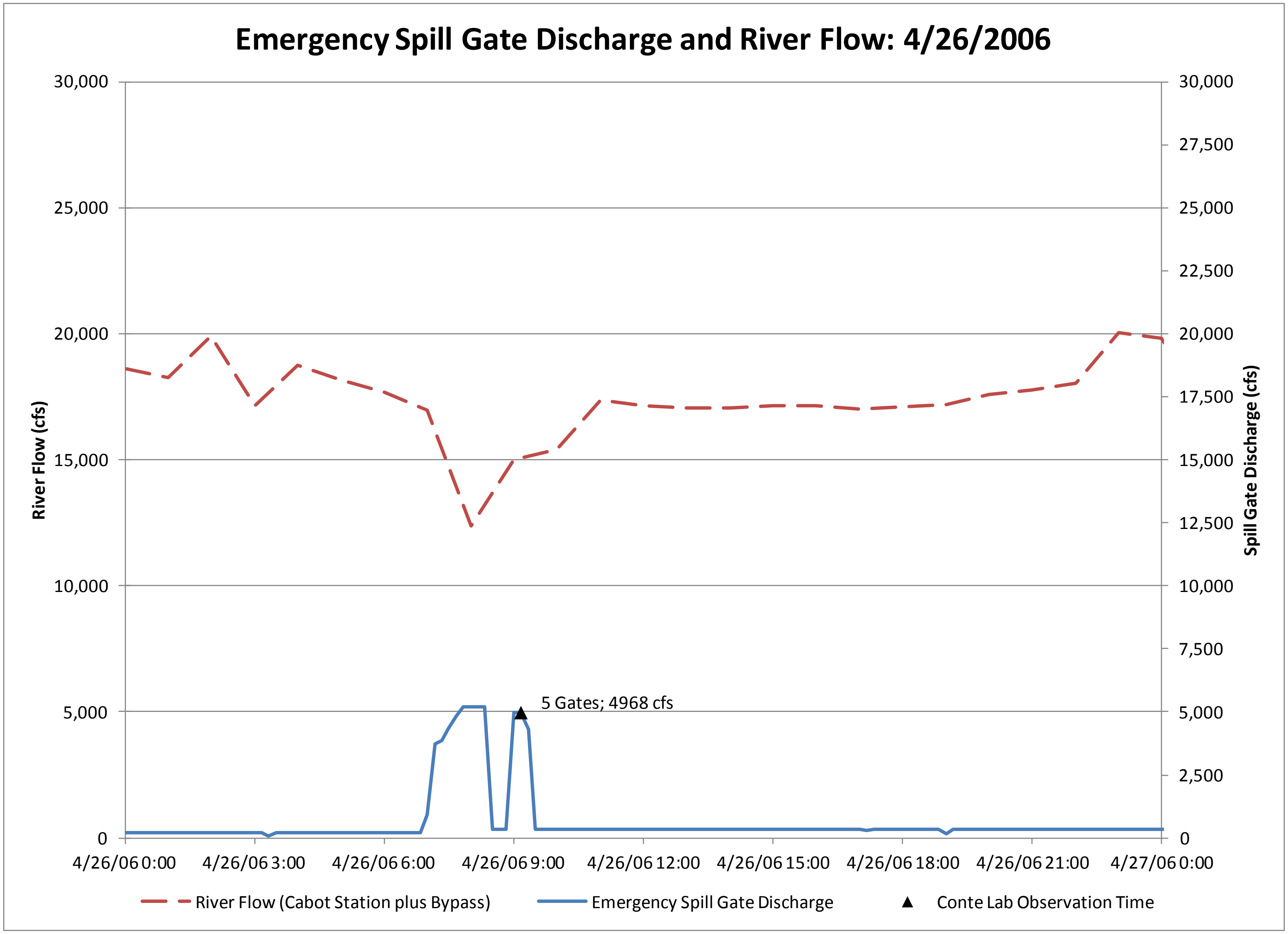
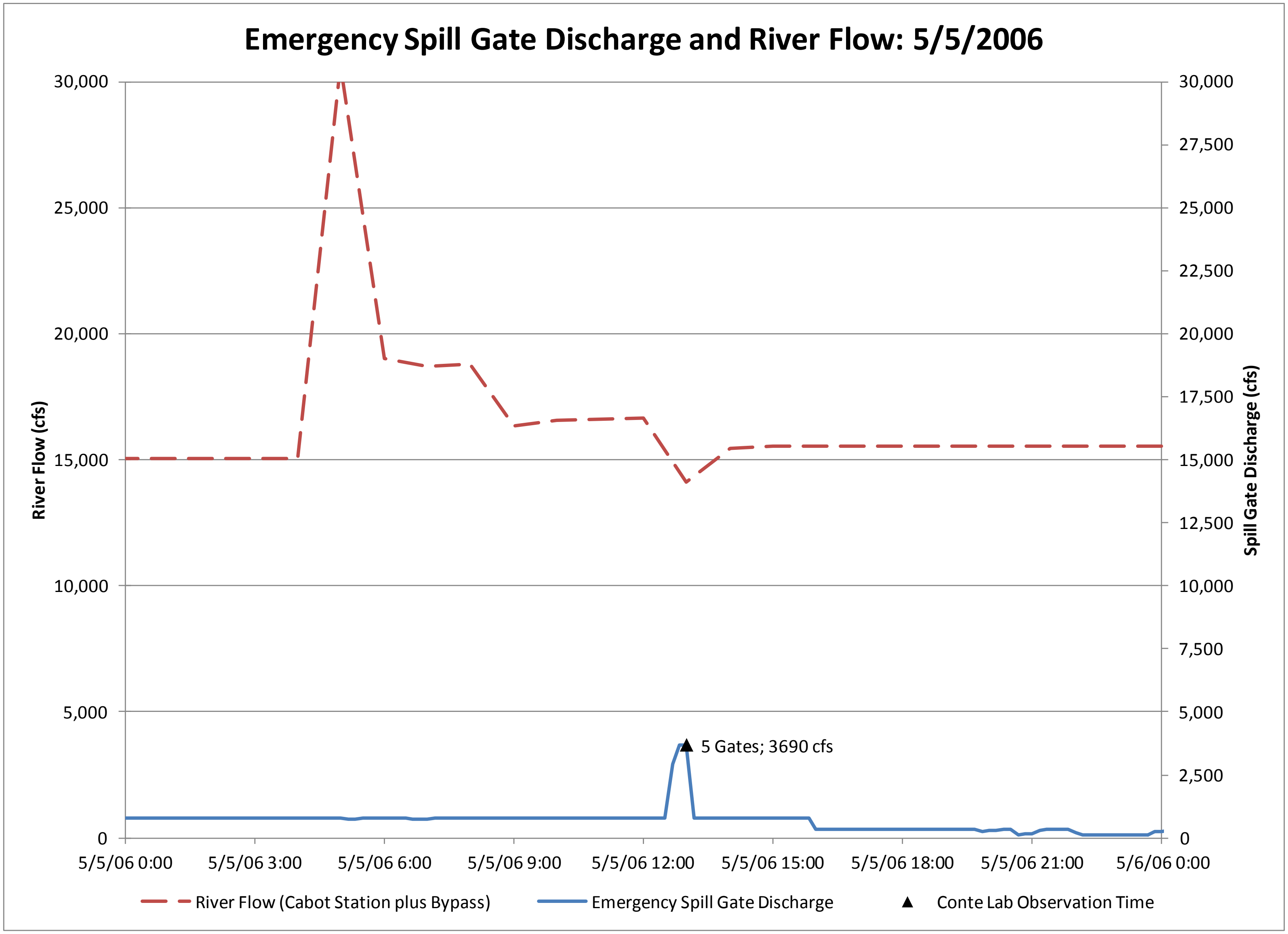
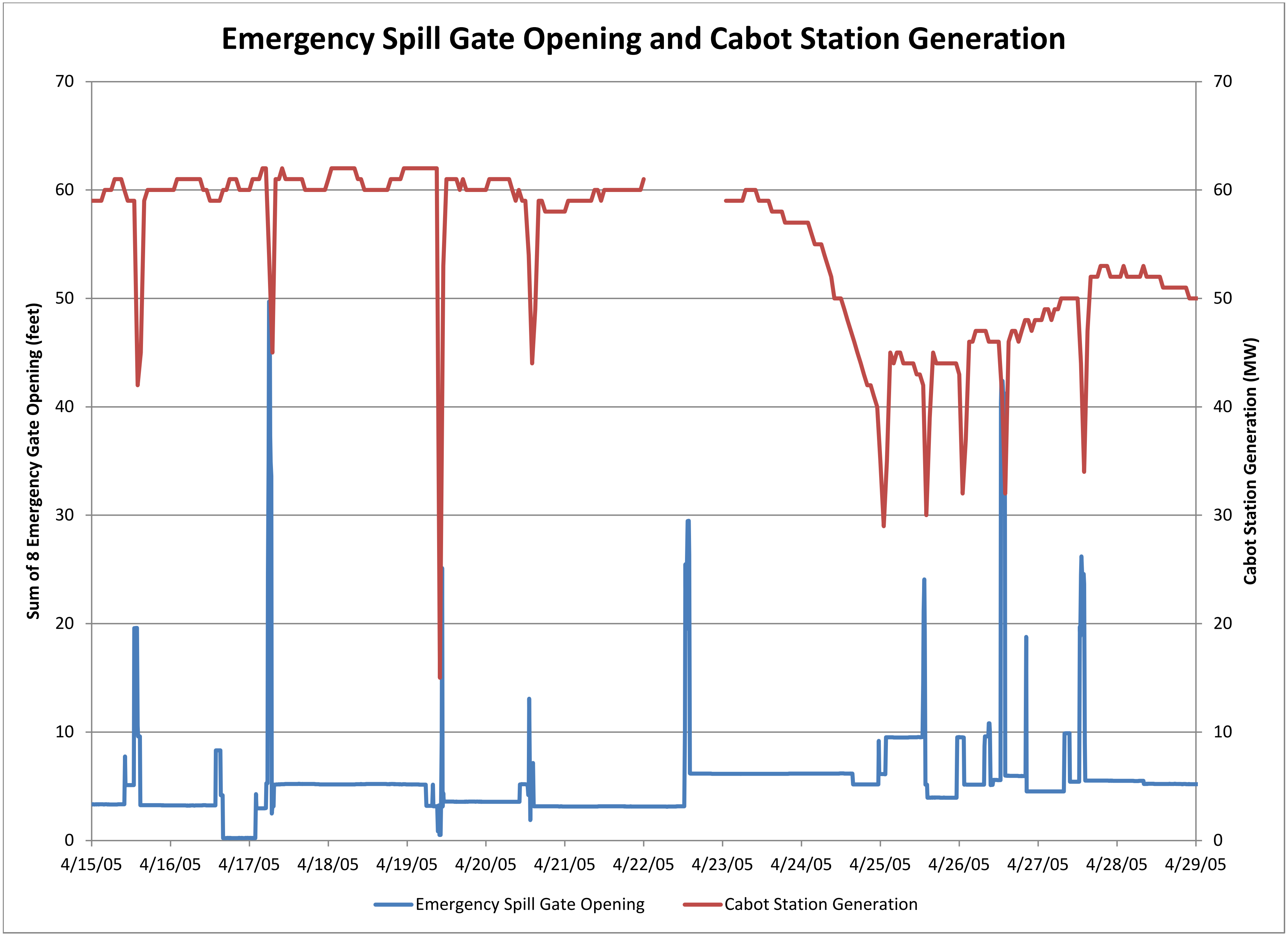


Figure 4-4: Spill Gate Release and River Flow on May 5, 2006.

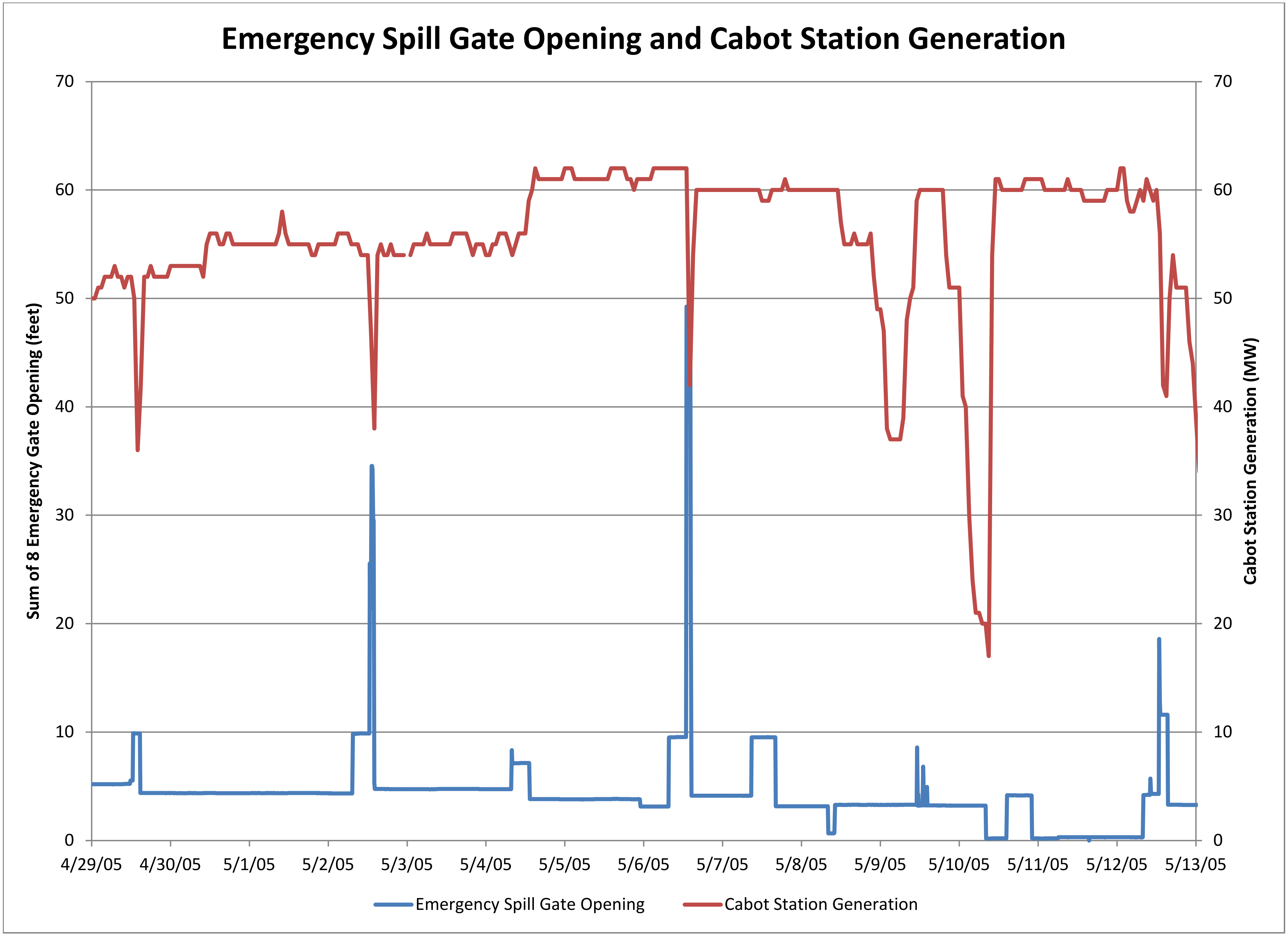


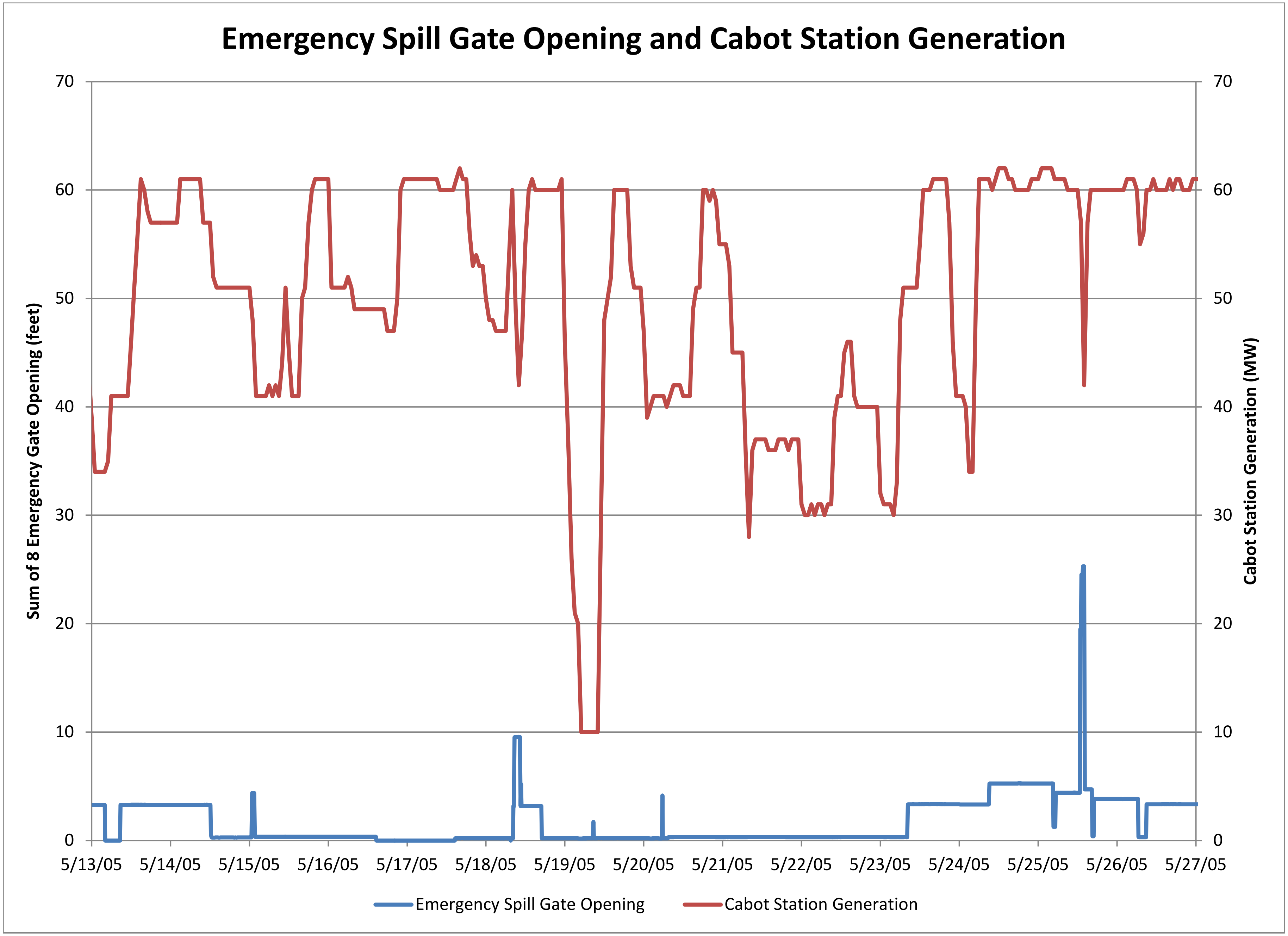
Document Accession #: 20140916-5028   Filed Date: 09/16/2014

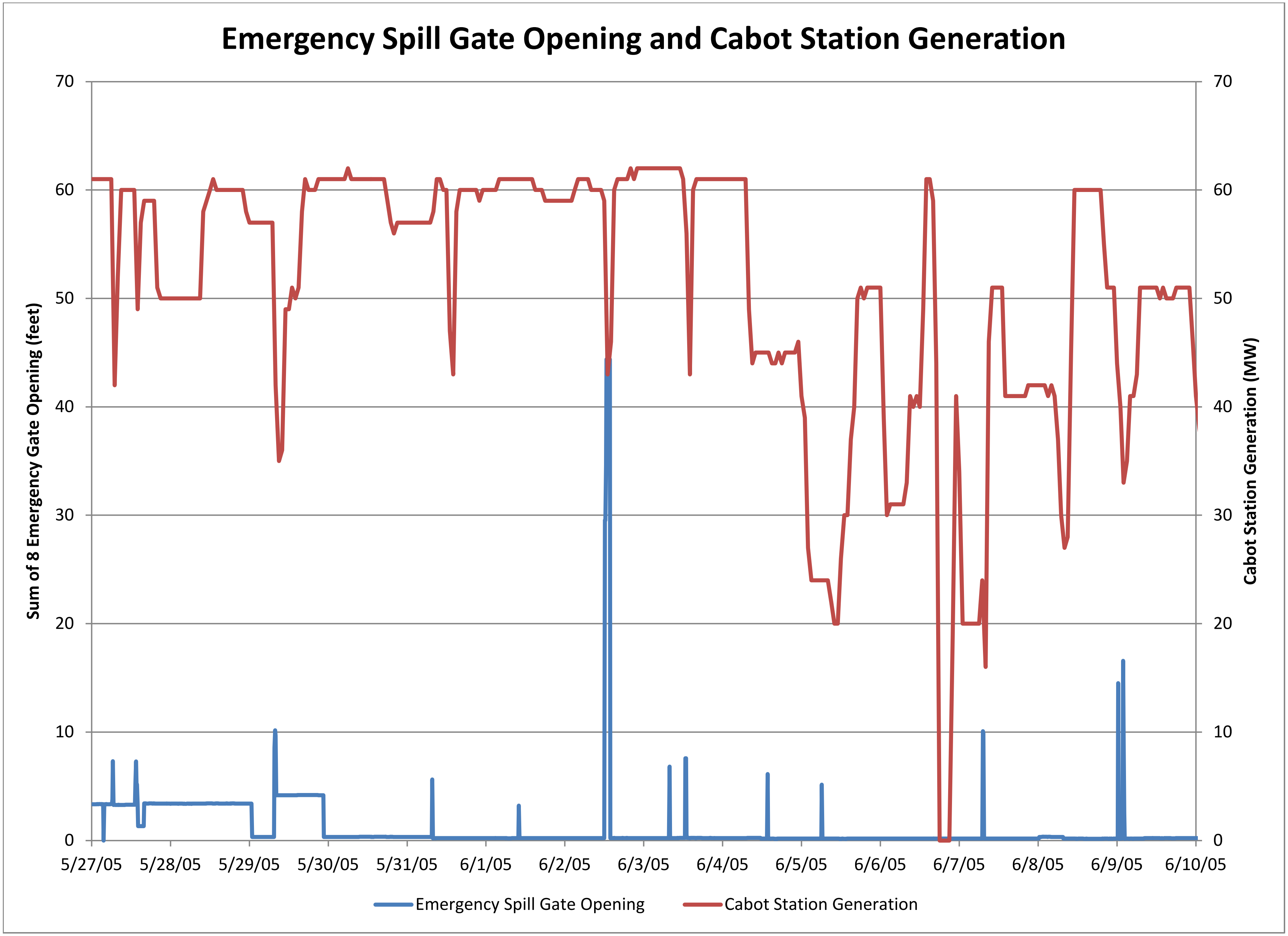
APPENDIX A – BI-WEEKLY CHARTS OF SPILL GATE OPENING VS. CABOT STATION GENERATION

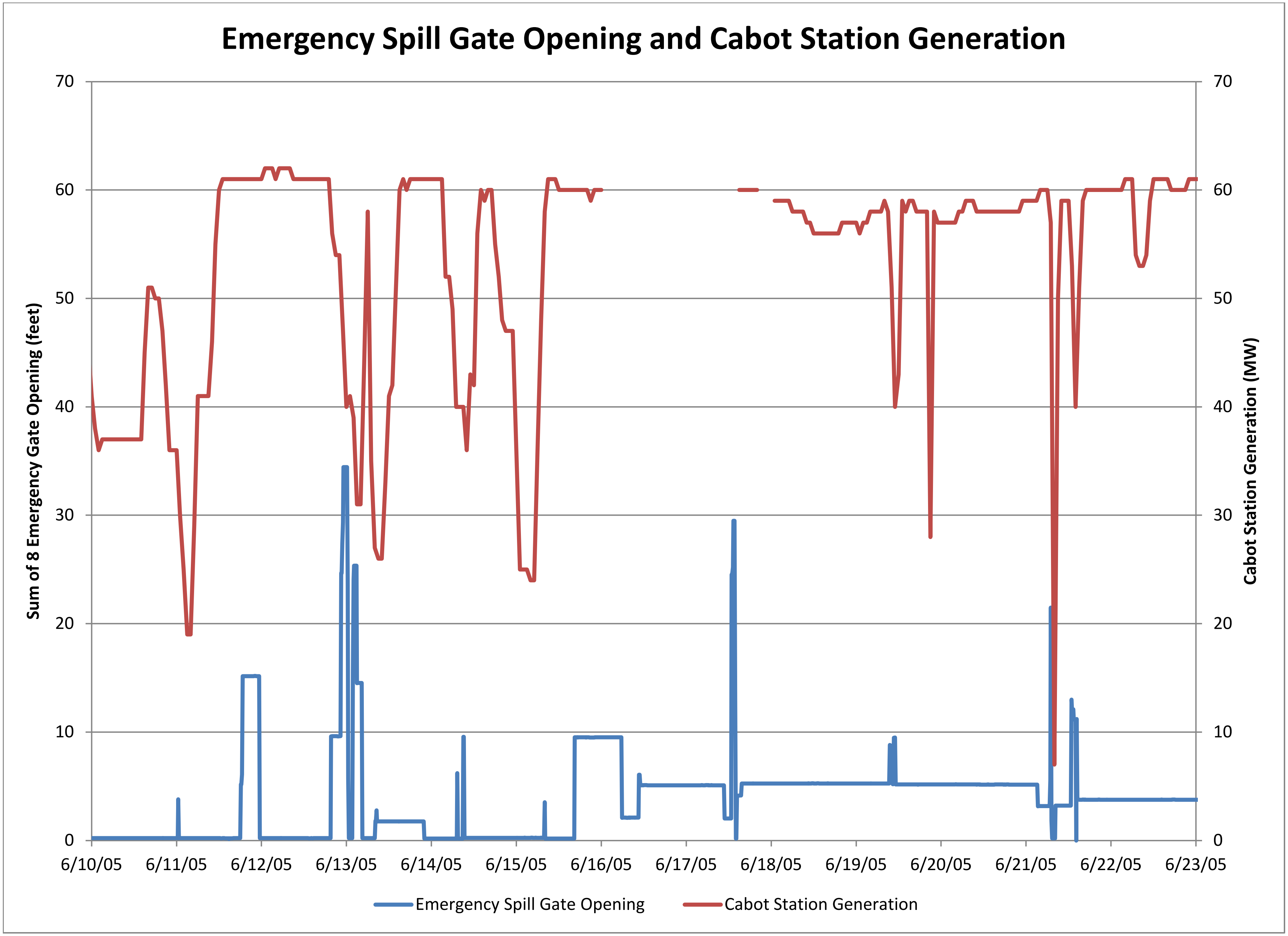


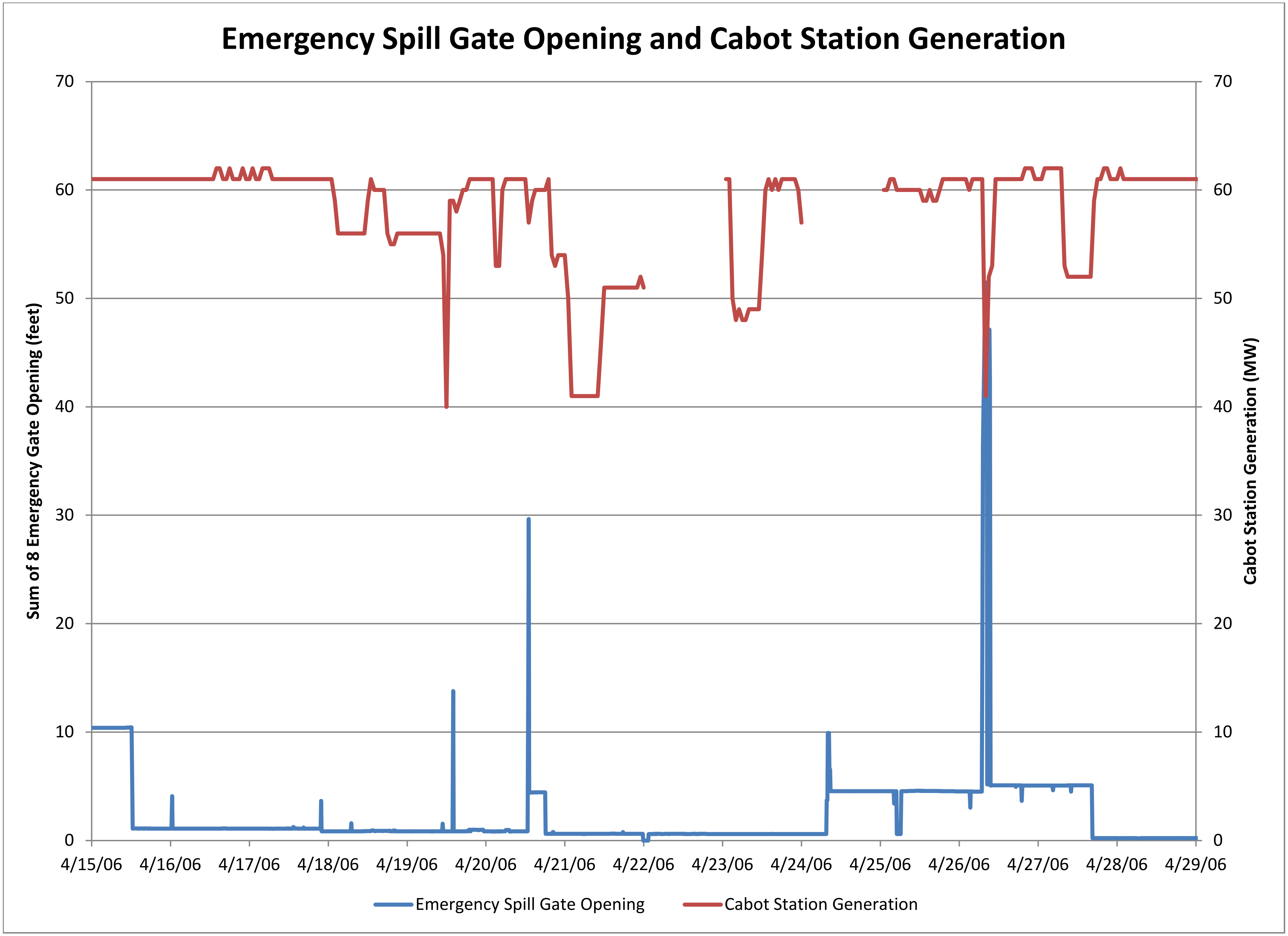
Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/15/05
4/16/05
4/17/05
4/18/05
4/19/05
4/20/05
4/21/05
4/22/05
4/23/05
4/24/05
4/25/05
4/26/05
4/27/05
4/28/05
4/29/05
Emergency Spill Gate Opening
Cabot Station Generation

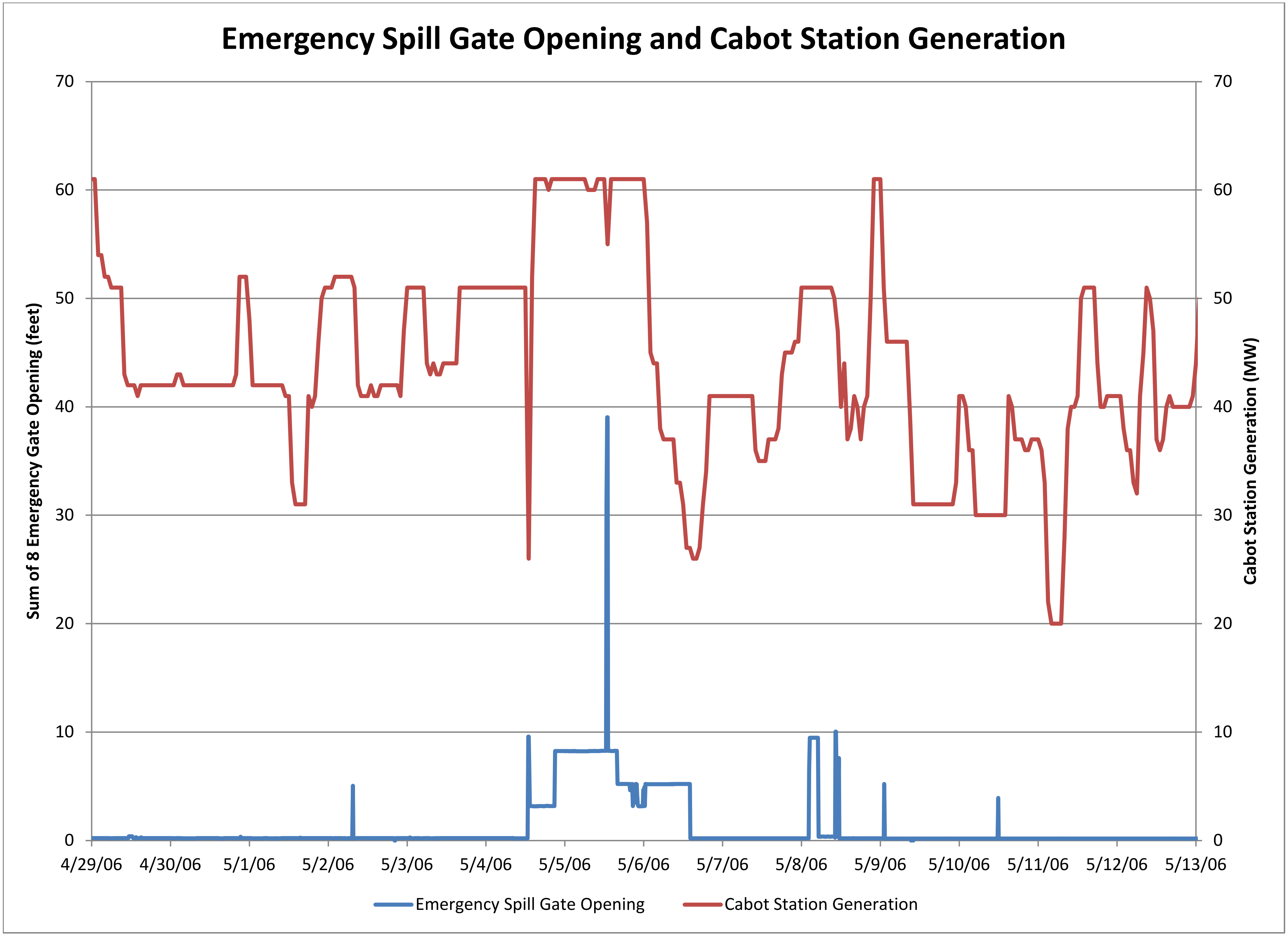

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/05
4/30/05
5/1/05
5/2/05
5/3/05
5/4/05
5/5/05
5/6/05
5/7/05
5/8/05
5/9/05
5/10/05
5/11/05
5/12/05
5/13/05
Emergency Spill Gate Opening
Cabot Station Generation

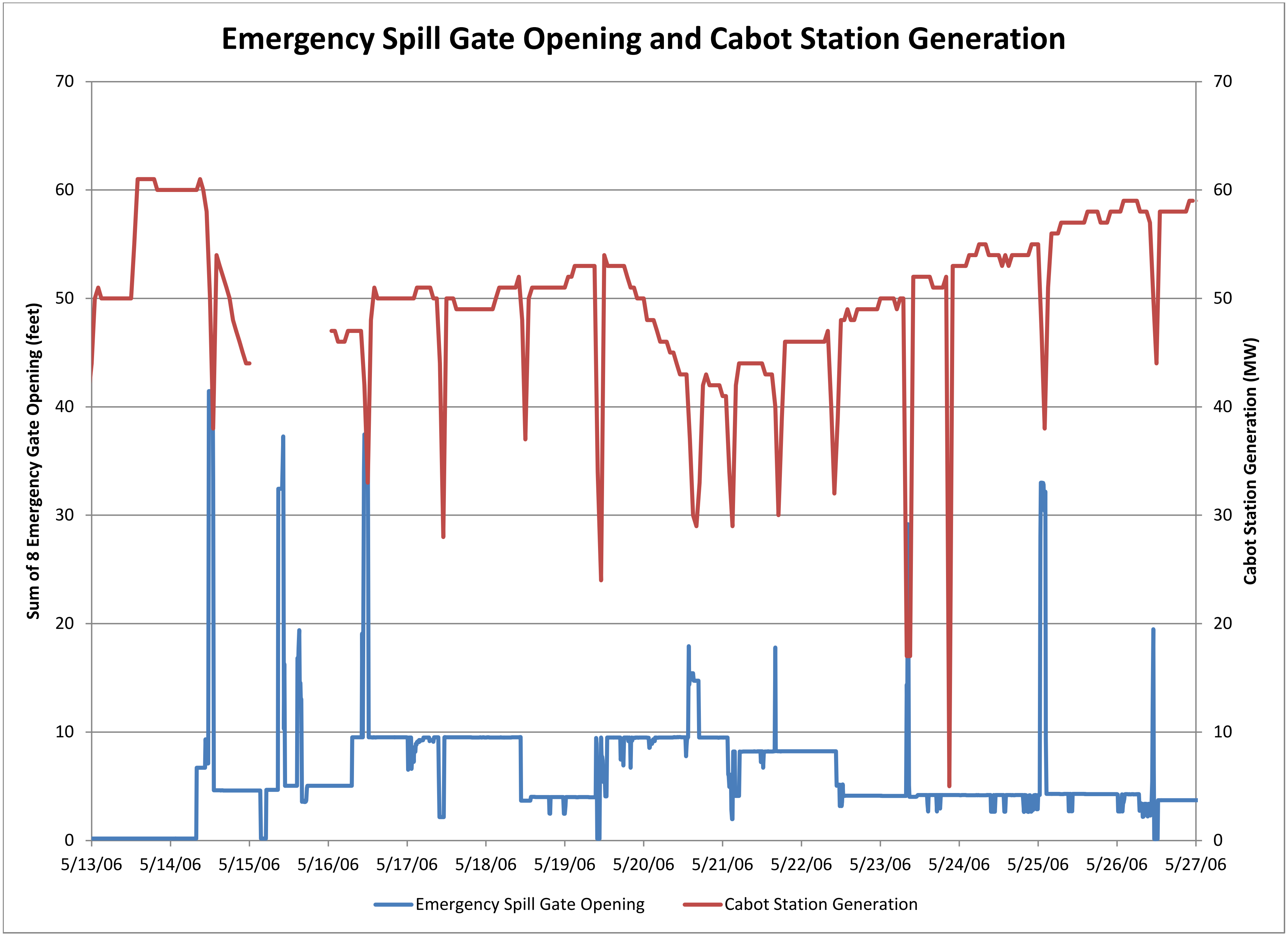

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/13/05
5/14/05
5/15/05
5/16/05
5/17/05
5/18/05
5/19/05
5/20/05
5/21/05
5/22/05
5/23/05
5/24/05
5/25/05
5/26/05
5/27/05
Emergency Spill Gate Opening
Cabot Station Generation

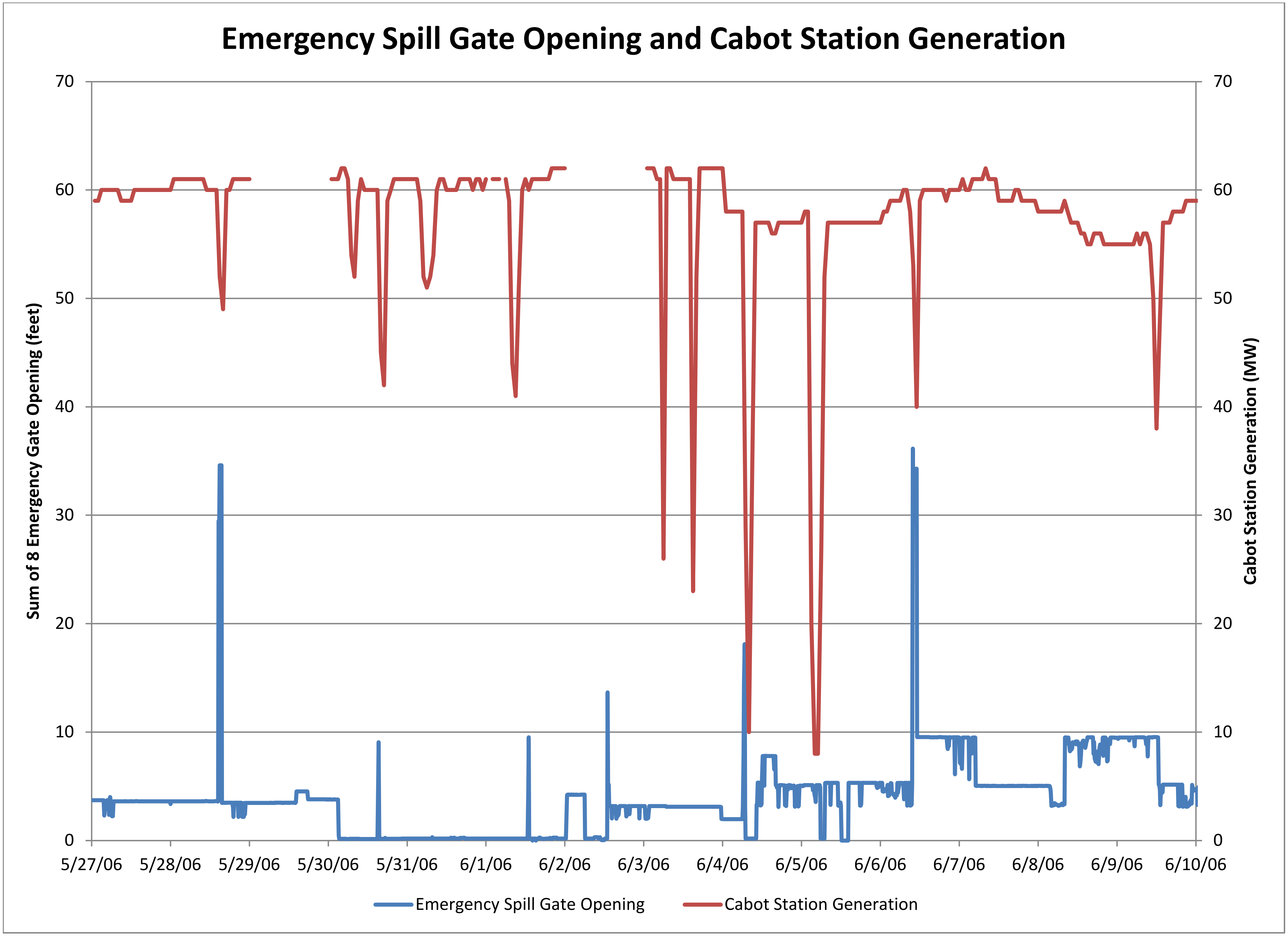

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/27/05
5/28/05
5/29/05
5/30/05
5/31/05
6/1/05
6/2/05
6/3/05
6/4/05
6/5/05
6/6/05
6/7/05
6/8/05
6/9/05
6/10/05
Emergency Spill Gate Opening
Cabot Station Generation

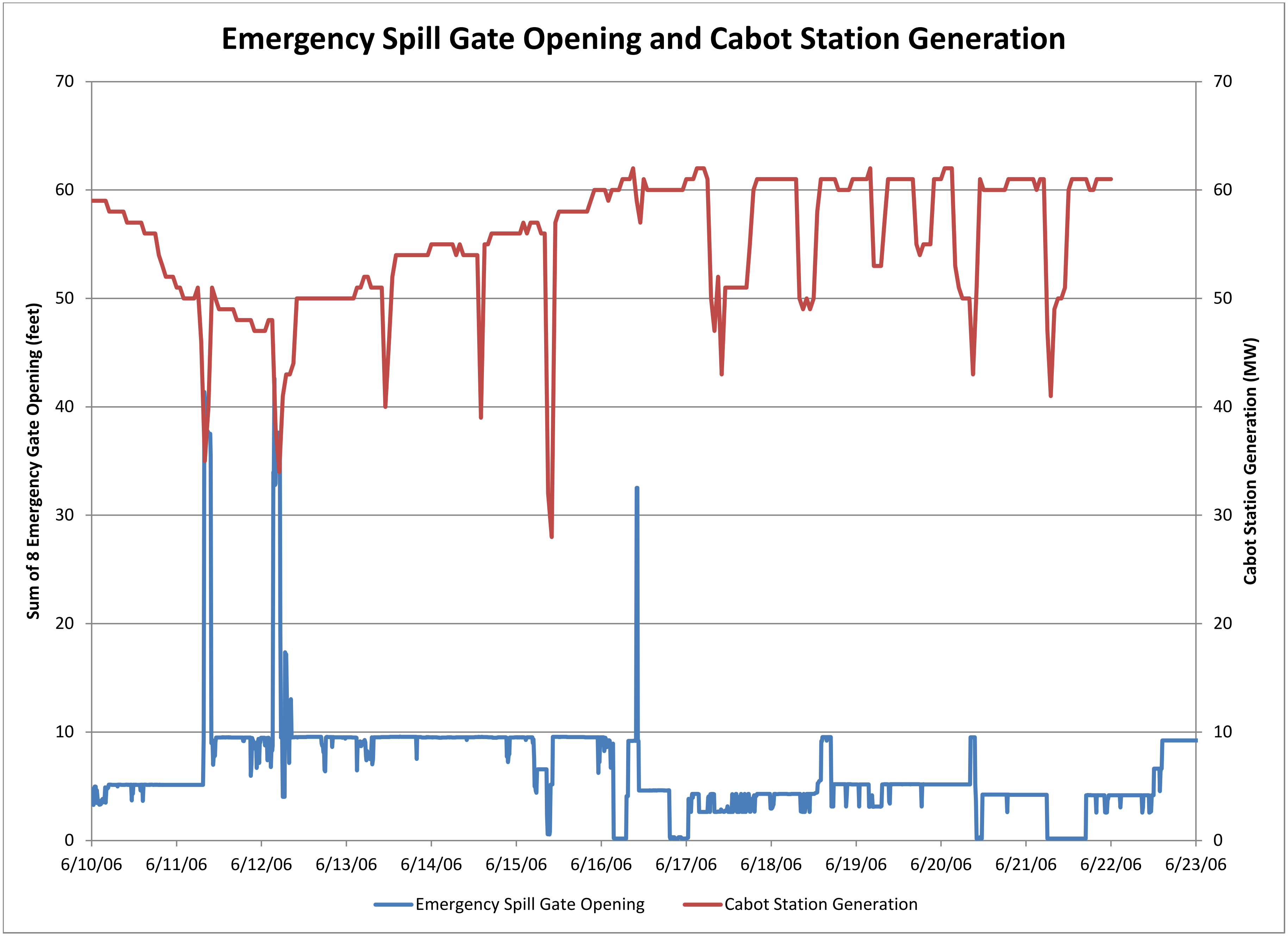

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
6/10/05
6/11/05
6/12/05
6/13/05
6/14/05
6/15/05
6/16/05
6/17/05
6/18/05
6/19/05
6/20/05
6/21/05
6/22/05
6/23/05
Emergency Spill Gate Opening
Cabot Station Generation

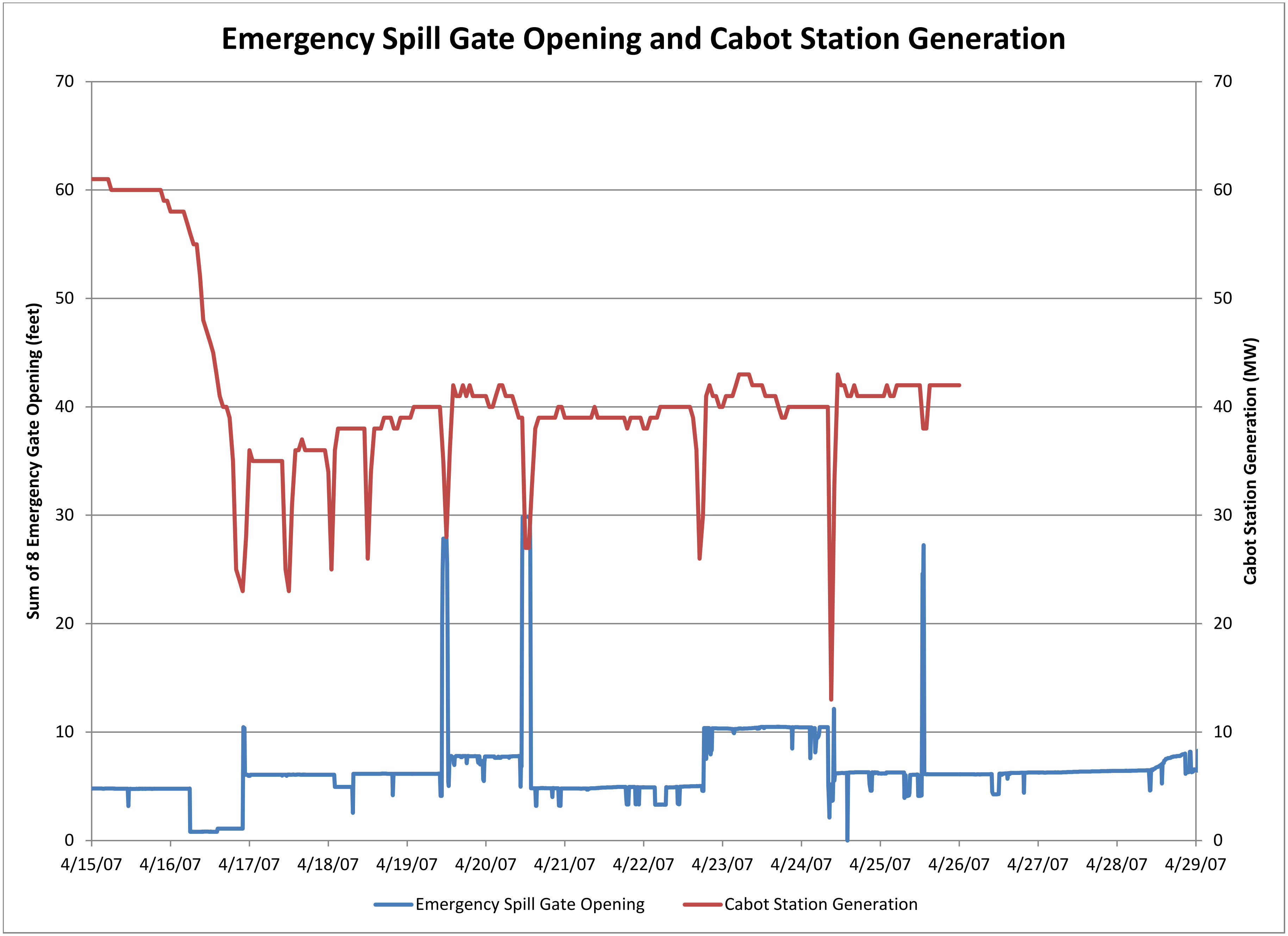

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/15/06
4/16/06
4/17/06
4/18/06
4/19/06
4/20/06
4/21/06
4/22/06
4/23/06
4/24/06
4/25/06
4/26/06
4/27/06
4/28/06
4/29/06
Emergency Spill Gate Opening
Cabot Station Generation

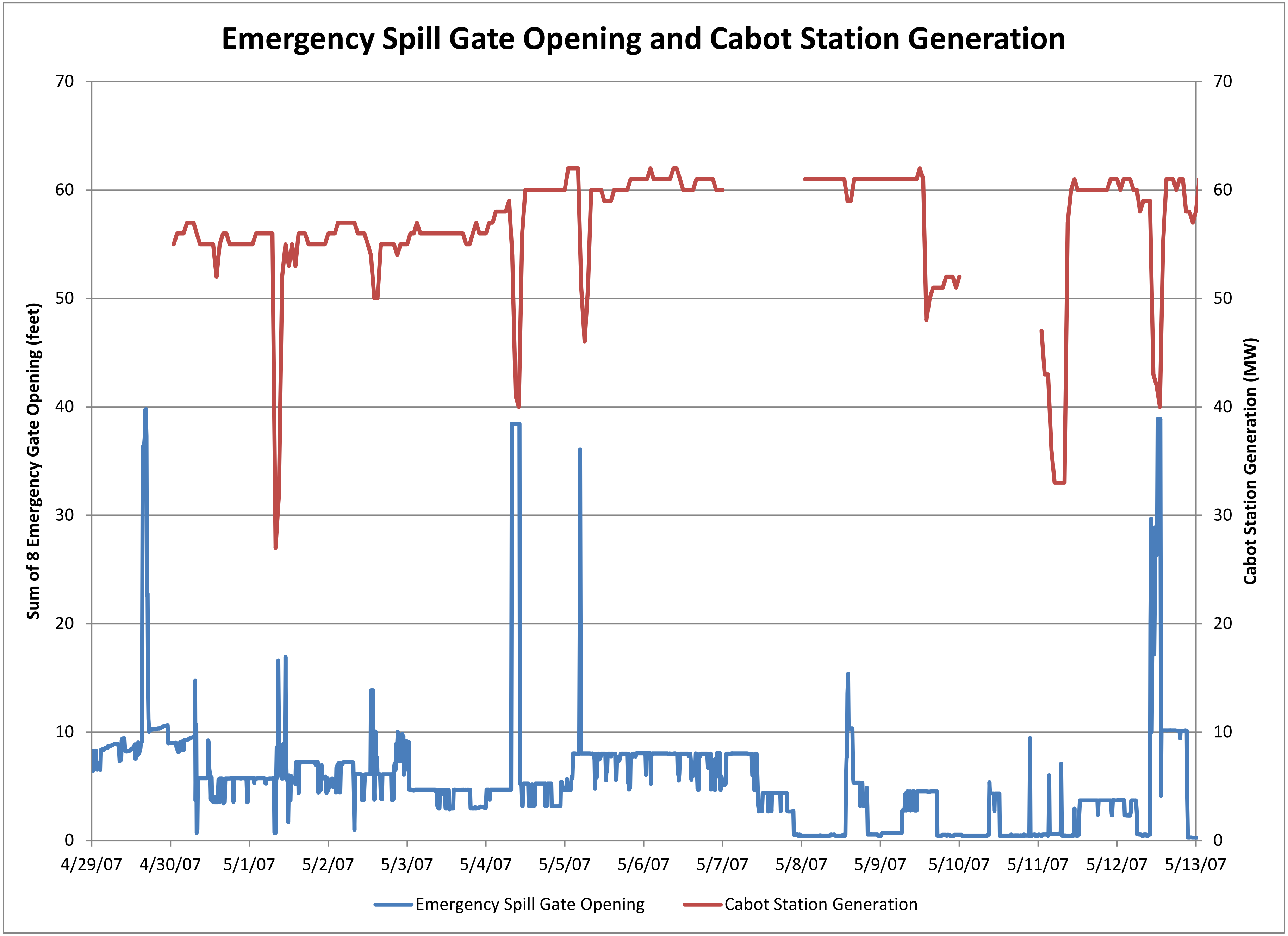

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/06
4/30/06
5/1/06
5/2/06
5/3/06
5/4/06
5/5/06
5/6/06
5/7/06
5/8/06
5/9/06
5/10/06
5/11/06
5/12/06
5/13/06
Emergency Spill Gate Opening
Cabot Station Generation

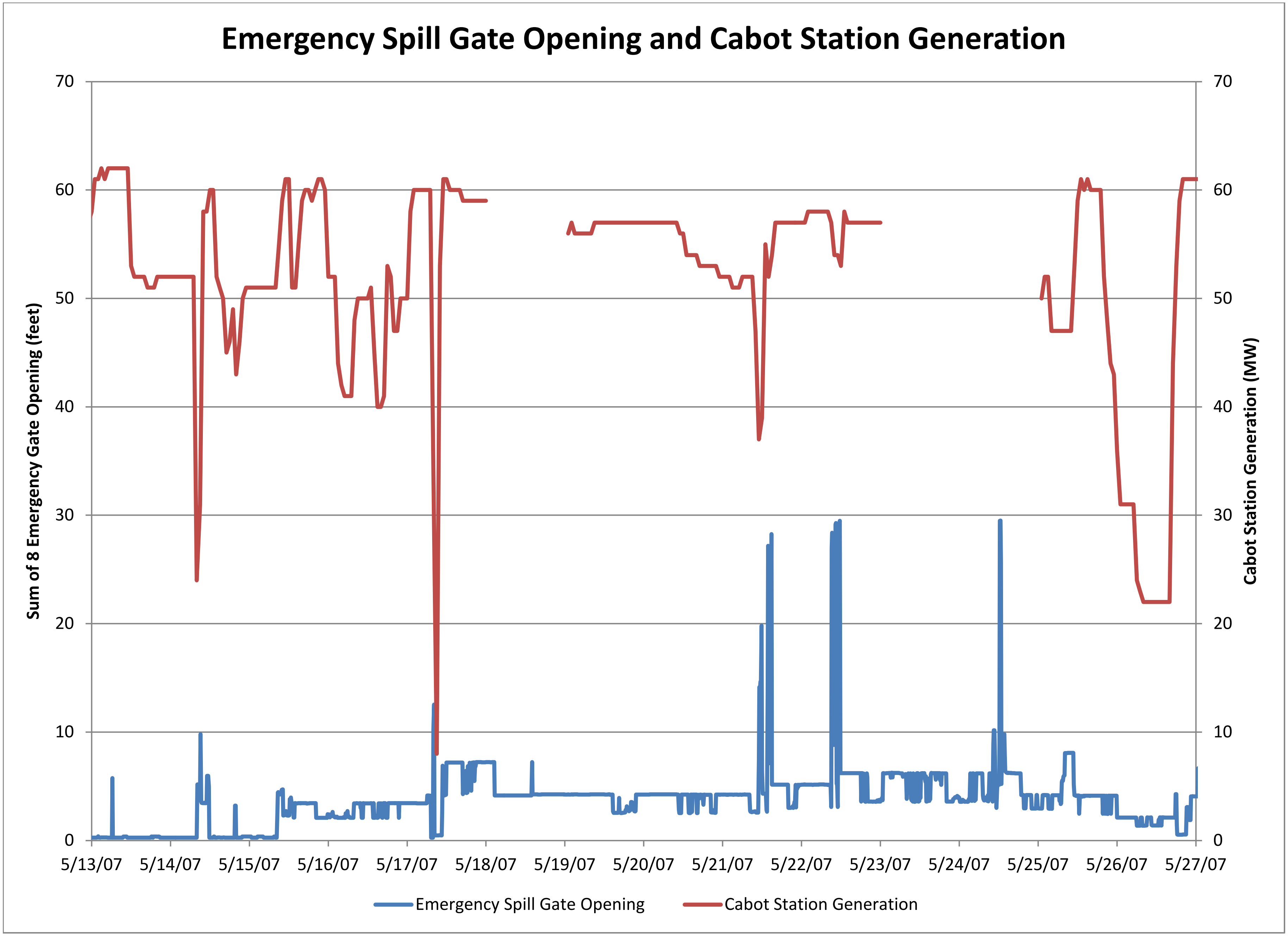

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/13/06
5/14/06
5/15/06
5/16/06
5/17/06
5/18/06
5/19/06
5/20/06
5/21/06
5/22/06
5/23/06
5/24/06
5/25/06
5/26/06
5/27/06
Emergency Spill Gate Opening
Cabot Station Generation

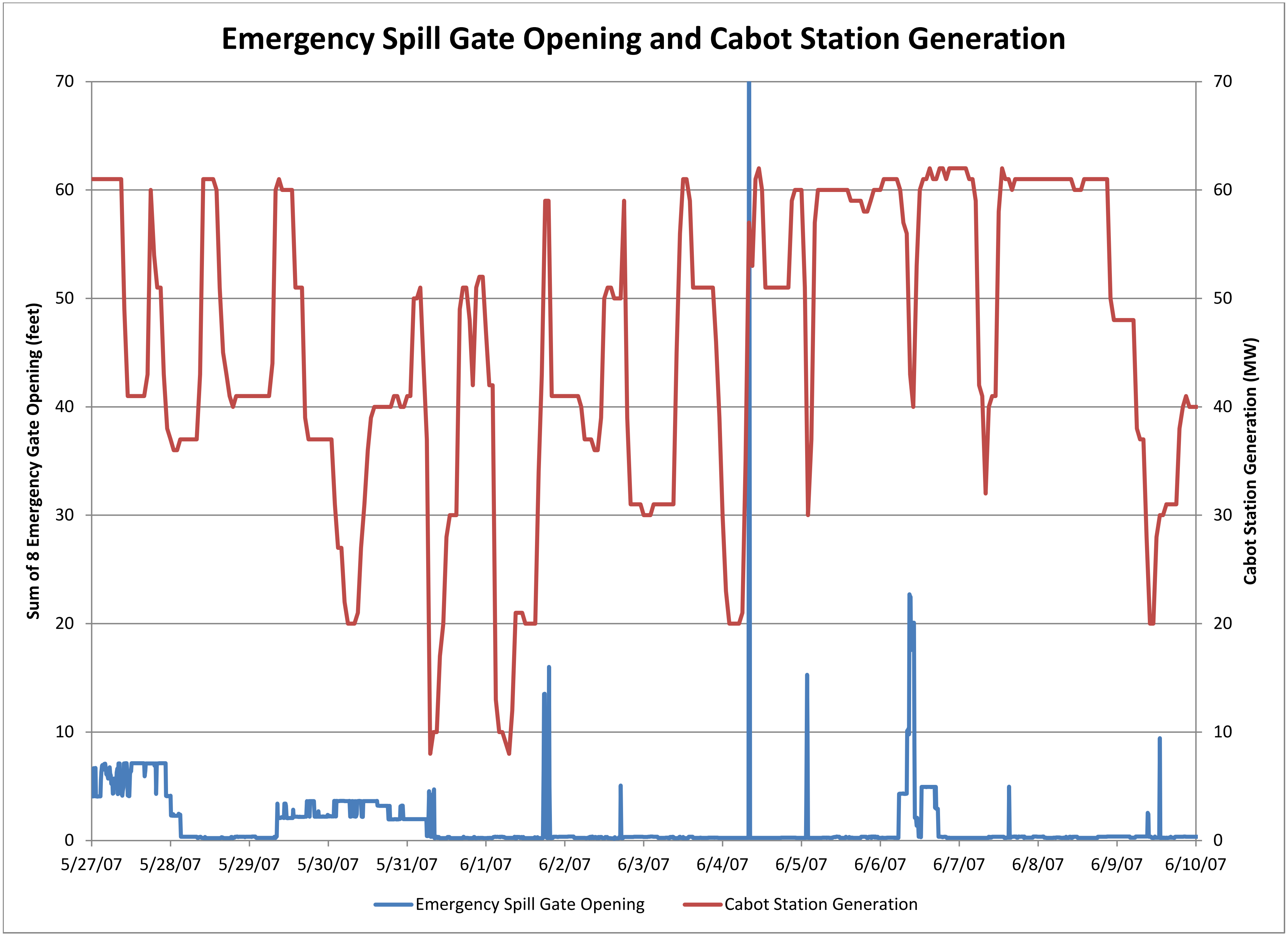

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/27/06
5/28/06
5/29/06
5/30/06
5/31/06
6/1/06
6/2/06
6/3/06
6/4/06
6/5/06
6/6/06
6/7/06
6/8/06
6/9/06
6/10/06
Emergency Spill Gate Opening
Cabot Station Generation

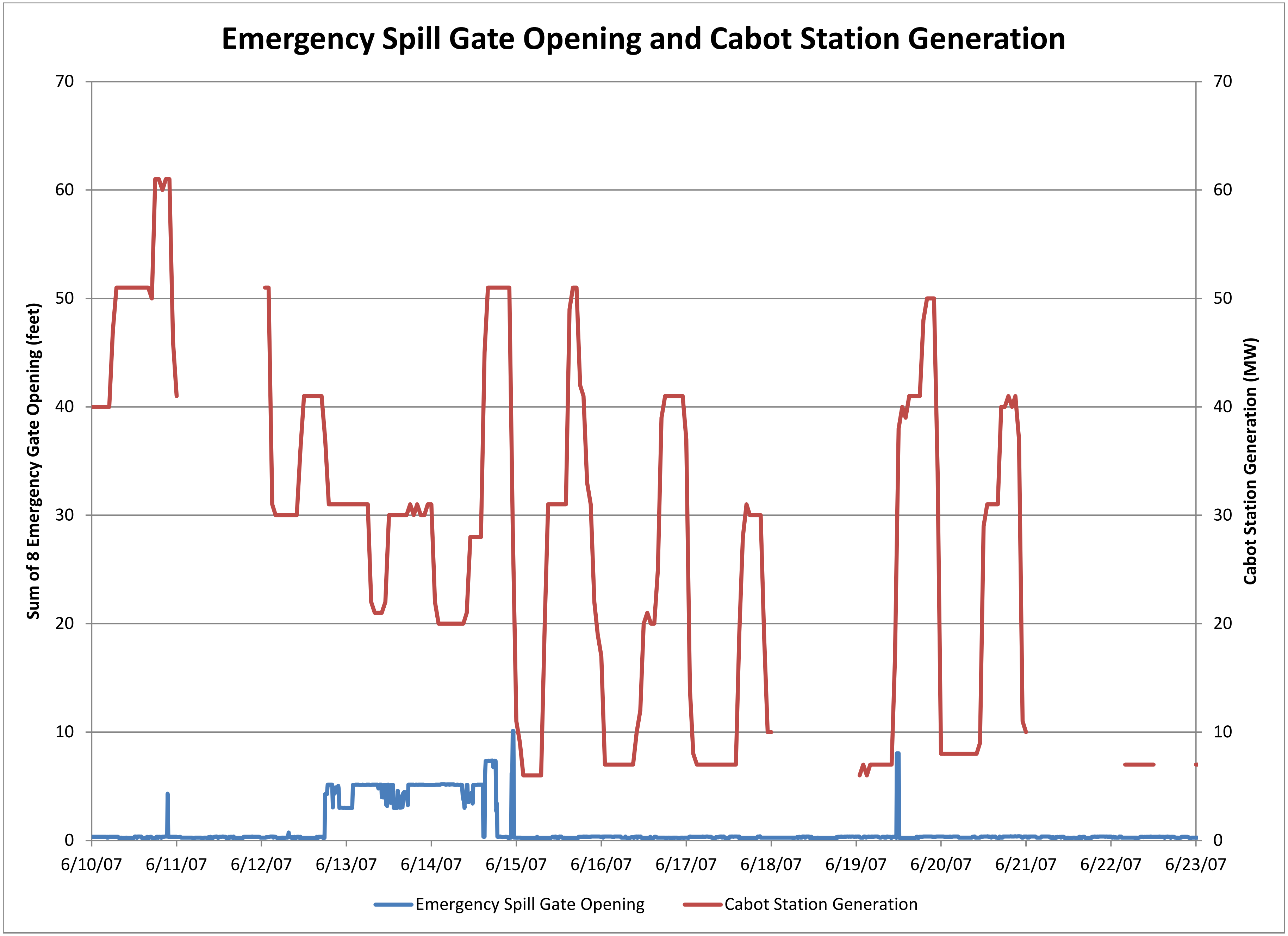

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
6/10/06
6/11/06
6/12/06
6/13/06
6/14/06
6/15/06
6/16/06
6/17/06
6/18/06
6/19/06
6/20/06
6/21/06
6/22/06
6/23/06
Emergency Spill Gate Opening
Cabot Station Generation


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/15/07
4/16/07
4/17/07
4/18/07
4/19/07
4/20/07
4/21/07
4/22/07
4/23/07
4/24/07
4/25/07
4/26/07
4/27/07
4/28/07
4/29/07
Emergency Spill Gate Opening
Cabot Station Generation

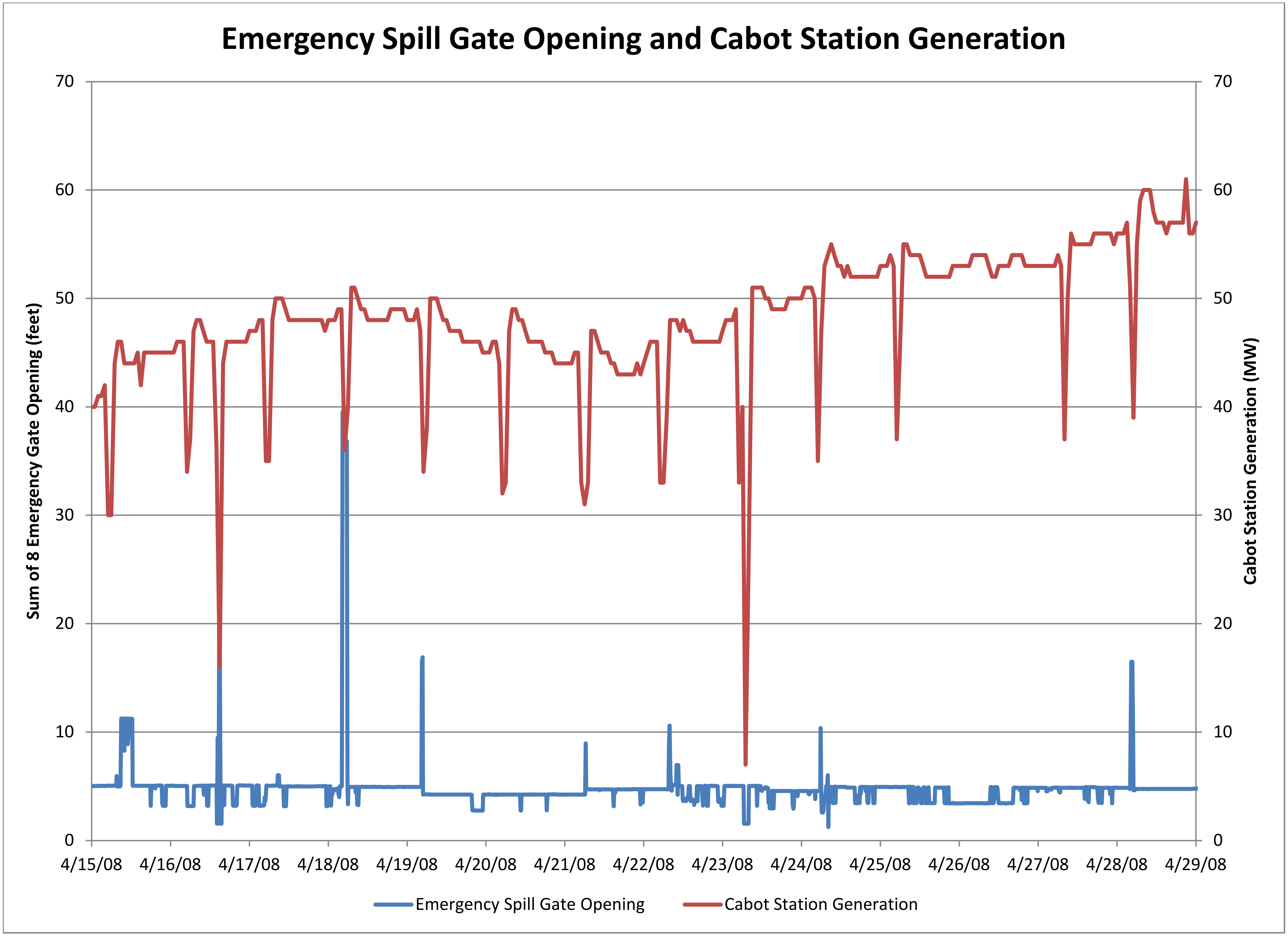

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/07
4/30/07
5/1/07
5/2/07
5/3/07
5/4/07
5/5/07
5/6/07
5/7/07
5/8/07
5/9/07
5/10/07
5/11/07
5/12/07
5/13/07
Emergency Spill Gate Opening
Cabot Station Generation


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
70
60
50
40
30
20
10
0
5/13/07
5/14/07
5/15/07
5/16/07
5/17/07
5/18/07
5/19/07
5/20/07
5/21/07
5/22/07
5/23/07
5/24/07
5/25/07
5/26/07
5/27/07
Emergency Spill Gate Opening
Cabot Station Generation

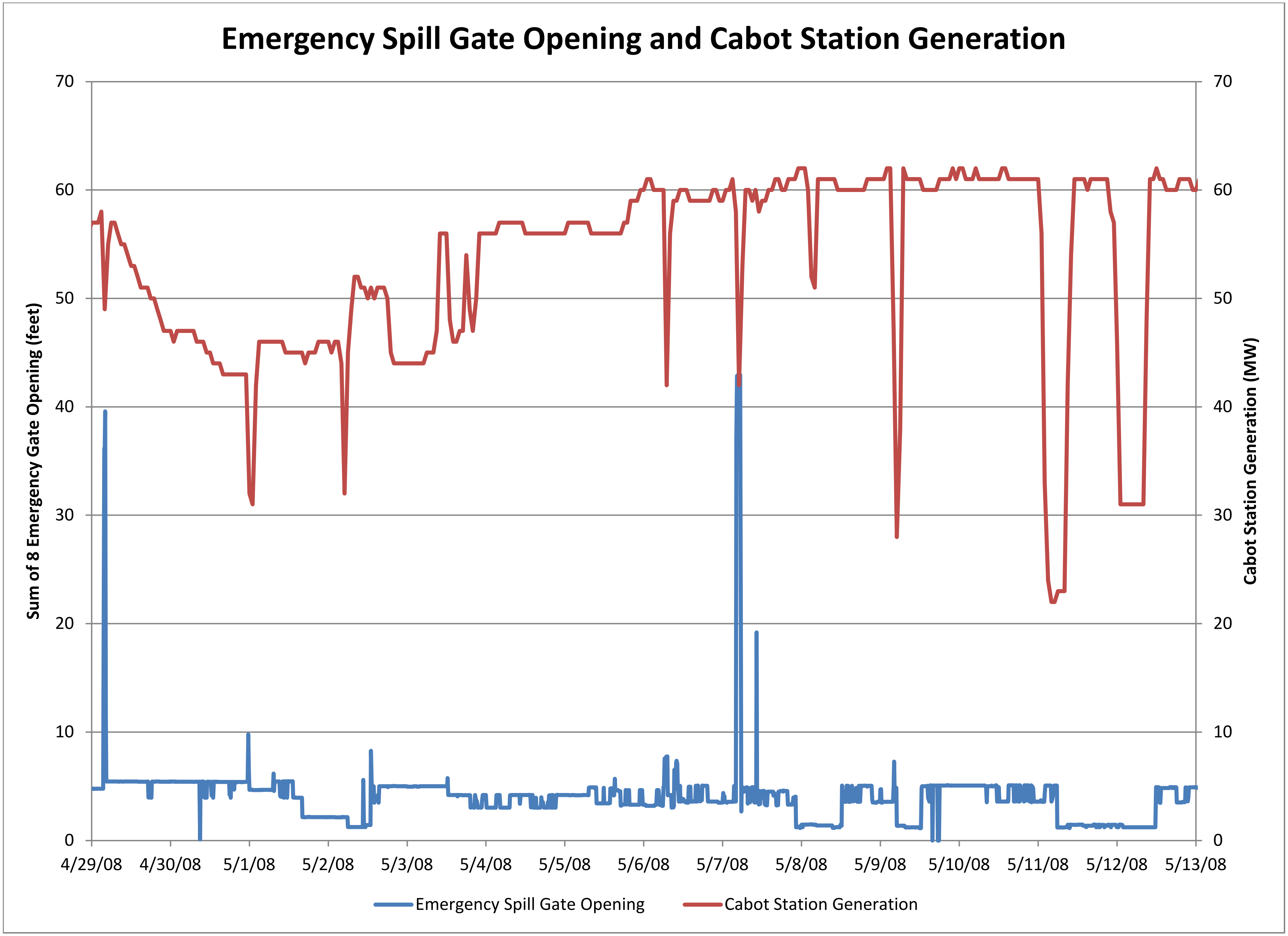

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/27/07
5/28/07
5/29/07
5/30/07
5/31/07
6/1/07
6/2/07
6/3/07
6/4/07
6/5/07
6/6/07
6/7/07
6/8/07
6/9/07
6/10/07
Emergency Spill Gate Opening
Cabot Station Generation

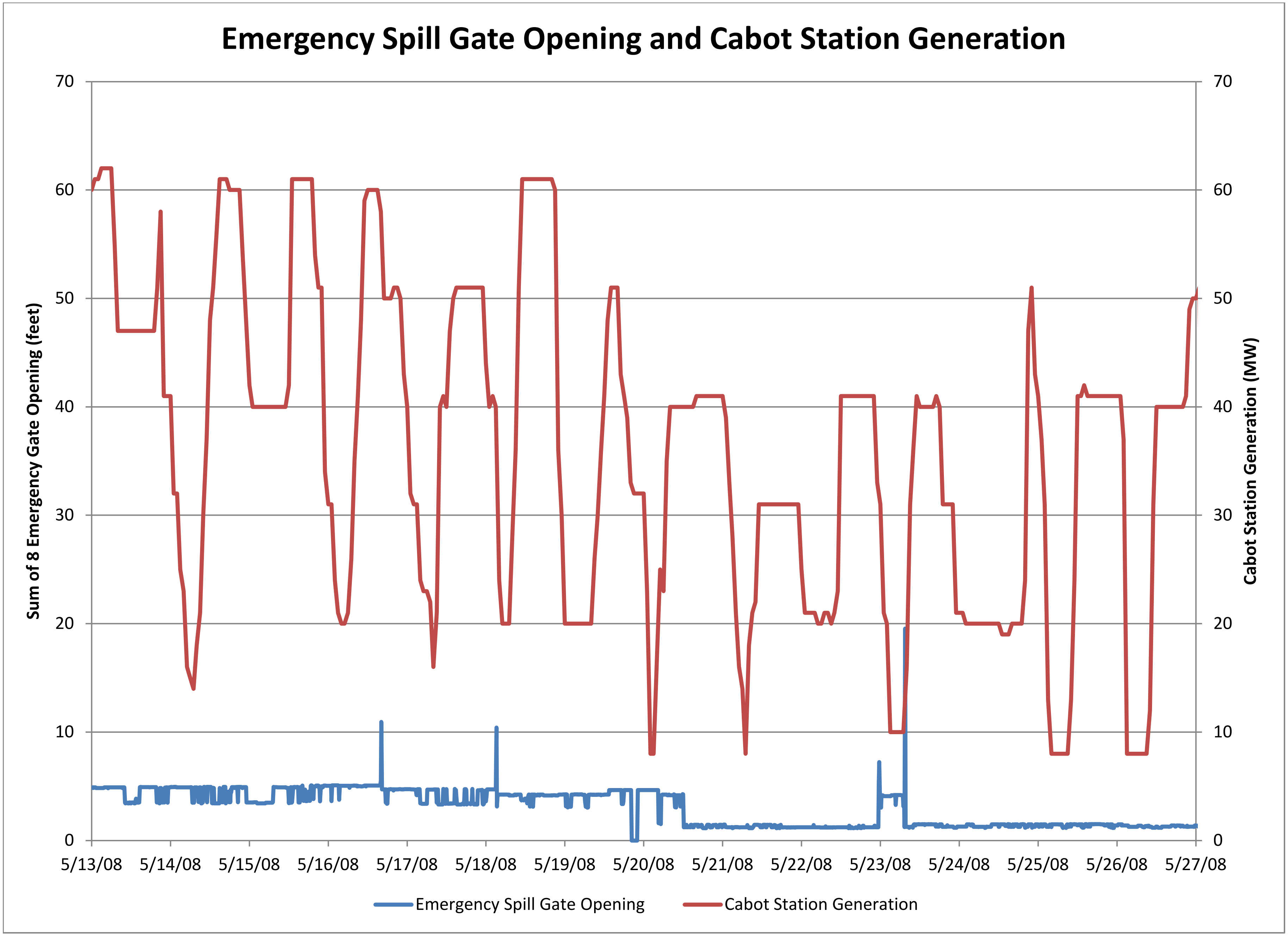


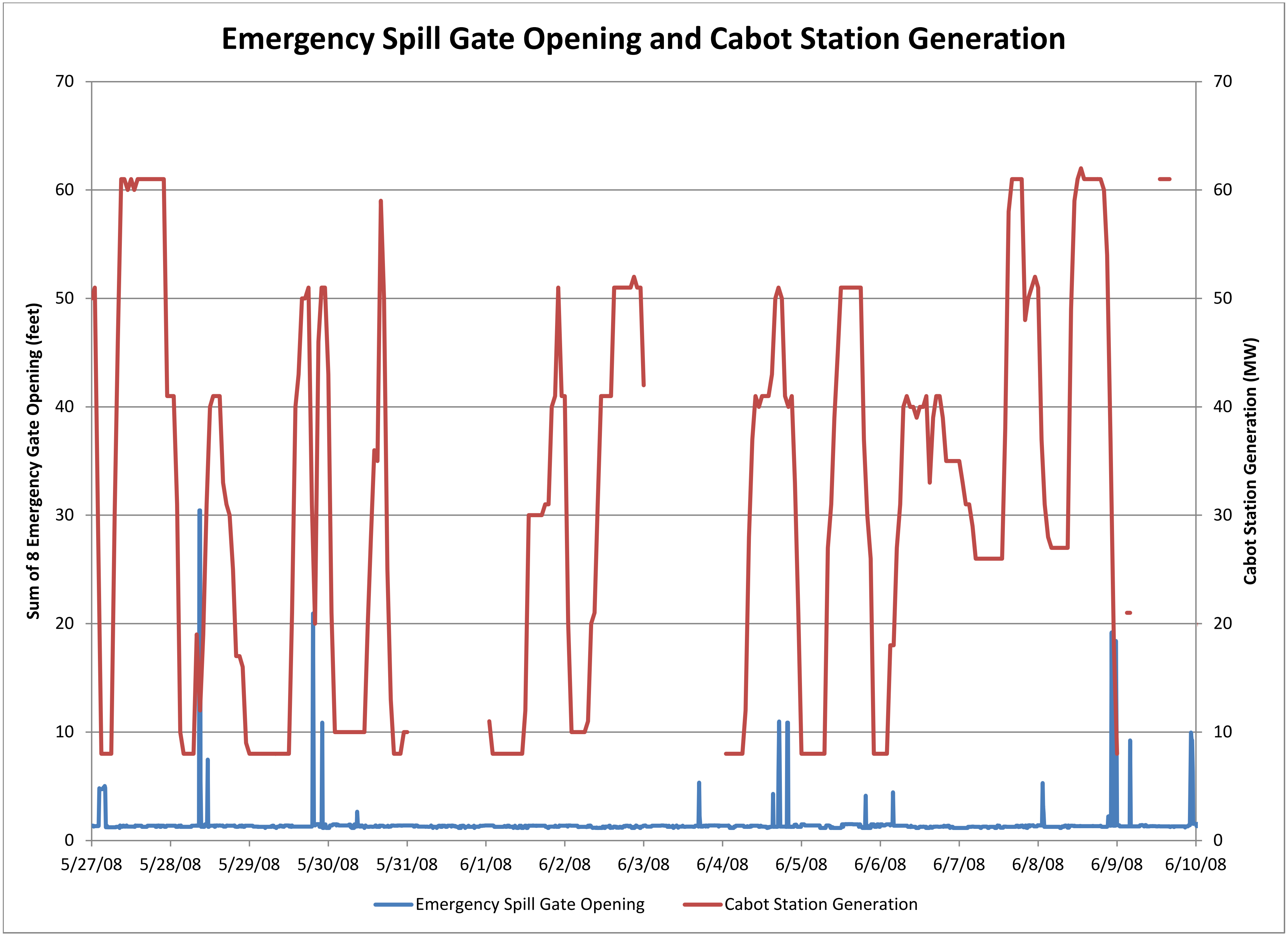
Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
6/10/07
6/11/07
6/12/07
6/13/07
6/14/07
6/15/07
6/16/07
6/17/07
6/18/07
6/19/07
6/20/07
6/21/07
6/22/07
6/23/07
Emergency Spill Gate Opening
Cabot Station Generation

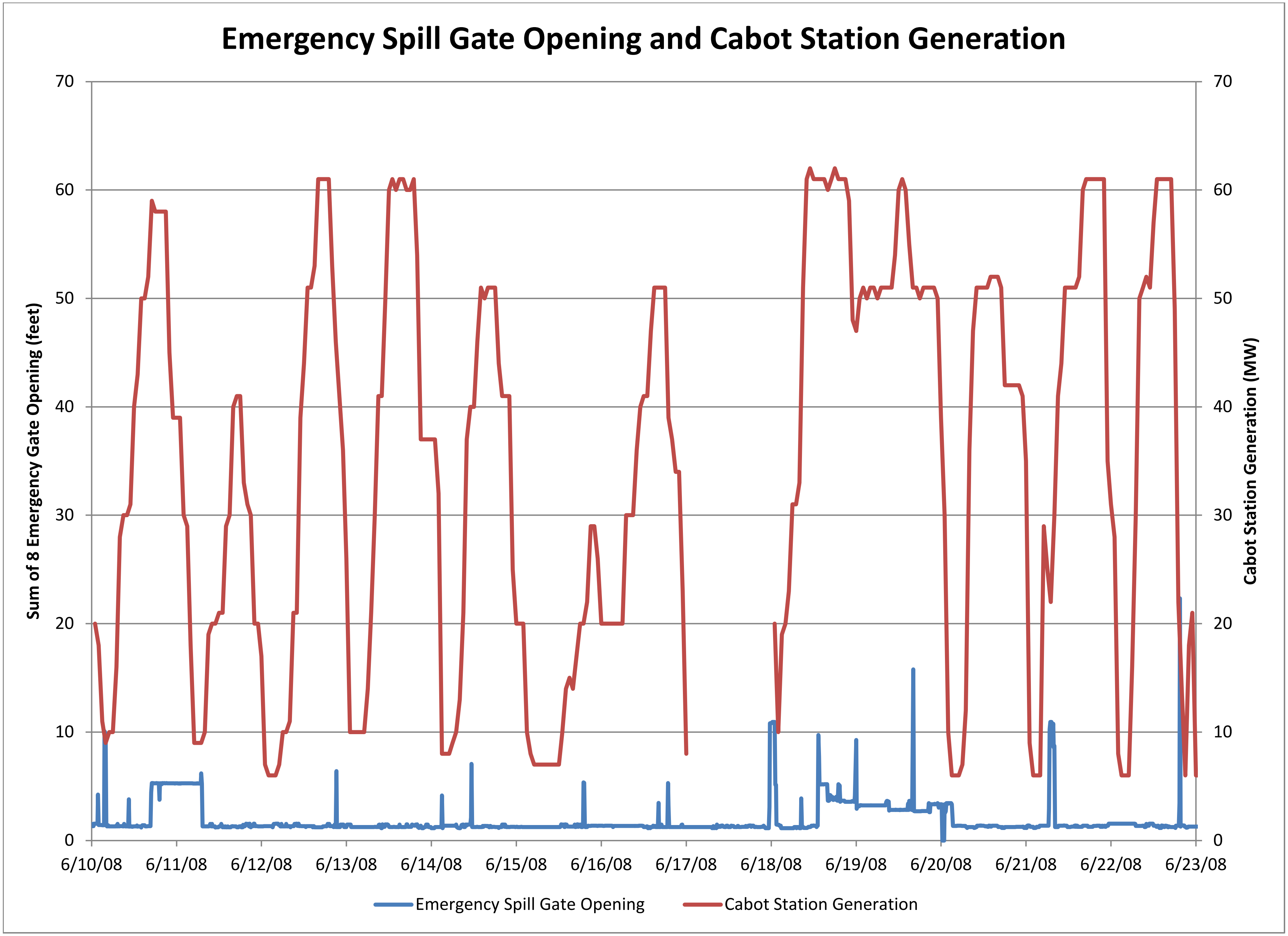


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/15/08
4/16/08
4/17/08
4/18/08
4/19/08
4/20/08
4/21/08
4/22/08
4/23/08
4/24/08
4/25/08
4/26/08
4/27/08
4/28/08
4/29/08
Emergency Spill Gate Opening
Cabot Station Generation

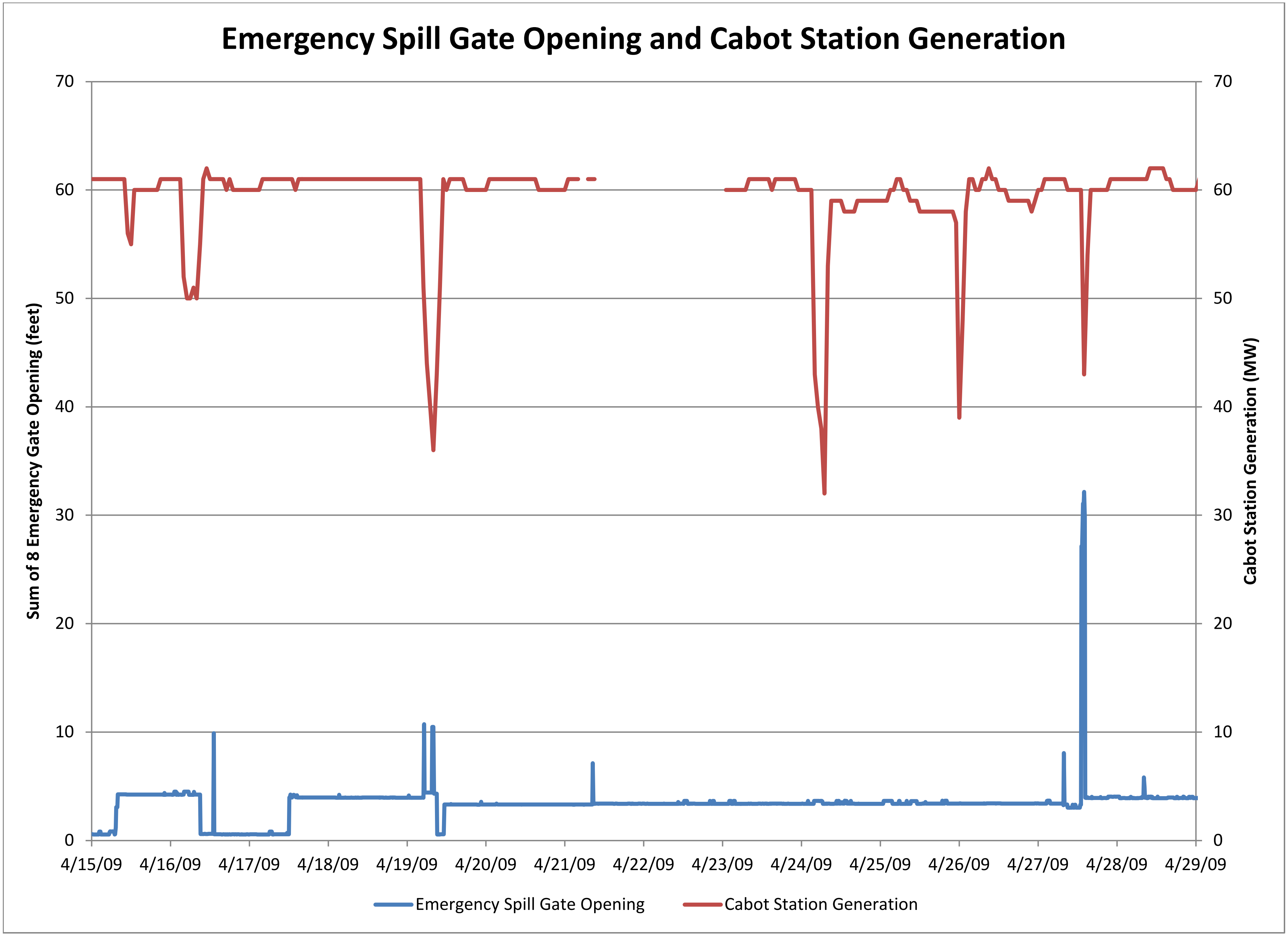

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/08
4/30/08
5/1/08
5/2/08
5/3/08
5/4/08
5/5/08
5/6/08
5/7/08
5/8/08
5/9/08
5/10/08
5/11/08
5/12/08
5/13/08
Emergency Spill Gate Opening
Cabot Station Generation

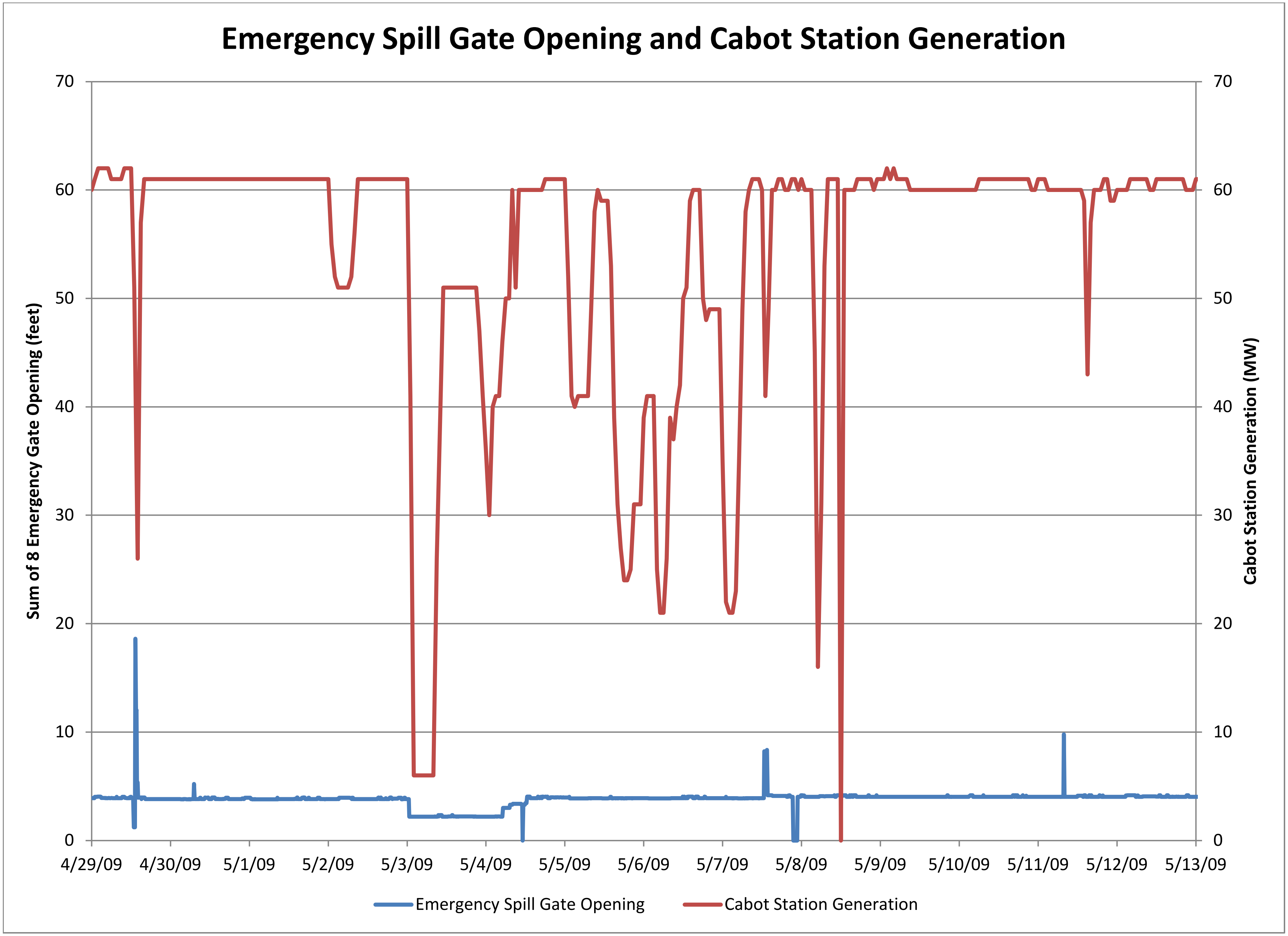

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/13/08
5/14/08
5/15/08
5/16/08
5/17/08
5/18/08
5/19/08
5/20/08
5/21/08
5/22/08
5/23/08
5/24/08
5/25/08
5/26/08
5/27/08
Emergency Spill Gate Opening
Cabot Station Generation


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/27/08
5/28/08
5/29/08
5/30/08
5/31/08
6/1/08
6/2/08
6/3/08
6/4/08
6/5/08
6/6/08
6/7/08
6/8/08
6/9/08
6/10/08
Emergency Spill Gate Opening
Cabot Station Generation

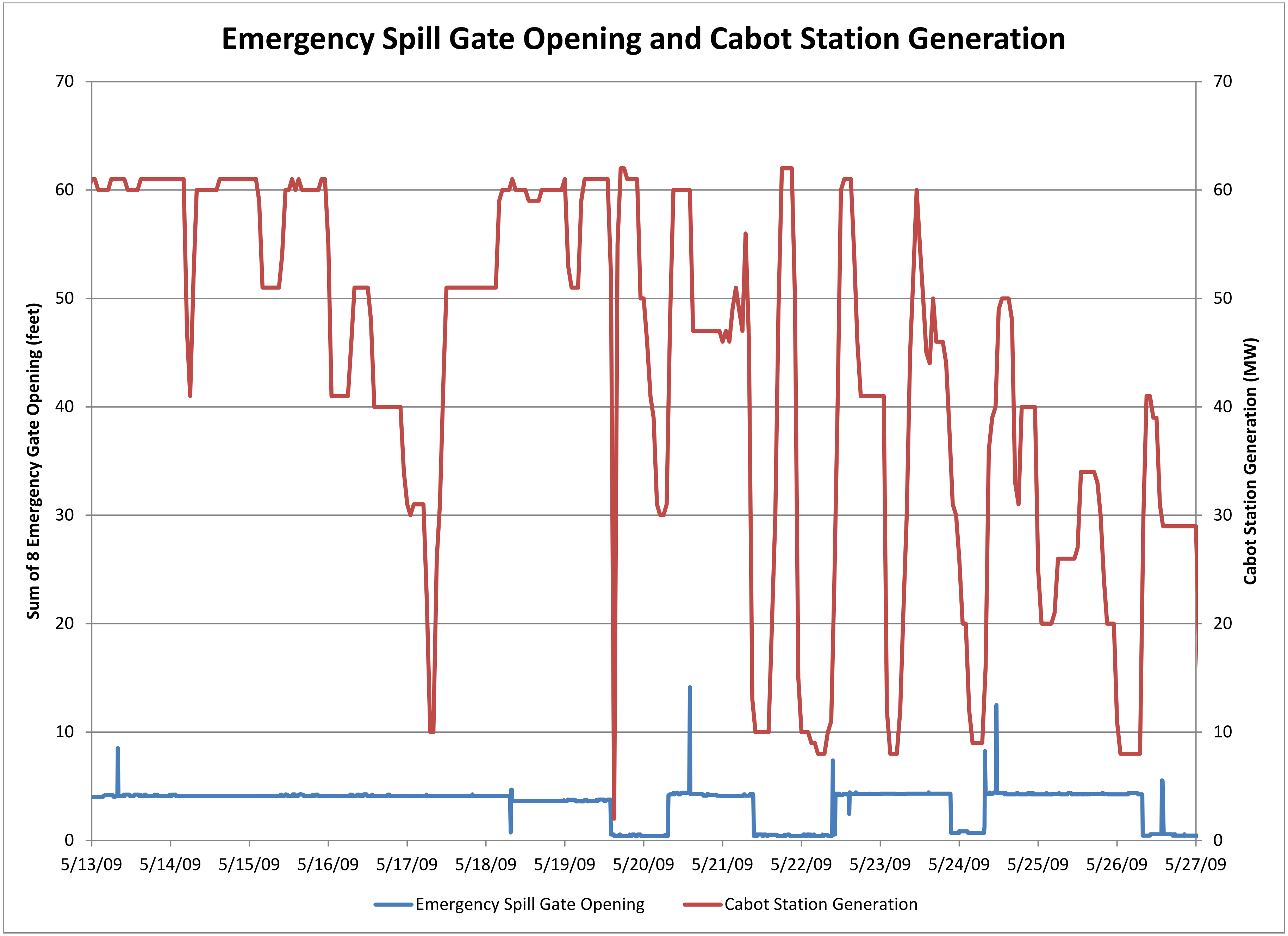


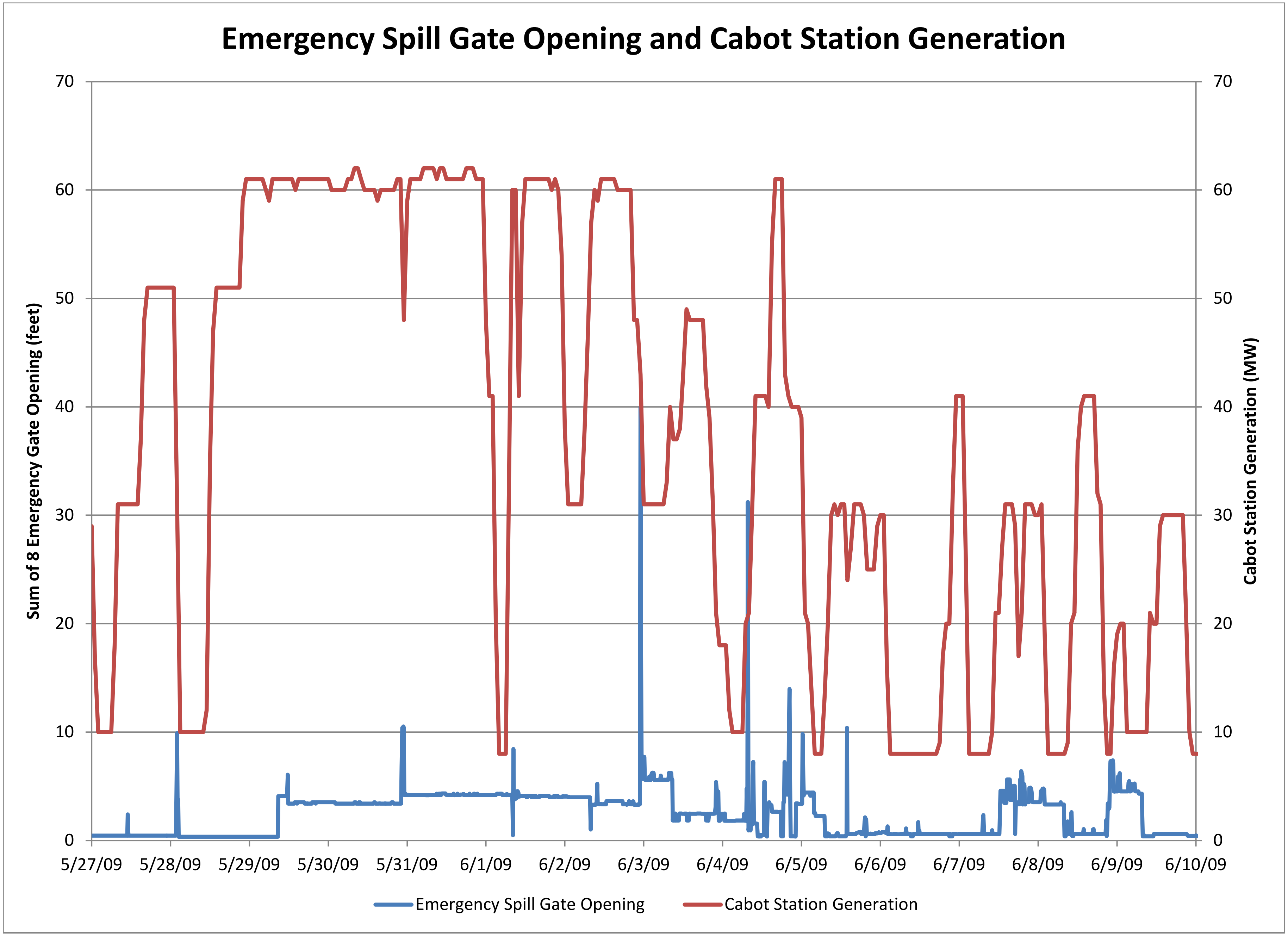
Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
6/10/08
6/11/08
6/12/08
6/13/08
6/14/08
6/15/08
6/16/08
6/17/08
6/18/08
6/19/08
6/20/08
6/21/08
6/22/08
6/23/08
Emergency Spill Gate Opening
Cabot Station Generation

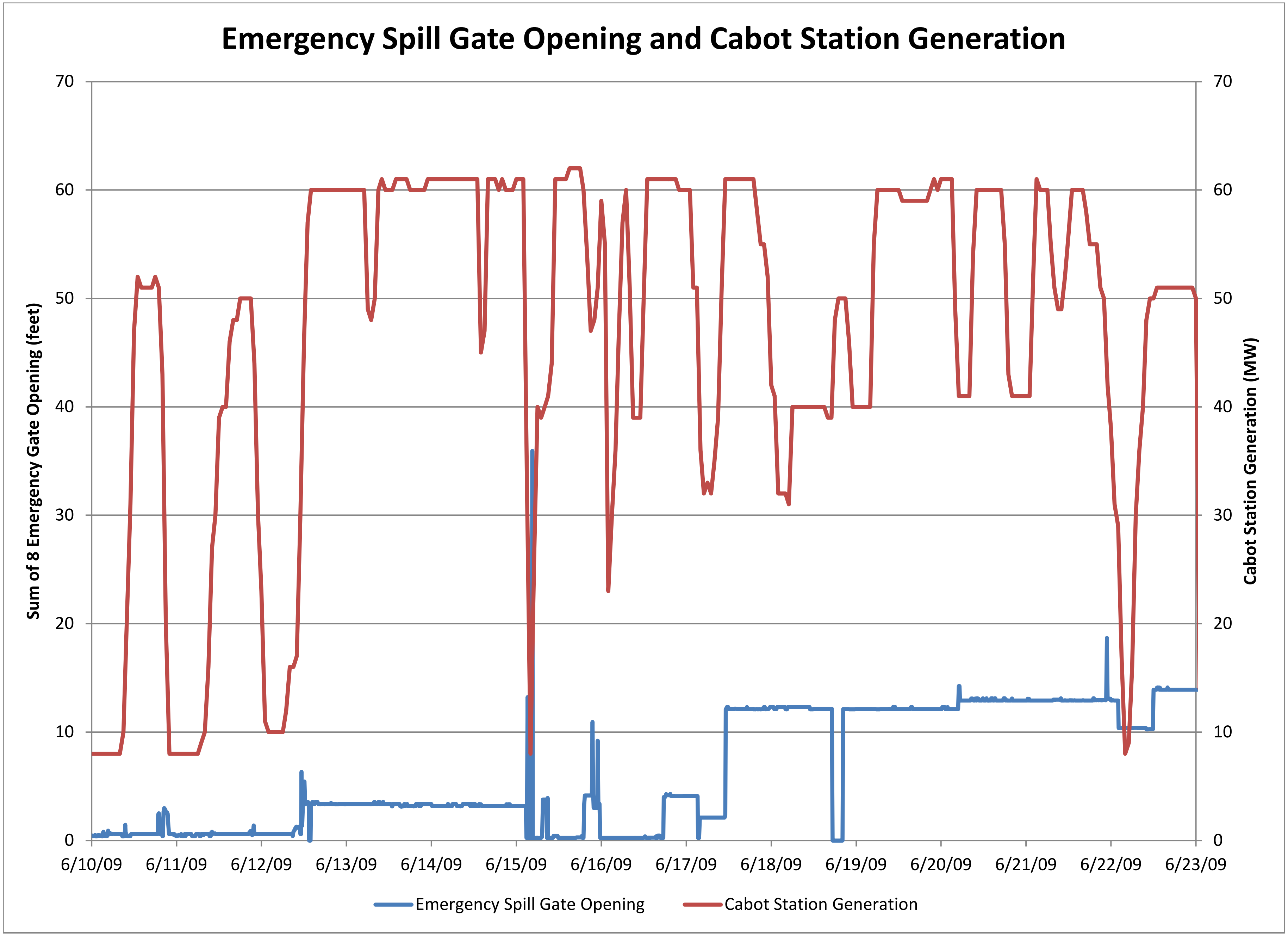

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/15/09
4/16/09
4/17/09
4/18/09
4/19/09
4/20/09
4/21/09
4/22/09
4/23/09
4/24/09
4/25/09
4/26/09
4/27/09
4/28/09
4/29/09
Emergency Spill Gate Opening
Cabot Station Generation

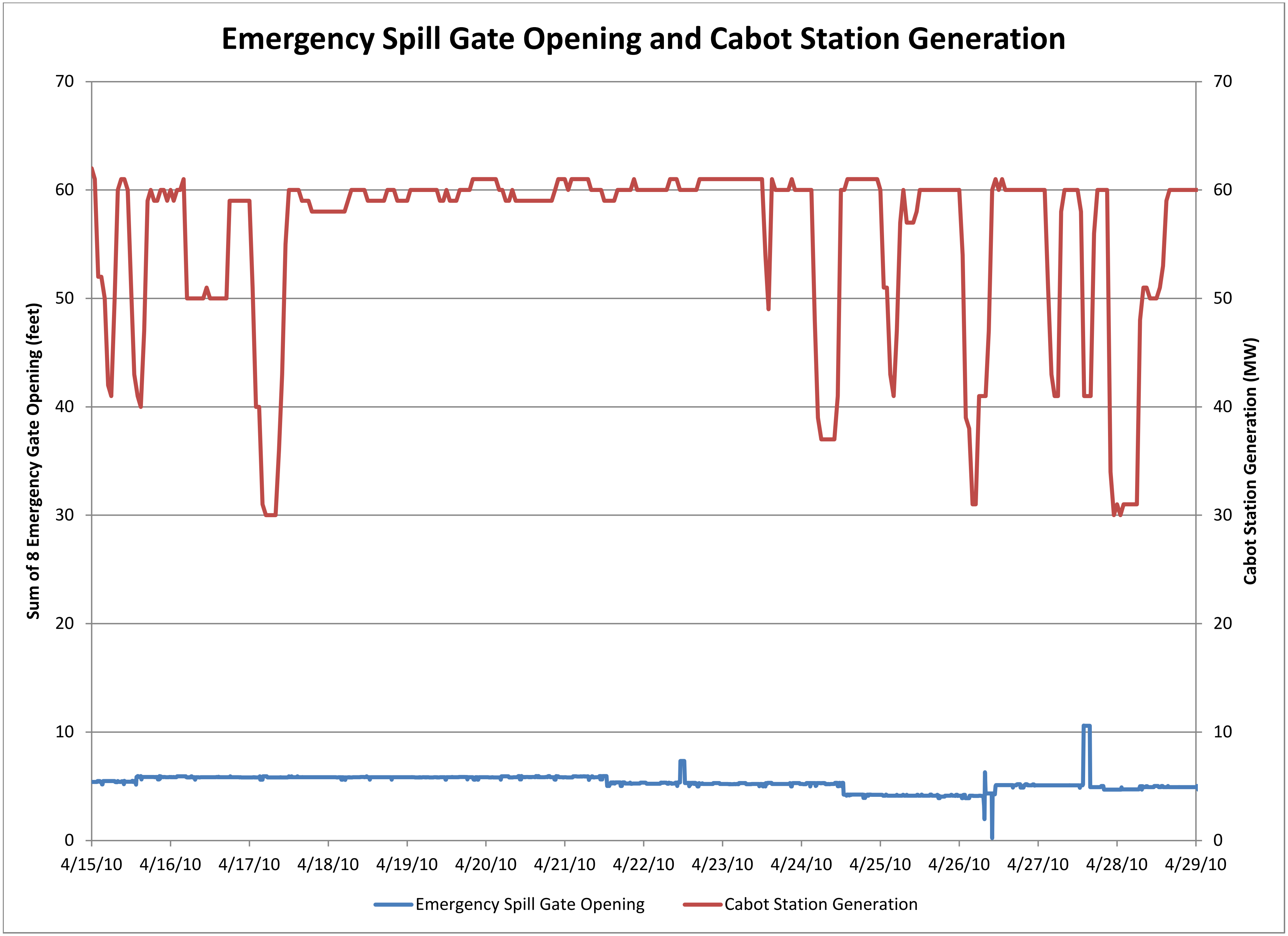


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/09
4/30/09
5/1/09
5/2/09
5/3/09
5/4/09
5/5/09
5/6/09
5/7/09
5/8/09
5/9/09
5/10/09
5/11/09
5/12/09
5/13/09
Emergency Spill Gate Opening
Cabot Station Generation

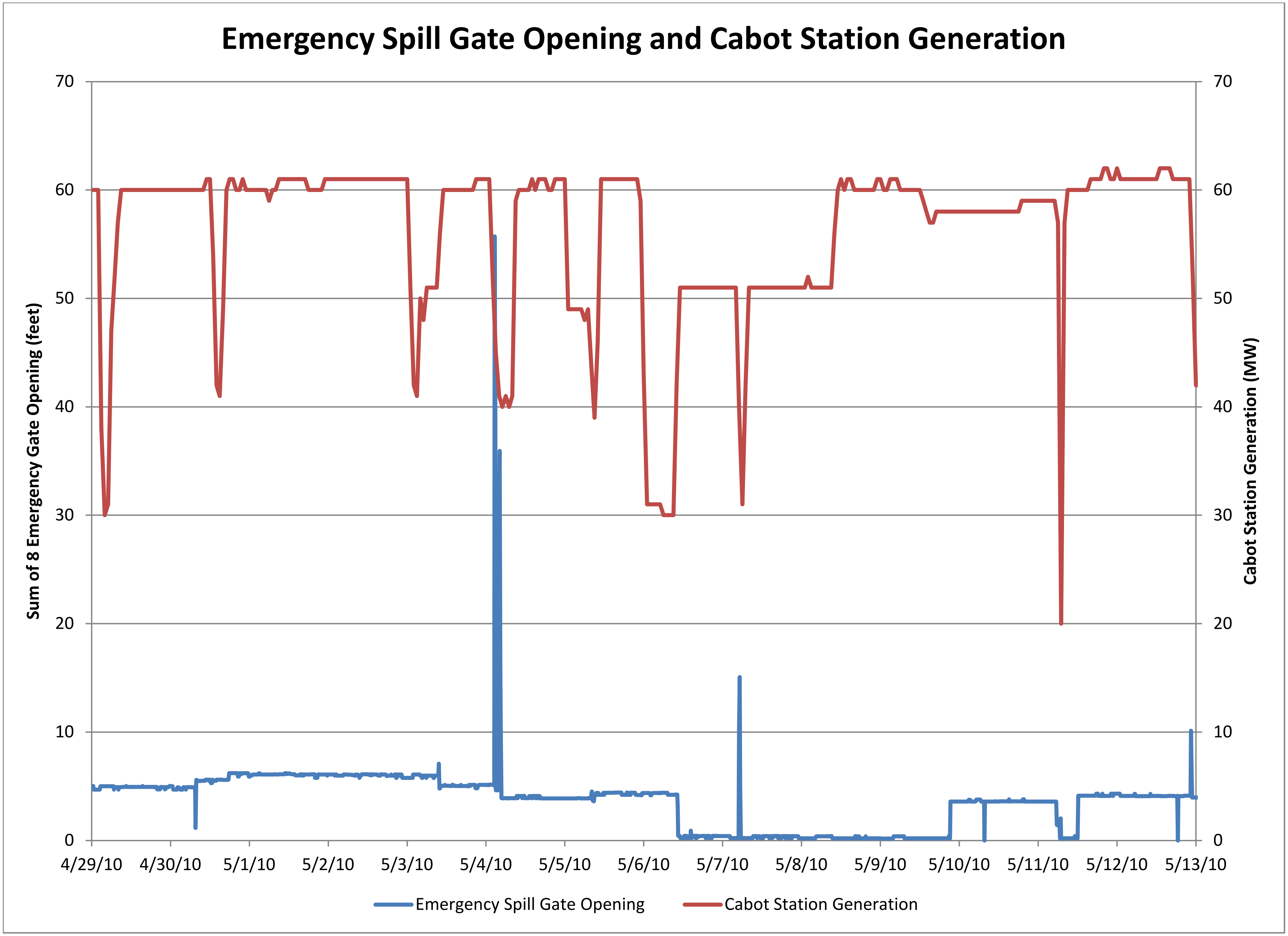

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/13/09
5/14/09
5/15/09
5/16/09
5/17/09
5/18/09
5/19/09
5/20/09
5/21/09
5/22/09
5/23/09
5/24/09
5/25/09
5/26/09
5/27/09
Emergency Spill Gate Opening
Cabot Station Generation


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
70
60
50
40
30
20
10
0
5/27/09
5/28/09
5/29/09
5/30/09
5/31/09
6/1/09
6/2/09
6/3/09
6/4/09
6/5/09
6/6/09
6/7/09
6/8/09
6/9/09
6/10/09
Emergency Spill Gate Opening
Cabot Station Generation

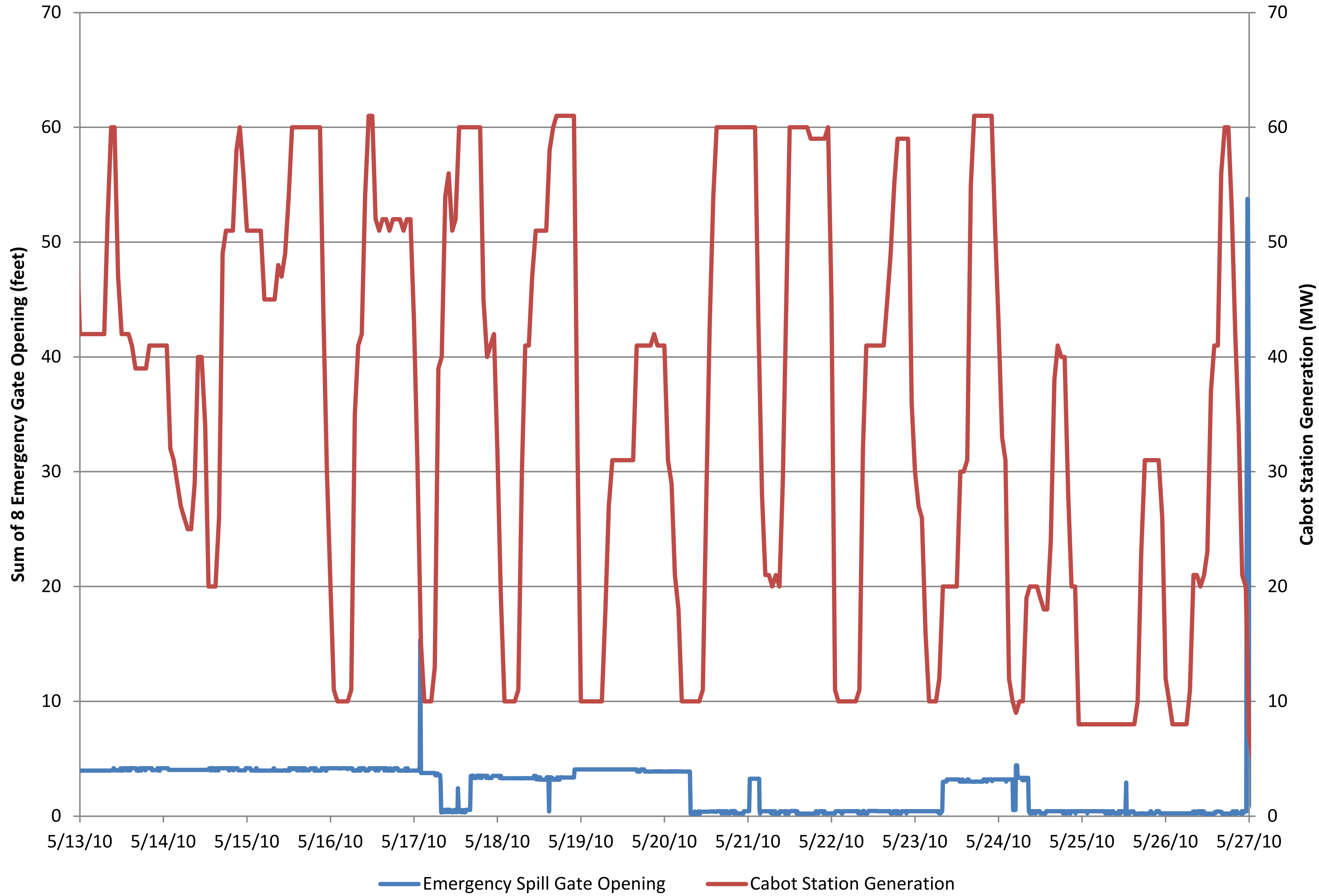

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
70
60
50
40
30
20
10
0
6/10/09
6/11/09
6/12/09
6/13/09
6/14/09
6/15/09
6/16/09
6/17/09
6/18/09
6/19/09
6/20/09
6/21/09
6/22/09
6/23/09
Emergency Spill Gate Opening
Cabot Station Generation

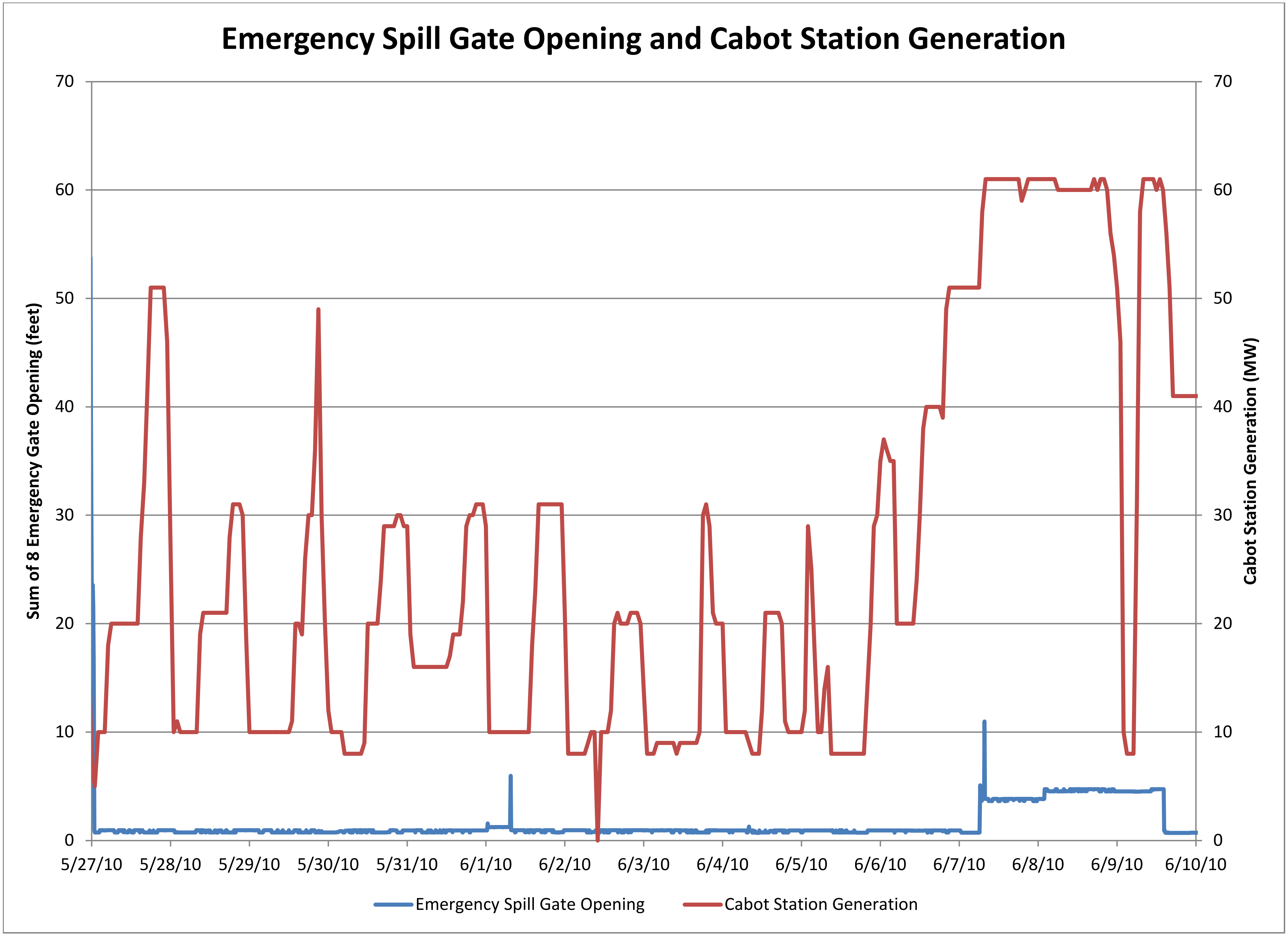


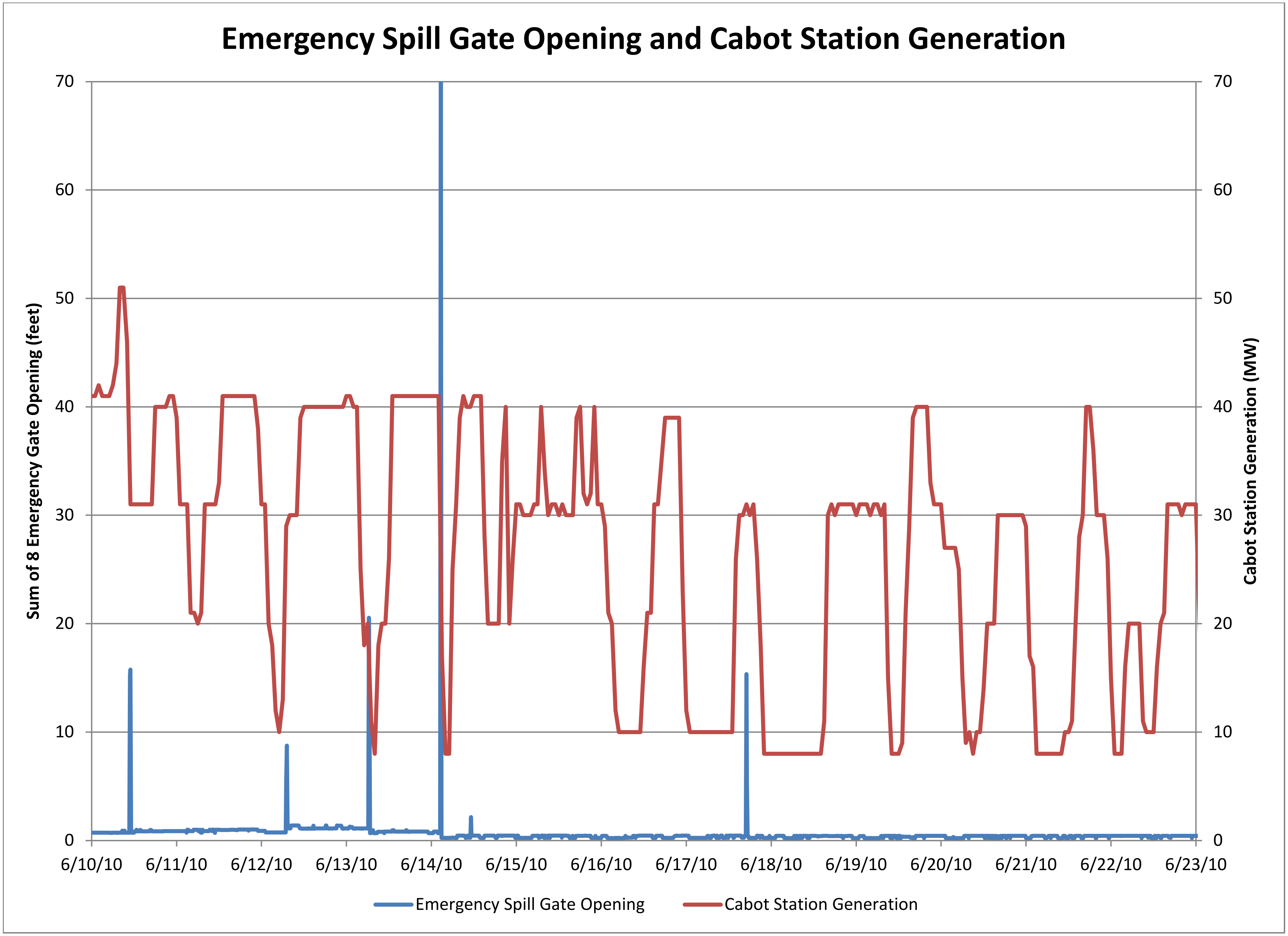
Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
70
60
50
40
30
20
10
0
4/15/10
4/16/10
4/17/10
4/18/10
4/19/10
4/20/10
4/21/10
4/22/10
4/23/10
4/24/10
4/25/10
4/26/10
4/27/10
4/28/10
4/29/10
Emergency Spill Gate Opening
Cabot Station Generation

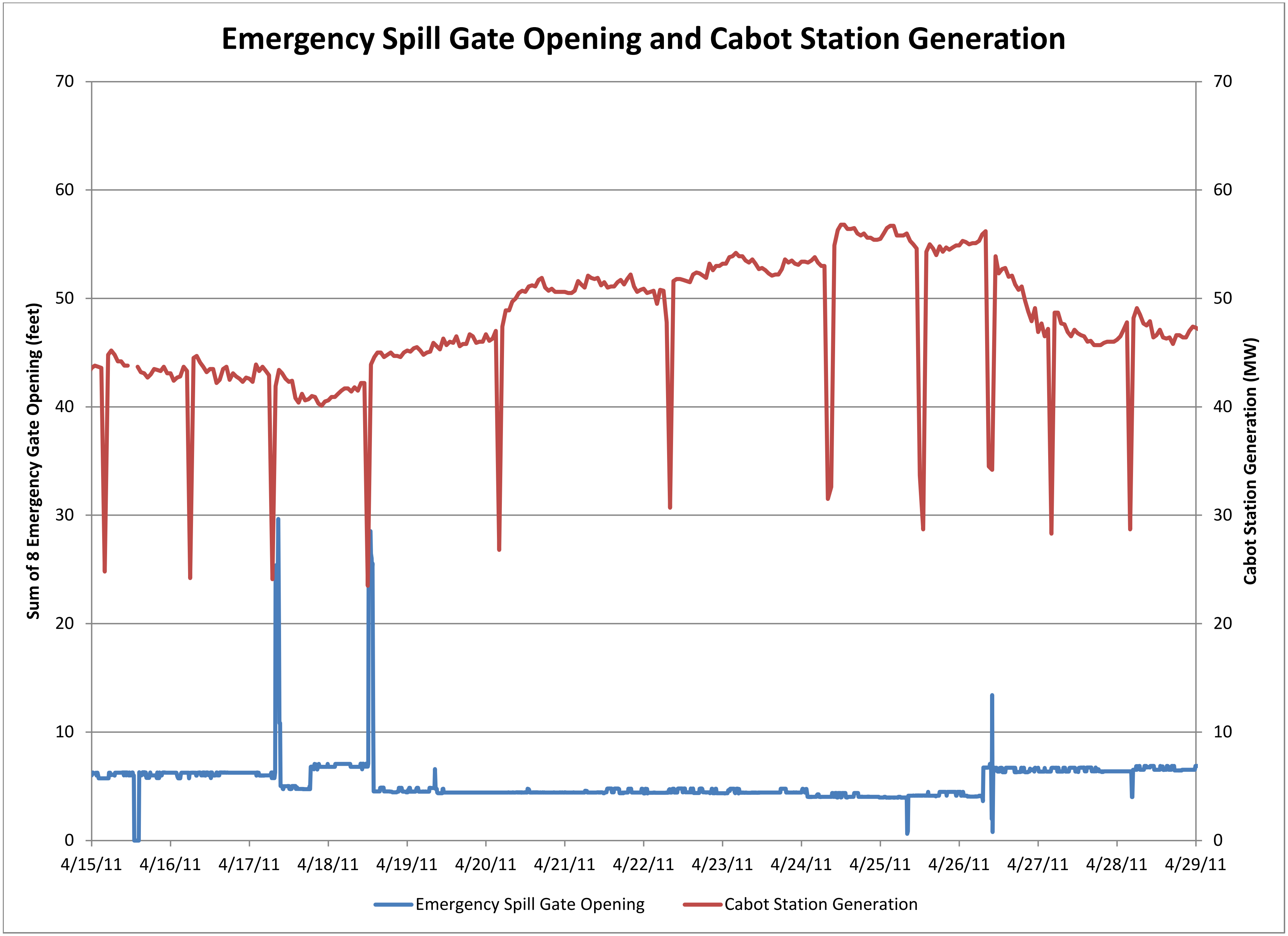

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/10
4/30/10
5/1/10
5/2/10
5/3/10
5/4/10
5/5/10
5/6/10
5/7/10
5/8/10
5/9/10
5/10/10
5/11/10
5/12/10
5/13/10
Emergency Spill Gate Opening
Cabot Station Generation

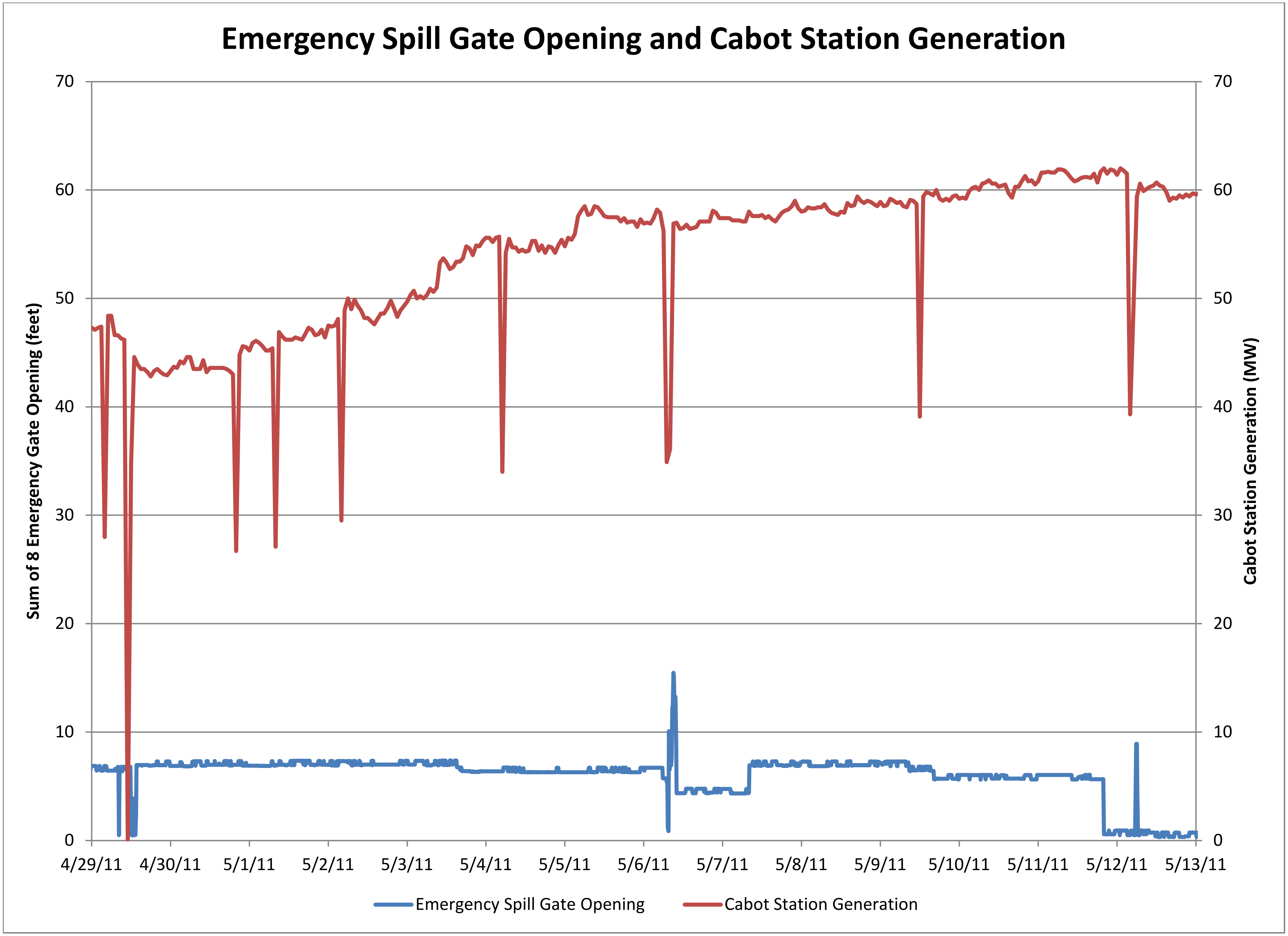
Emergency Spill Gate Opening and Cabot Station Generation

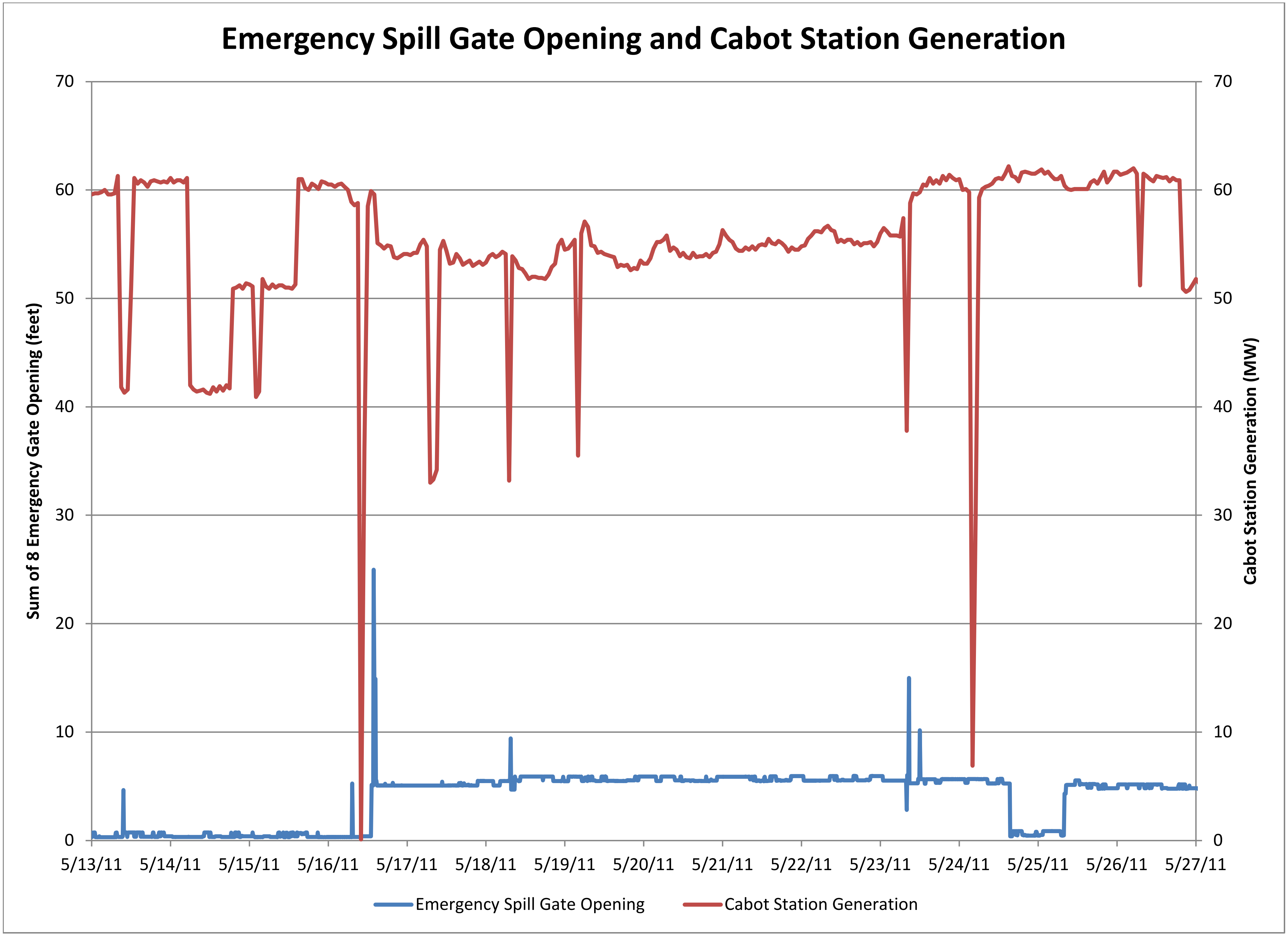


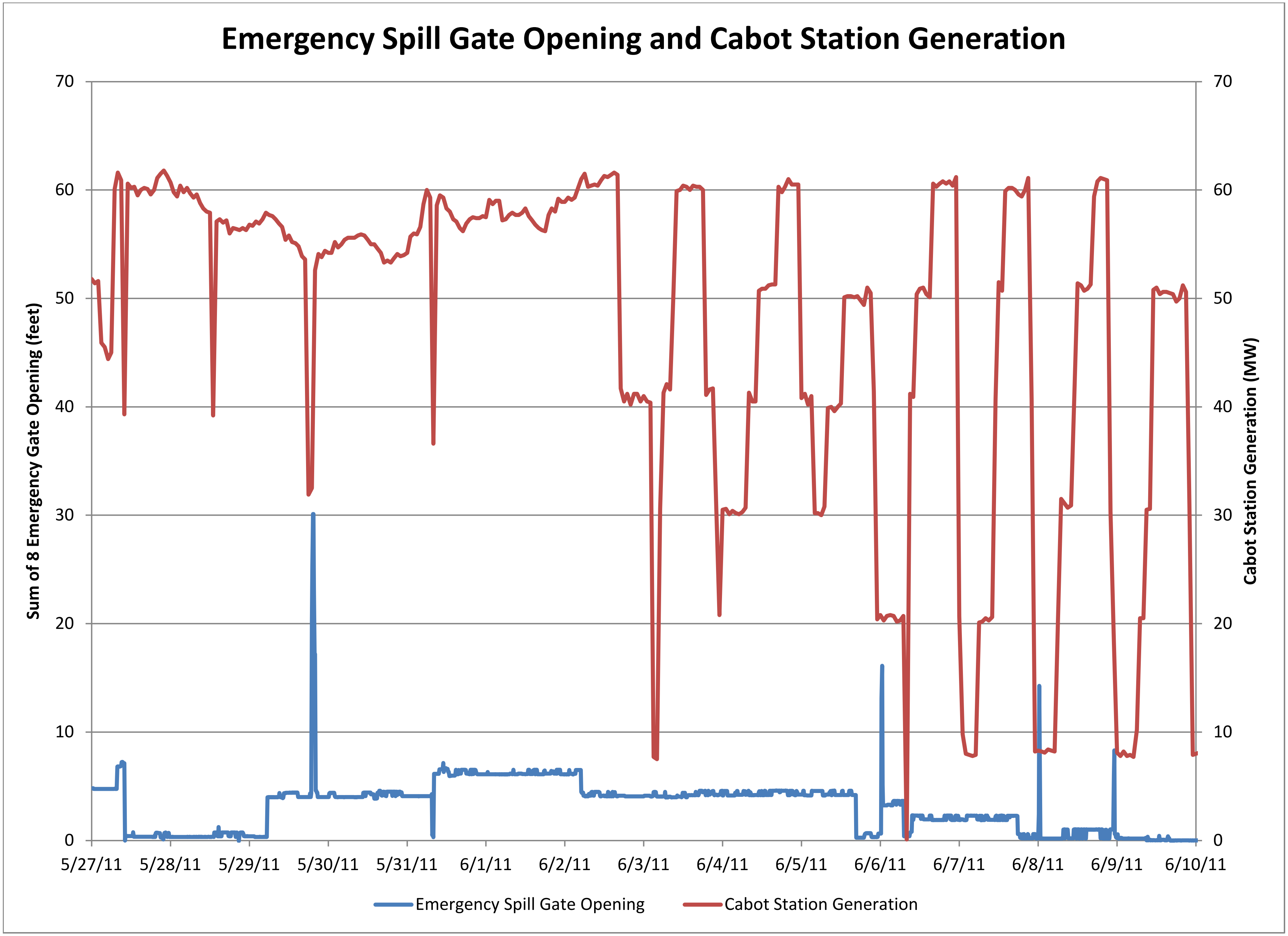

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/27/10
5/28/10
5/29/10
5/30/10
5/31/10
6/1/10
6/2/10
6/3/10
6/4/10
6/5/10
6/6/10
6/7/10
6/8/10
6/9/10
6/10/10
Emergency Spill Gate Opening
Cabot Station Generation

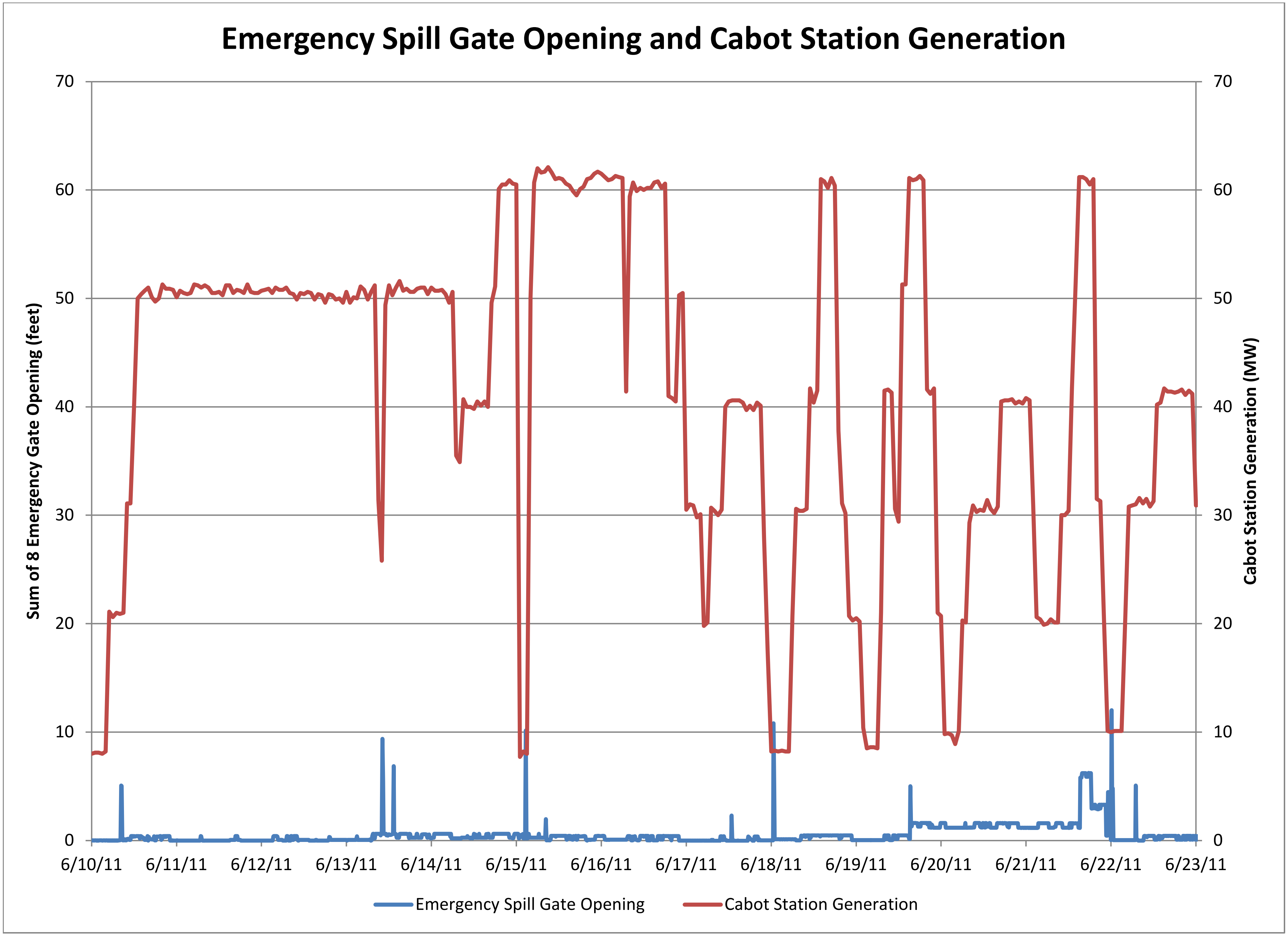

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
6/10/10
6/11/10
6/12/10
6/13/10
6/14/10
6/15/10
6/16/10
6/17/10
6/18/10
6/19/10
6/20/10
6/21/10
6/22/10
6/23/10
Emergency Spill Gate Opening
Cabot Station Generation


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/15/11
4/16/11
4/17/11
4/18/11
4/19/11
4/20/11
4/21/11
4/22/11
4/23/11
4/24/11
4/25/11
4/26/11
4/27/11
4/28/11
4/29/11
Emergency Spill Gate Opening
Cabot Station Generation

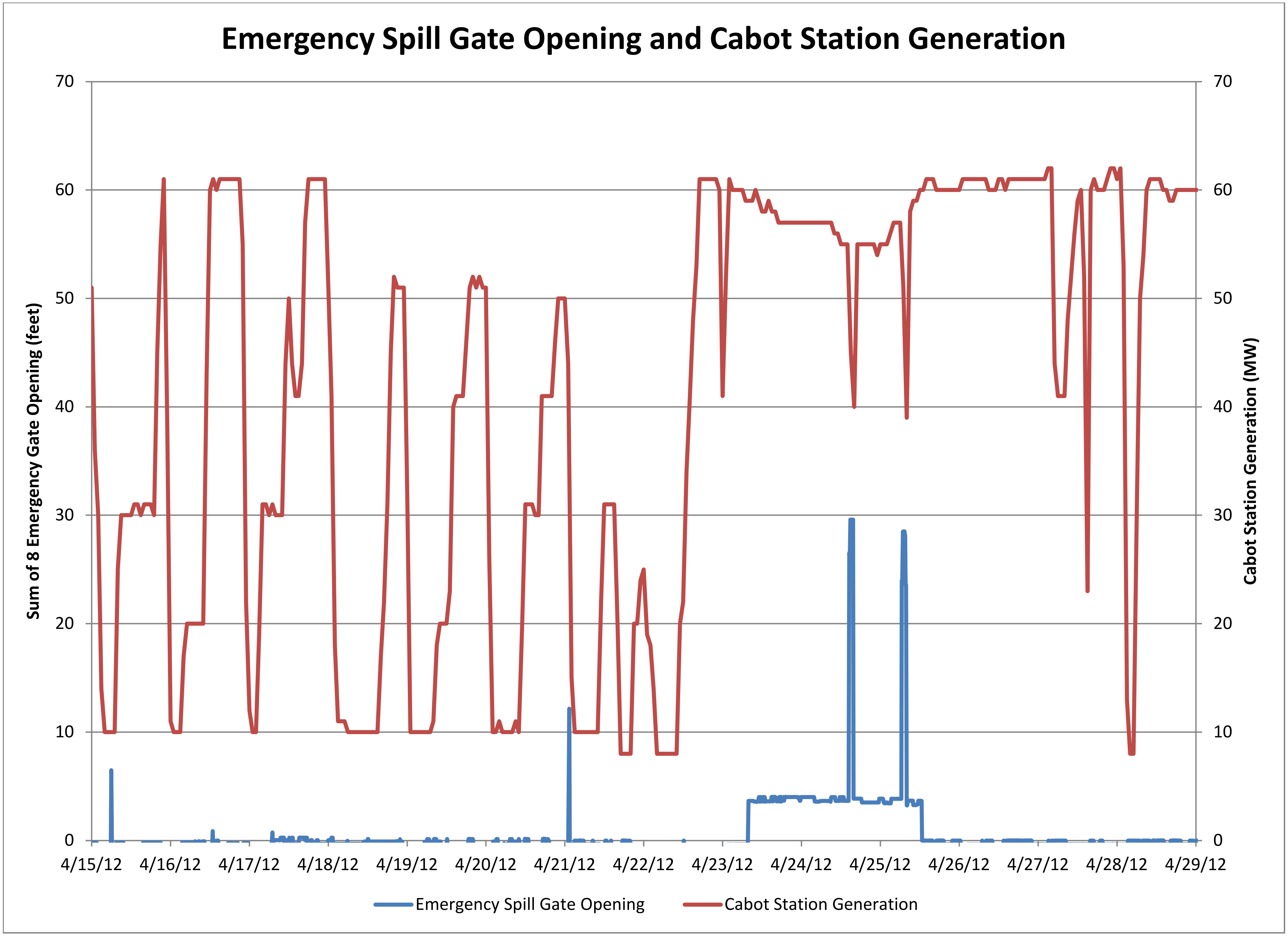

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/11
4/30/11
5/1/11
5/2/11
5/3/11
5/4/11
5/5/11
5/6/11
5/7/11
5/8/11
5/9/11
5/10/11
5/11/11
5/12/11
5/13/11
Emergency Spill Gate Opening
Cabot Station Generation

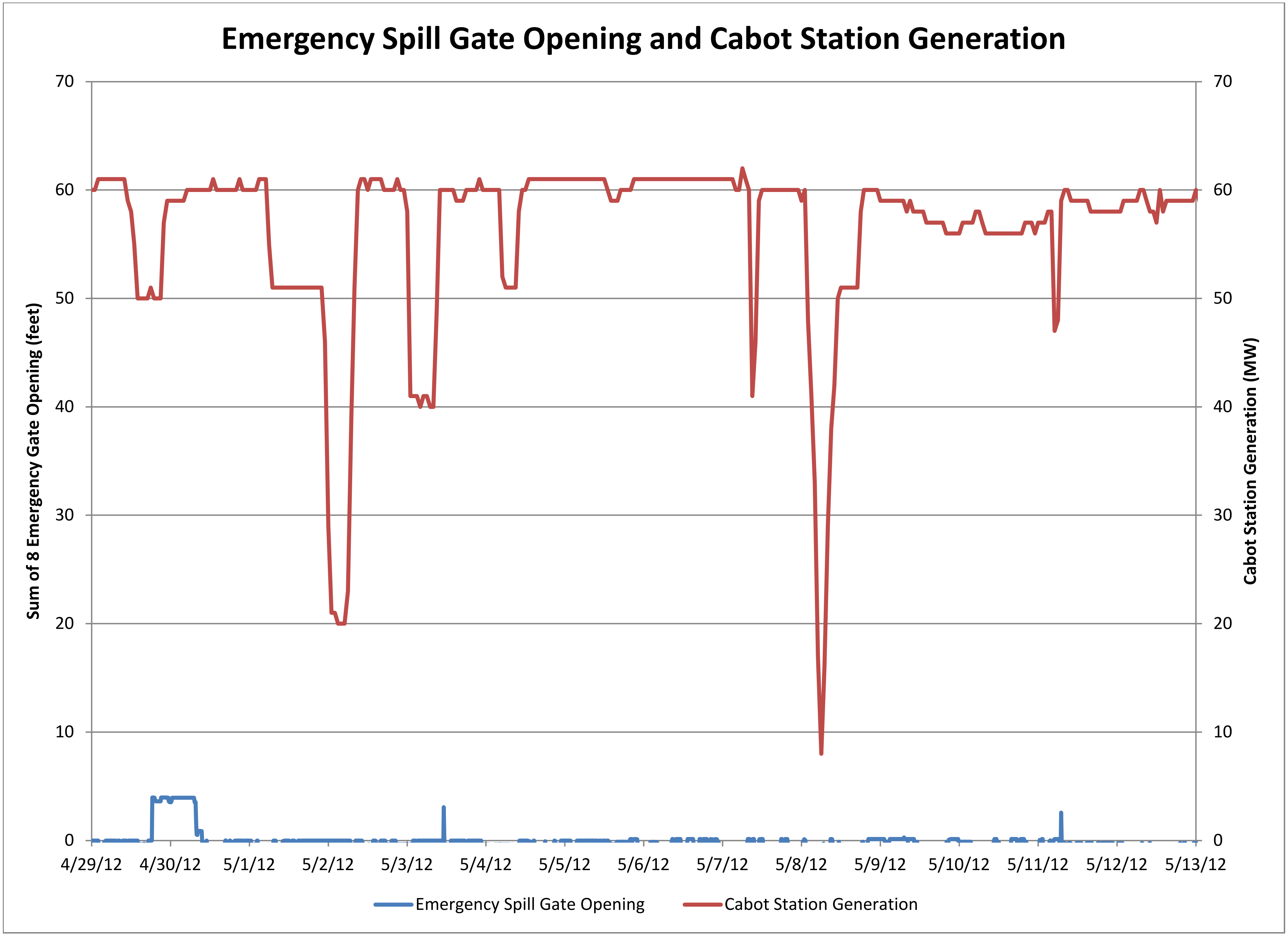

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/13/11
5/14/11
5/15/11
5/16/11
5/17/11
5/18/11
5/19/11
5/20/11
5/21/11
5/22/11
5/23/11
5/24/11
5/25/11
5/26/11
5/27/11
Emergency Spill Gate Opening
Cabot Station Generation

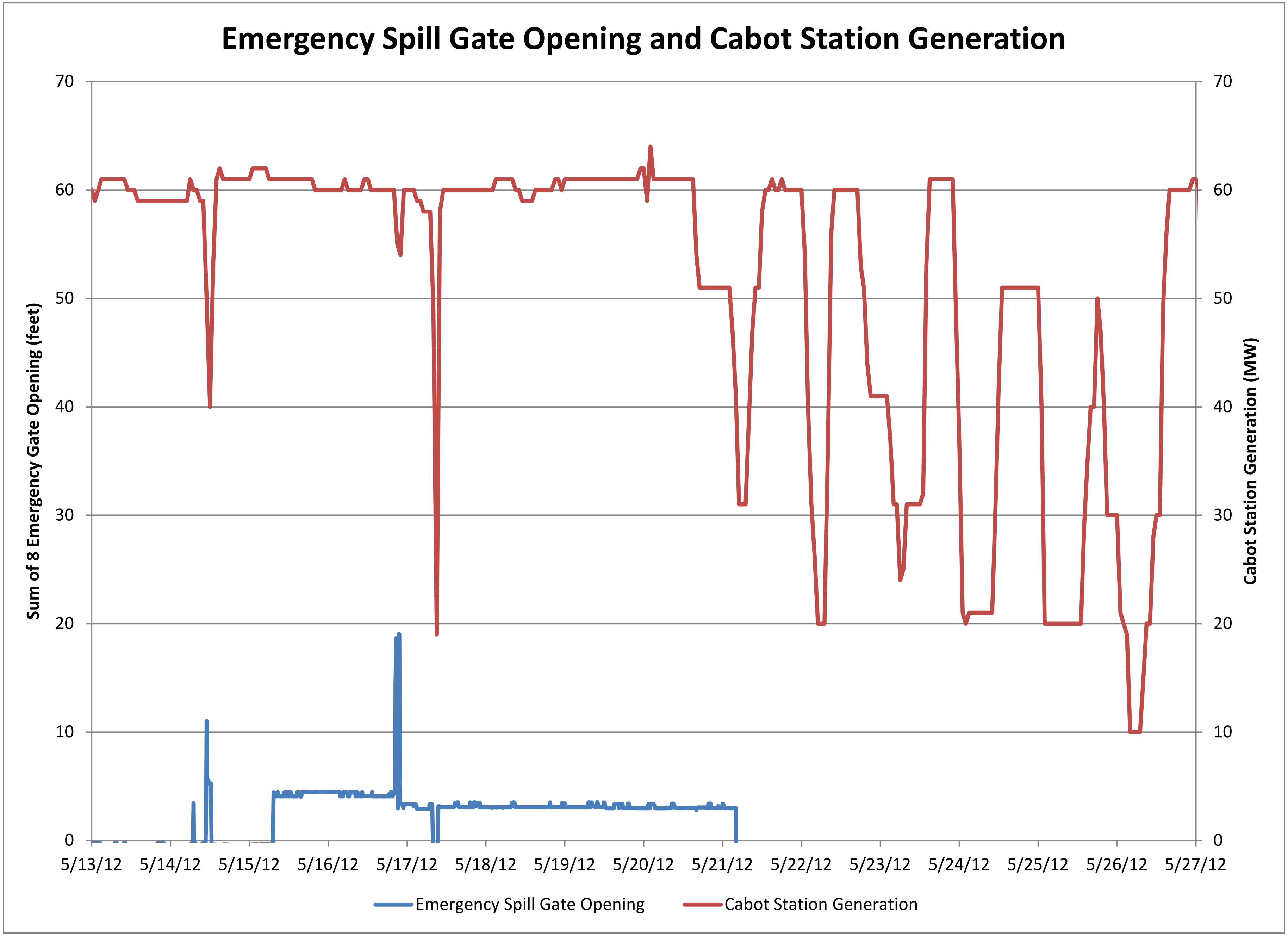

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/27/11
5/28/11
5/29/11
5/30/11
5/31/11
6/1/11
6/2/11
6/3/11
6/4/11
6/5/11
6/6/11
6/7/11
6/8/11
6/9/11
6/10/11
Emergency Spill Gate Opening
Cabot Station Generation

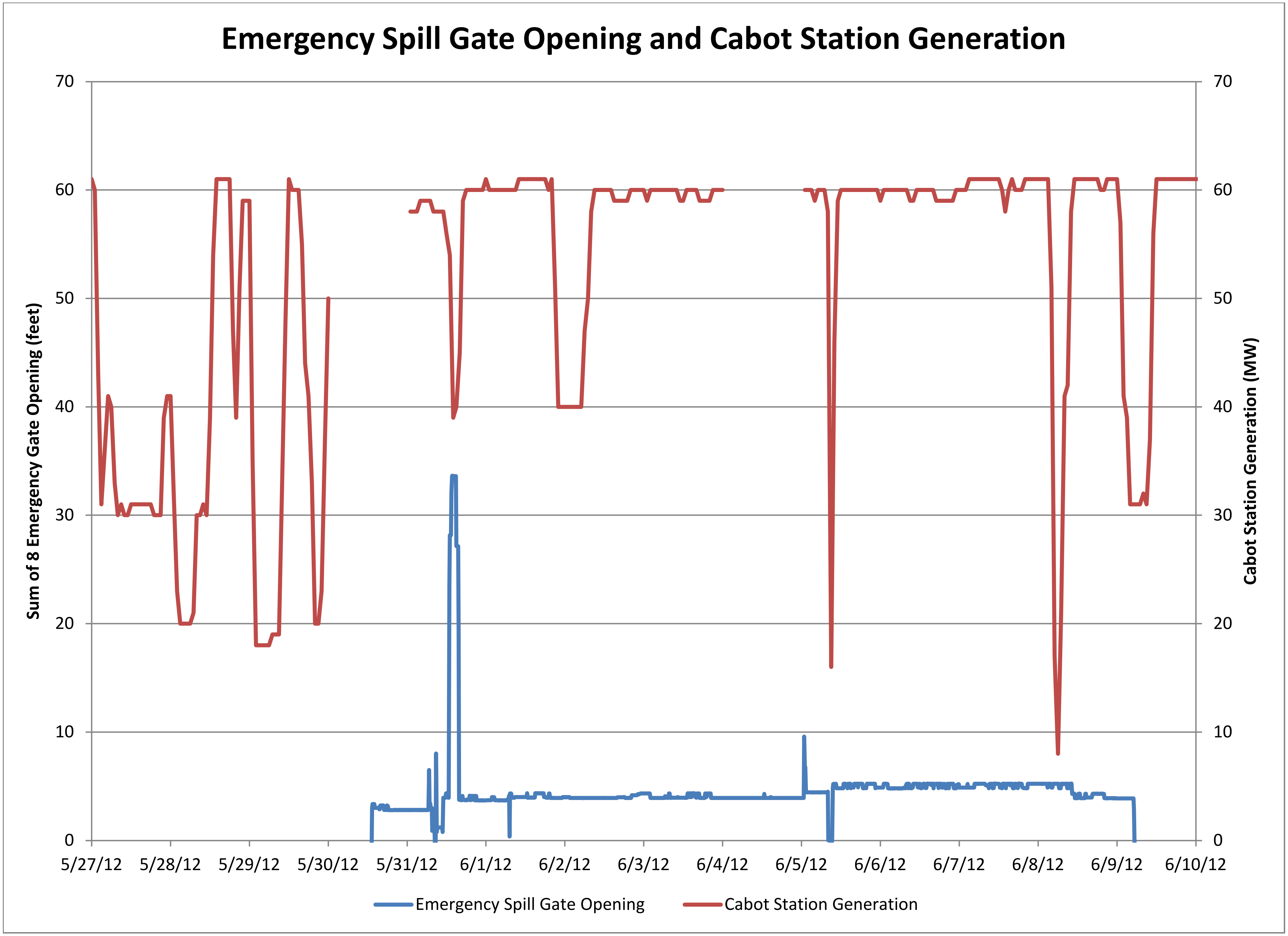


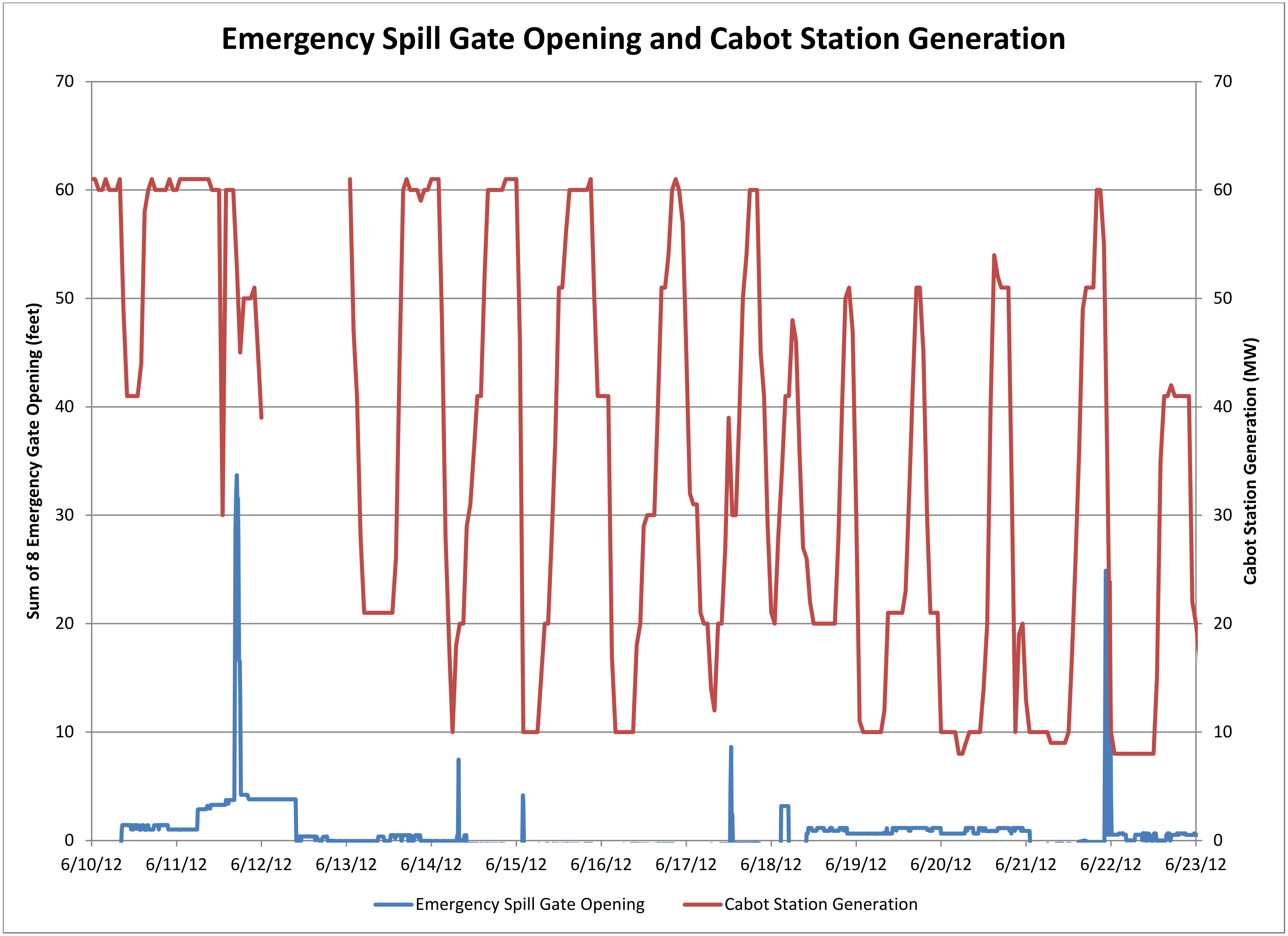
Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
6/10/11
6/11/11
6/12/11
6/13/11
6/14/11
6/15/11
6/16/11
6/17/11
6/18/11
6/19/11
6/20/11
6/21/11
6/22/11
6/23/11
Emergency Spill Gate Opening
Cabot Station Generation


Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/15/12
4/16/12
4/17/12
4/18/12
4/19/12
4/20/12
4/21/12
4/22/12
4/23/12
4/24/12
4/25/12
4/26/12
4/27/12
4/28/12
4/29/12
Emergency Spill Gate Opening
Cabot Station Generation

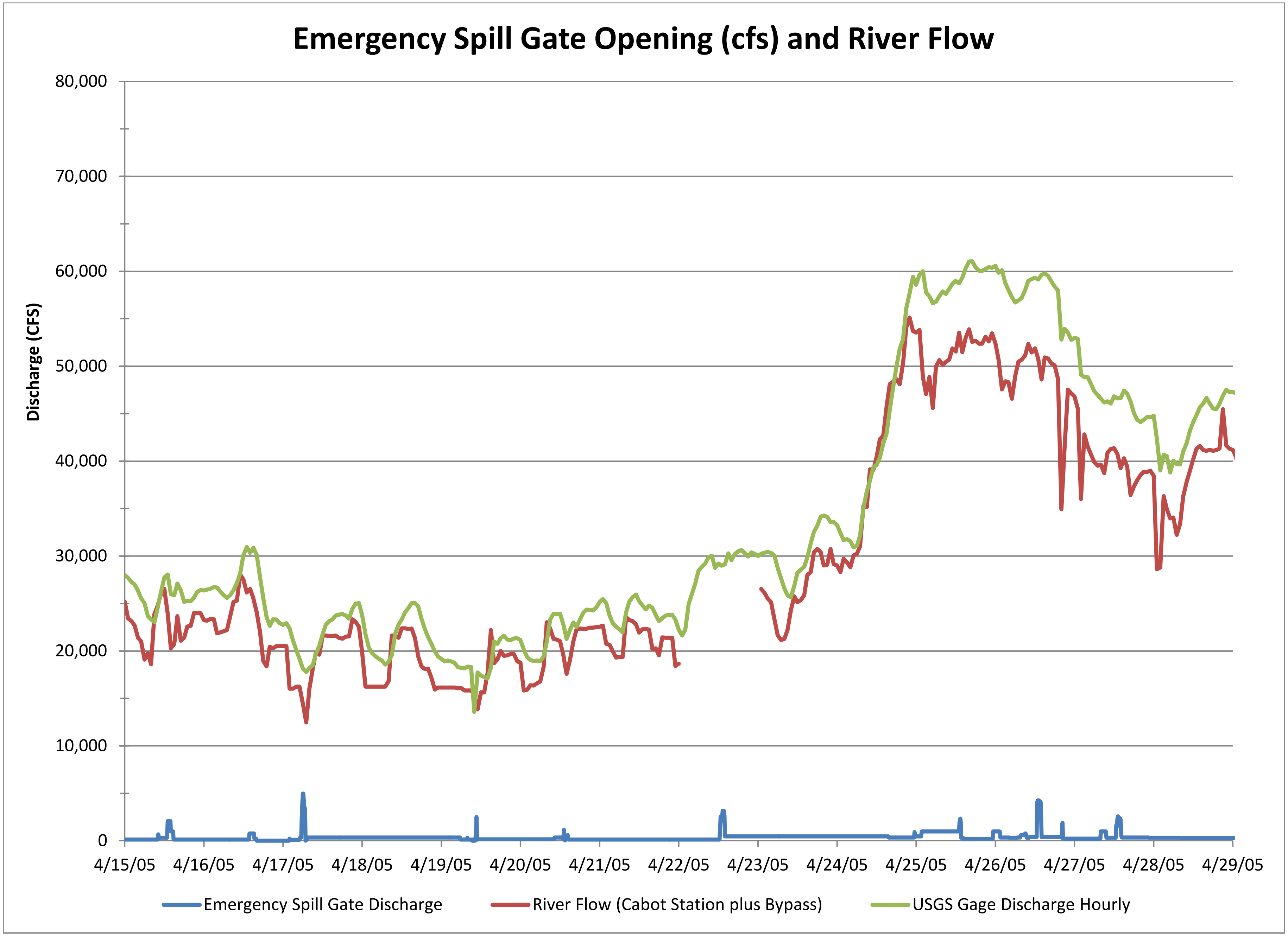

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
4/29/12
4/30/12
5/1/12
5/2/12
5/3/12
5/4/12
5/5/12
5/6/12
5/7/12
5/8/12
5/9/12
5/10/12
5/11/12
5/12/12
5/13/12
Emergency Spill Gate Opening
Cabot Station Generation

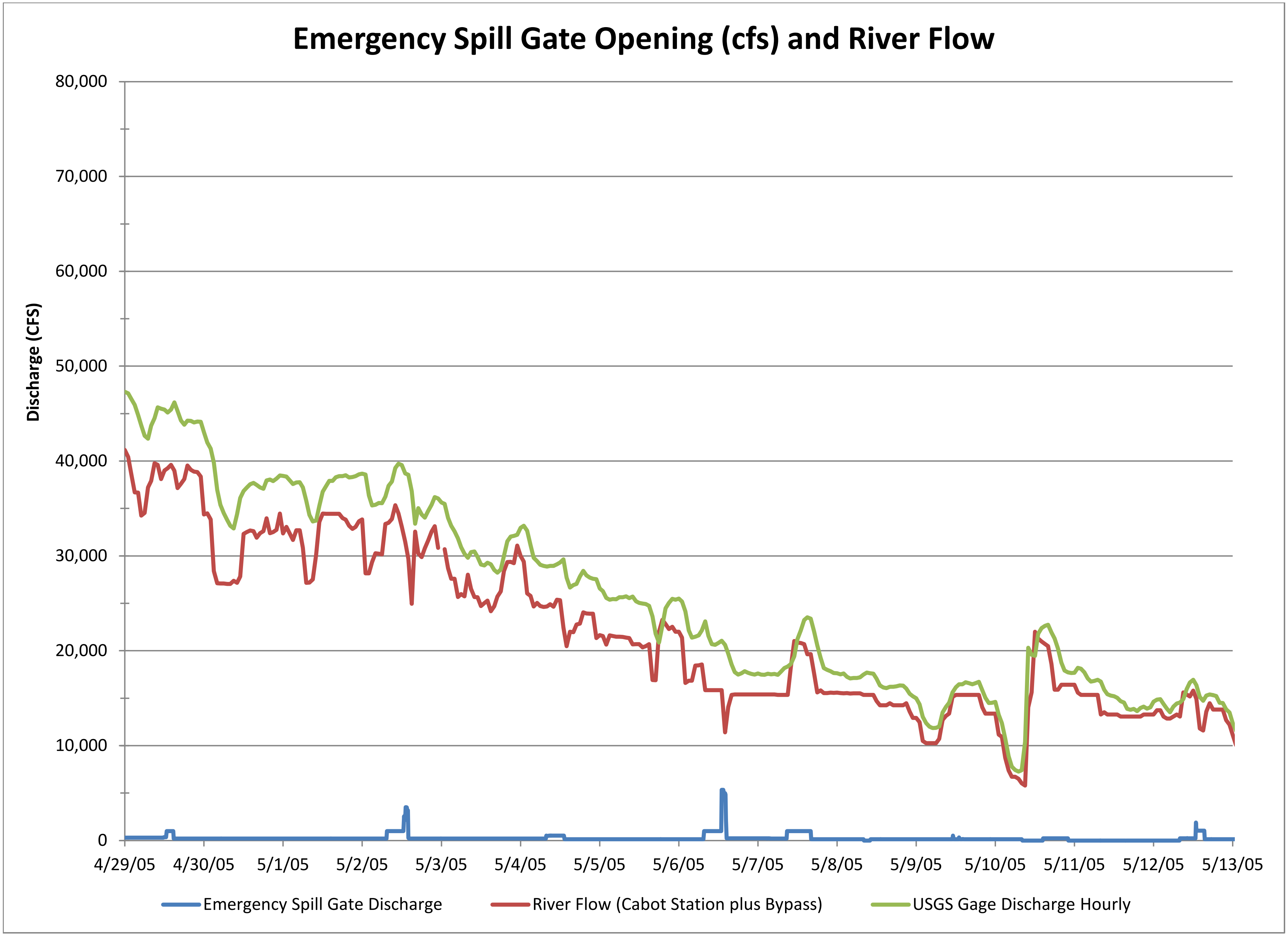

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/13/12
5/14/12
5/15/12
5/16/12
5/17/12
5/18/12
5/19/12
5/20/12
5/21/12
5/22/12
5/23/12
5/24/12
5/25/12
5/26/12
5/27/12
Emergency Spill Gate Opening
Cabot Station Generation

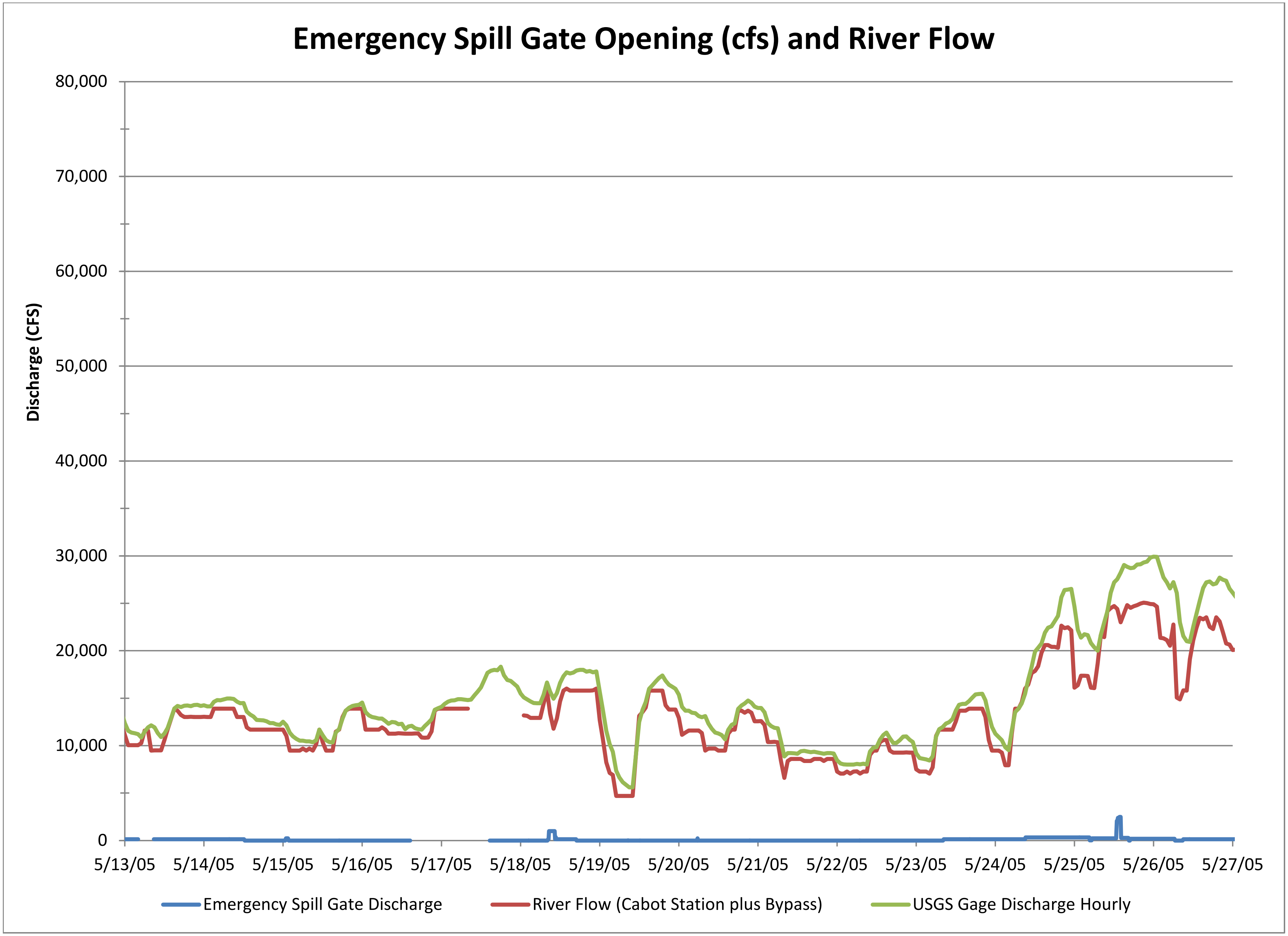

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
0
10
20
30
40
50
60
70
5/27/12
5/28/12
5/29/12
5/30/12
5/31/12
6/1/12
6/2/12
6/3/12
6/4/12
6/5/12
6/6/12
6/7/12
6/8/12
6/9/12
6/10/12
Emergency Spill Gate Opening
Cabot Station Generation

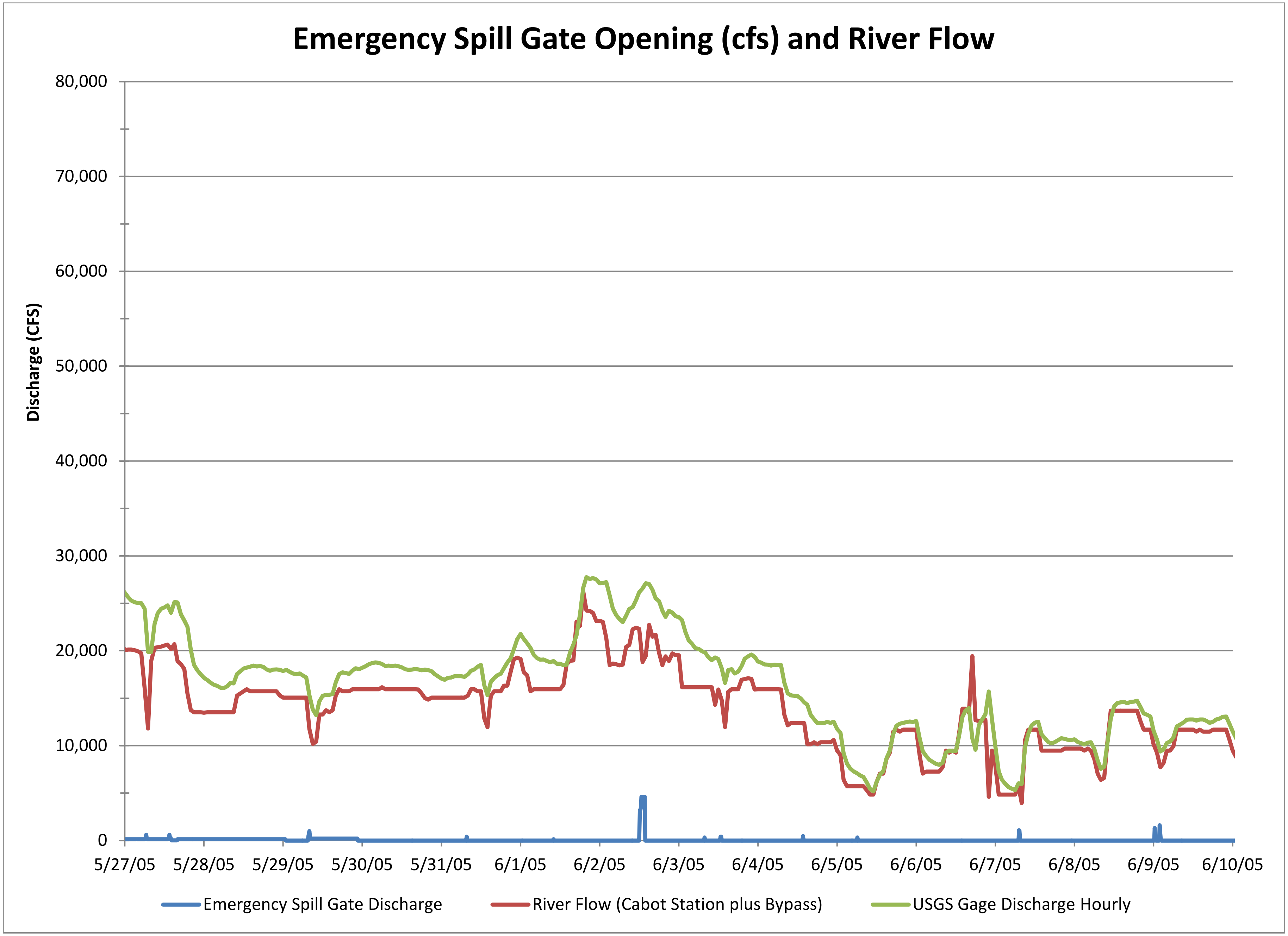

Emergency Spill Gate Opening and Cabot Station Generation
Sum of 8 Emergency Gate Opening (feet)
Cabot Station Generation (MW)
70
60
50
40
30
20
10
0
6/10/12
6/11/12
6/12/12
6/13/12
6/14/12
6/15/12
6/16/12
6/17/12
6/18/12
6/19/12
6/20/12
6/21/12
6/22/12
6/23/12
Emergency Spill Gate Opening
Cabot Station Generation

APPENDIX B – BI-WEEKLY CHARTS OF SPILL GATE DISCHARGE VS. RIVER DISCHARGE

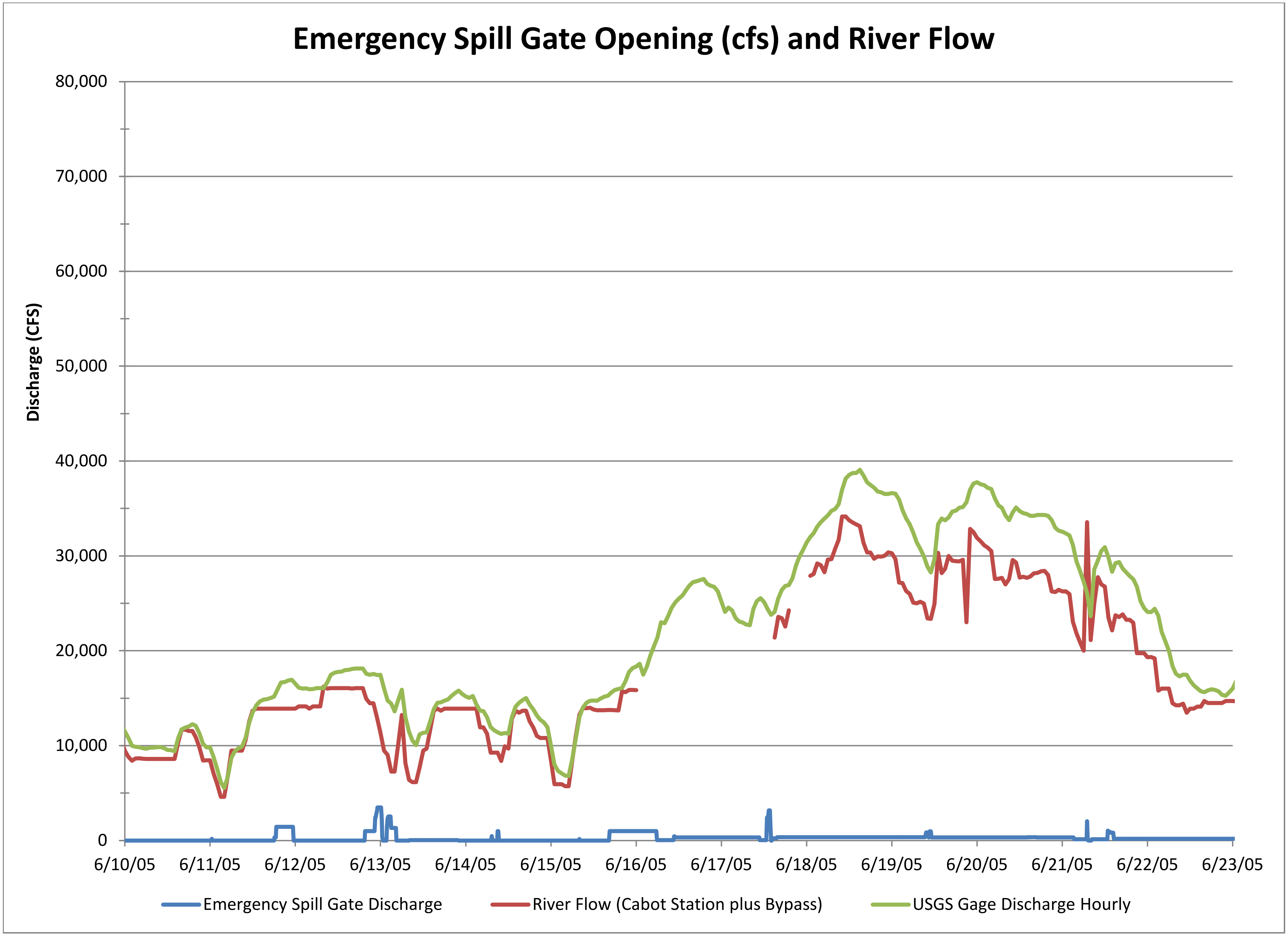

Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/15/05
4/16/05
4/17/05
4/18/05
4/19/05
4/20/05
4/21/05
4/22/05
4/23/05
4/24/05
4/25/05
4/26/05
4/27/05
4/28/05
4/29/05
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly

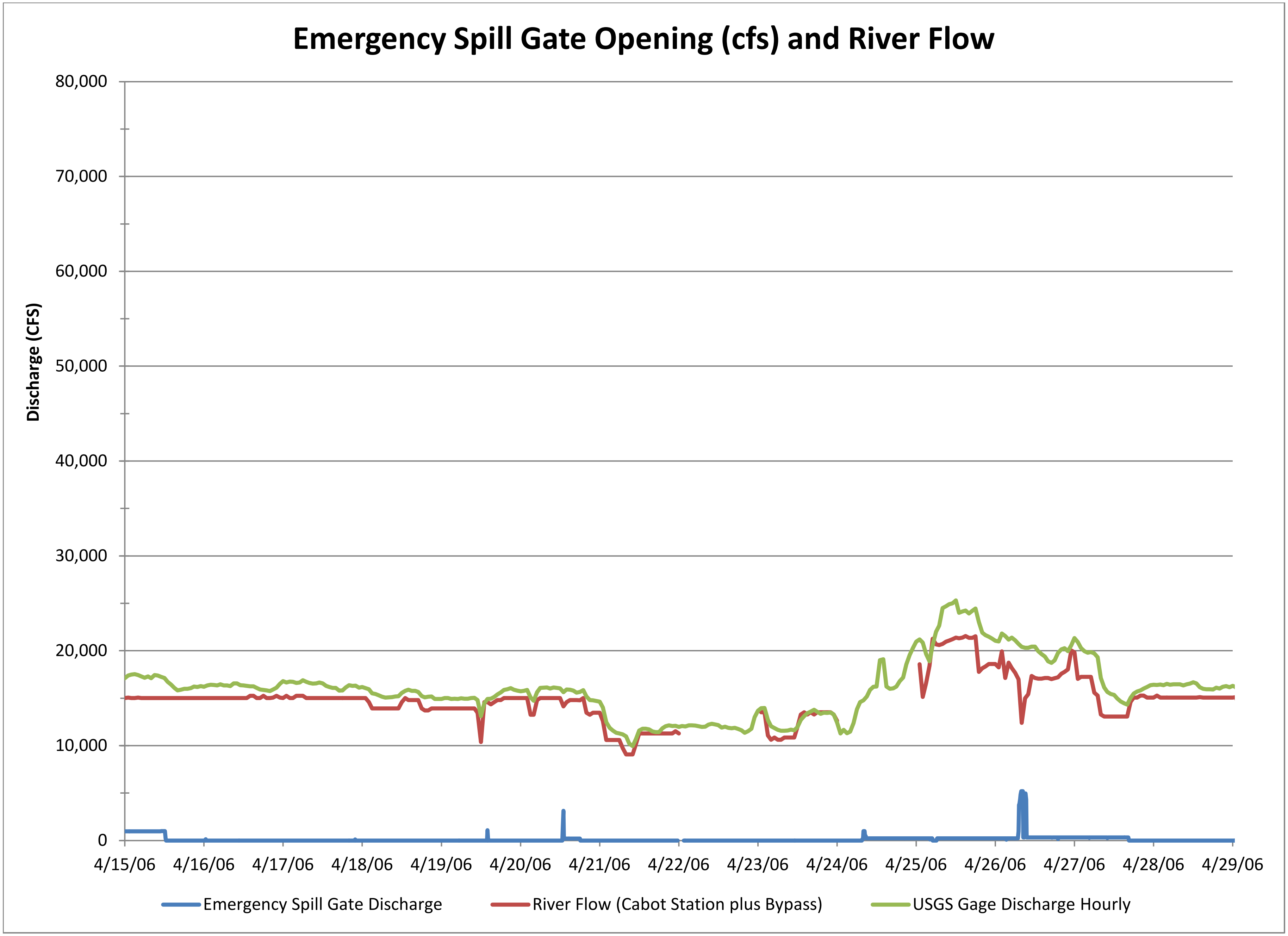

Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/29/05
4/30/05
5/1/05
5/2/05
5/3/05
5/4/05
5/5/05
5/6/05
5/7/05
5/8/05
5/9/05
5/10/05
5/11/05
5/12/05
5/13/05
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly

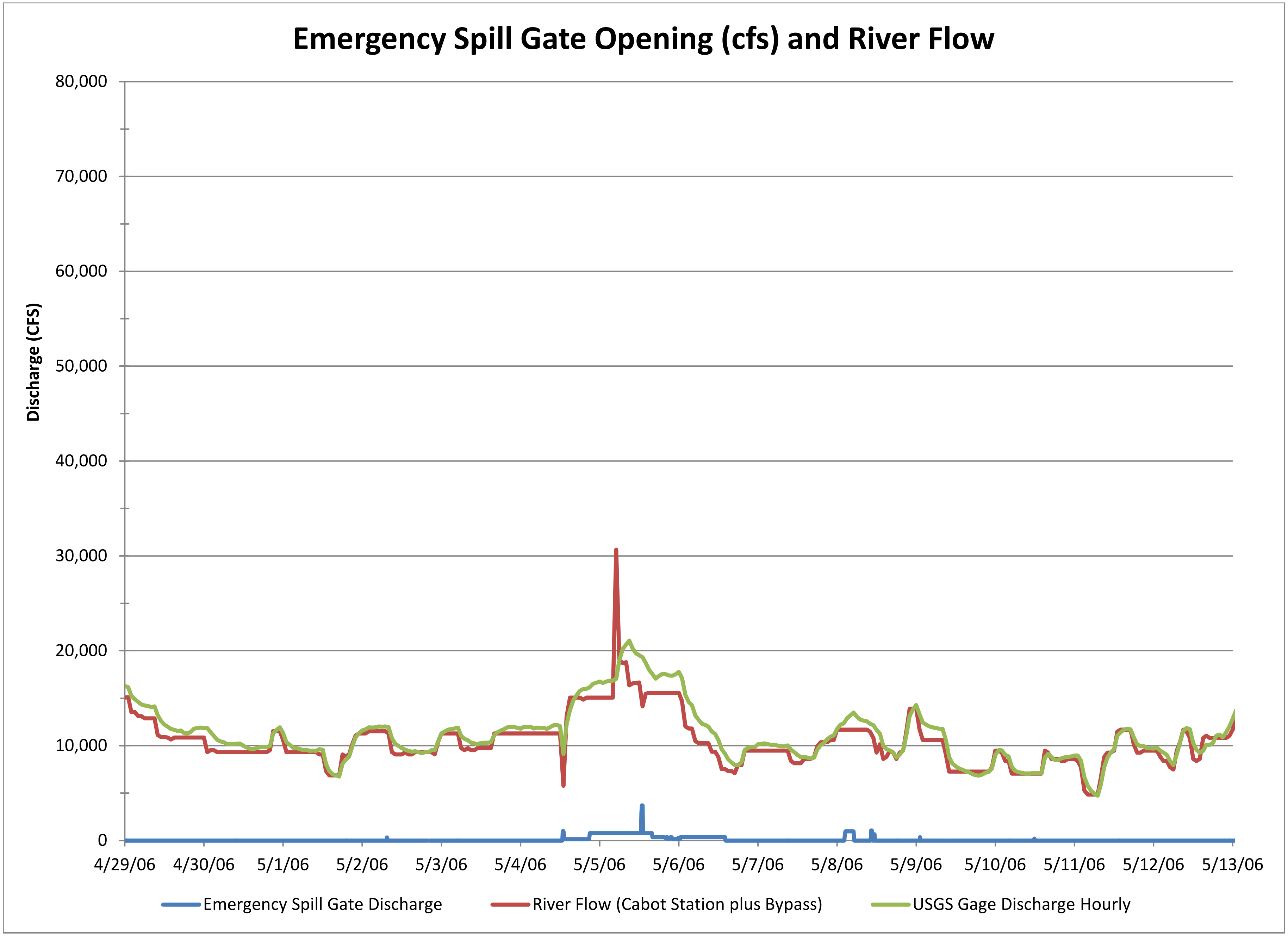

Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/13/05
5/14/05
5/15/05
5/16/05
5/17/05
5/18/05
5/19/05
5/20/05
5/21/05
5/22/05
5/23/05
5/24/05
5/25/05
5/26/05
5/27/05
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly

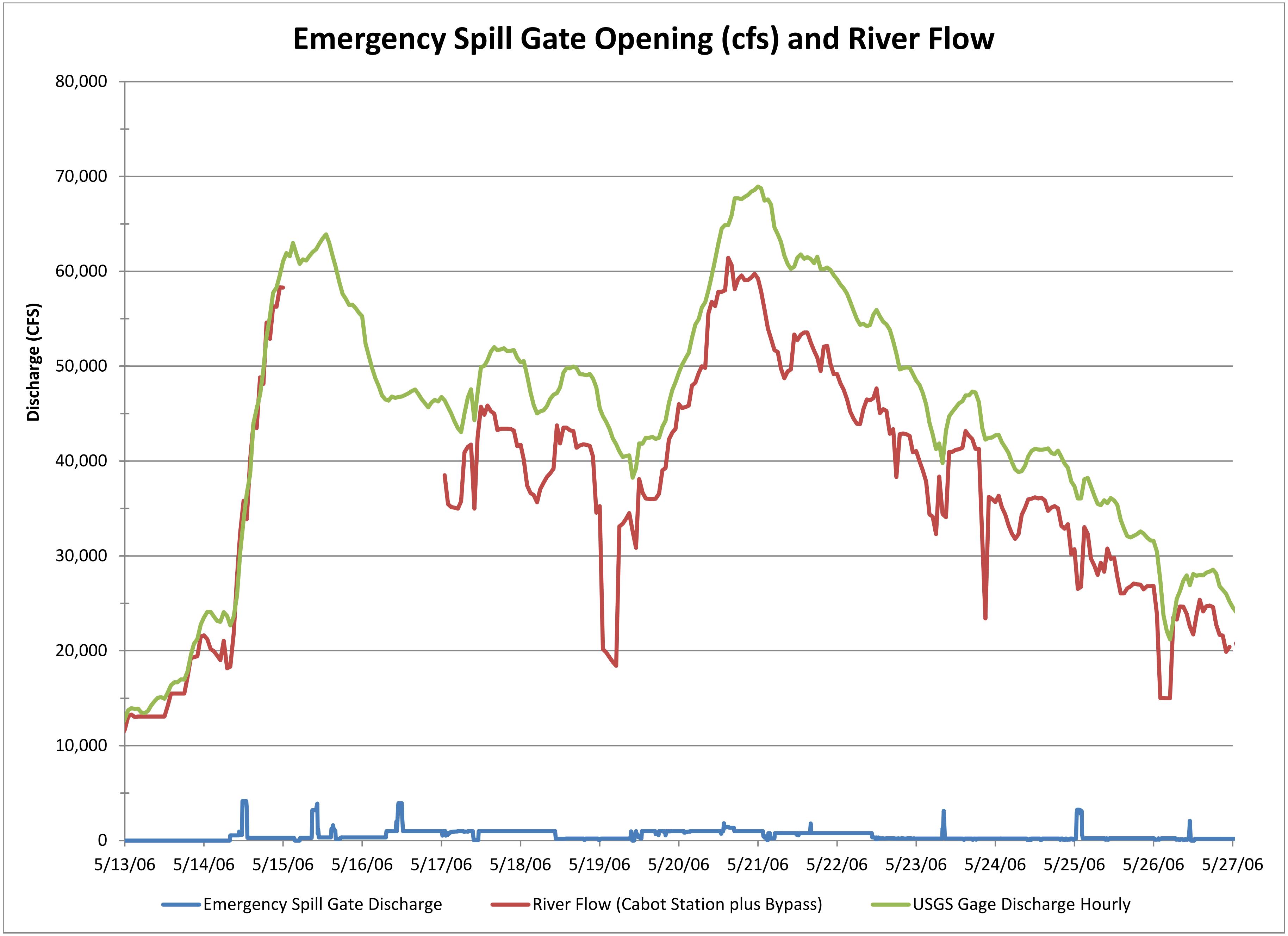


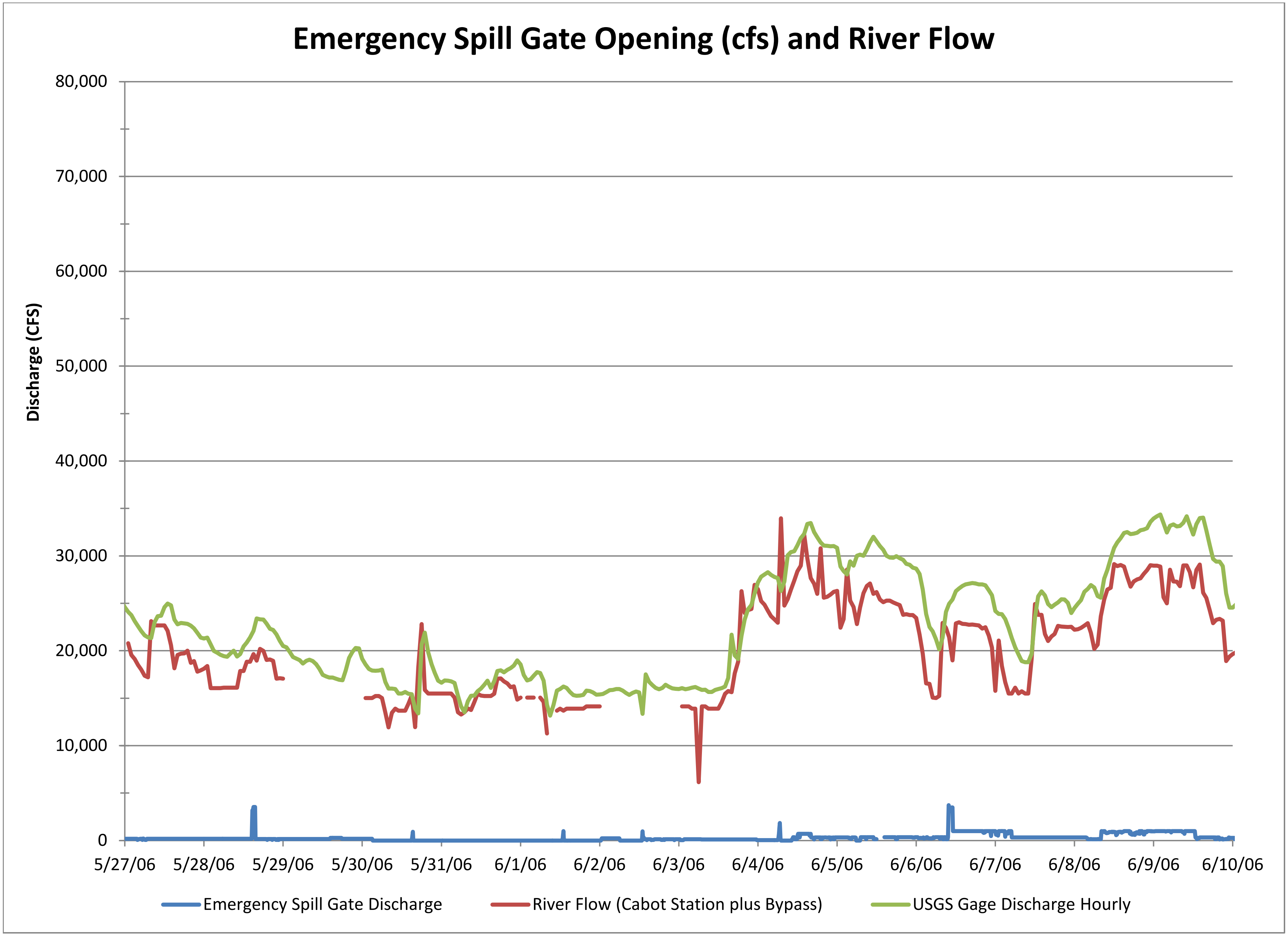
Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/27/05
5/28/05
5/29/05
5/30/05
5/31/05
6/1/05
6/2/05
6/3/05
6/4/05
6/5/05
6/6/05
6/7/05
6/8/05
6/9/05
6/10/05
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly

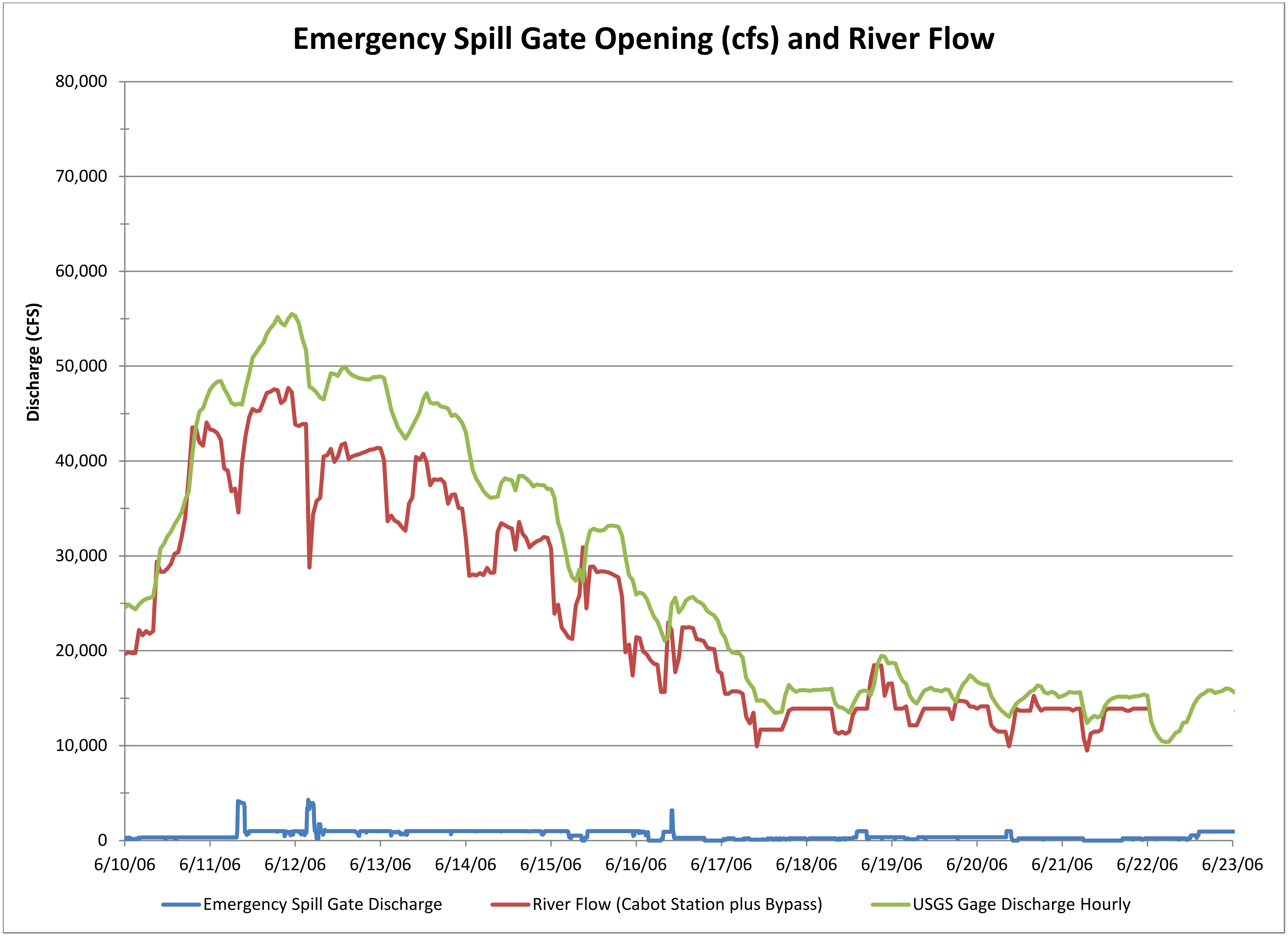

Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
6/10/05
6/11/05
6/12/05
6/13/05
6/14/05
6/15/05
6/16/05
6/17/05
6/18/05
6/19/05
6/20/05
6/21/05
6/22/05
6/23/05
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/15/06
4/16/06
4/17/06
4/18/06
4/19/06
4/20/06
4/21/06
4/22/06
4/23/06
4/24/06
4/25/06
4/26/06
4/27/06
4/28/06
4/29/06
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/29/06
4/30/06
5/1/06
5/2/06
5/3/06
5/4/06
5/5/06
5/6/06
5/7/06
5/8/06
5/9/06
5/10/06
5/11/06
5/12/06
5/13/06
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/13/06
5/14/06
5/15/06
5/16/06
5/17/06
5/18/06
5/19/06
5/20/06
5/21/06
5/22/06
5/23/06
5/24/06
5/25/06
5/26/06
5/27/06
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/27/06
5/28/06
5/29/06
5/30/06
5/31/06
6/1/06
6/2/06
6/3/06
6/4/06
6/5/06
6/6/06
6/7/06
6/8/06
6/9/06
6/10/06
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
6/10/06
6/11/06
6/12/06
6/13/06
6/14/06
6/15/06
6/16/06
6/17/06
6/18/06
6/19/06
6/20/06
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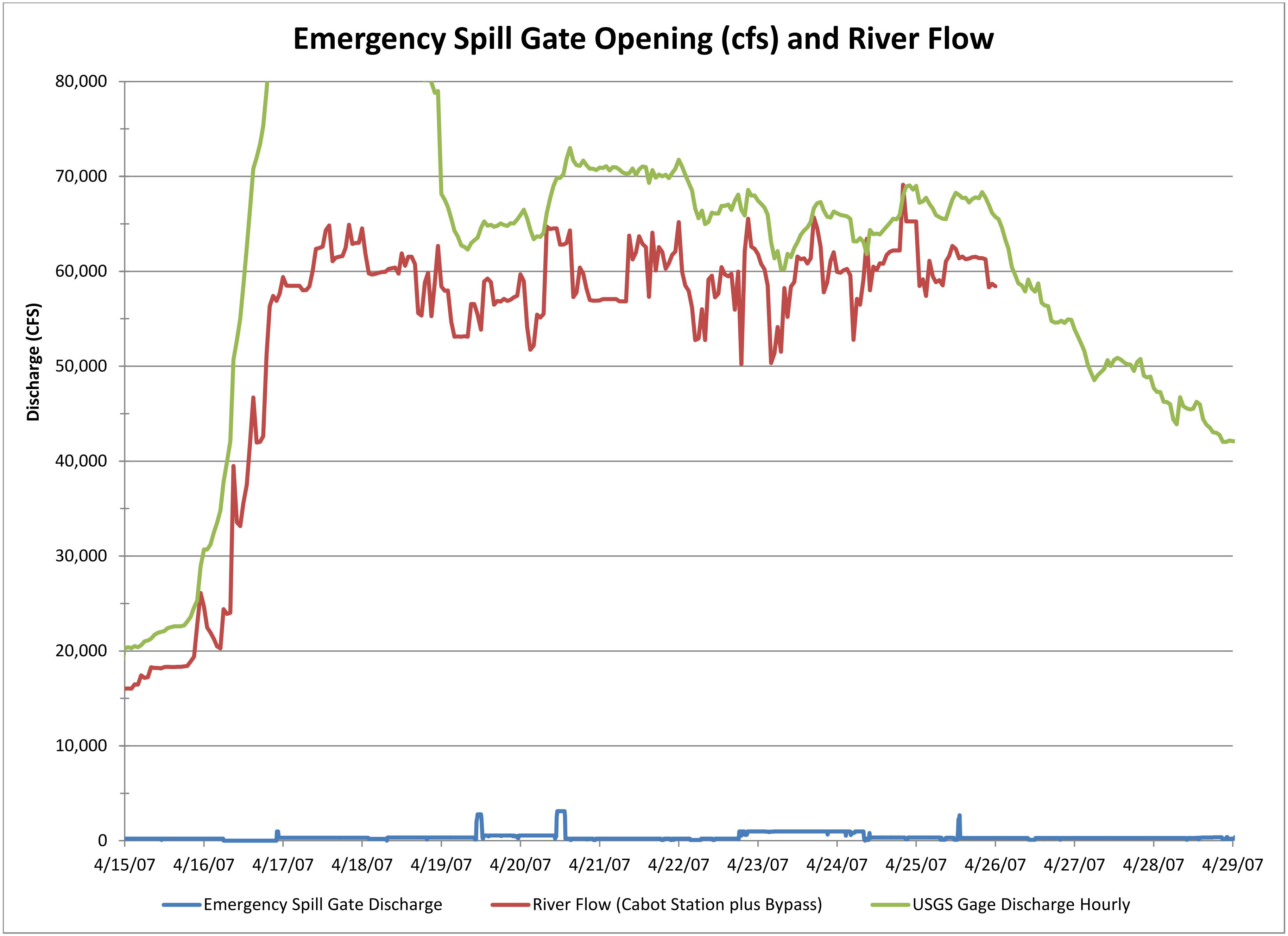
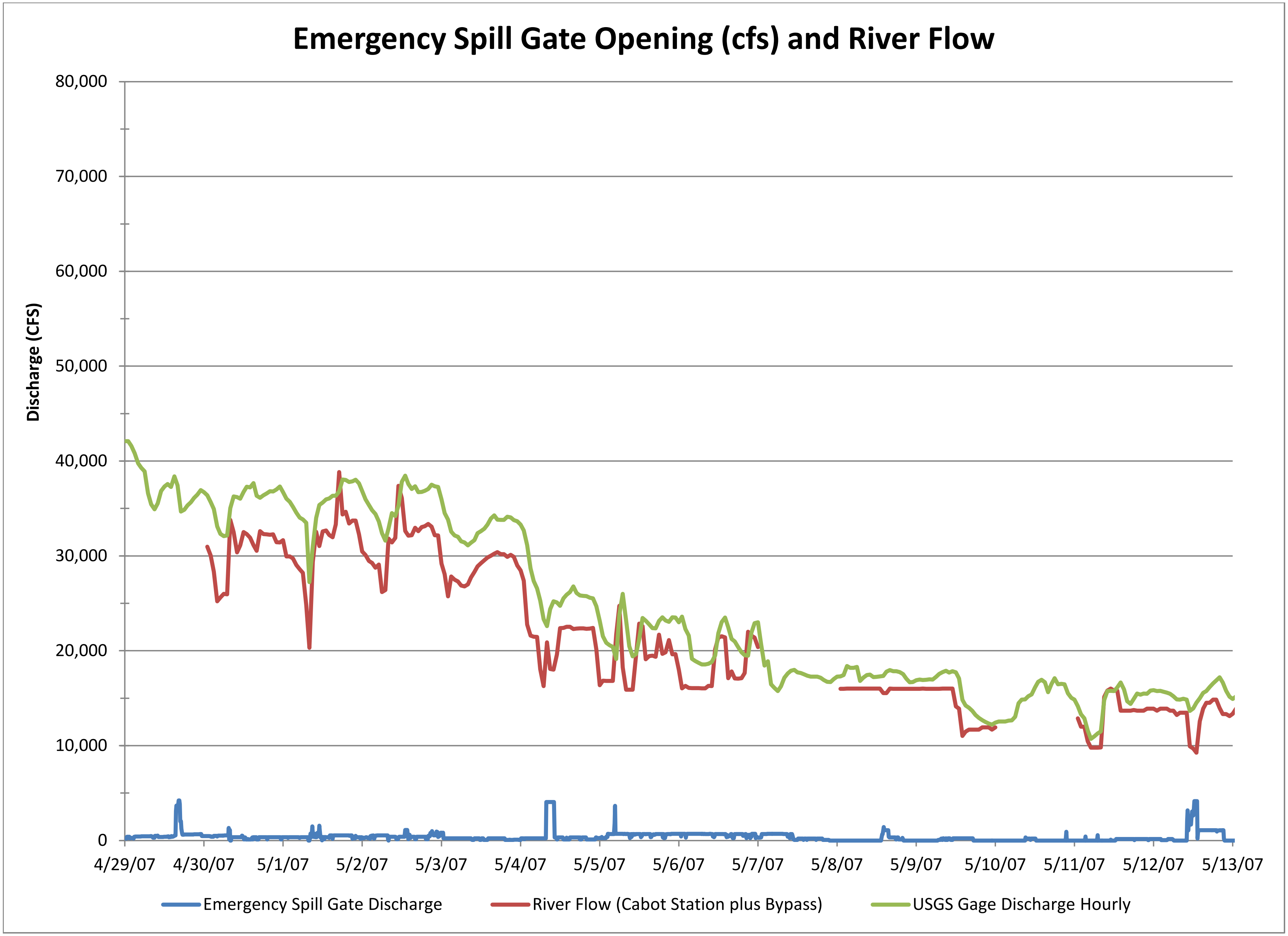
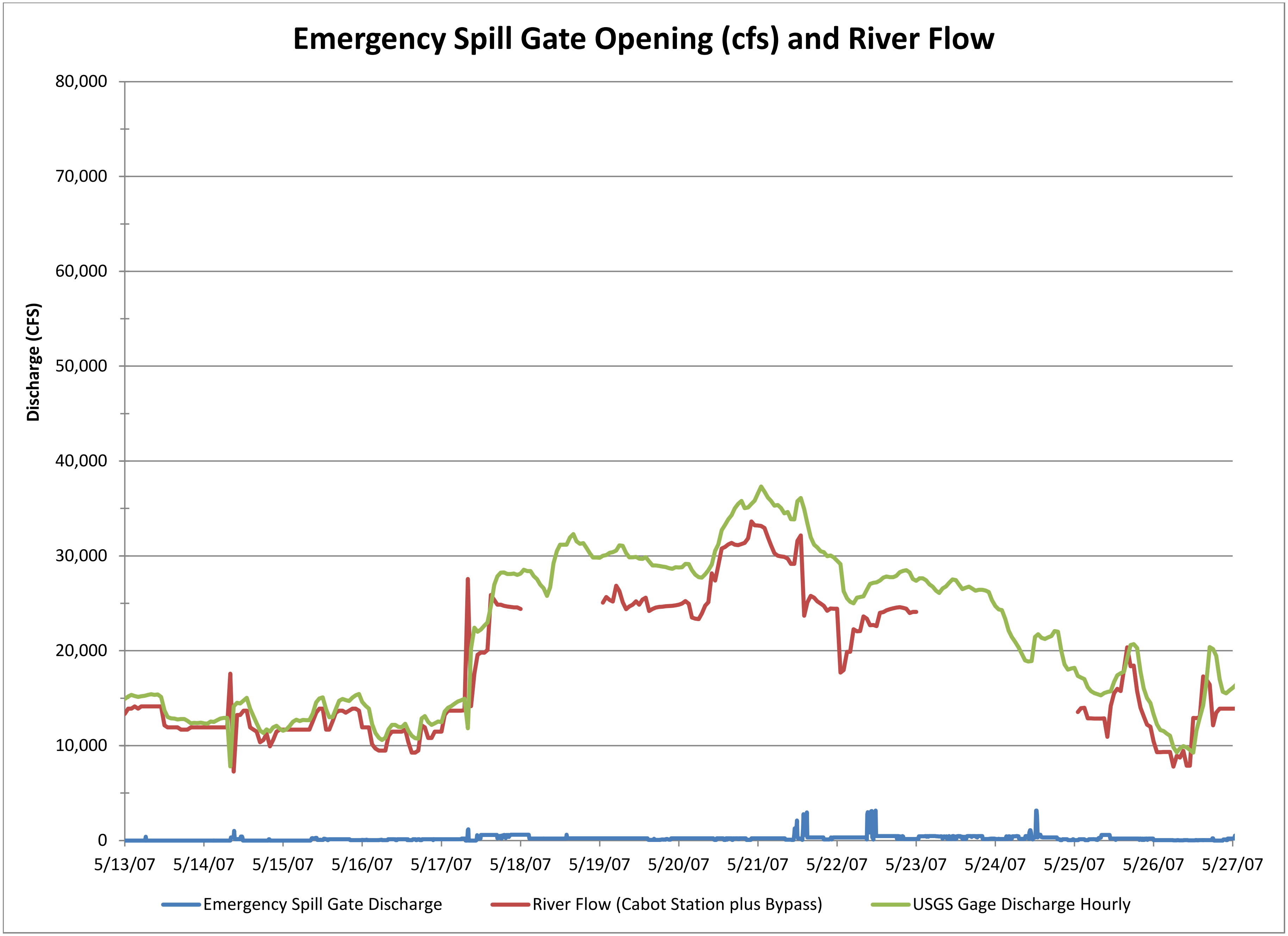
6/22/06
6/23/06
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly



Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/15/07
4/16/07
4/17/07
4/18/07
4/19/07
4/20/07
4/21/07
4/22/07
4/23/07
4/24/07
4/25/07
4/26/07
4/27/07
4/28/07
4/29/07
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/29/07
4/30/07
5/1/07
5/2/07
5/3/07
5/4/07
5/5/07
5/6/07
5/7/07
5/8/07
5/9/07
5/10/07
5/11/07
5/12/07
5/13/07
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly



Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/13/07
5/14/07
5/15/07
5/16/07
5/17/07
5/18/07
5/19/07
5/20/07
5/21/07
5/22/07
5/23/07
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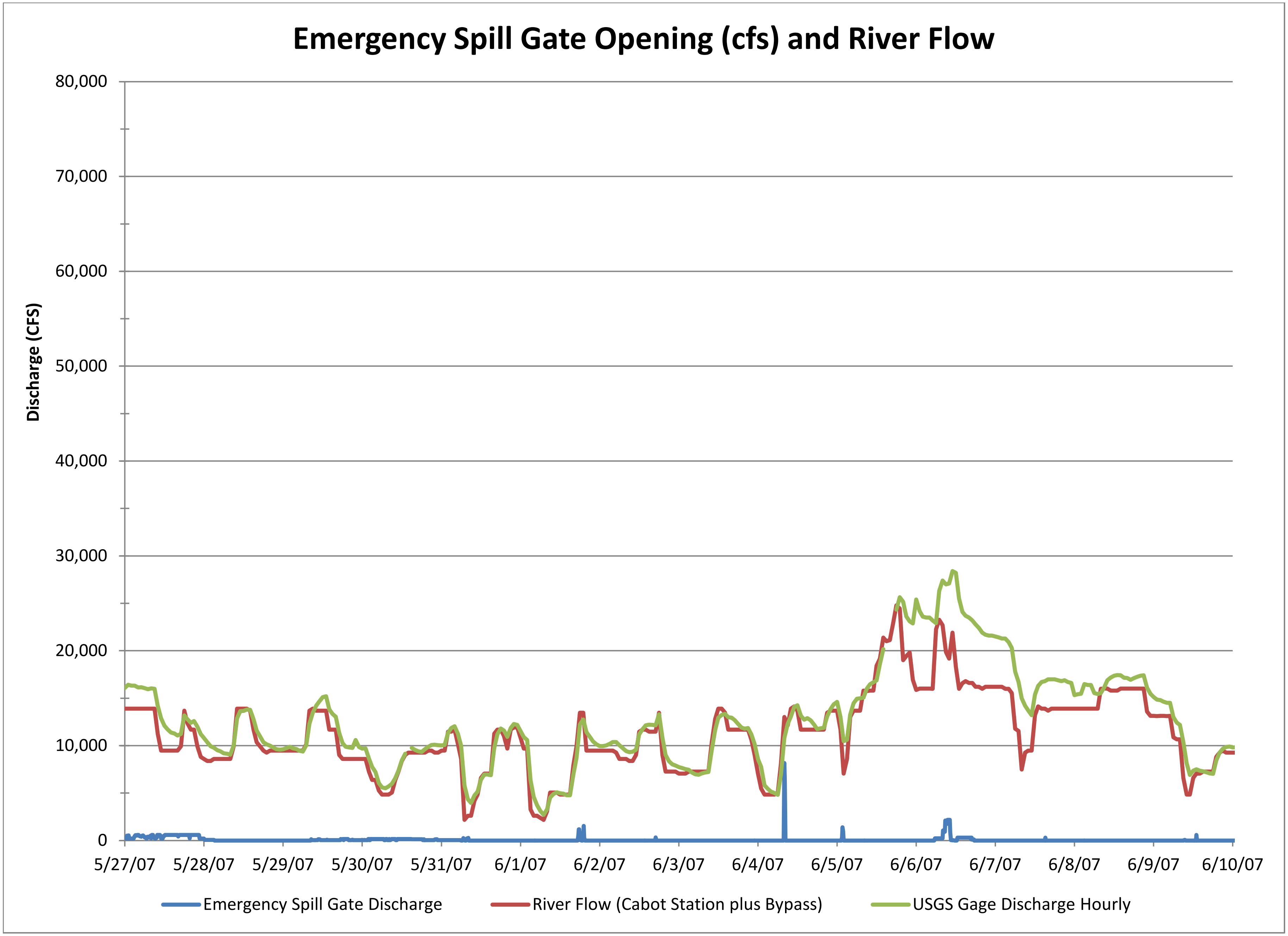
5/26/07
5/27/07
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/27/07
5/28/07
5/29/07
5/30/07
5/31/07
6/1/07
6/2/07
6/3/07
6/4/07
6/5/07
6/6/07
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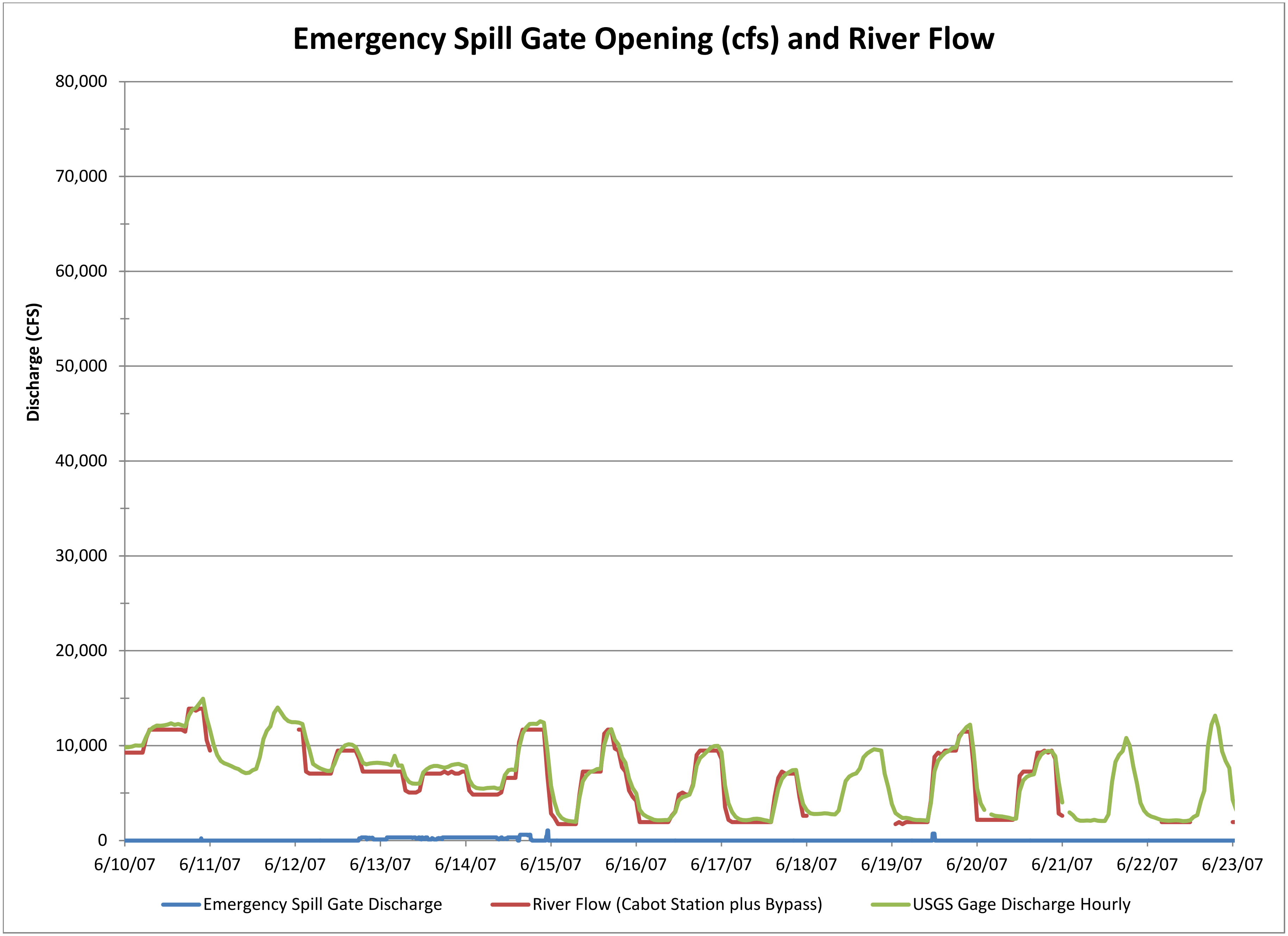
6/9/07
6/10/07
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly



Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
6/10/07
6/11/07
6/12/07
6/13/07
6/14/07
6/15/07
6/16/07
6/17/07
6/18/07
6/19/07
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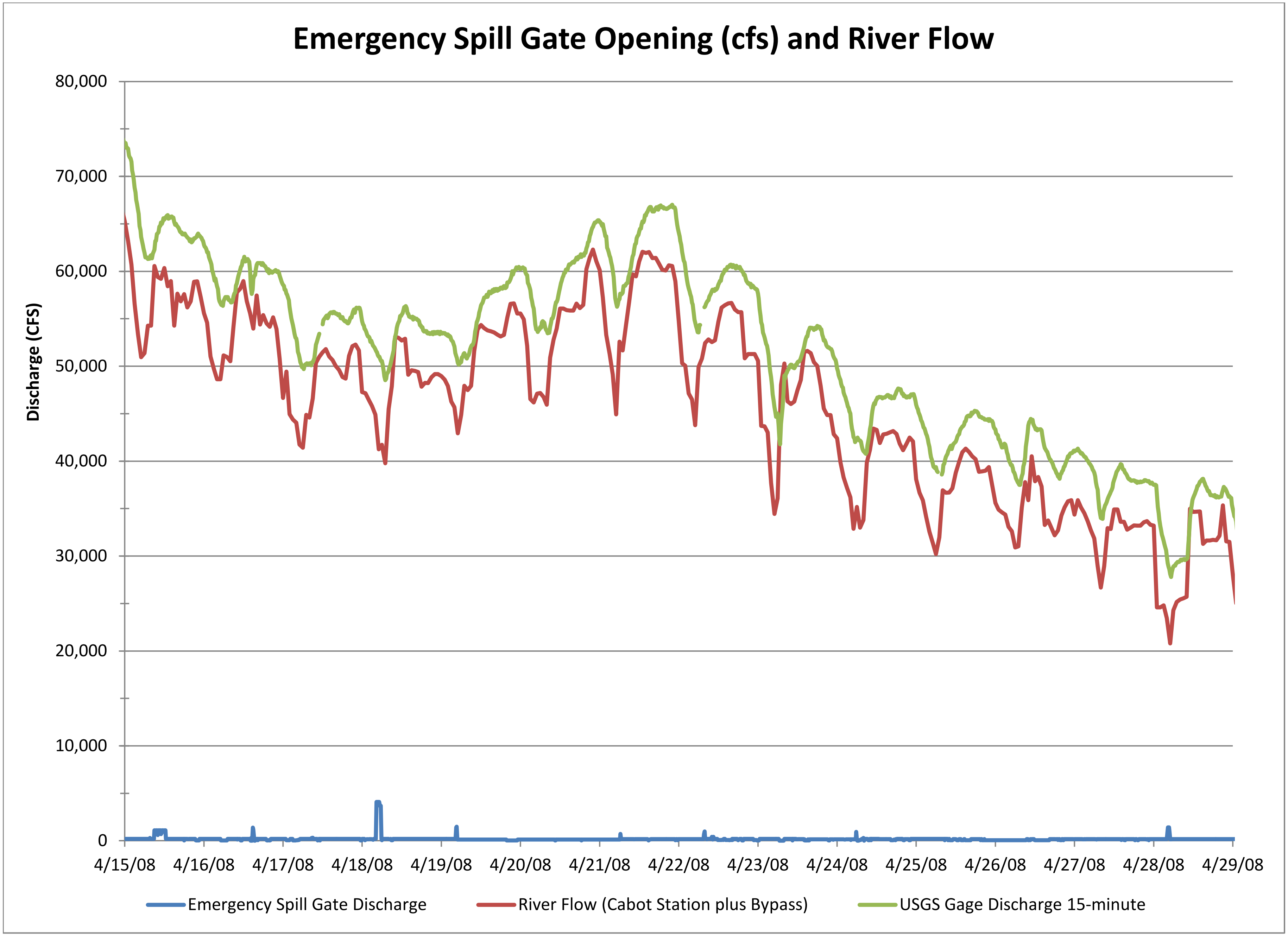
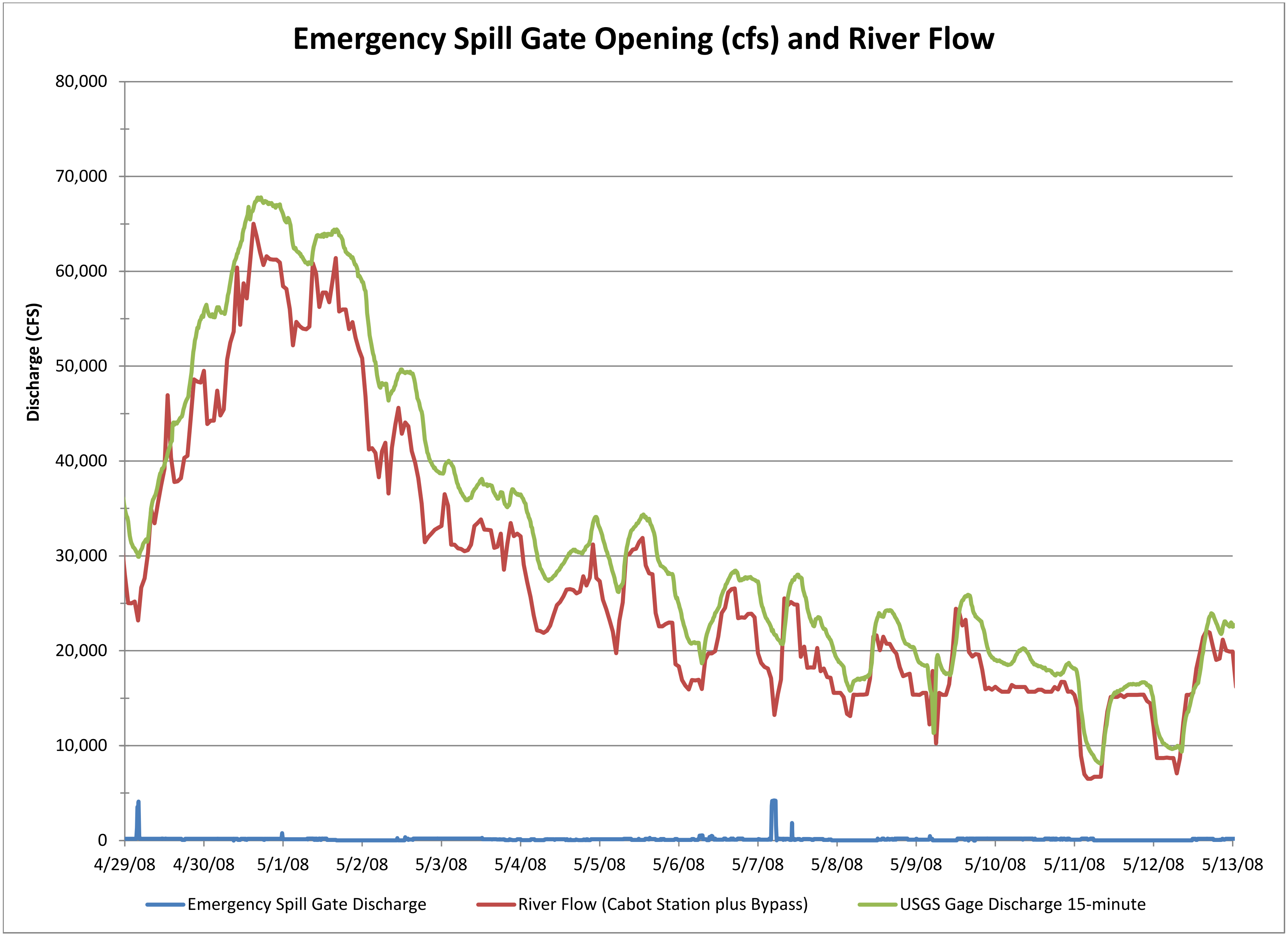
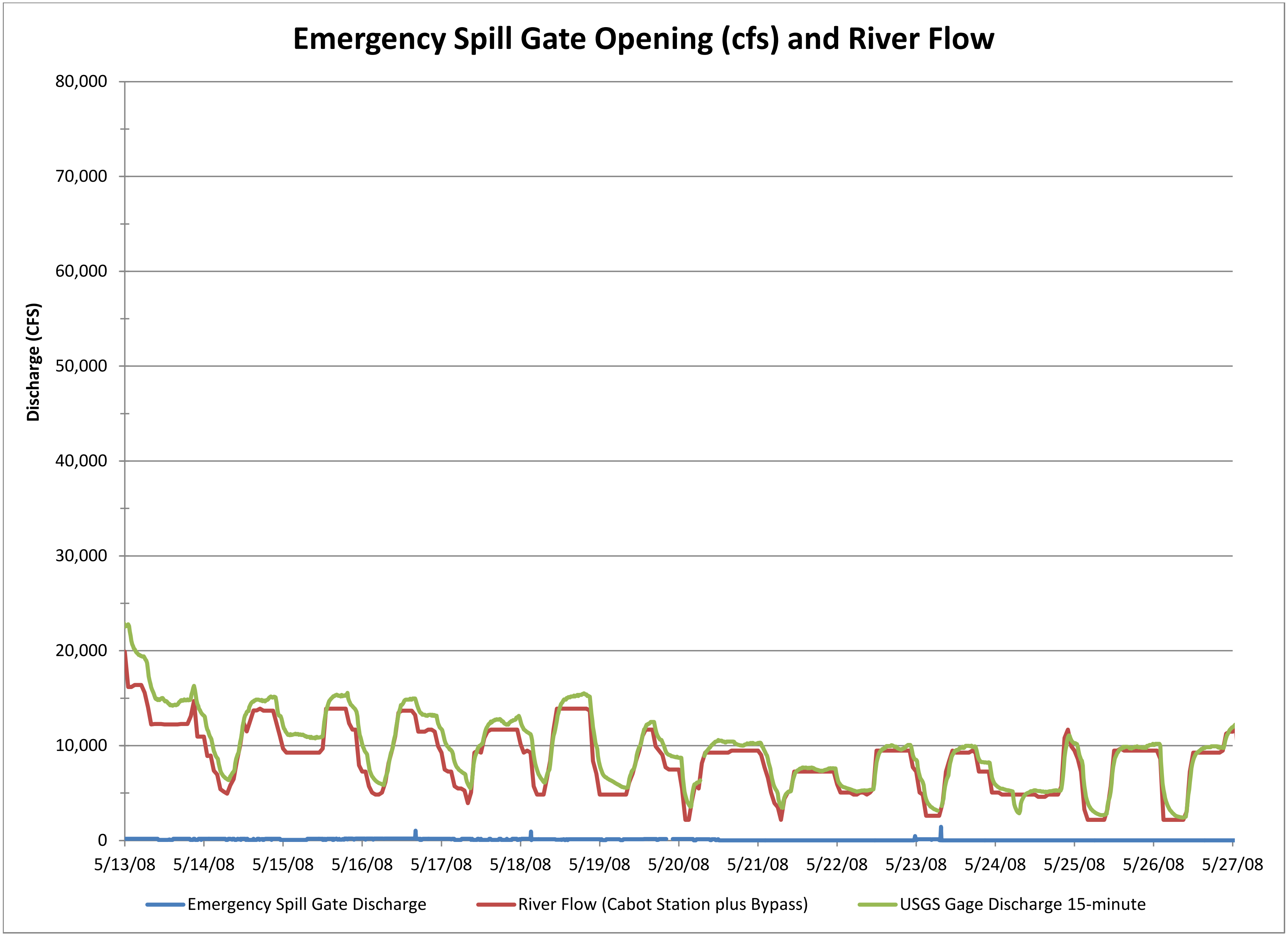
6/22/07
6/23/07
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge Hourly


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/15/08
4/16/08
4/17/08
4/18/08
4/19/08
4/20/08
4/21/08
4/22/08
4/23/08
4/24/08
4/25/08
4/26/08
4/27/08
4/28/08
4/29/08
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/29/08
4/30/08
5/1/08
5/2/08
5/3/08
5/4/08
5/5/08
5/6/08
5/7/08
5/8/08
5/9/08
5/10/08
5/11/08
5/12/08
5/13/08
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
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10,000
0
5/13/08
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5/15/08
5/16/08
5/17/08
5/18/08
5/19/08
5/20/08
5/21/08
5/22/08
5/23/08
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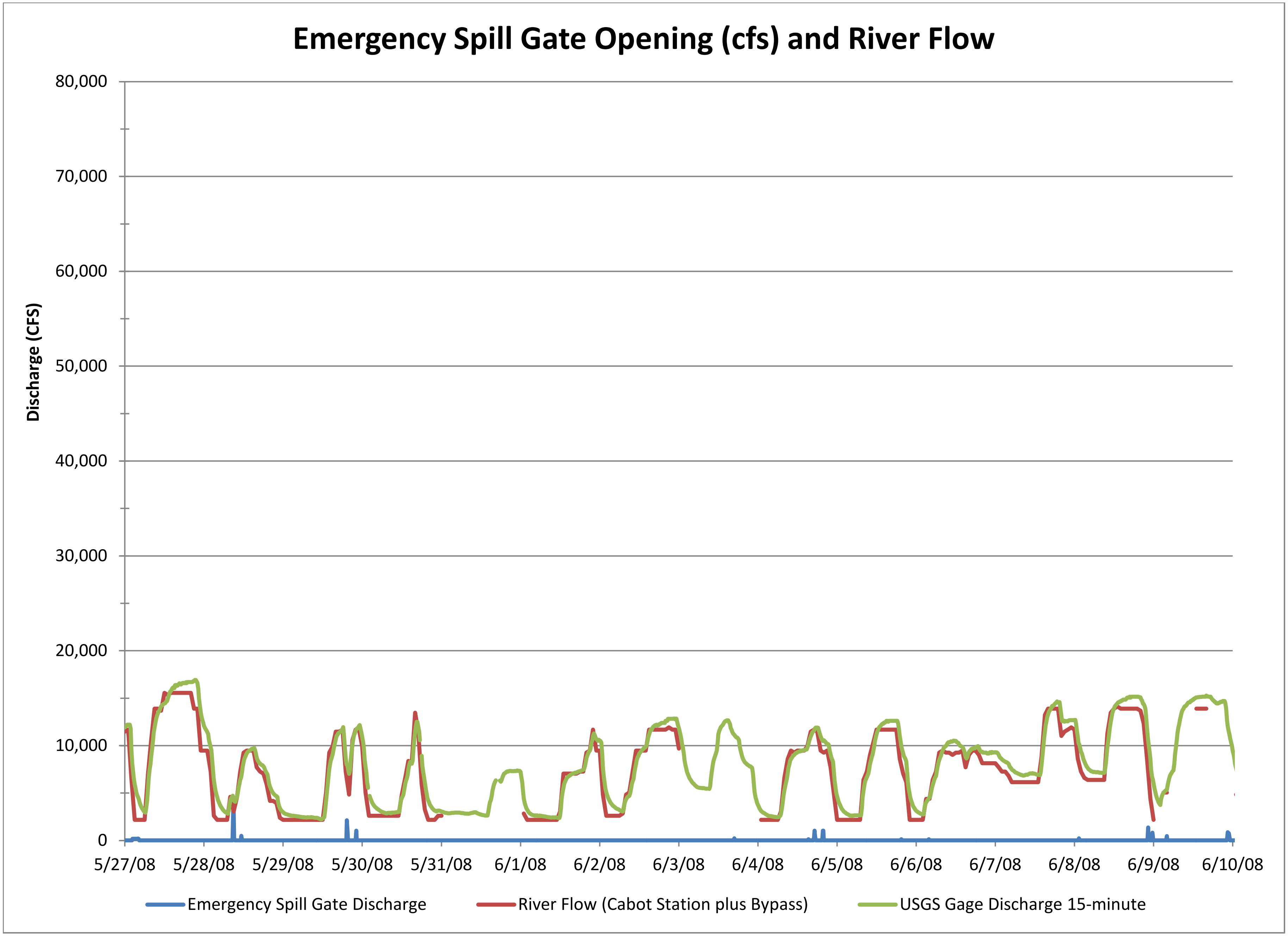
5/25/08
5/26/08
5/27/08
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute



Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
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5/29/08
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5/31/08
6/1/08
6/2/08
6/3/08
6/4/08
6/5/08
6/6/08
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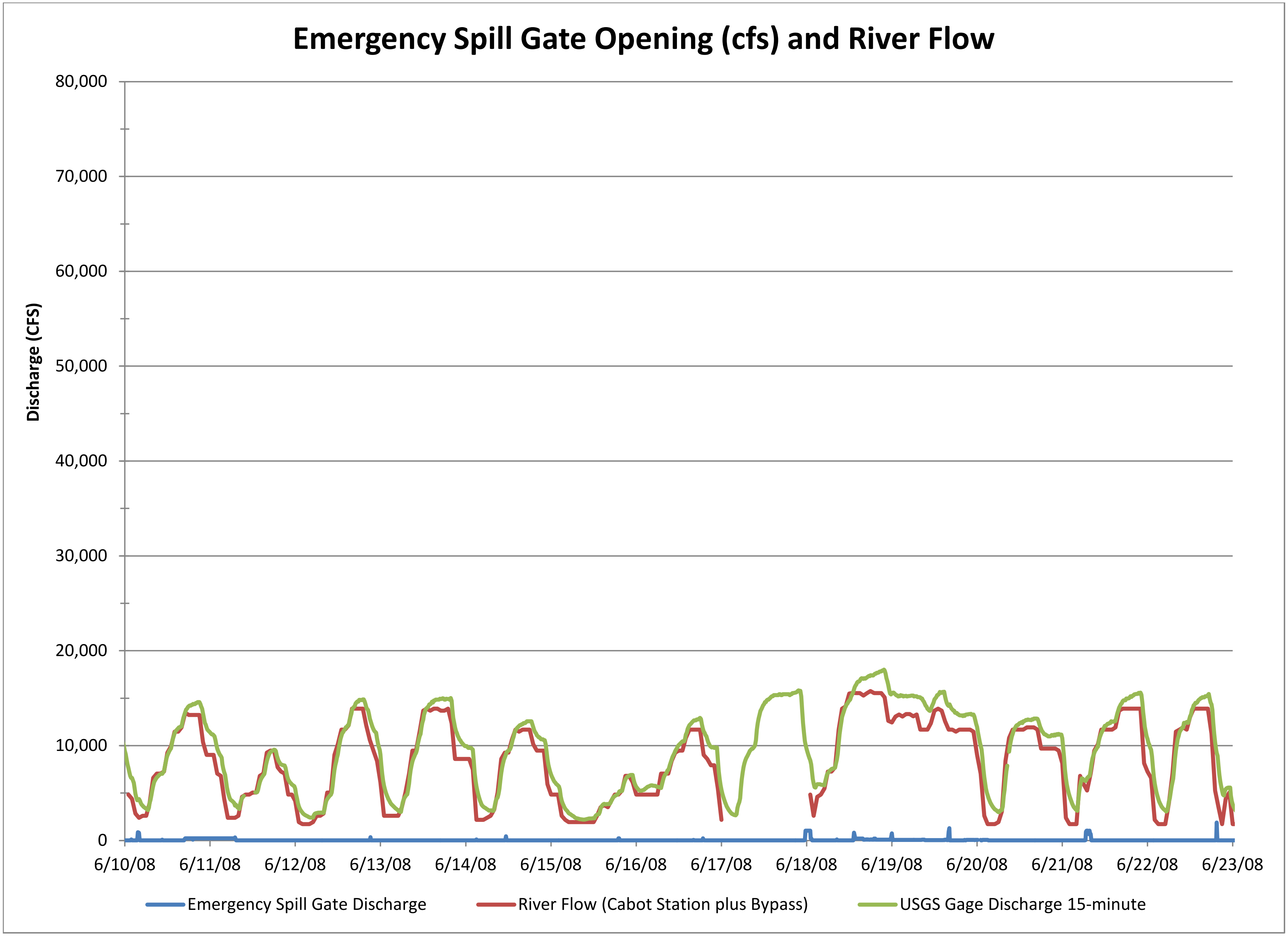
6/9/08
6/10/08
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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6/22/08
6/23/08
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute

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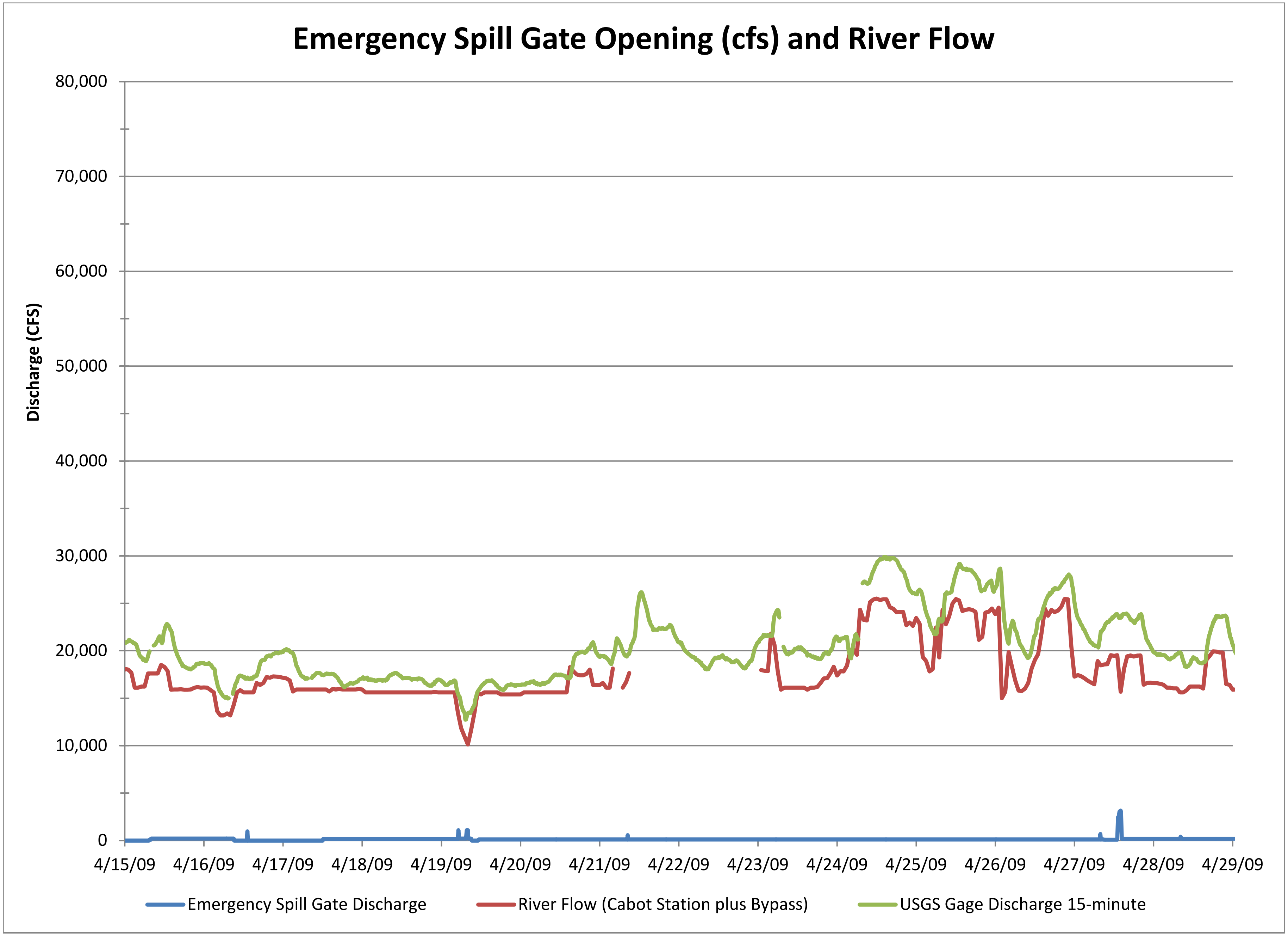

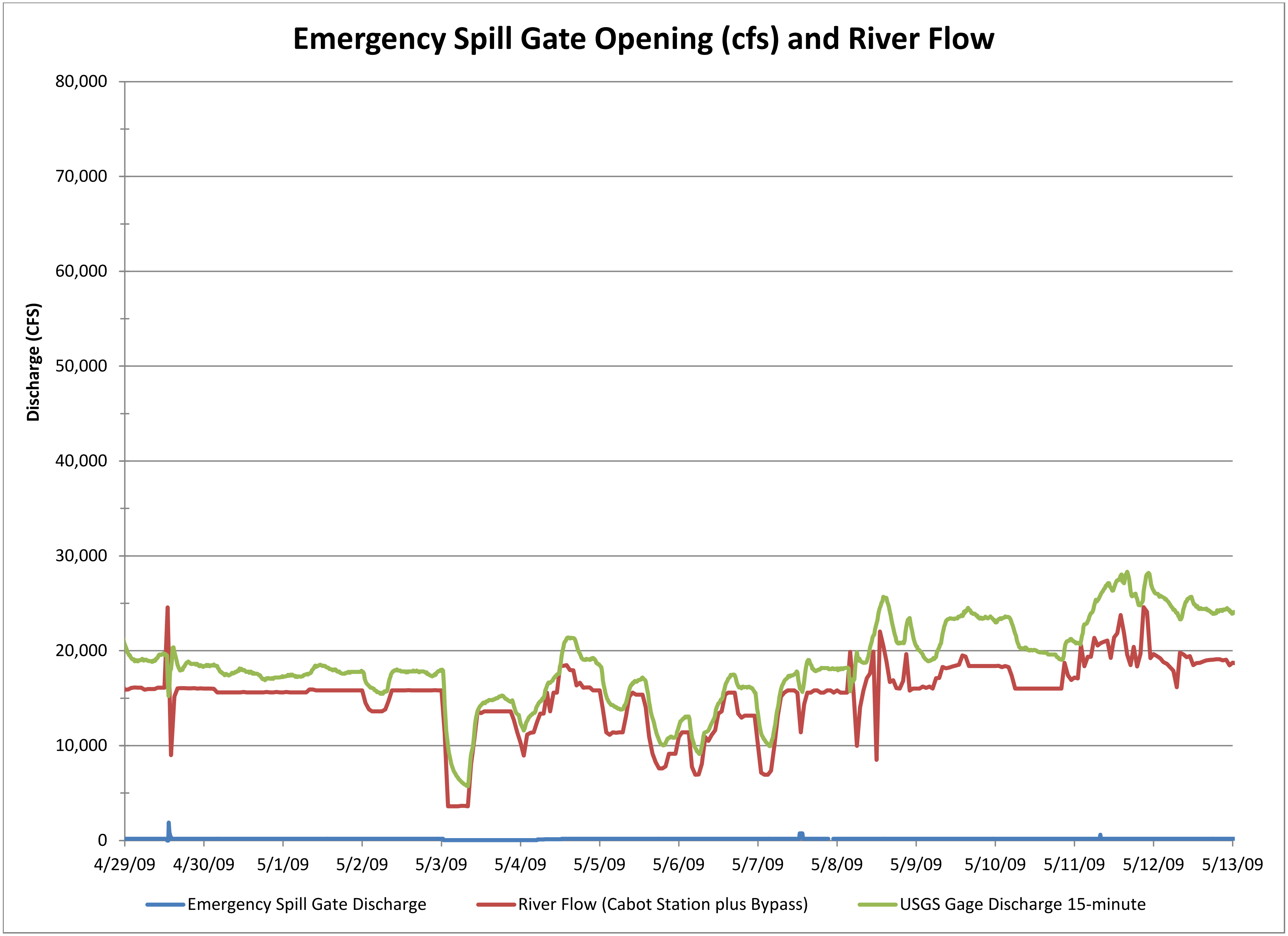
Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
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4/29/09
4/30/09
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5/8/09
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5/10/09
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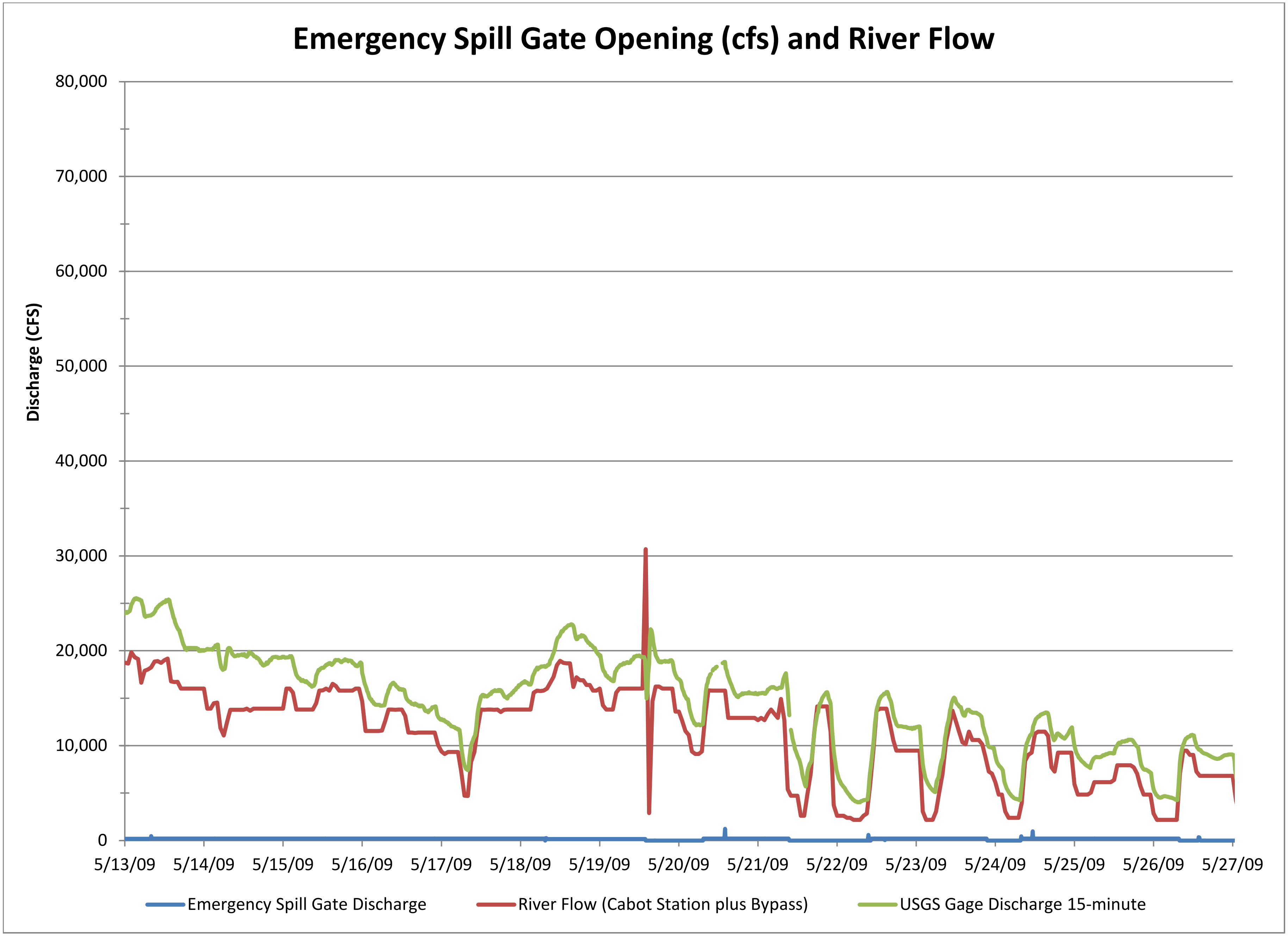
5/12/09
5/13/09
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
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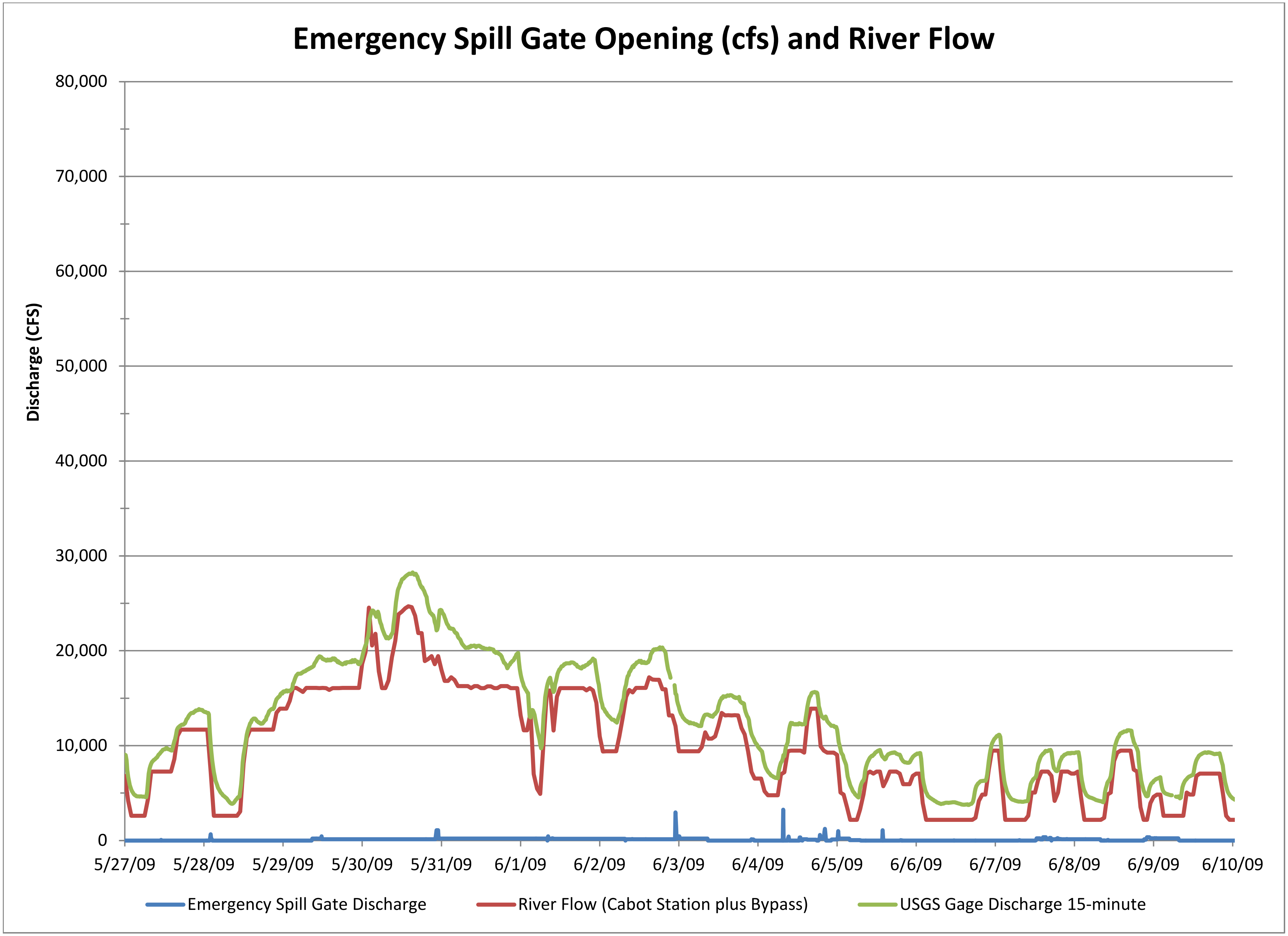
5/26/09
5/27/09
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
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6/2/09
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6/5/09
6/6/09
6/7/09
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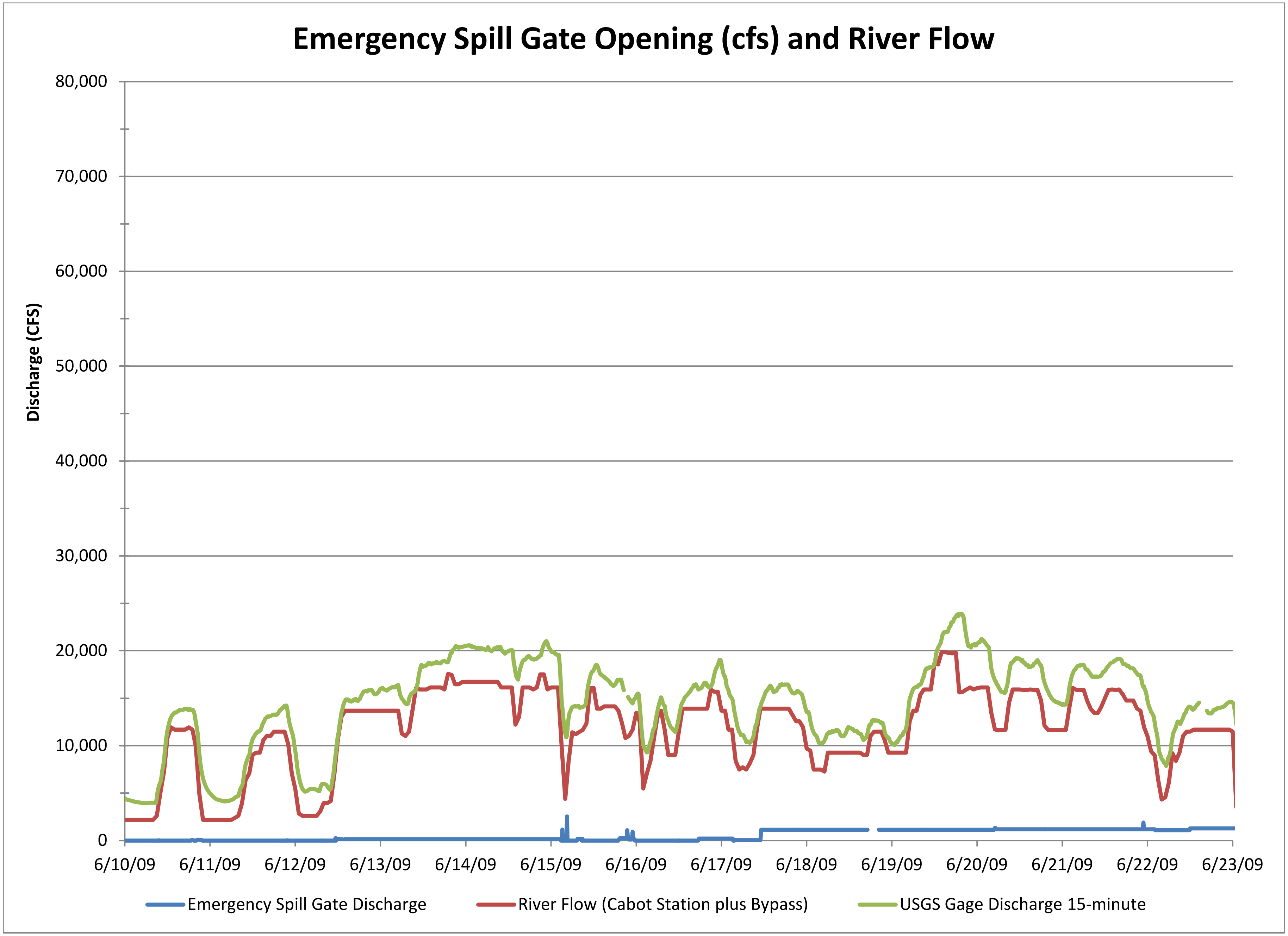
6/9/09
6/10/09
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute



Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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6/18/09
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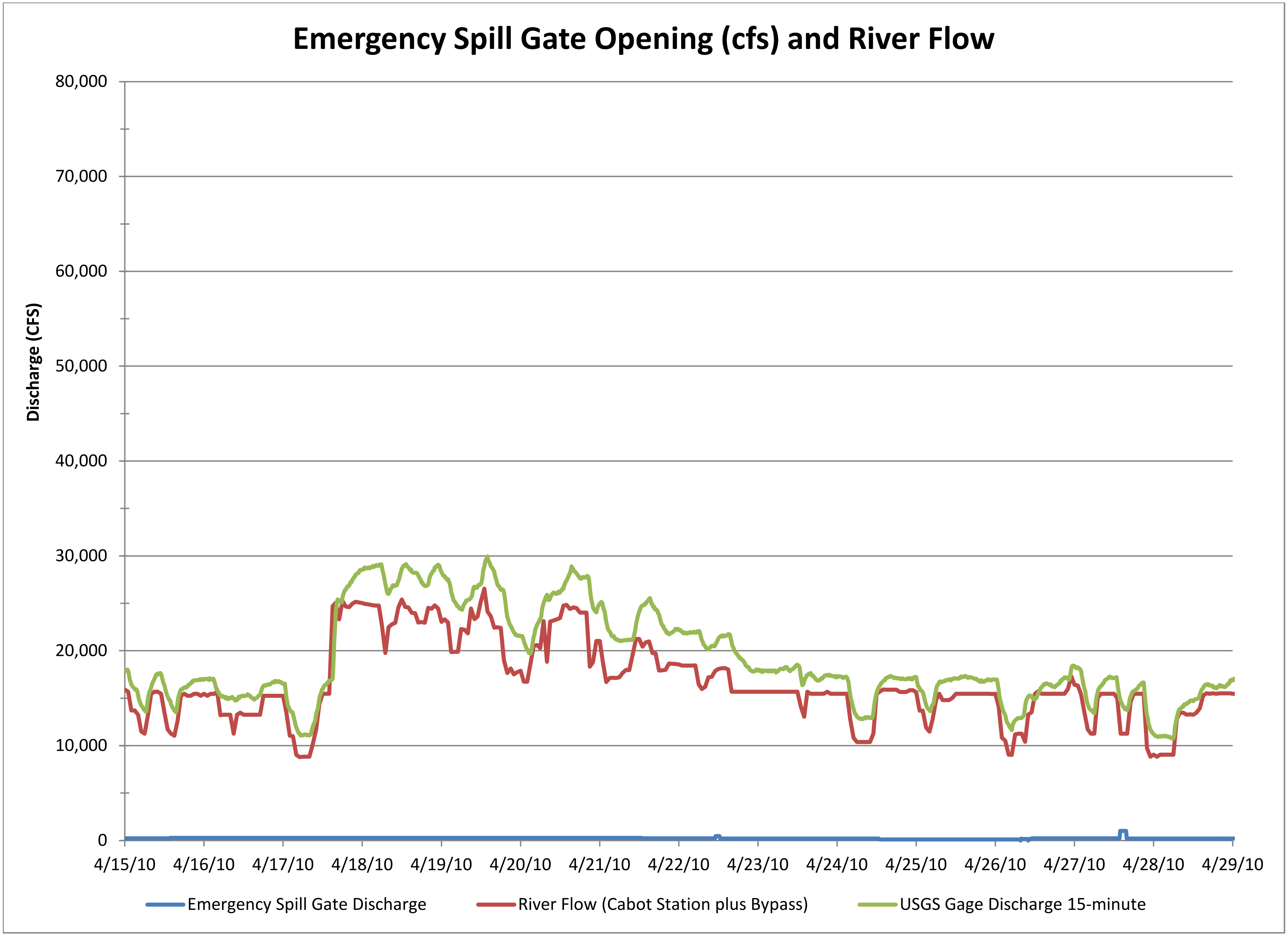
6/20/09
6/21/09
6/22/09
6/23/09
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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4/15/10
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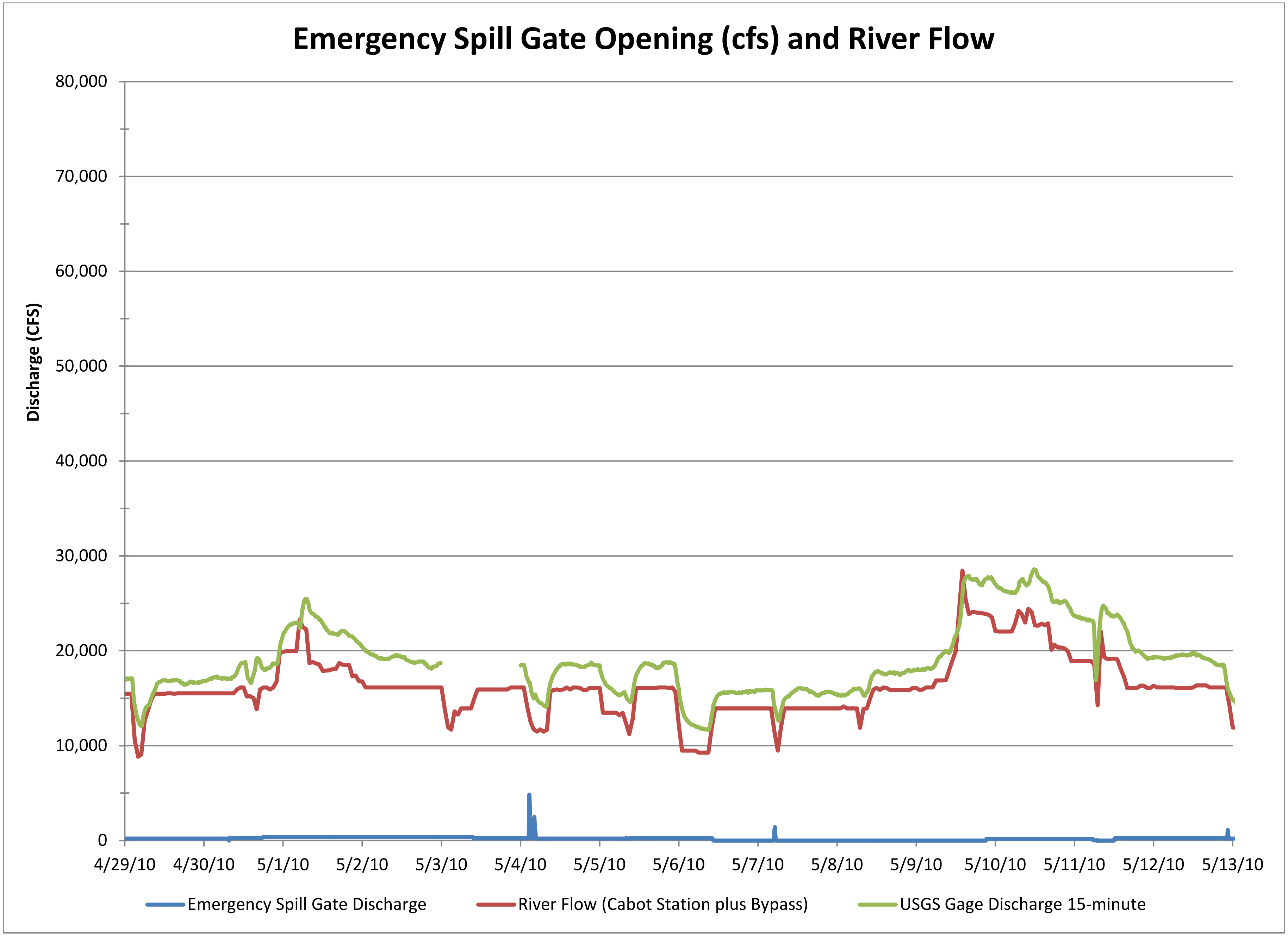
4/23/10
4/24/10
4/25/10
4/26/10
4/27/10
4/28/10
4/29/10
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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20,000
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0
4/29/10
4/30/10
5/1/10
5/2/10
5/3/10
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5/5/10
5/6/10
5/7/10
5/8/10
5/9/10
5/10/10
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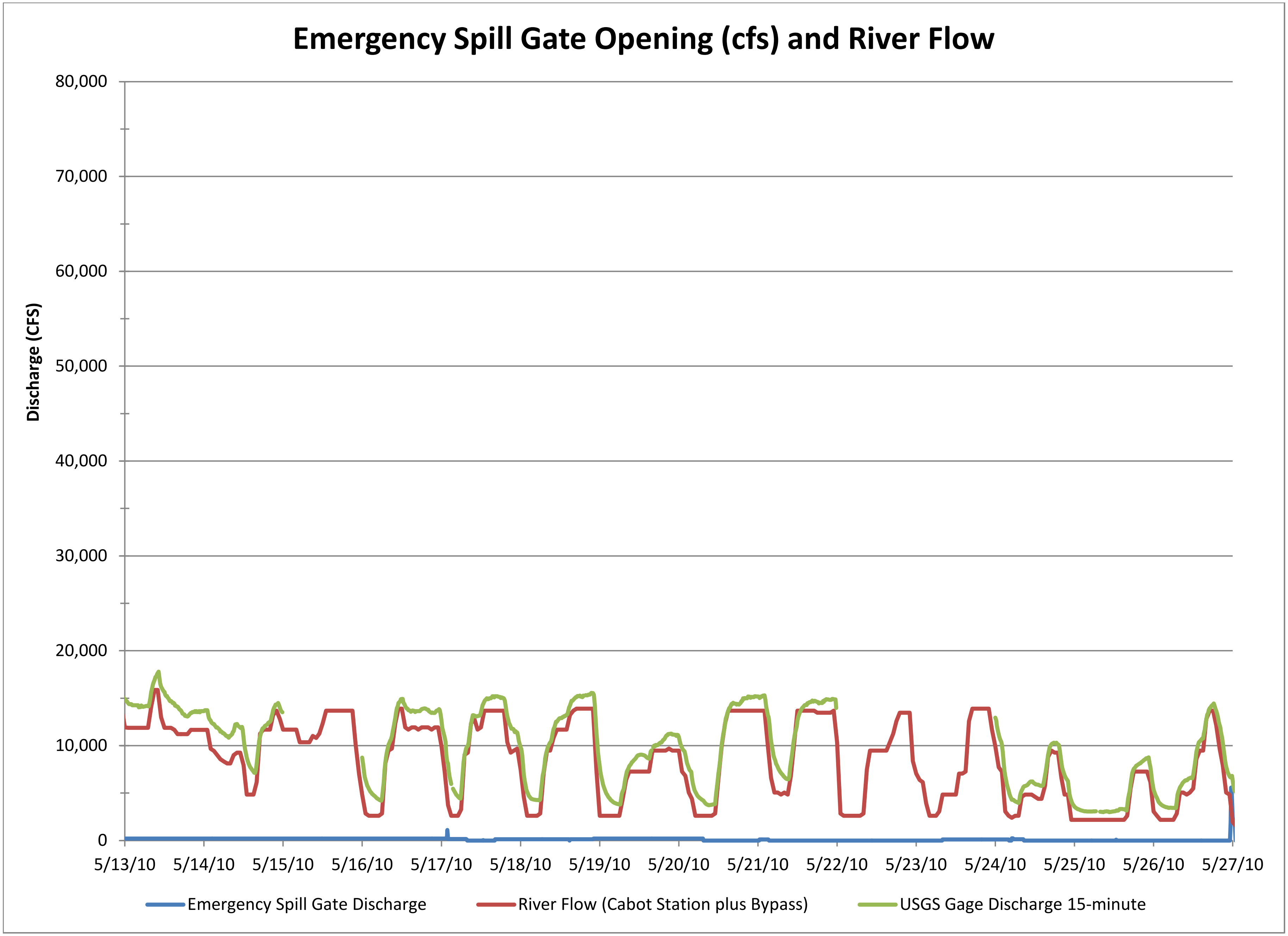
5/13/10
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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70,000
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5/13/10
5/14/10
5/15/10
5/16/10
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5/21/10
5/22/10
5/23/10
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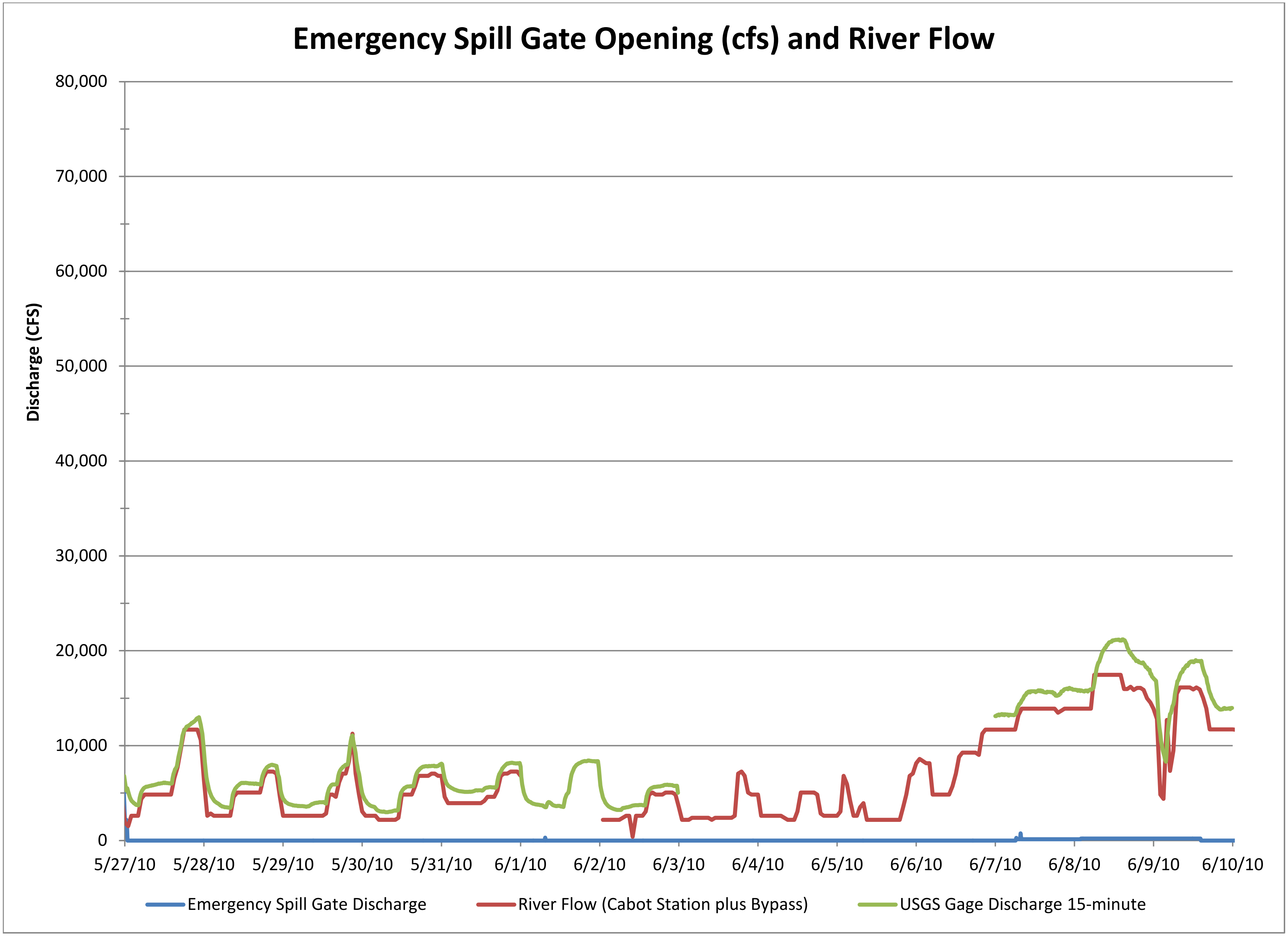
5/26/10
5/27/10
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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70,000
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10,000
0
5/27/10
5/28/10
5/29/10
5/30/10
5/31/10
6/1/10
6/2/10
6/3/10
6/4/10
6/5/10
6/6/10
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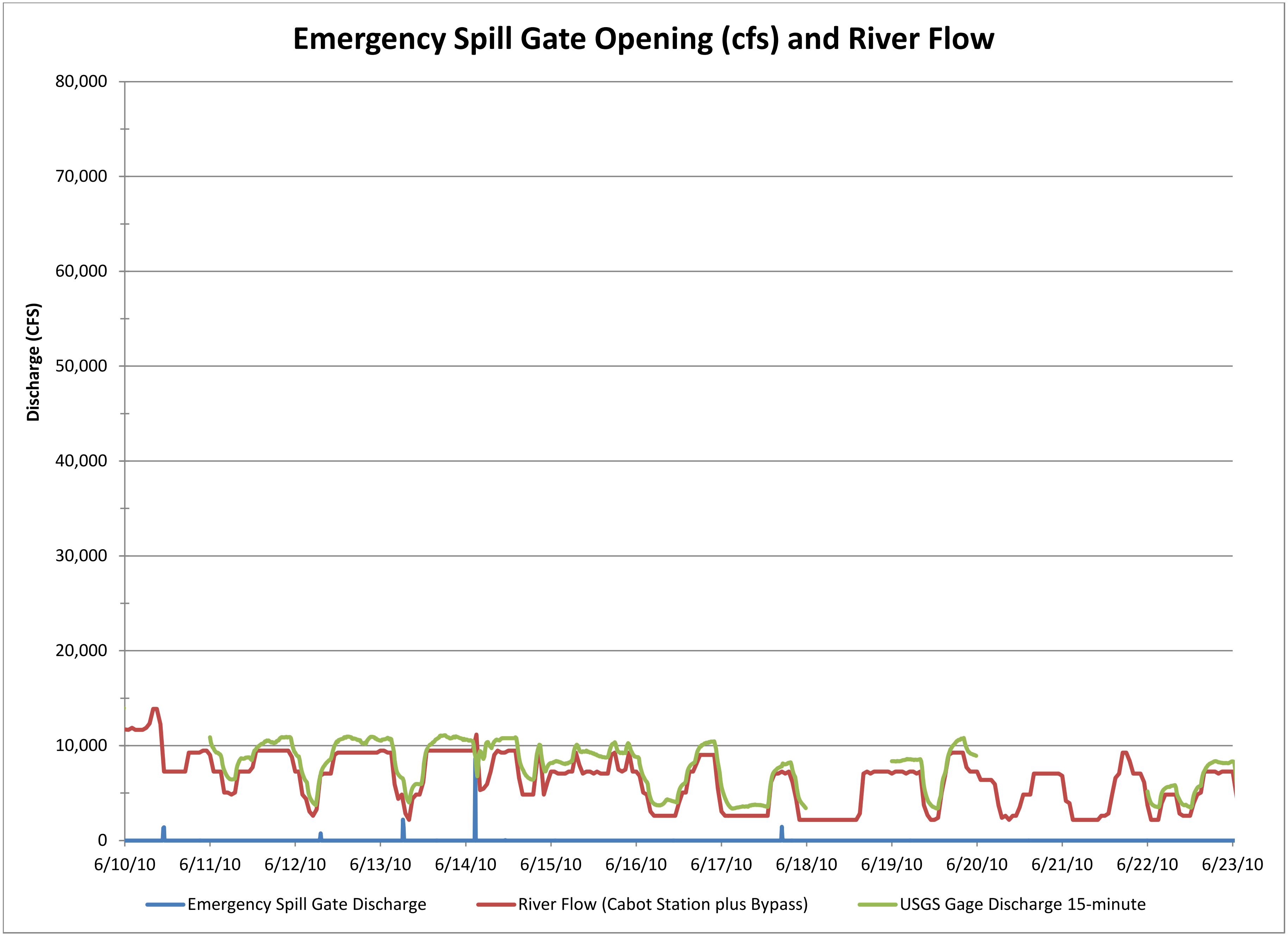
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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0
6/10/10
6/11/10
6/12/10
6/13/10
6/14/10
6/15/10
6/16/10
6/17/10
6/18/10
6/19/10
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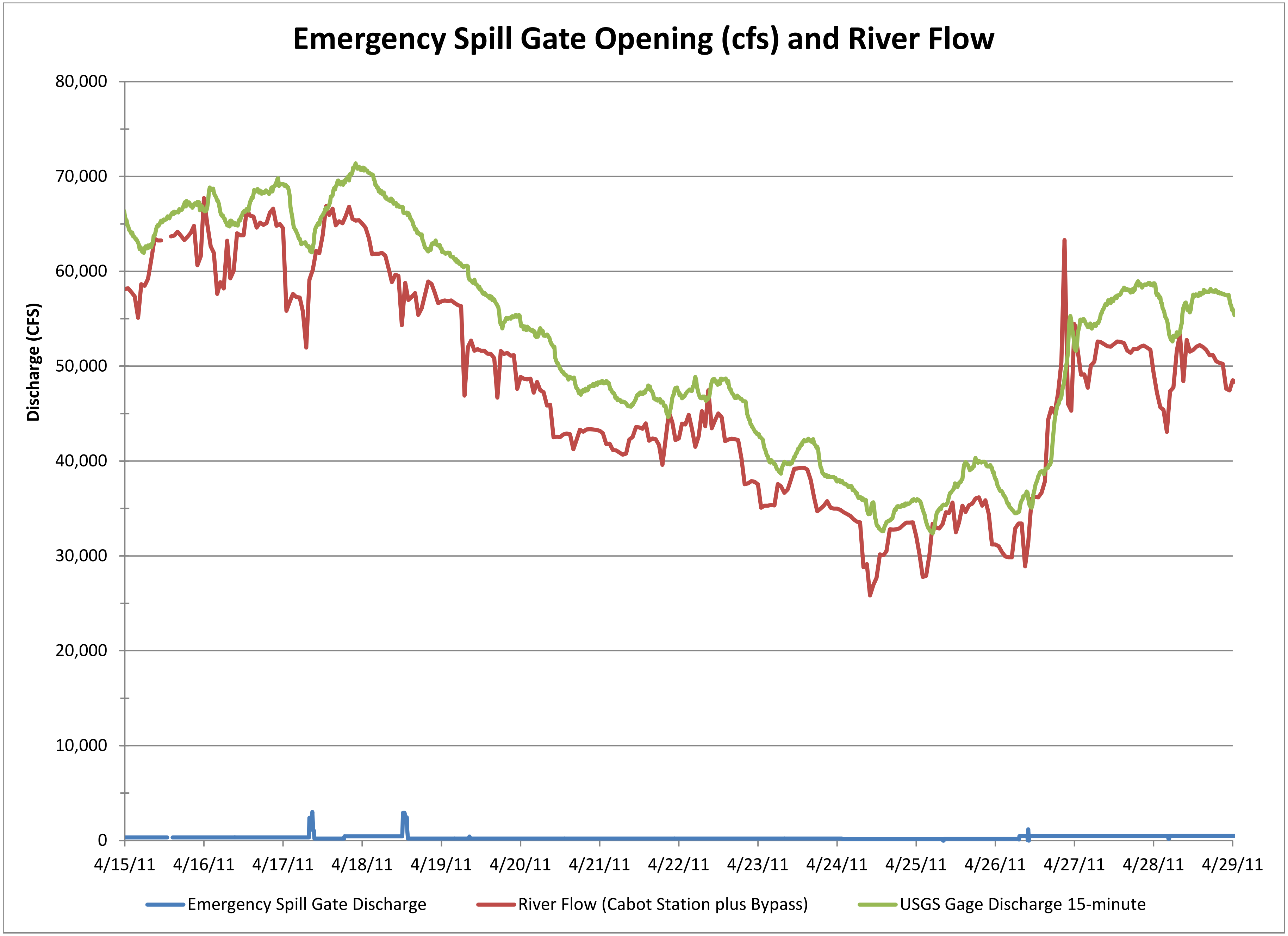
6/23/10
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
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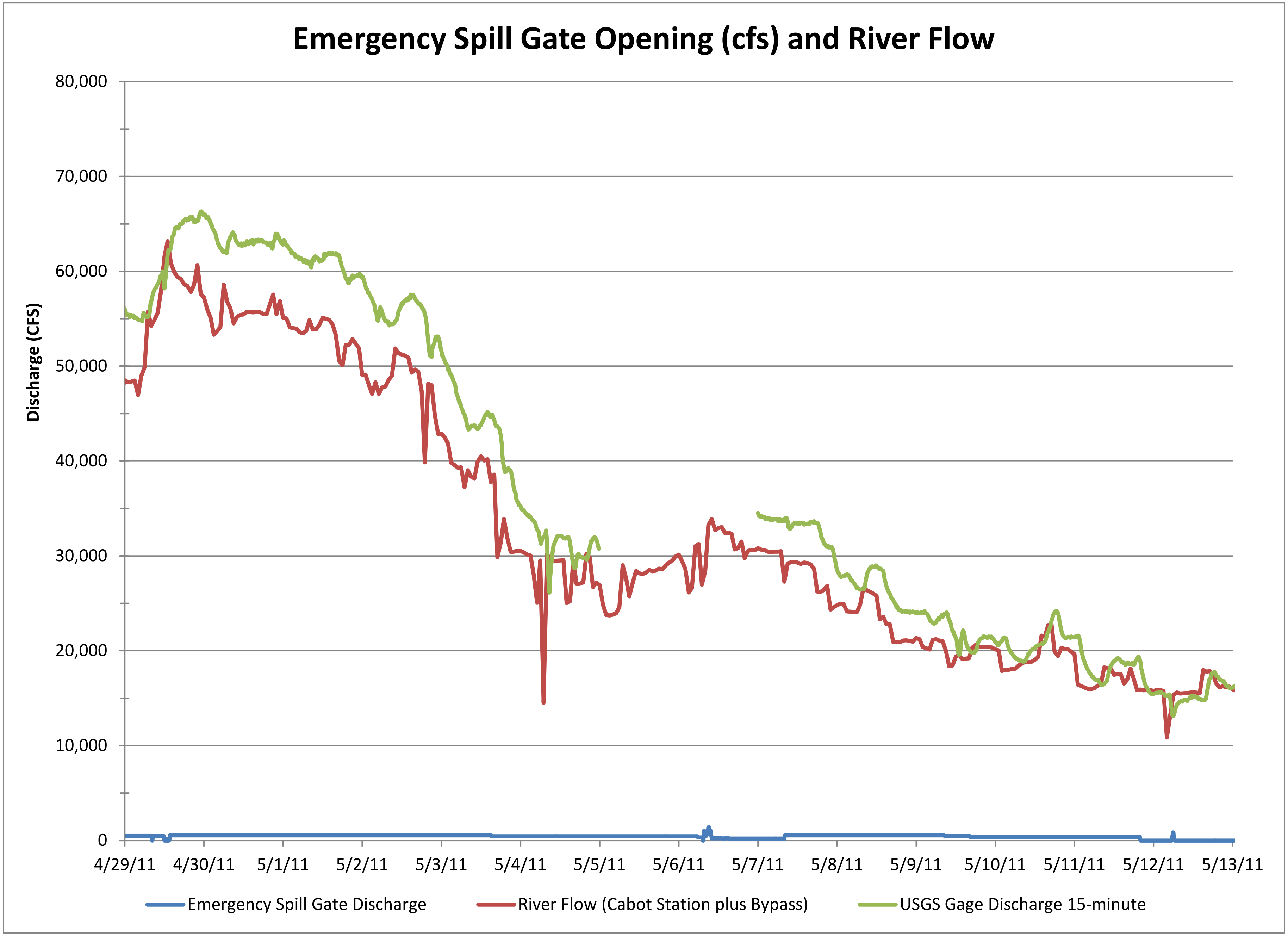
10,000
0
4/15/11
4/16/11
4/17/11
4/18/11
4/19/11
4/20/11
4/21/11
4/22/11
4/23/11
4/24/11
4/25/11
4/26/11
4/27/11
4/28/11
4/29/11
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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10,000
0
4/29/11
4/30/11
5/1/11
5/2/11
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5/7/11
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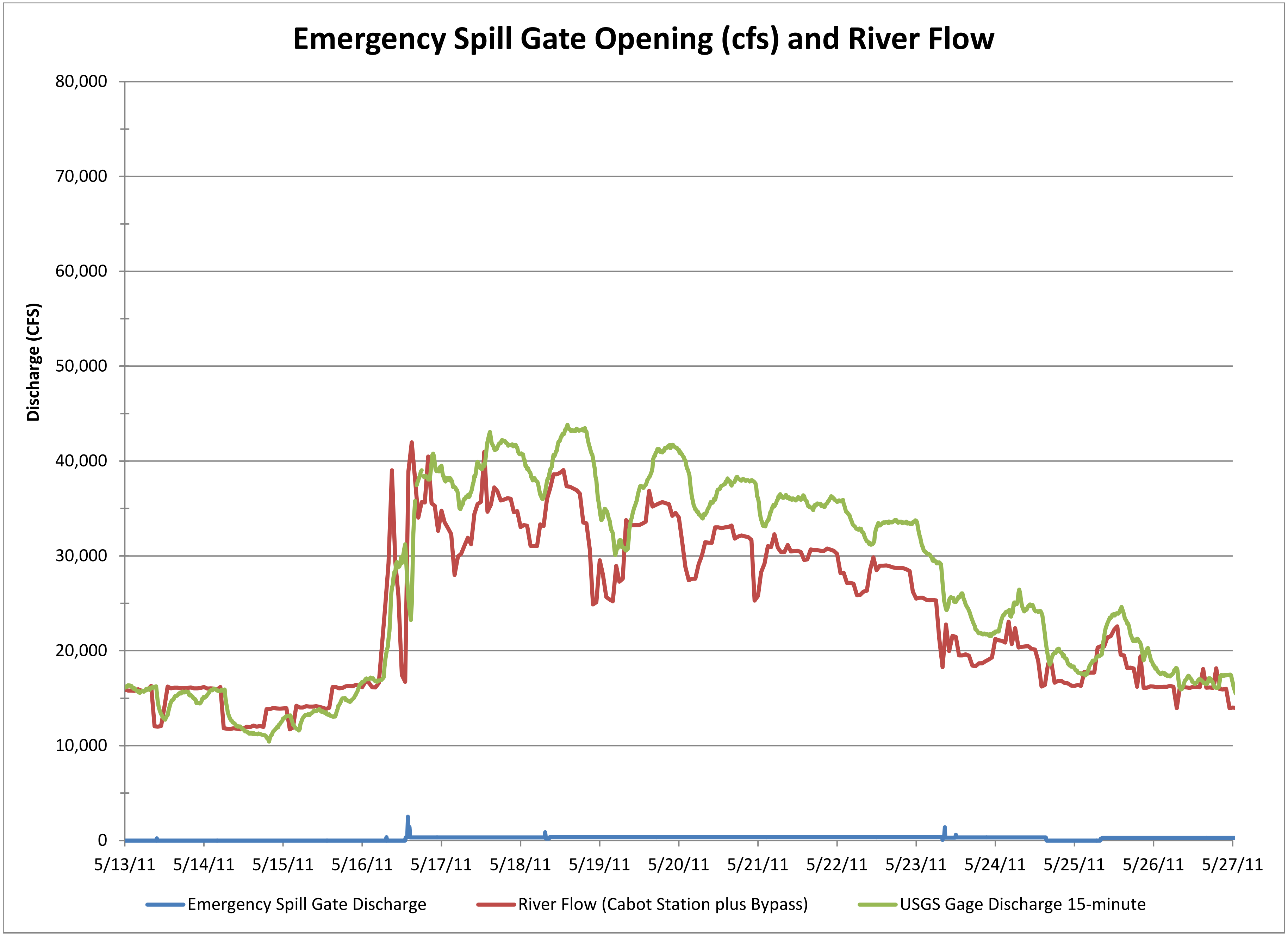
5/13/11
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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5/13/11
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5/21/11
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5/23/11
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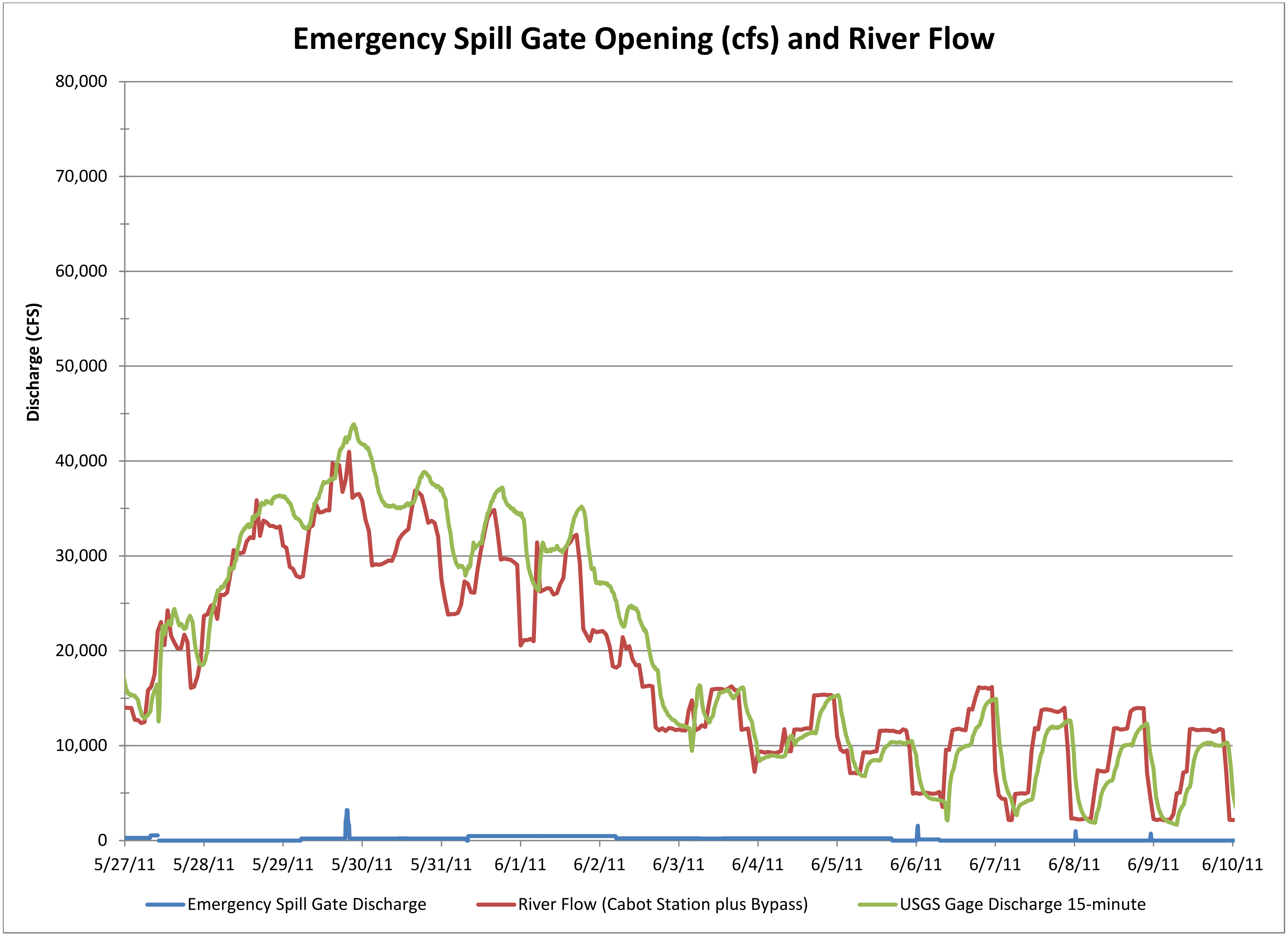
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute



Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
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0
5/27/11
5/28/11
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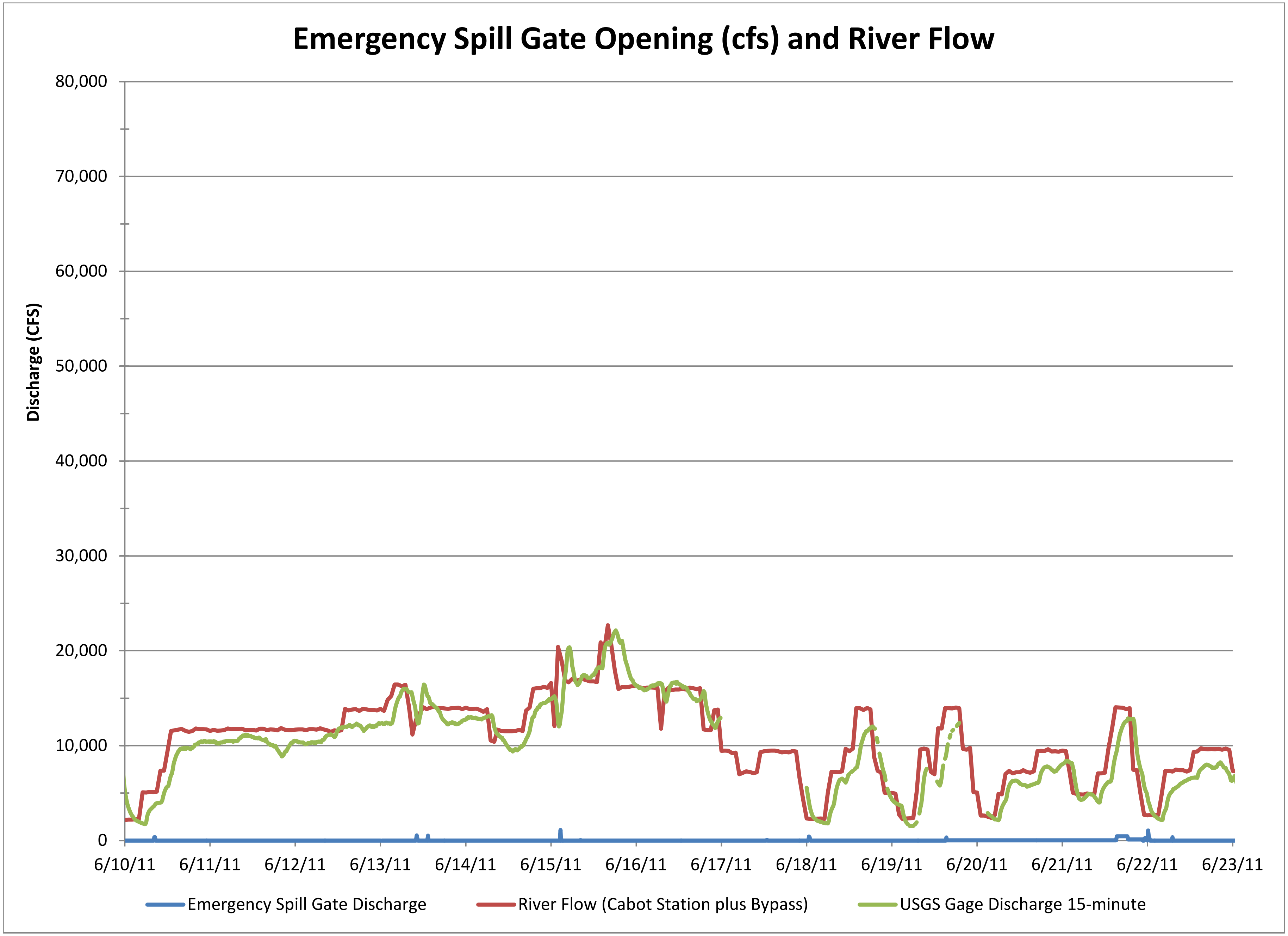
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
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6/10/11
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6/18/11
6/19/11
6/20/11
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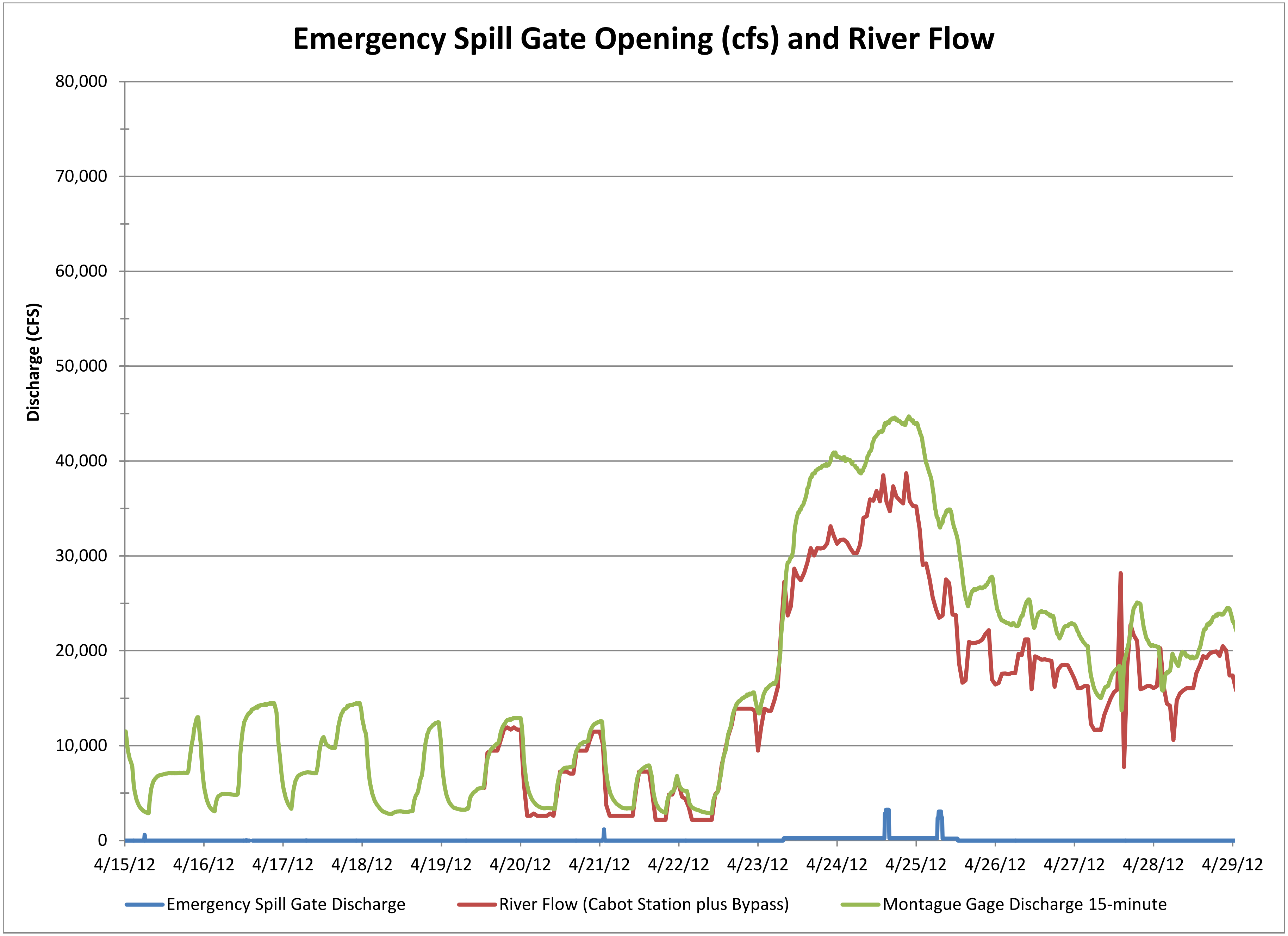
6/23/11
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
USGS Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
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70,000
60,000
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30,000
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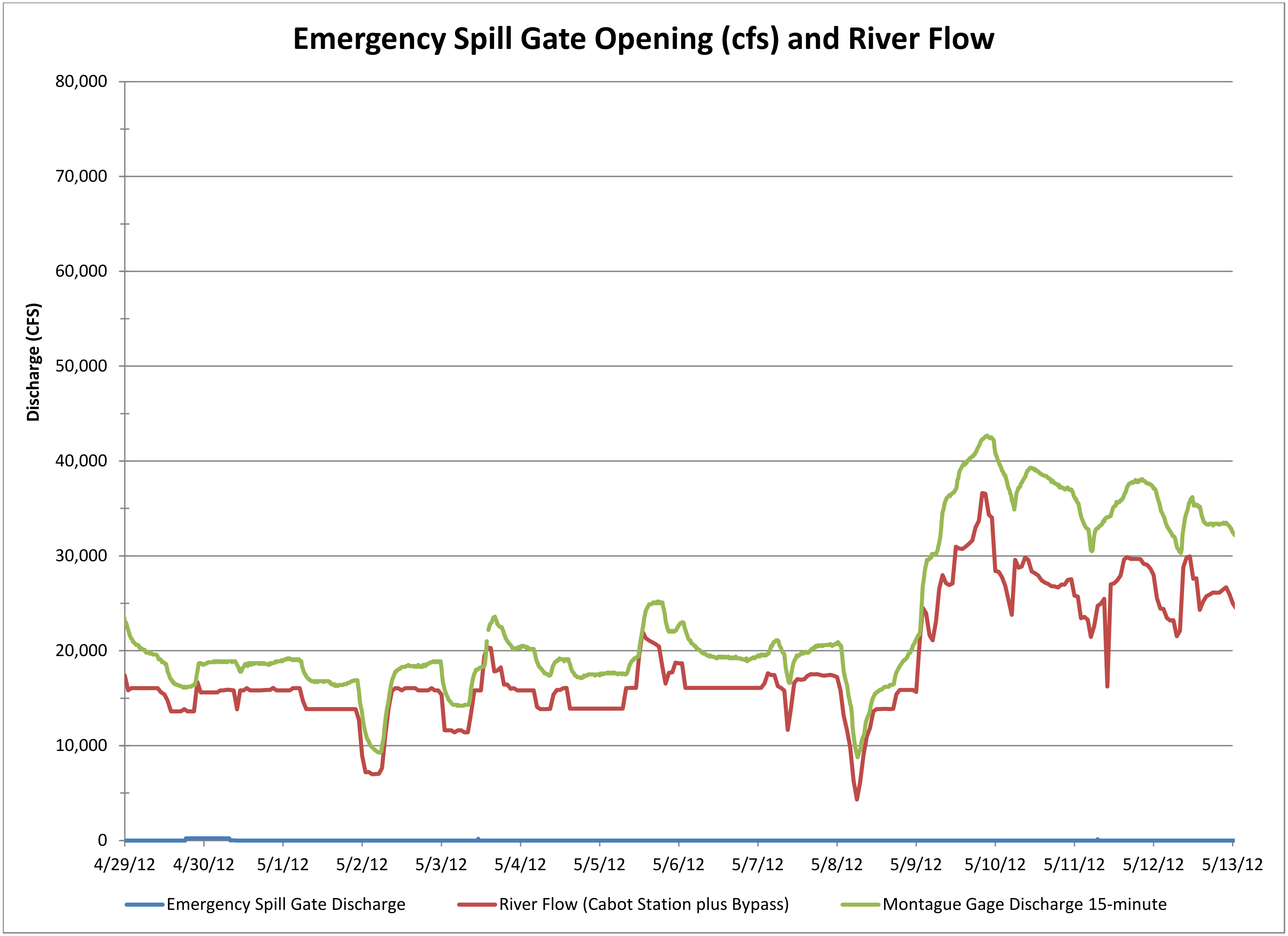
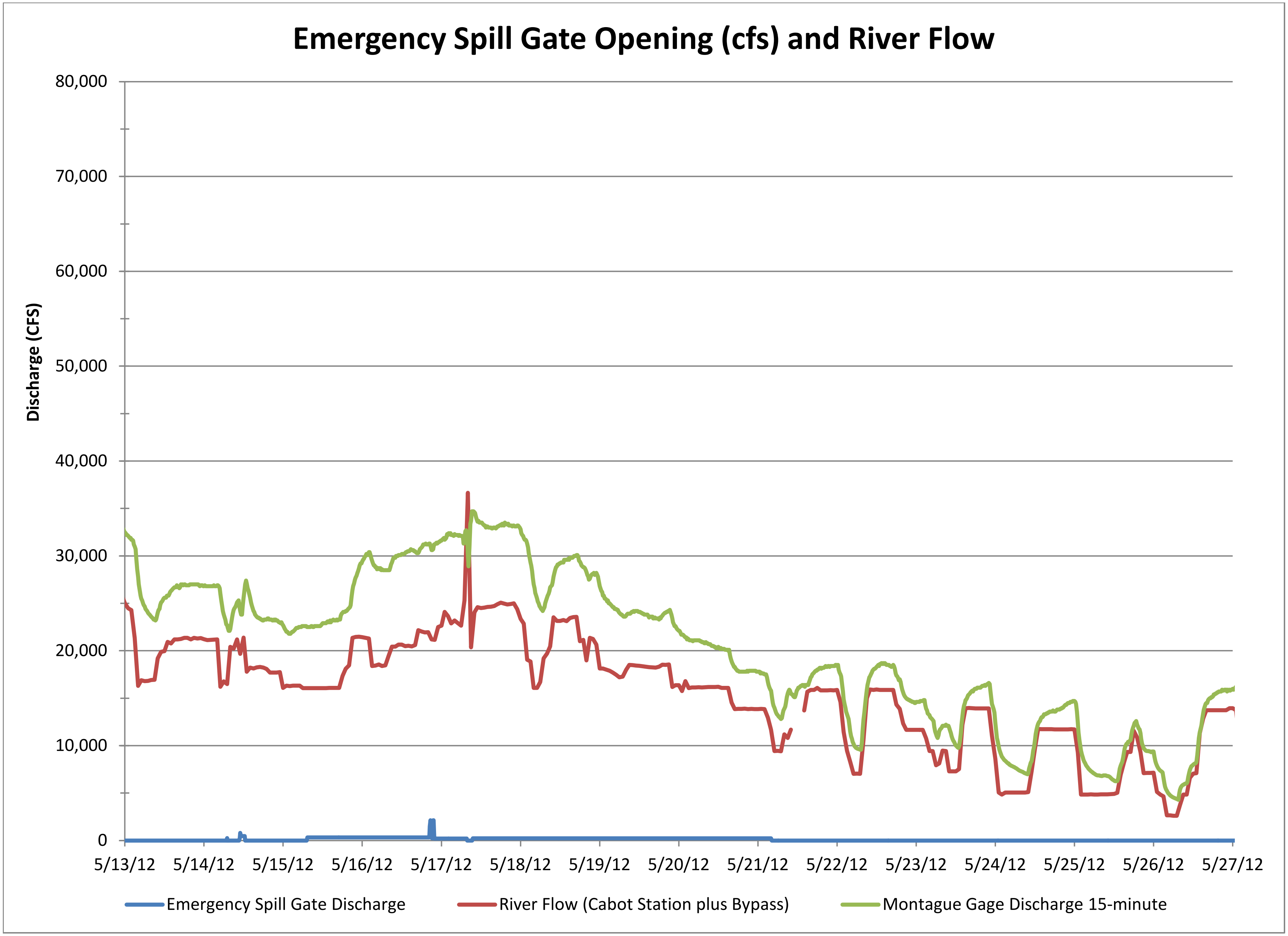
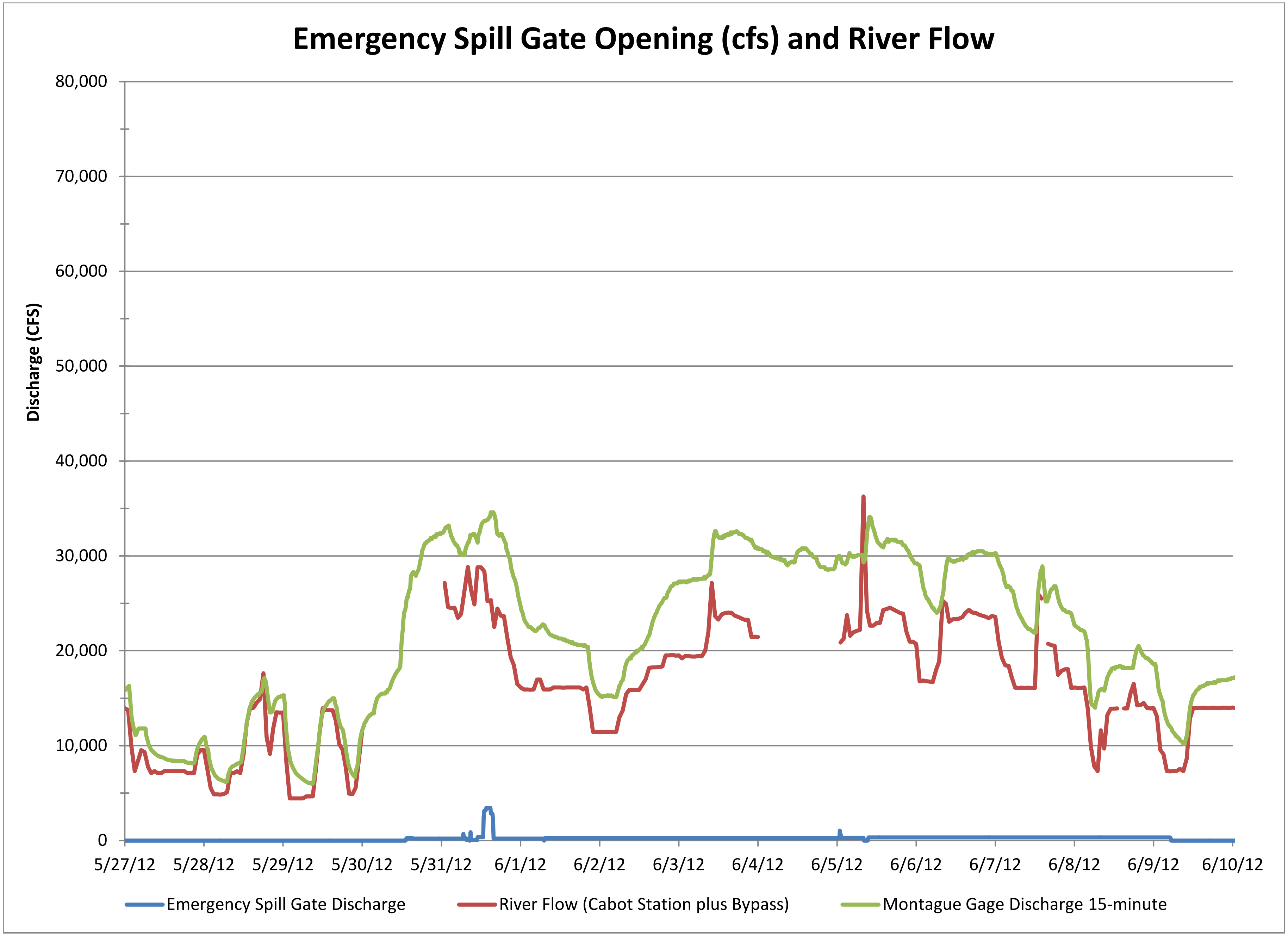
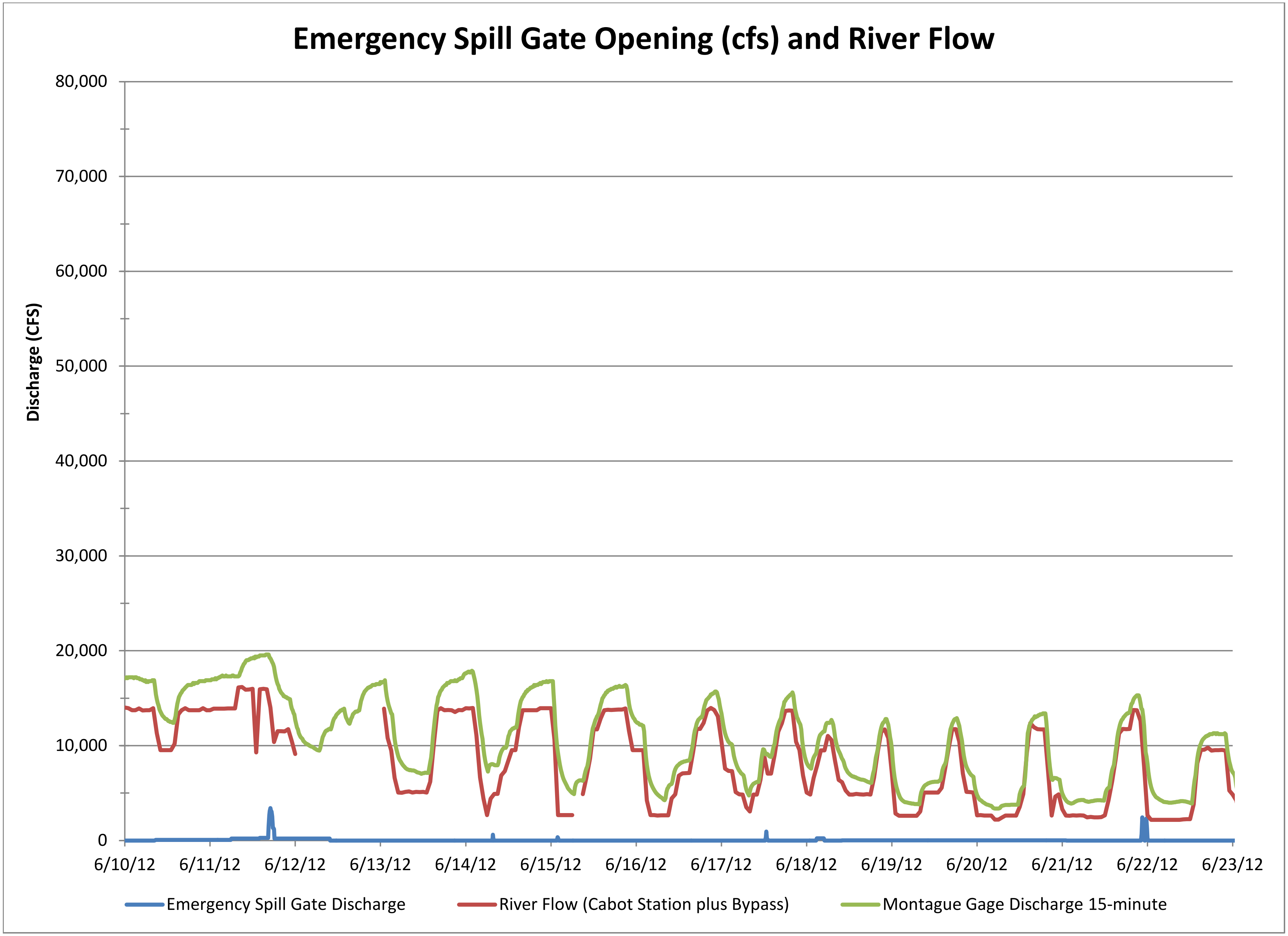
4/15/12
4/16/12
4/17/12
4/18/12
4/19/12
4/20/12
4/21/12
4/22/12
4/23/12
4/24/12
4/25/12
4/26/12
4/27/12
4/28/12
4/29/12
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
Montague Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/29/12
4/30/12
5/1/12
5/2/12
5/3/12
5/4/12
5/5/12
5/6/12
5/7/12
5/8/12
5/9/12
5/10/12
5/11/12
5/12/12
5/13/12
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
Montague Gage Discharge 15-minute


Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/13/12
5/14/12
5/15/12
5/16/12
5/17/12
5/18/12
5/19/12
5/20/12
5/21/12
5/22/12
5/23/12
5/24/12
5/25/12
5/26/12
5/27/12
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
Montague Gage Discharge 15-minute

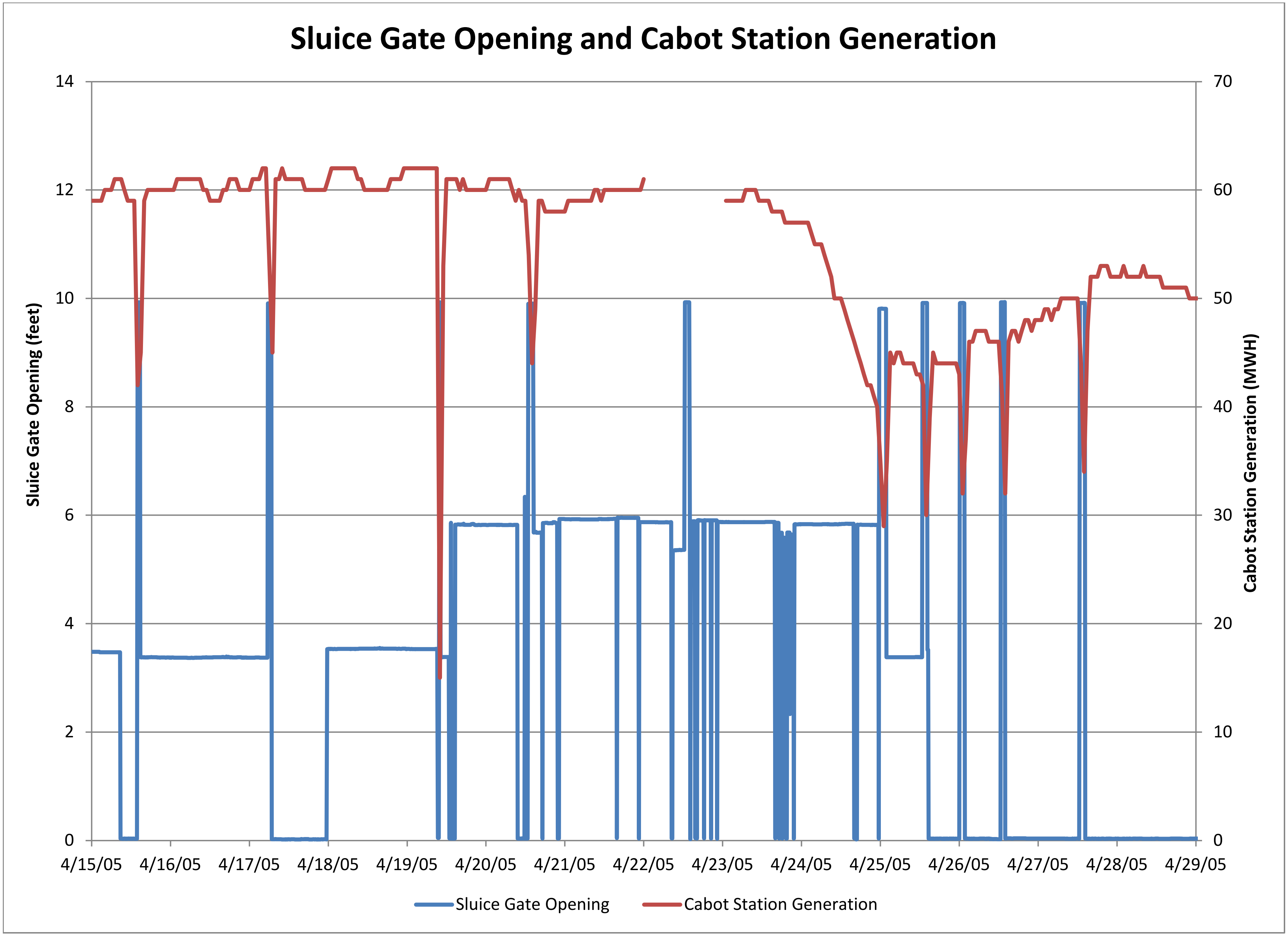


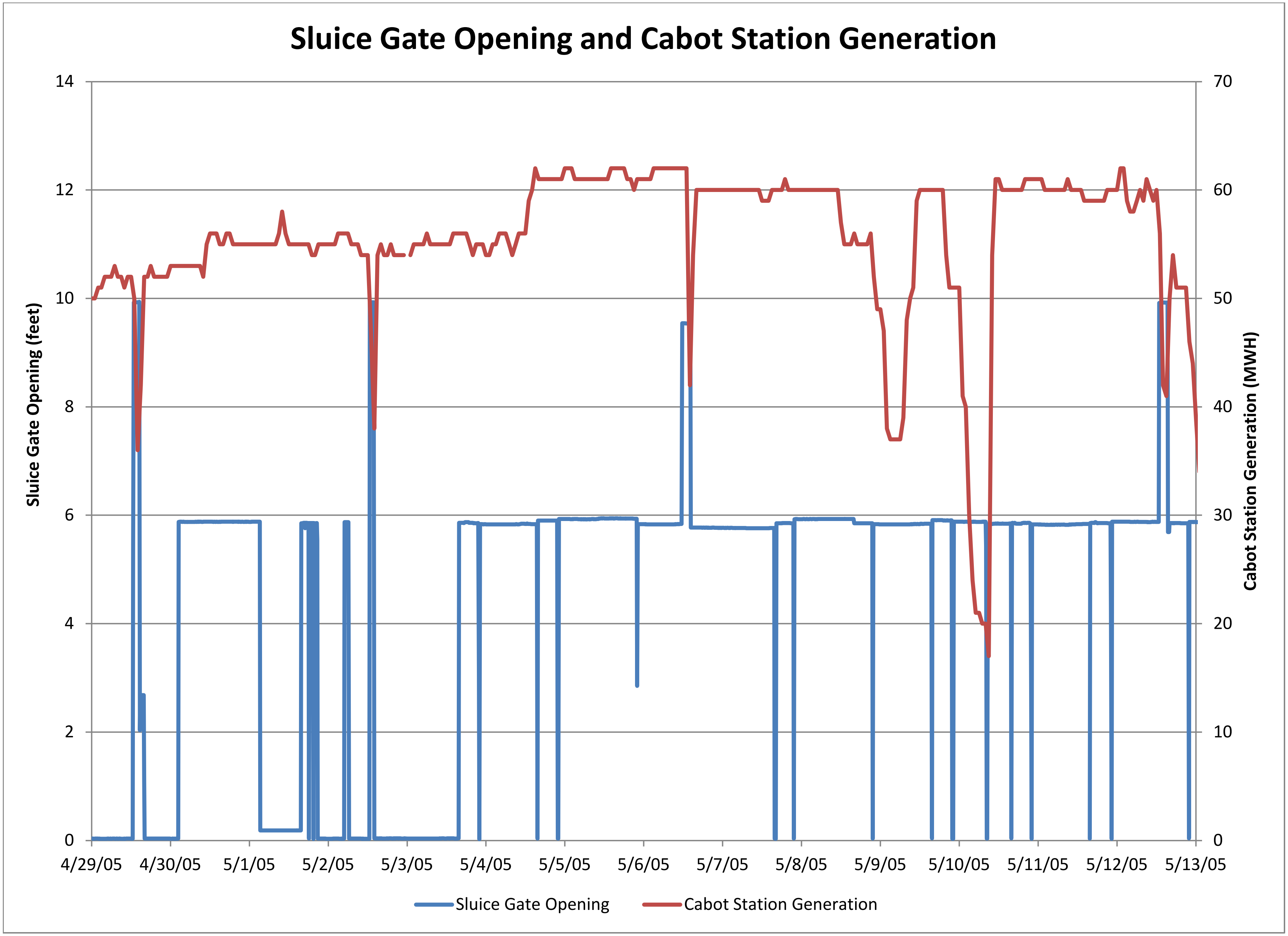
Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/27/12
5/28/12
5/29/12
5/30/12
5/31/12
6/1/12
6/2/12
6/3/12
6/4/12
6/5/12
6/6/12
6/7/12
6/8/12
6/9/12
6/10/12
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
Montague Gage Discharge 15-minute

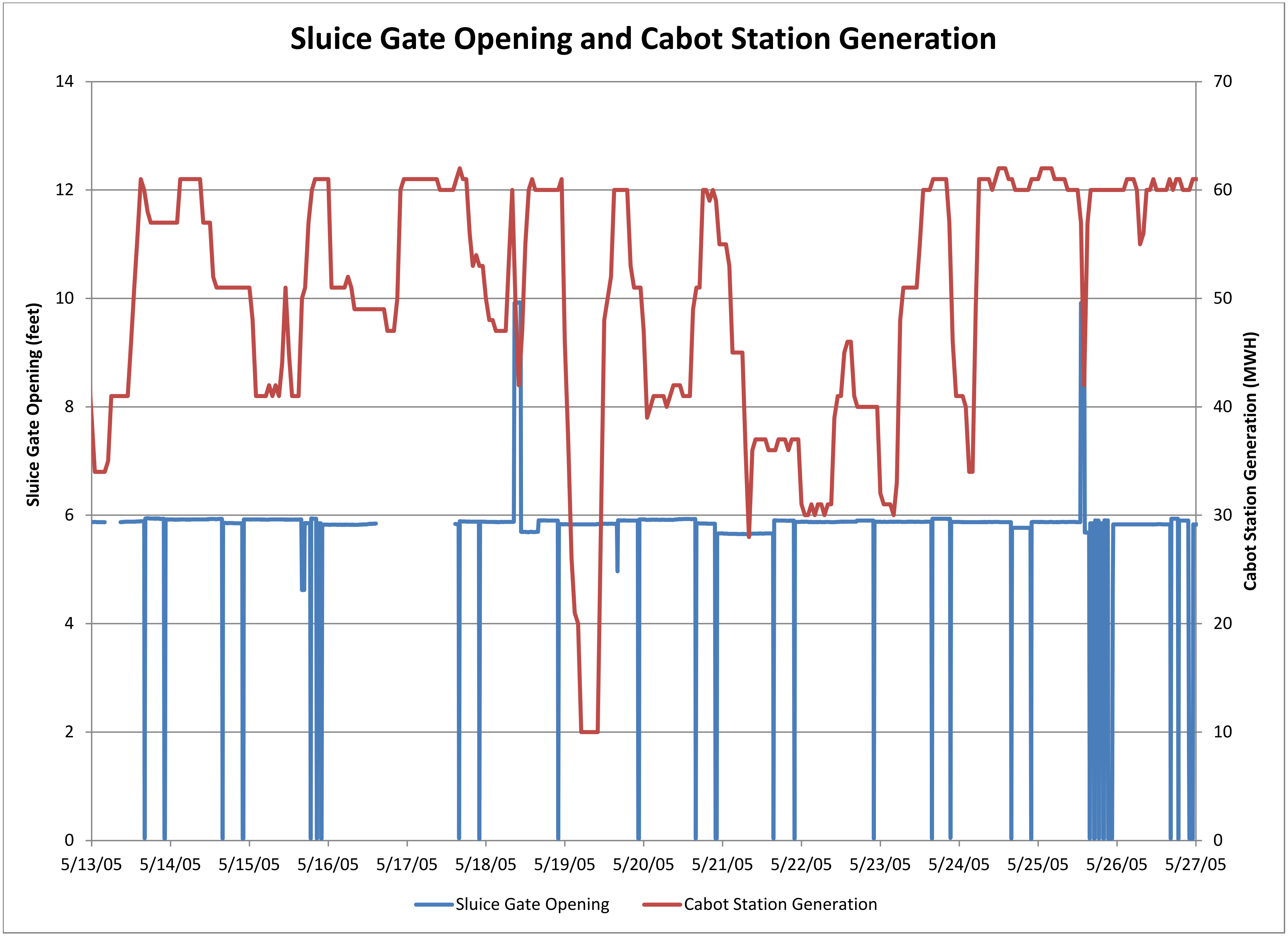


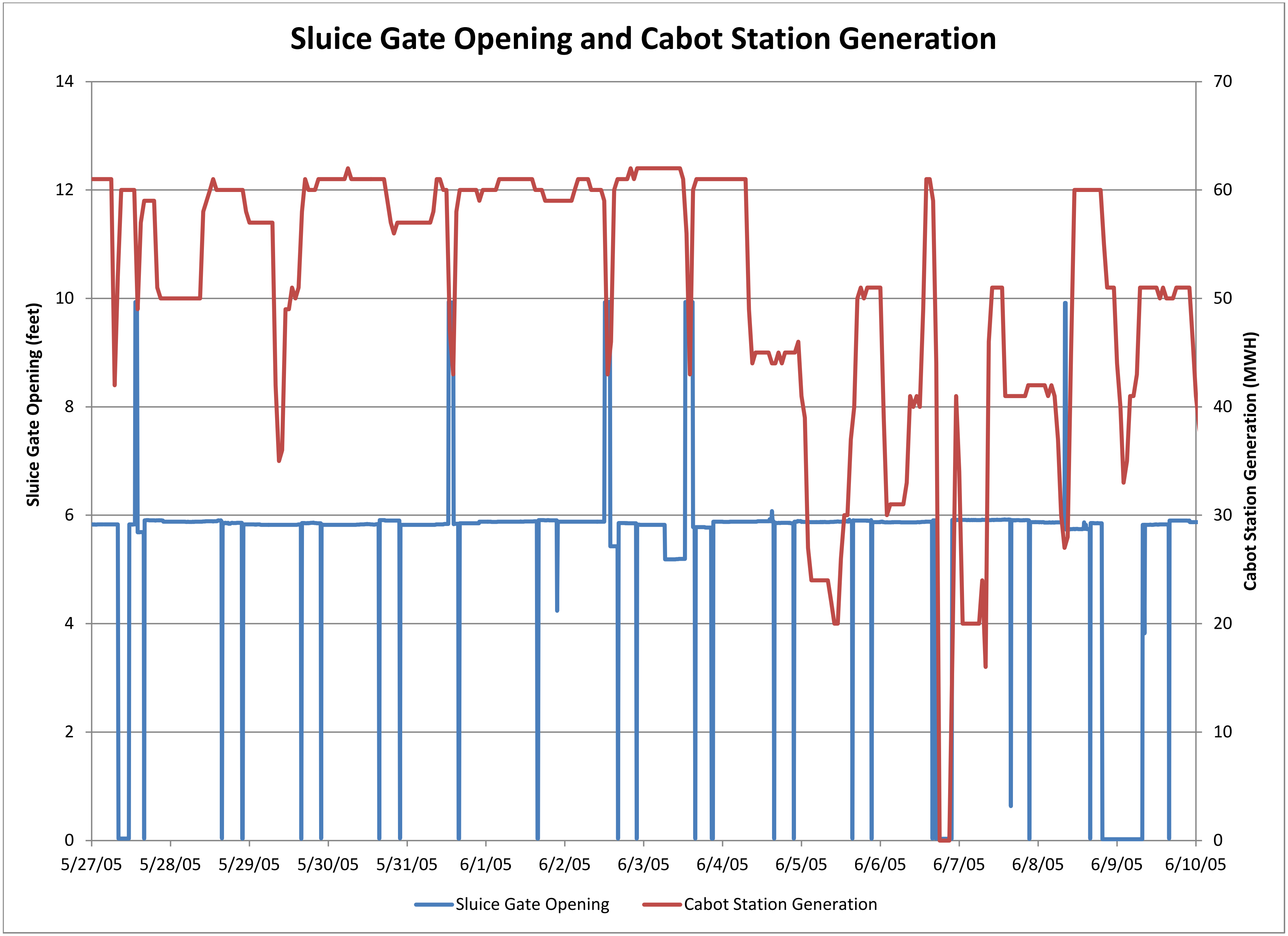
Emergency Spill Gate Opening (cfs) and River Flow
Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
6/10/12
6/11/12
6/12/12
6/13/12
6/14/12
6/15/12
6/16/12
6/17/12
6/18/12
6/19/12
6/20/12
6/21/12
6/22/12
6/23/12
Emergency Spill Gate Discharge
River Flow (Cabot Station plus Bypass)
Montague Gage Discharge 15-minute

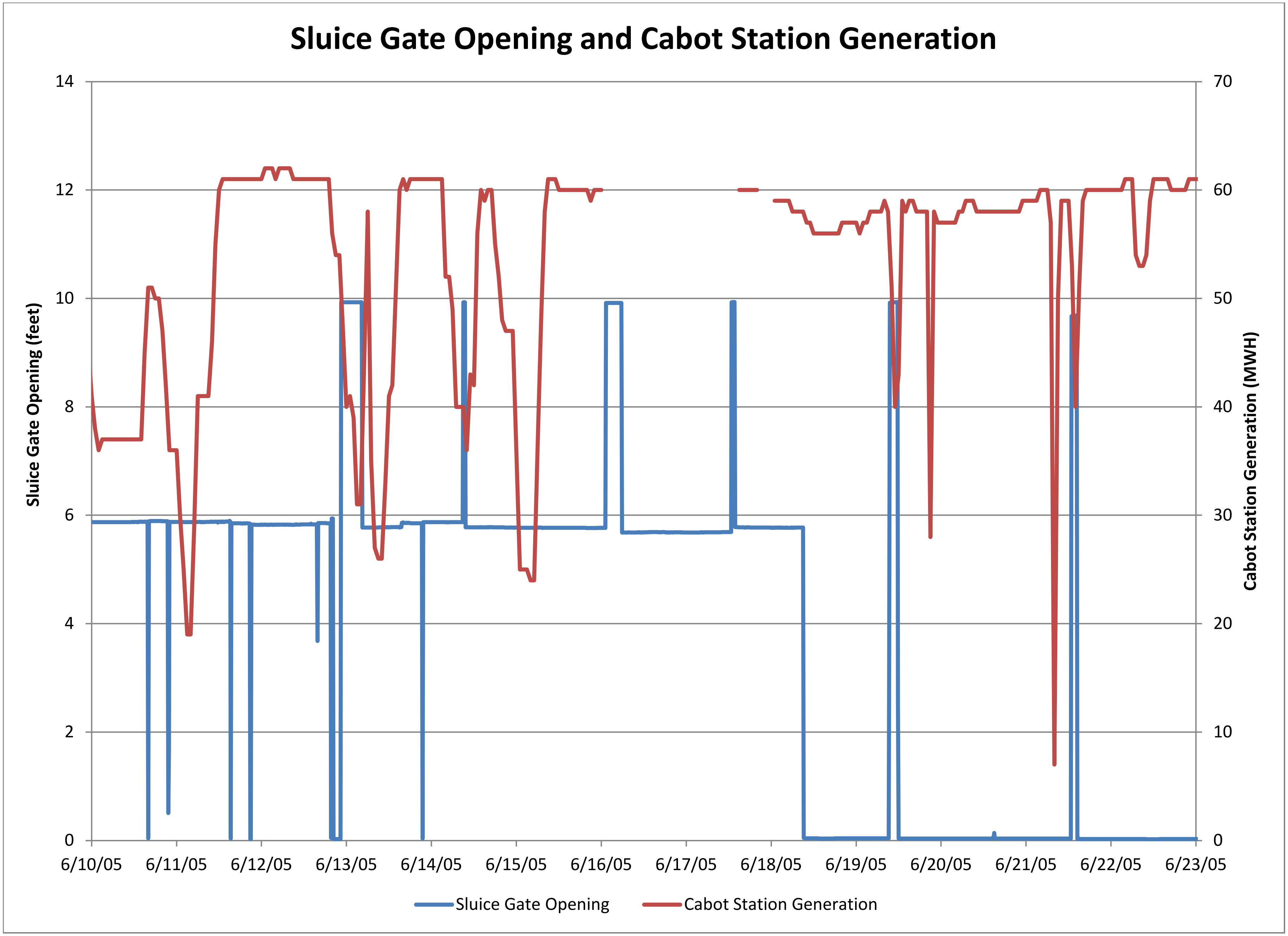
APPENDIX C – BI-WEEKLY CHARTS OF SLUICE GATE OPENING VS. CABOT STATION GENERATION

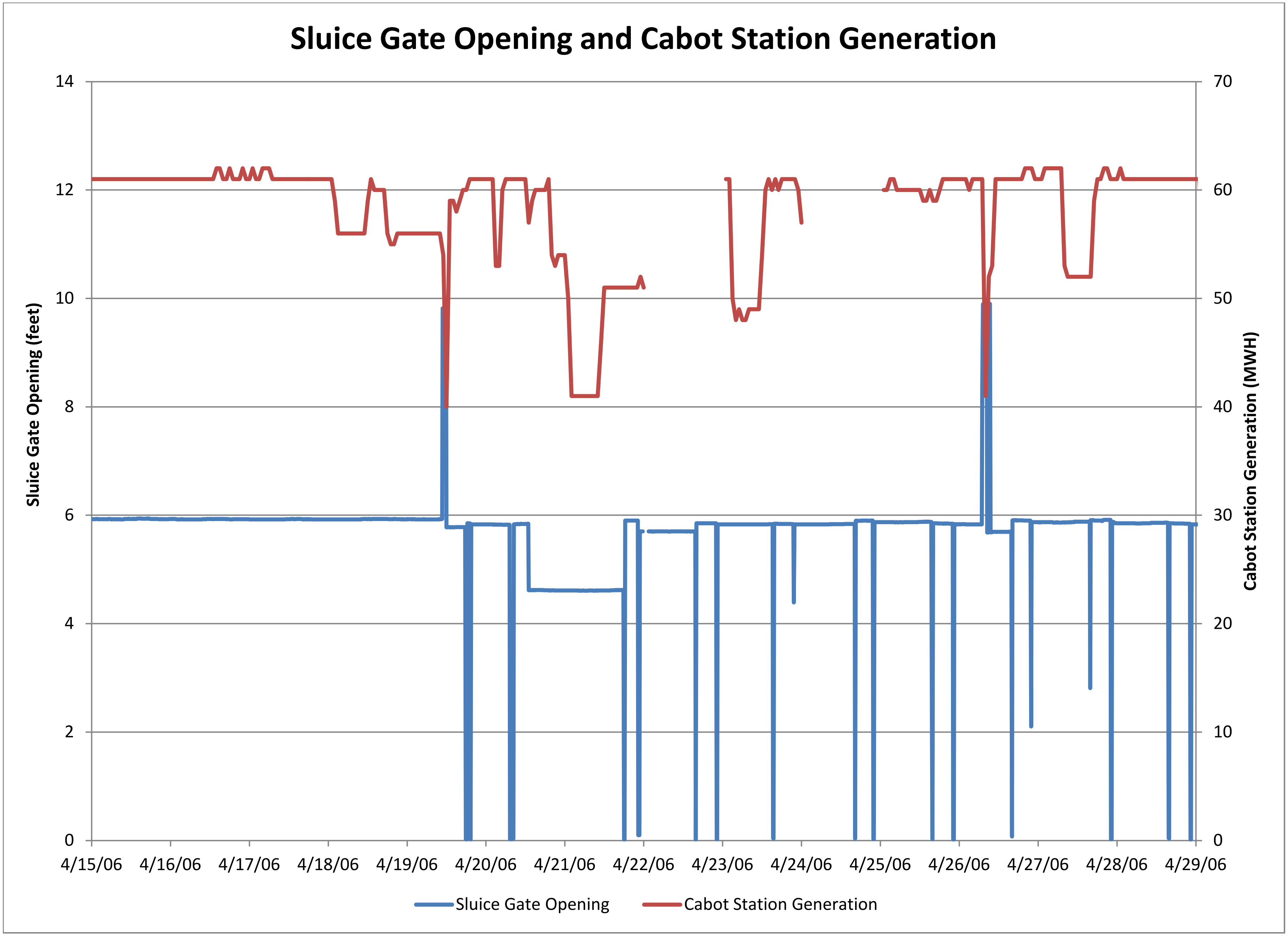

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/15/05
4/16/05
4/17/05
4/18/05
4/19/05
4/20/05
4/21/05
4/22/05
4/23/05
4/24/05
4/25/05
4/26/05
4/27/05
4/28/05
4/29/05
Sluice Gate Opening
Cabot Station Generation

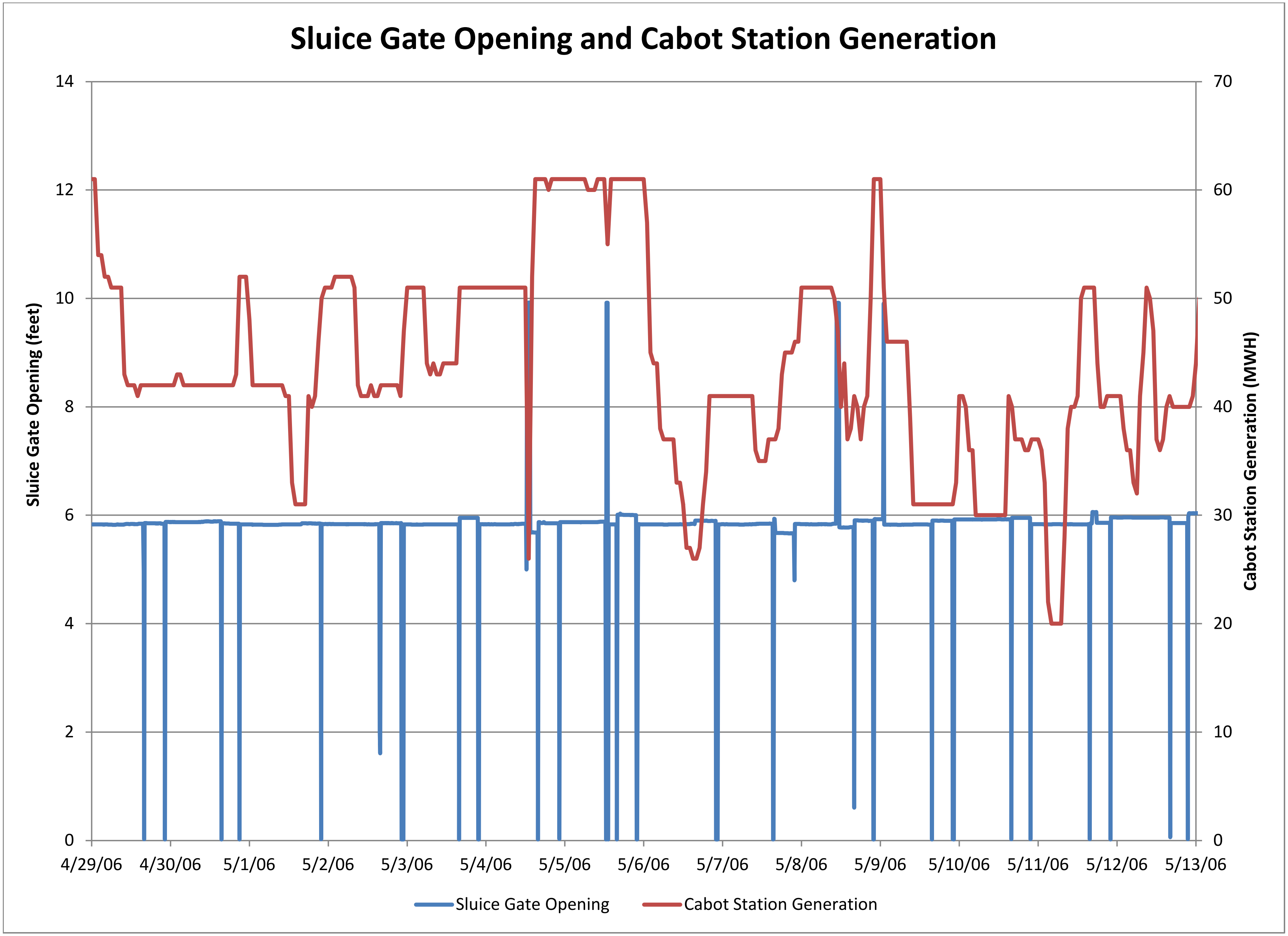

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/05
4/30/05
5/1/05
5/2/05
5/3/05
5/4/05
5/5/05
5/6/05
5/7/05
5/8/05
5/9/05
5/10/05
5/11/05
5/12/05
5/13/05
Sluice Gate Opening
Cabot Station Generation


Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/13/05
5/14/05
5/15/05
5/16/05
5/17/05
5/18/05
5/19/05
5/20/05
5/21/05
5/22/05
5/23/05
5/24/05
5/25/05
5/26/05
5/27/05
Sluice Gate Opening
Cabot Station Generation

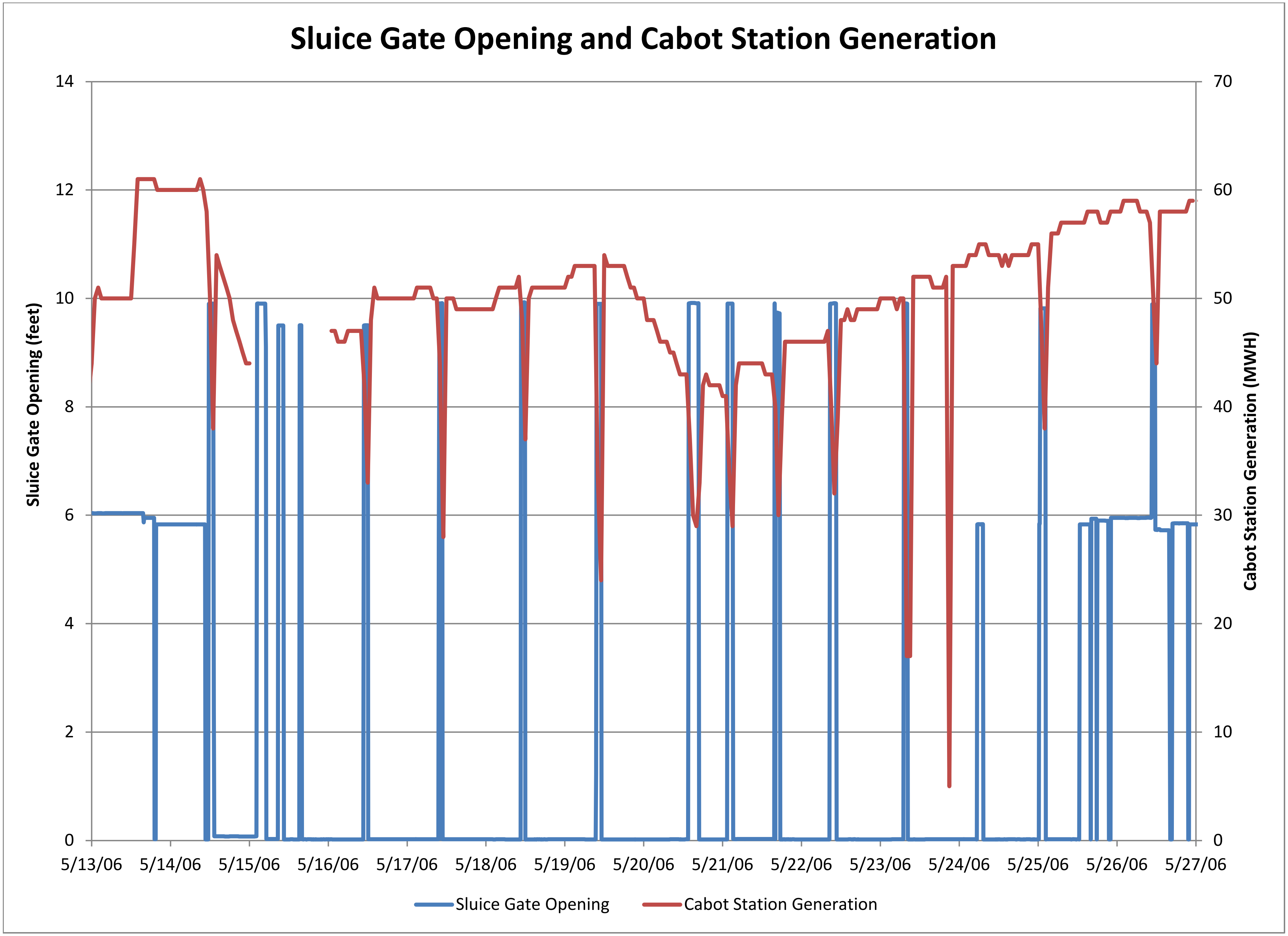

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/27/05
5/28/05
5/29/05
5/30/05
5/31/05
6/1/05
6/2/05
6/3/05
6/4/05
6/5/05
6/6/05
6/7/05
6/8/05
6/9/05
6/10/05
Sluice Gate Opening
Cabot Station Generation

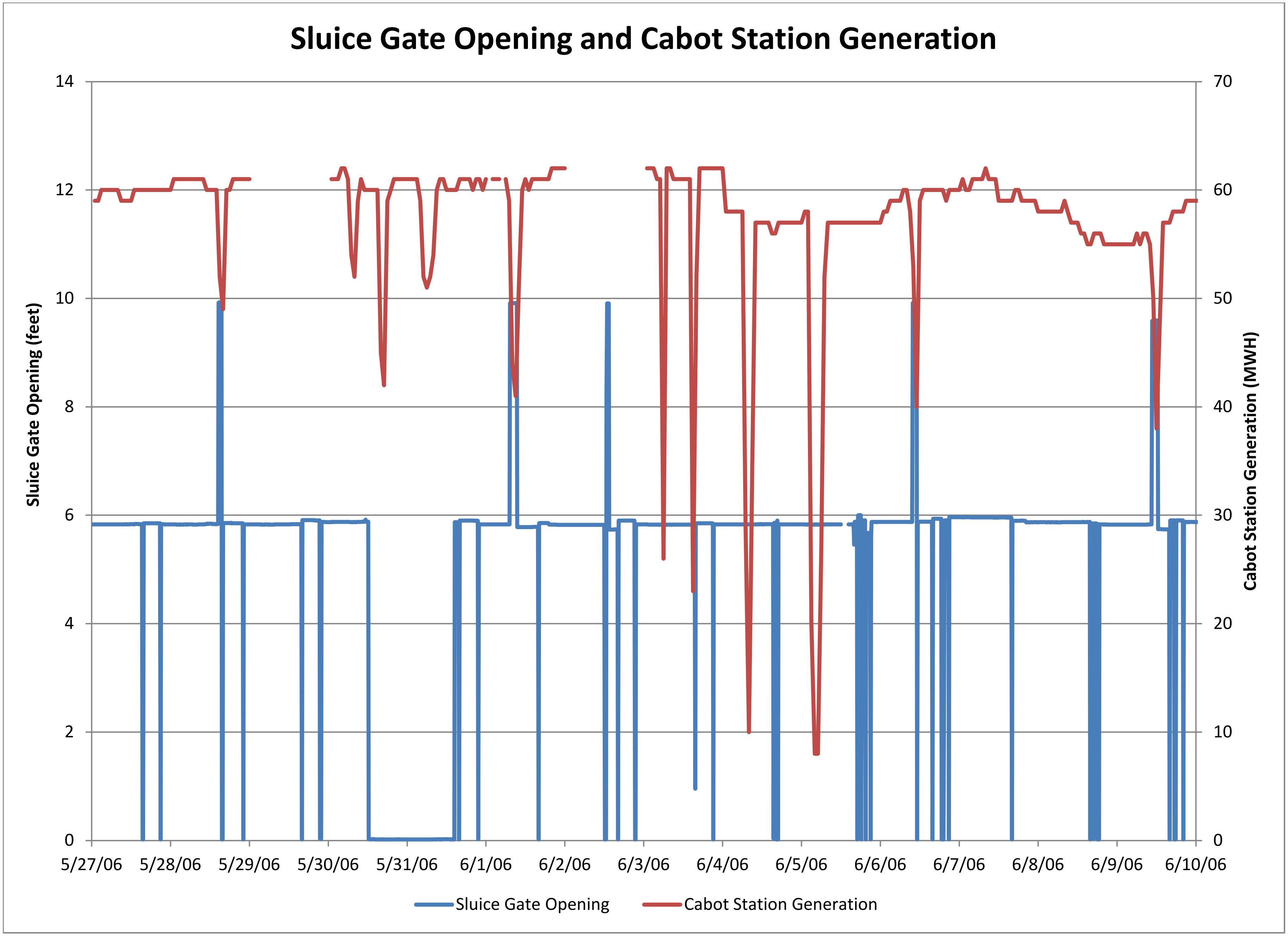

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
6/10/05
6/11/05
6/12/05
6/13/05
6/14/05
6/15/05
6/16/05
6/17/05
6/18/05
6/19/05
6/20/05
6/21/05
6/22/05
6/23/05
Sluice Gate Opening
Cabot Station Generation

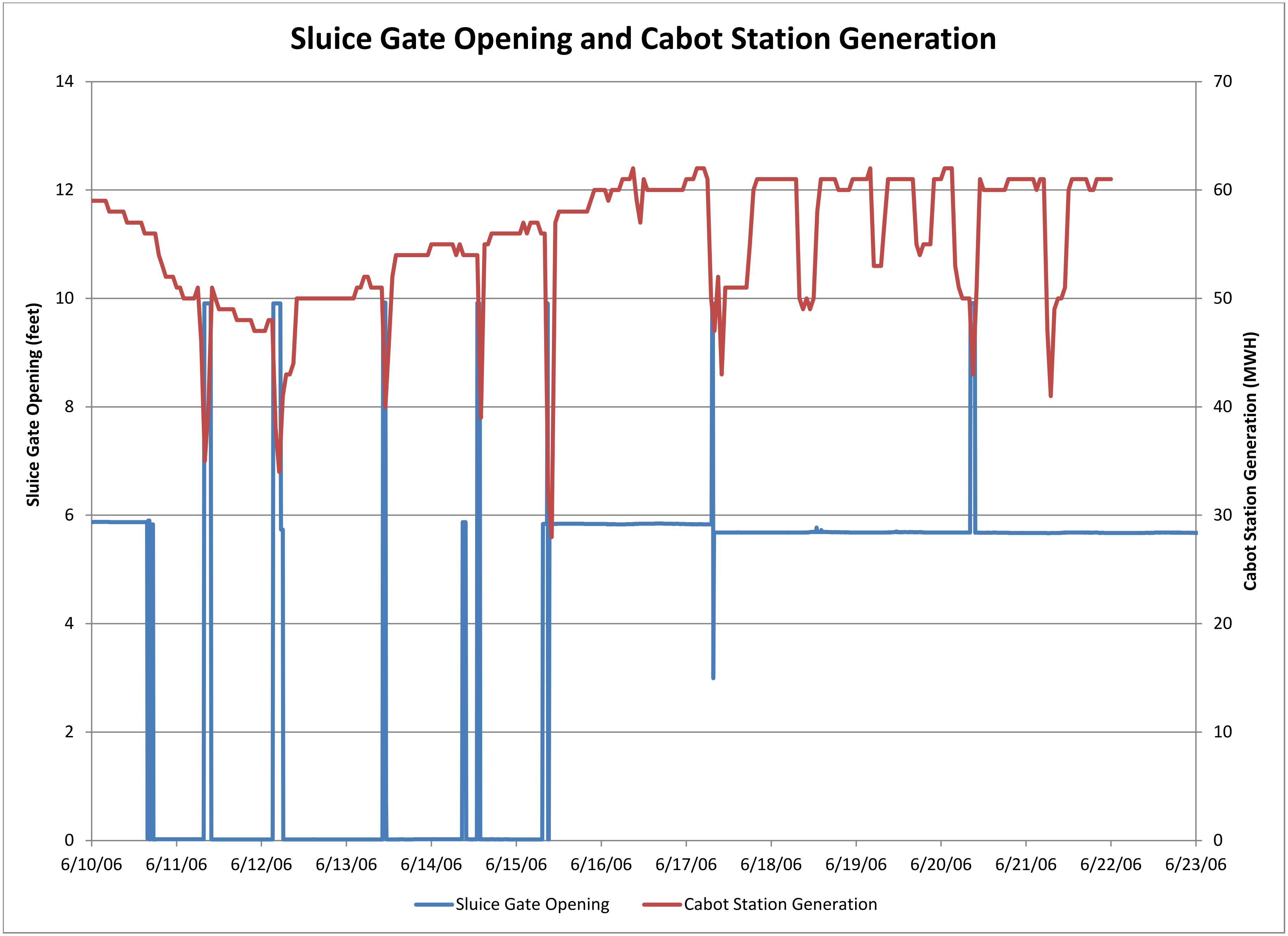

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/15/06
4/16/06
4/17/06
4/18/06
4/19/06
4/20/06
4/21/06
4/22/06
4/23/06
4/24/06
4/25/06
4/26/06
4/27/06
4/28/06
4/29/06
Sluice Gate Opening
Cabot Station Generation

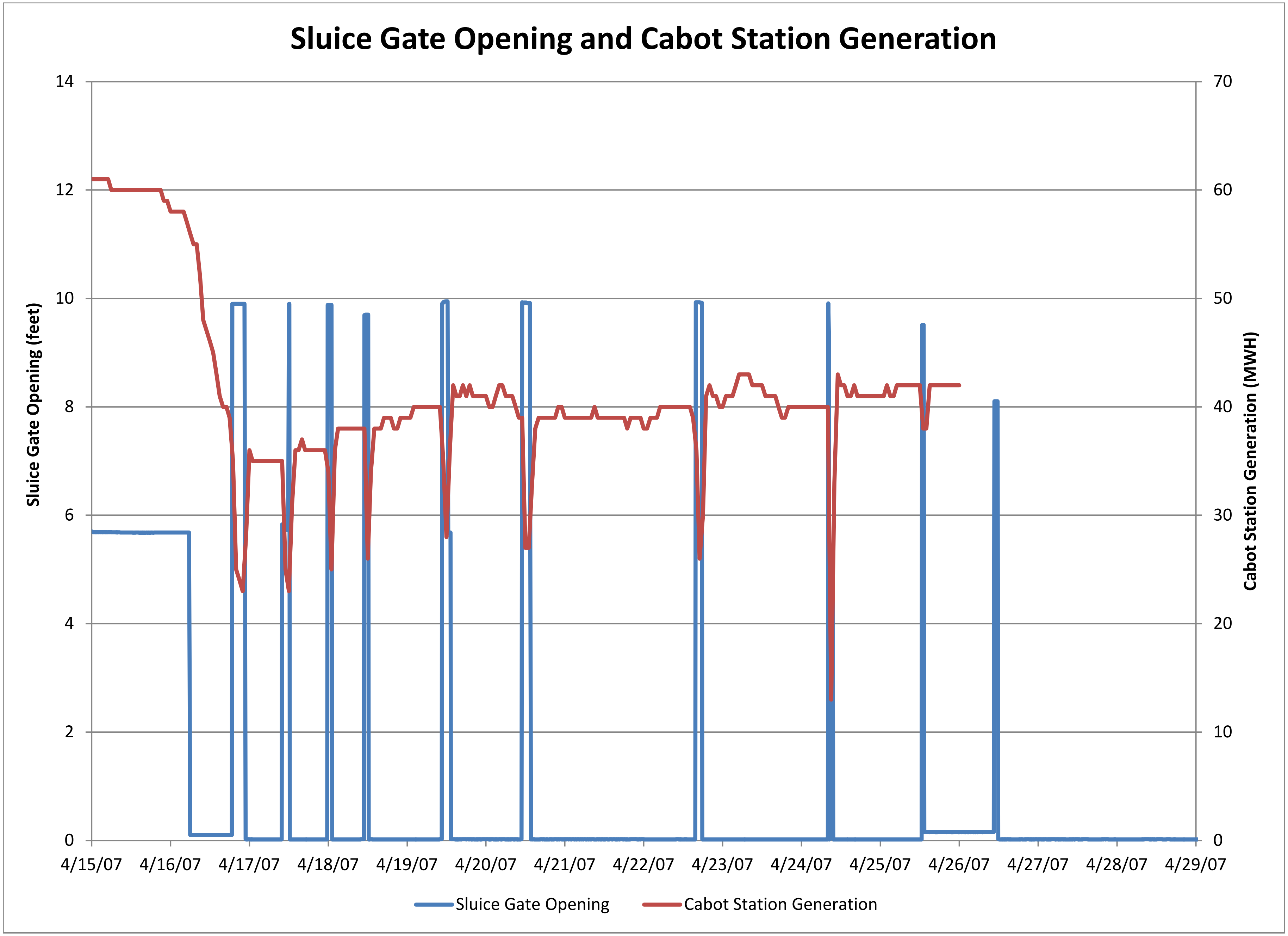


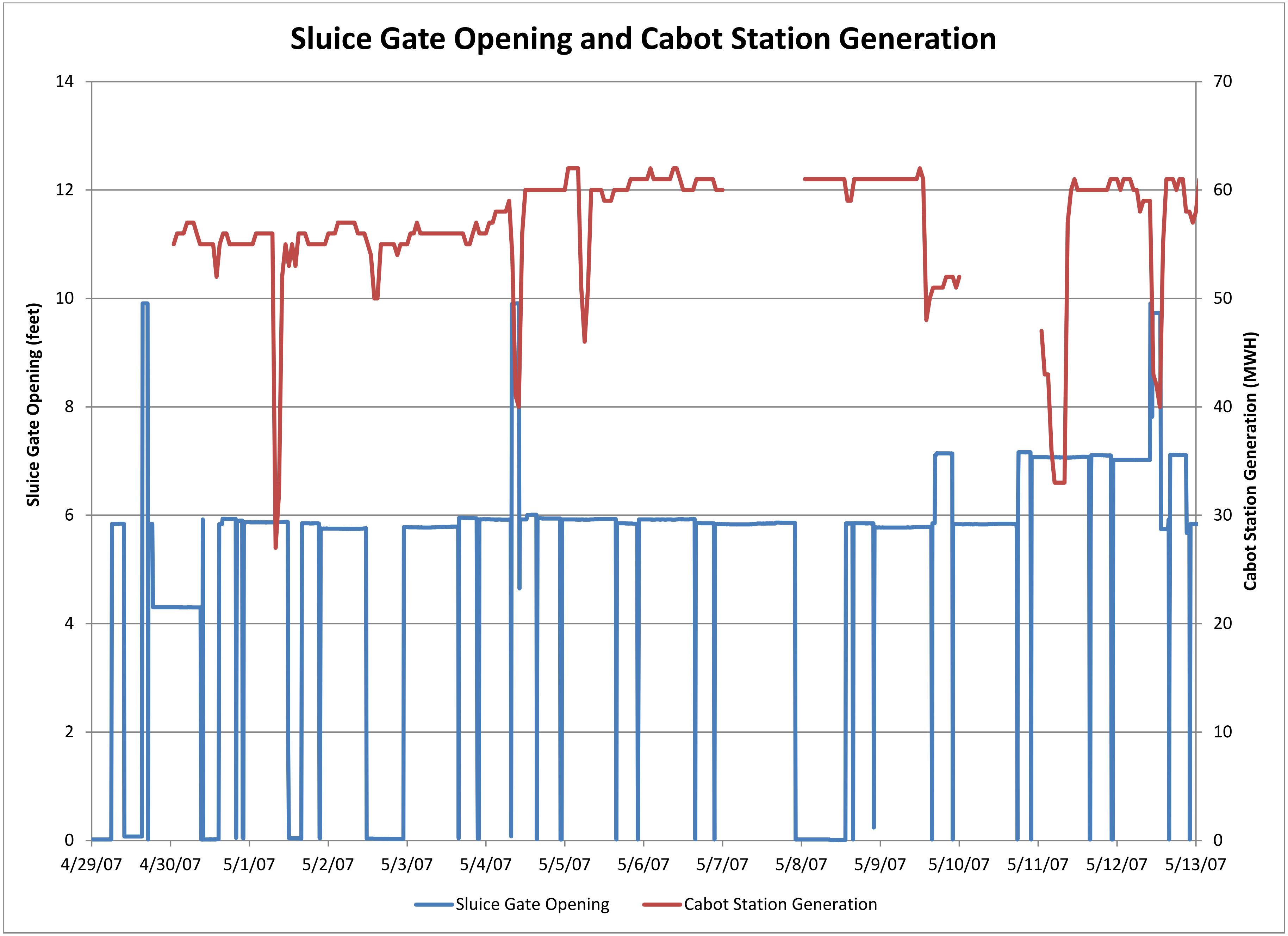
Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/06
4/30/06
5/1/06
5/2/06
5/3/06
5/4/06
5/5/06
5/6/06
5/7/06
5/8/06
5/9/06
5/10/06
5/11/06
5/12/06
5/13/06
Sluice Gate Opening
Cabot Station Generation

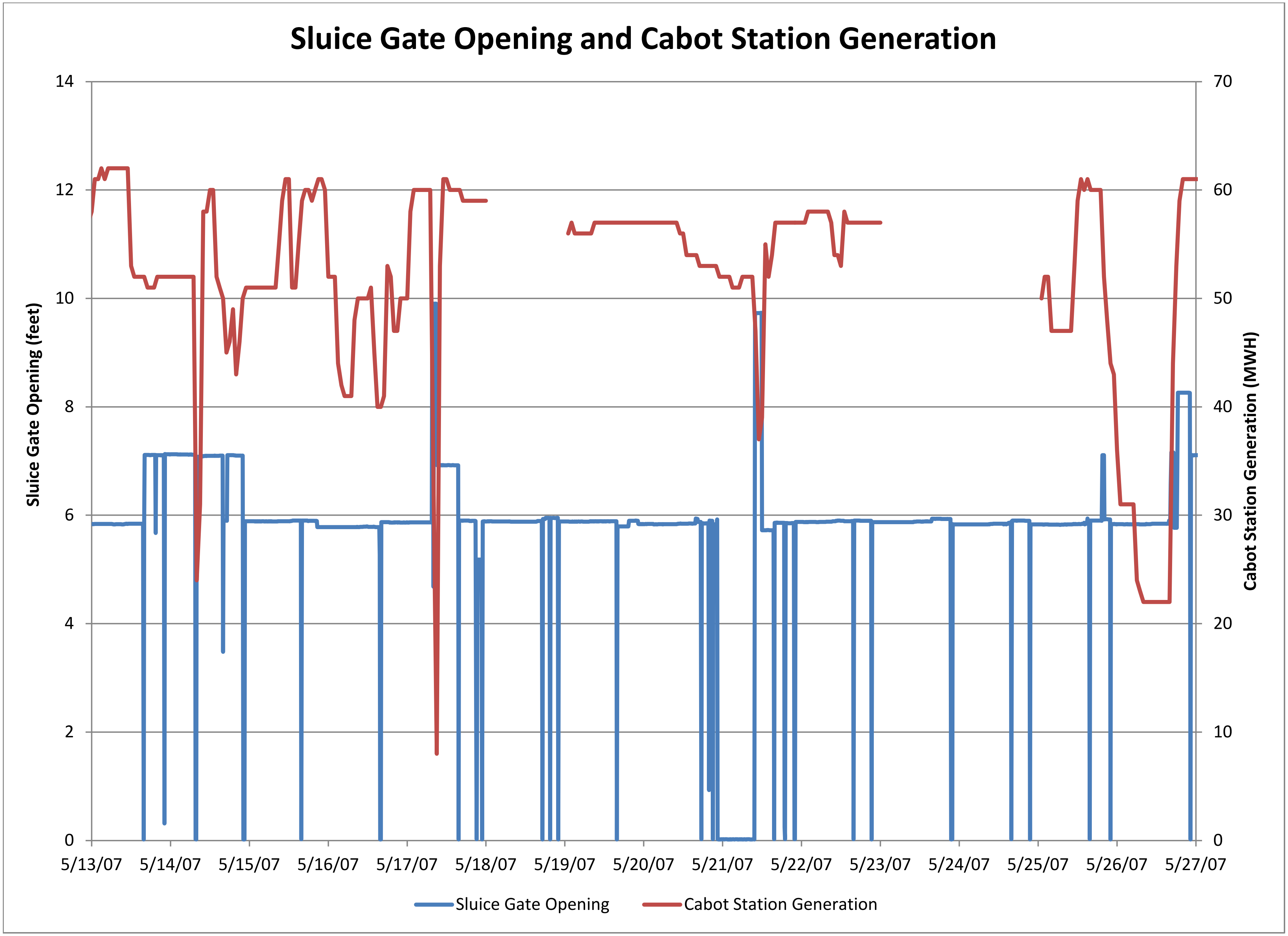

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
5/13/06
5/14/06
5/15/06
5/16/06
5/17/06
5/18/06
5/19/06
5/20/06
5/21/06
5/22/06
5/23/06
5/24/06
5/25/06
5/26/06
5/27/06
Sluice Gate Opening
Cabot Station Generation

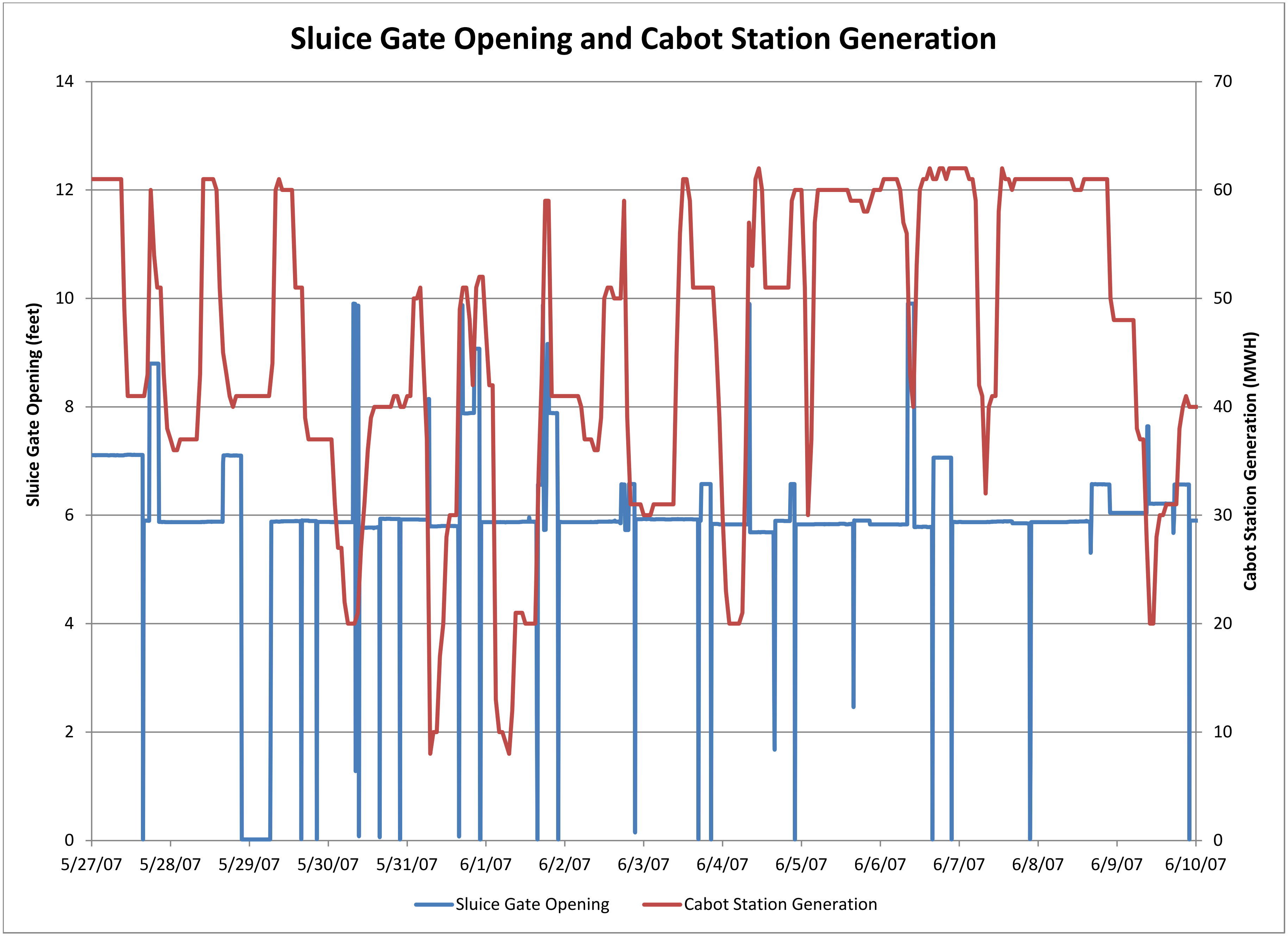

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
5/27/06
5/28/06
5/29/06
5/30/06
5/31/06
6/1/06
6/2/06
6/3/06
6/4/06
6/5/06
6/6/06
6/7/06
6/8/06
6/9/06
6/10/06
Sluice Gate Opening
Cabot Station Generation

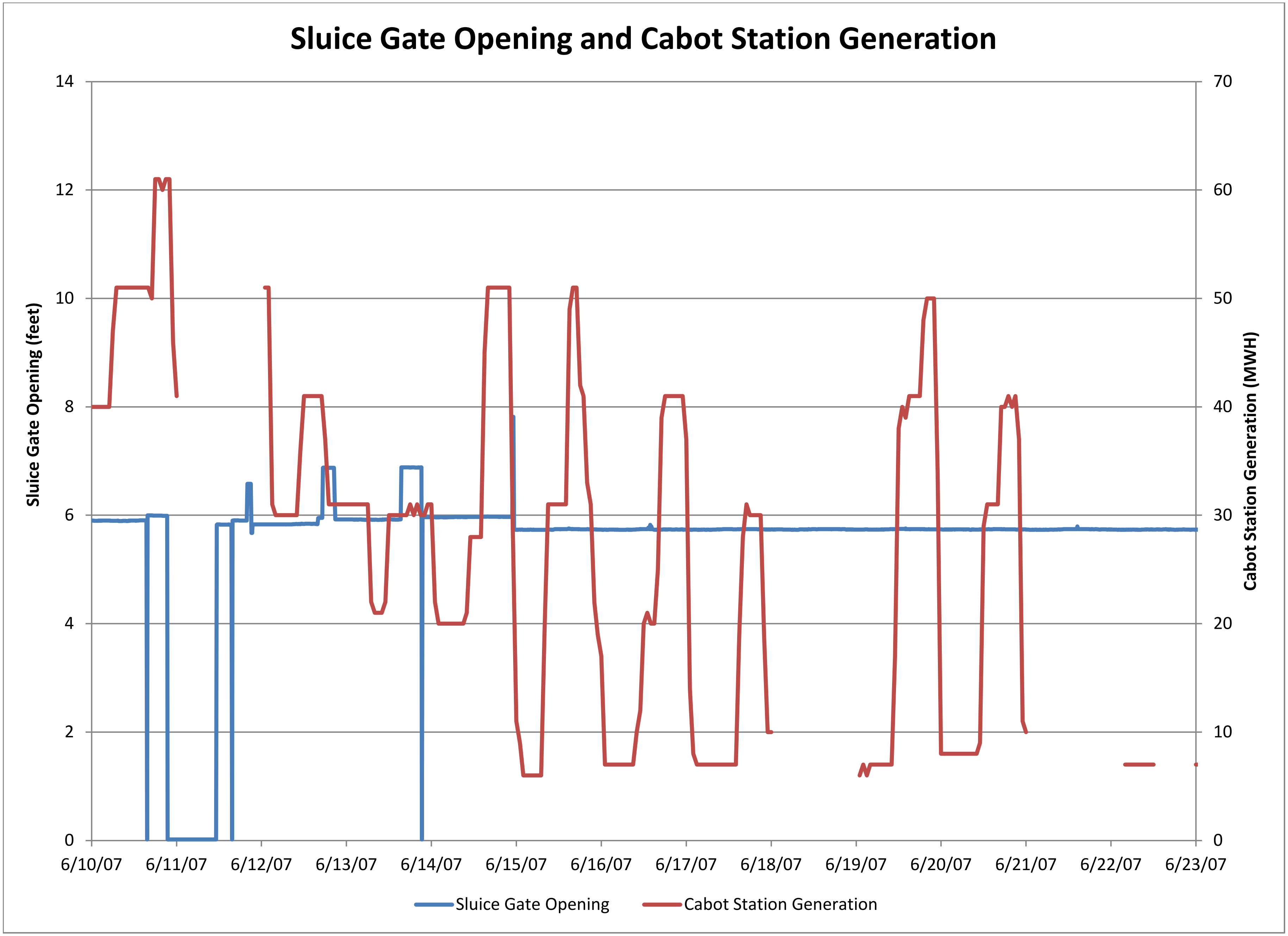

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
6/10/06
6/11/06
6/12/06
6/13/06
6/14/06
6/15/06
6/16/06
6/17/06
6/18/06
6/19/06
6/20/06
6/21/06
6/22/06
6/23/06
Sluice Gate Opening
Cabot Station Generation

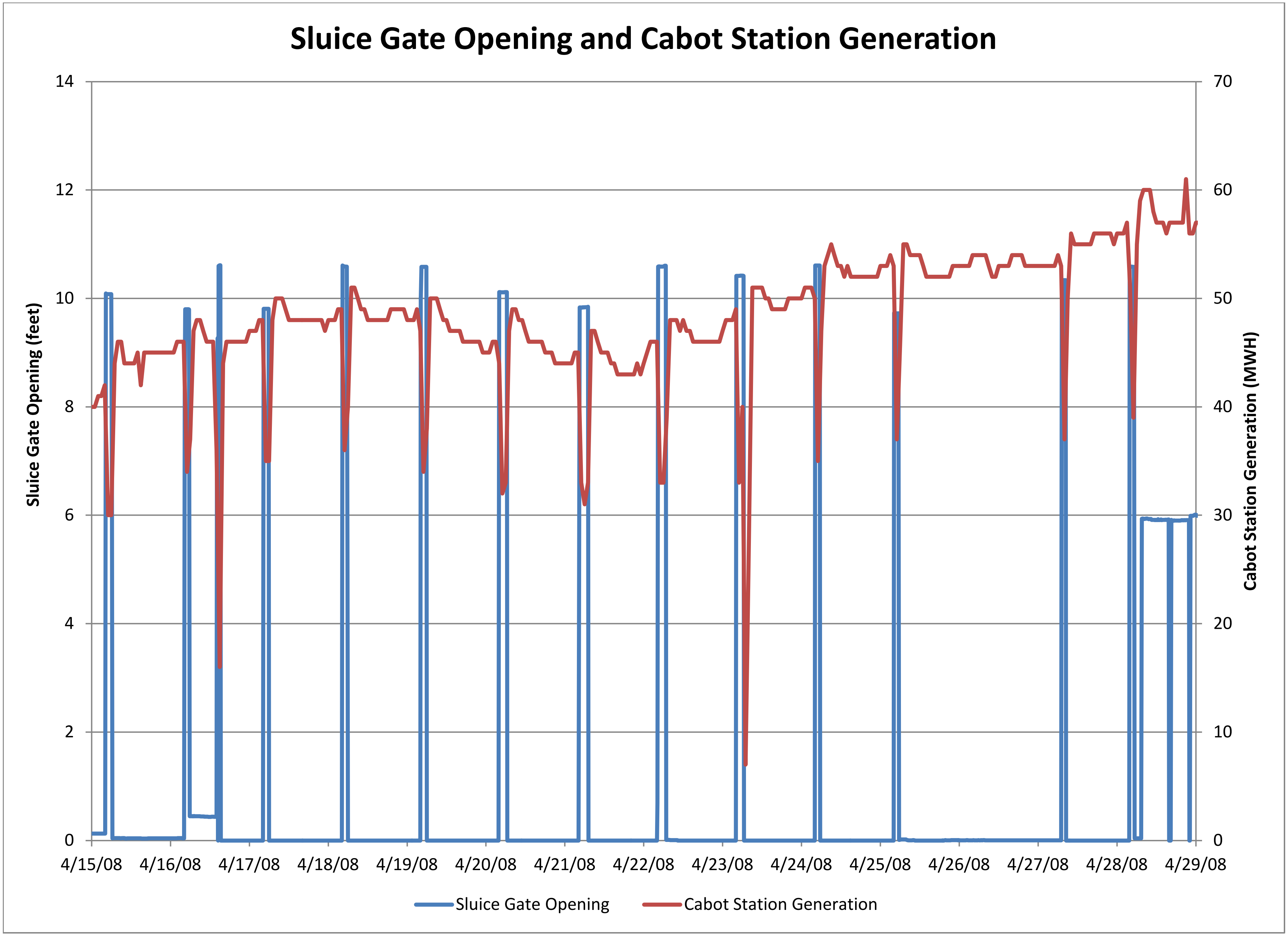

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/15/07
4/16/07
4/17/07
4/18/07
4/19/07
4/20/07
4/21/07
4/22/07
4/23/07
4/24/07
4/25/07
4/26/07
4/27/07
4/28/07
4/29/07
Sluice Gate Opening
Cabot Station Generation

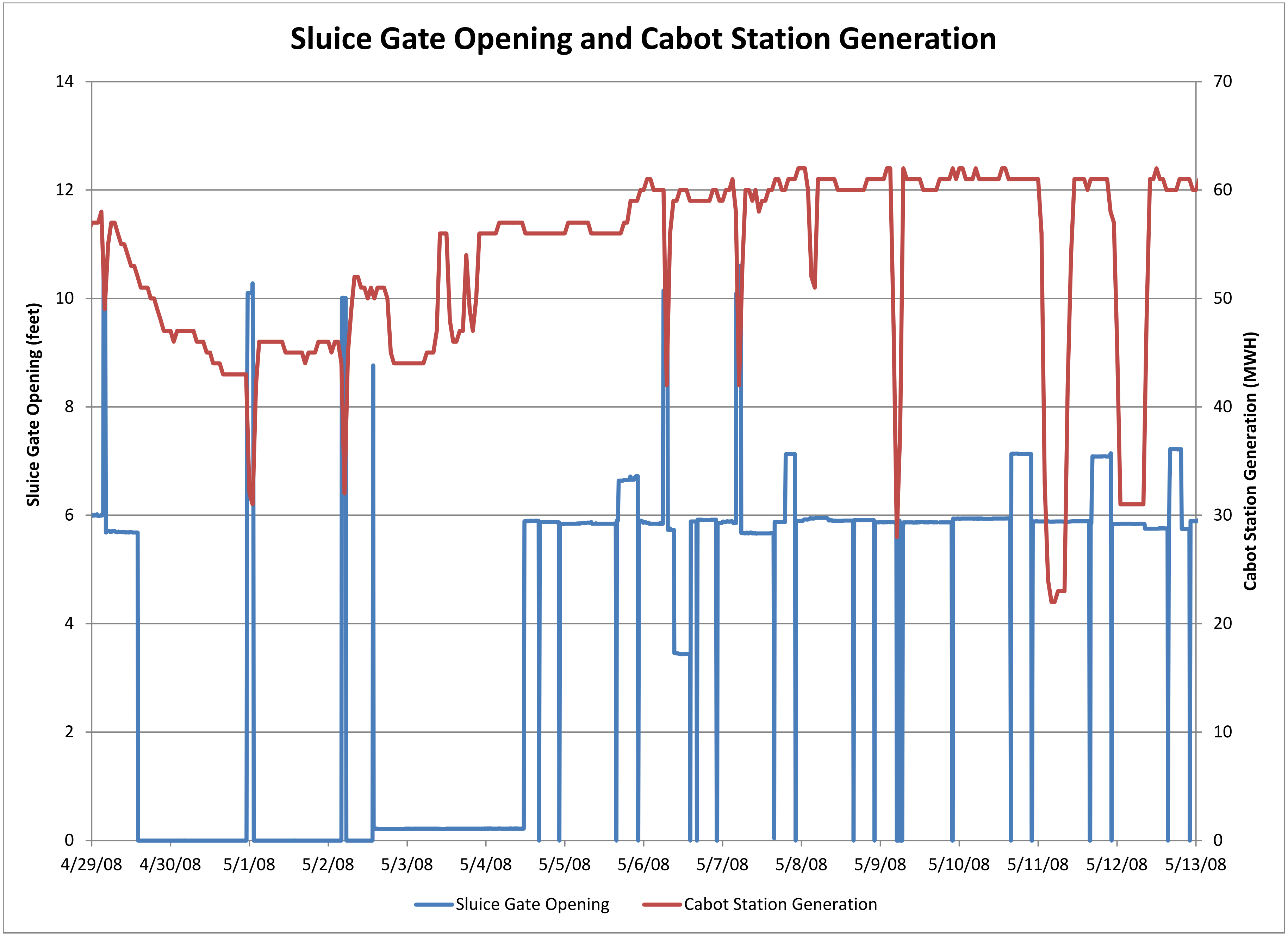

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/07
4/30/07
5/1/07
5/2/07
5/3/07
5/4/07
5/5/07
5/6/07
5/7/07
5/8/07
5/9/07
5/10/07
5/11/07
5/12/07
5/13/07
Sluice Gate Opening
Cabot Station Generation

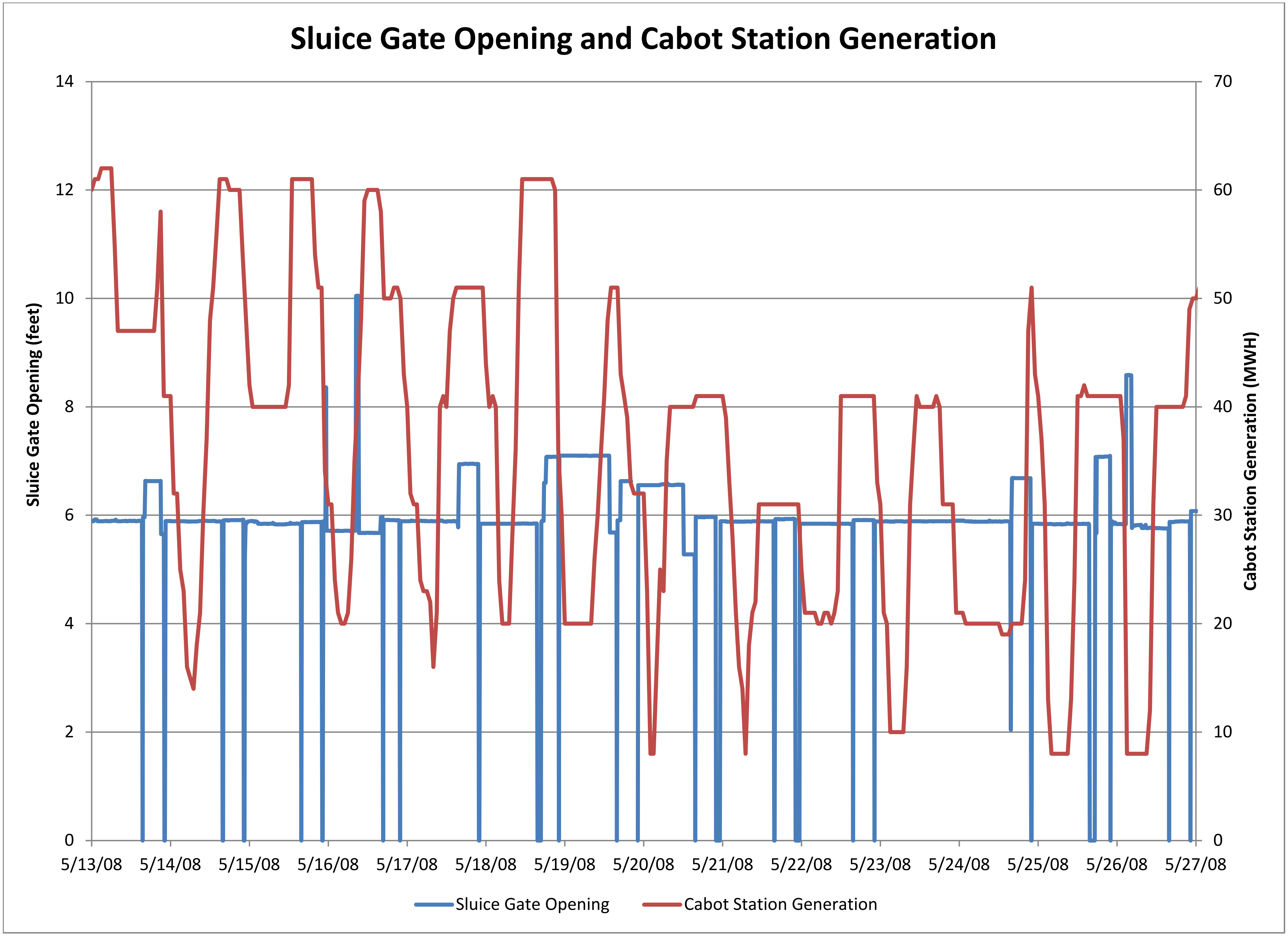

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/13/07
5/14/07
5/15/07
5/16/07
5/17/07
5/18/07
5/19/07
5/20/07
5/21/07
5/22/07
5/23/07
5/24/07
5/25/07
5/26/07
5/27/07
Sluice Gate Opening
Cabot Station Generation

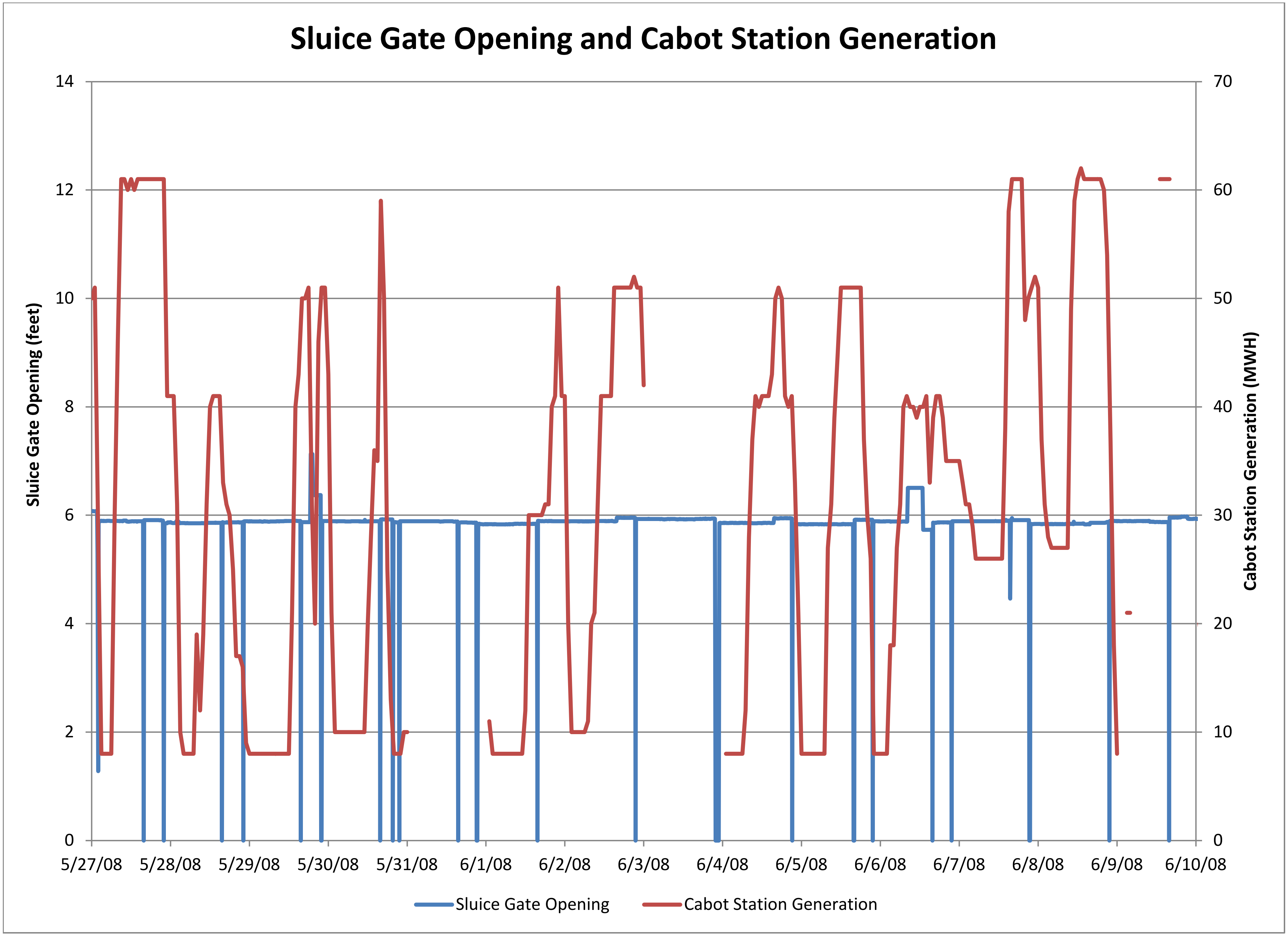

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/27/07
5/28/07
5/29/07
5/30/07
5/31/07
6/1/07
6/2/07
6/3/07
6/4/07
6/5/07
6/6/07
6/7/07
6/8/07
6/9/07
6/10/07
Sluice Gate Opening
Cabot Station Generation

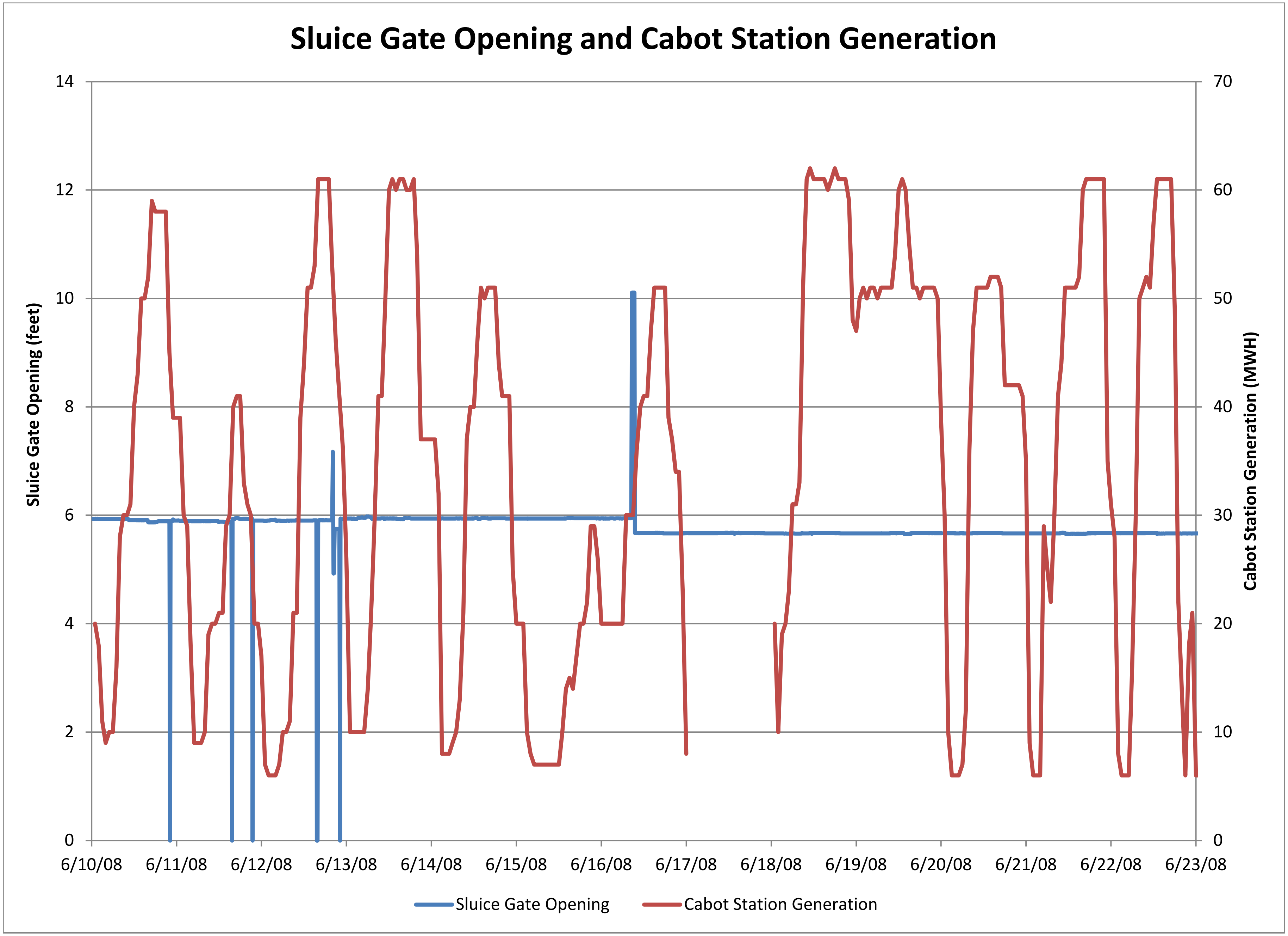

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
6/10/07
6/11/07
6/12/07
6/13/07
6/14/07
6/15/07
6/16/07
6/17/07
6/18/07
6/19/07
6/20/07
6/21/07
6/22/07
6/23/07
Sluice Gate Opening
Cabot Station Generation


Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/15/08
4/16/08
4/17/08
4/18/08
4/19/08
4/20/08
4/21/08
4/22/08
4/23/08
4/24/08
4/25/08
4/26/08
4/27/08
4/28/08
4/29/08
Sluice Gate Opening
Cabot Station Generation

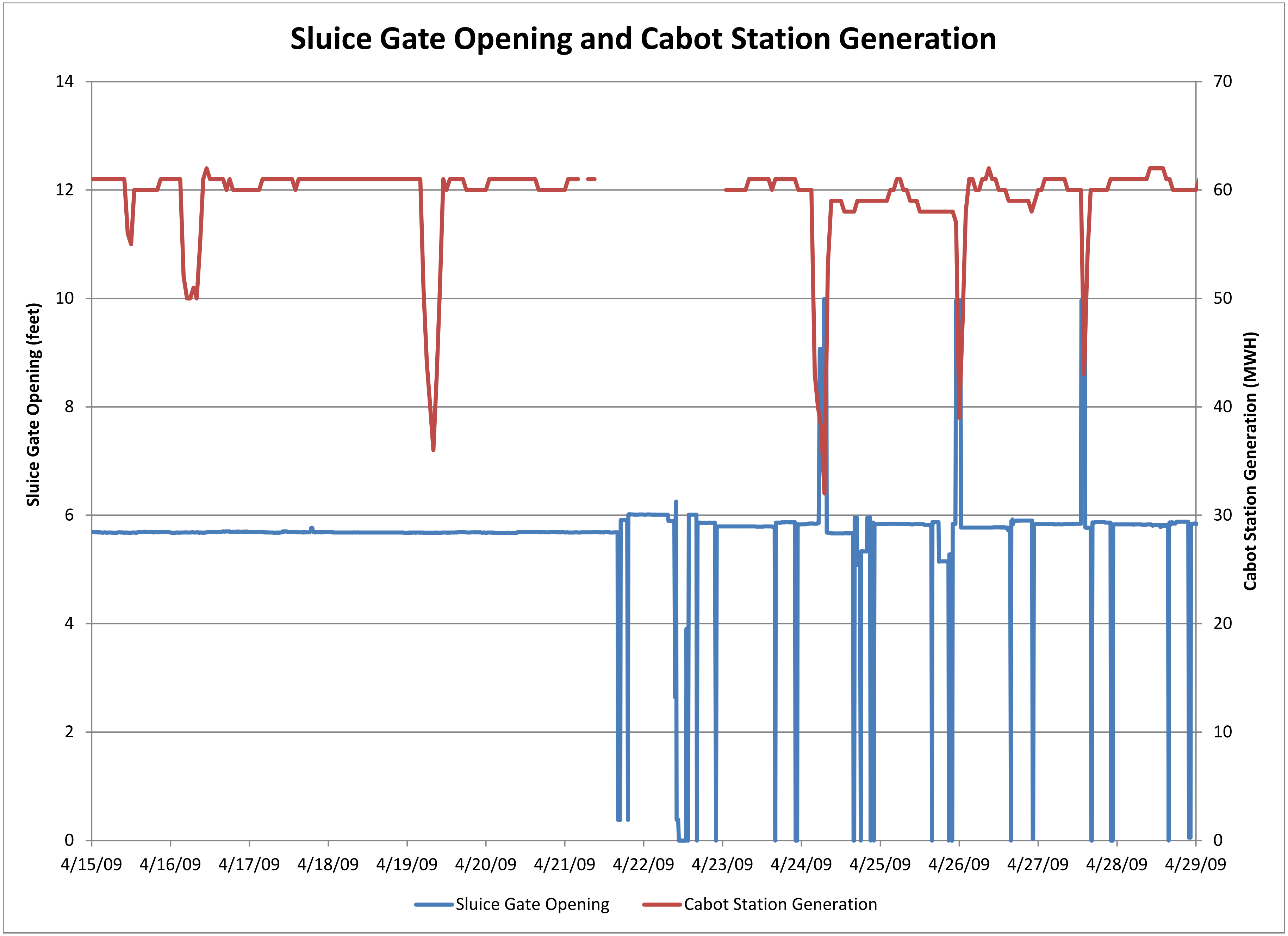

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/08
4/30/08
5/1/08
5/2/08
5/3/08
5/4/08
5/5/08
5/6/08
5/7/08
5/8/08
5/9/08
5/10/08
5/11/08
5/12/08
5/13/08
Sluice Gate Opening
Cabot Station Generation

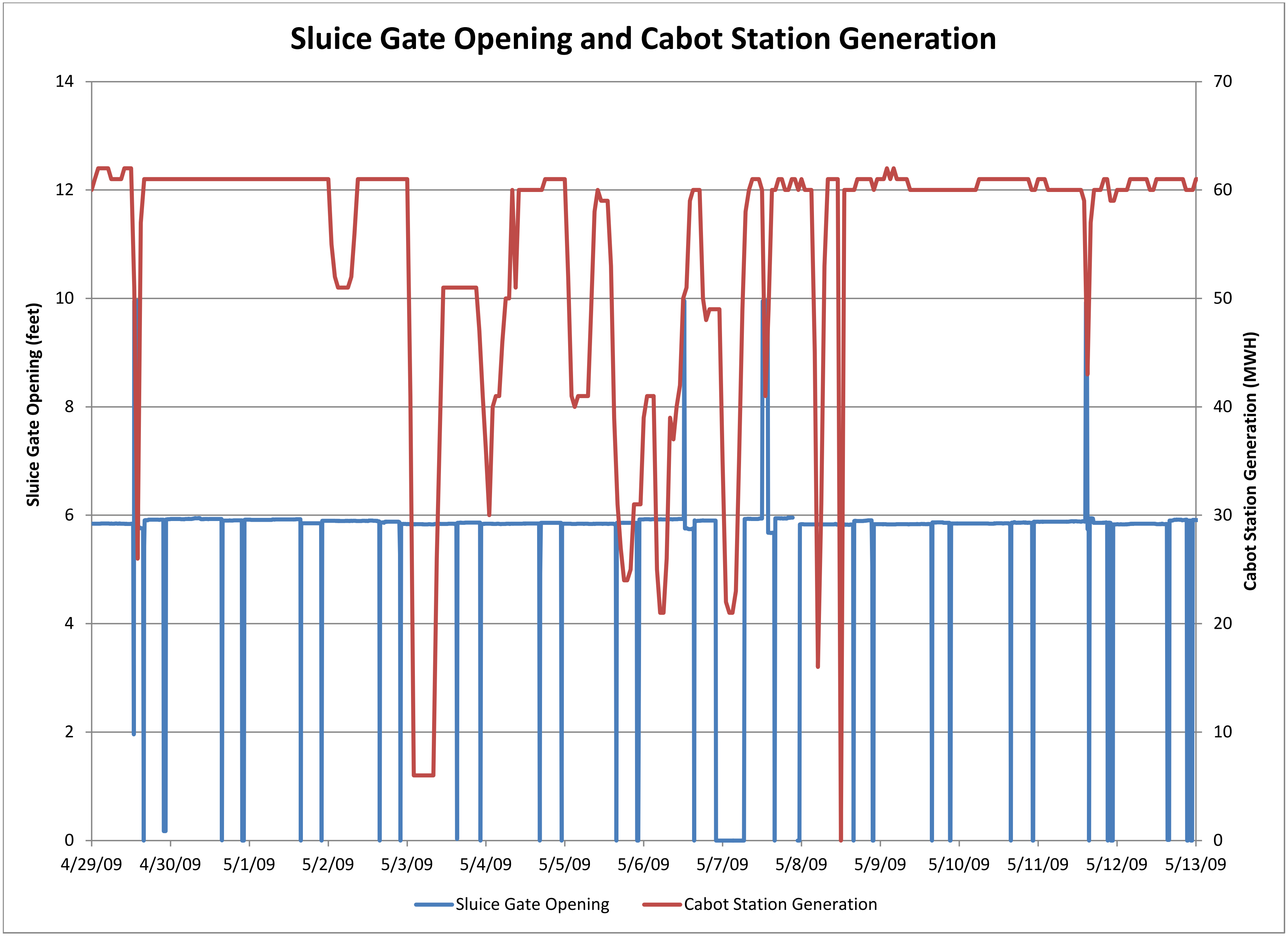

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
5/13/08
5/14/08
5/15/08
5/16/08
5/17/08
5/18/08
5/19/08
5/20/08
5/21/08
5/22/08
5/23/08
5/24/08
5/25/08
5/26/08
5/27/08
Sluice Gate Opening
Cabot Station Generation

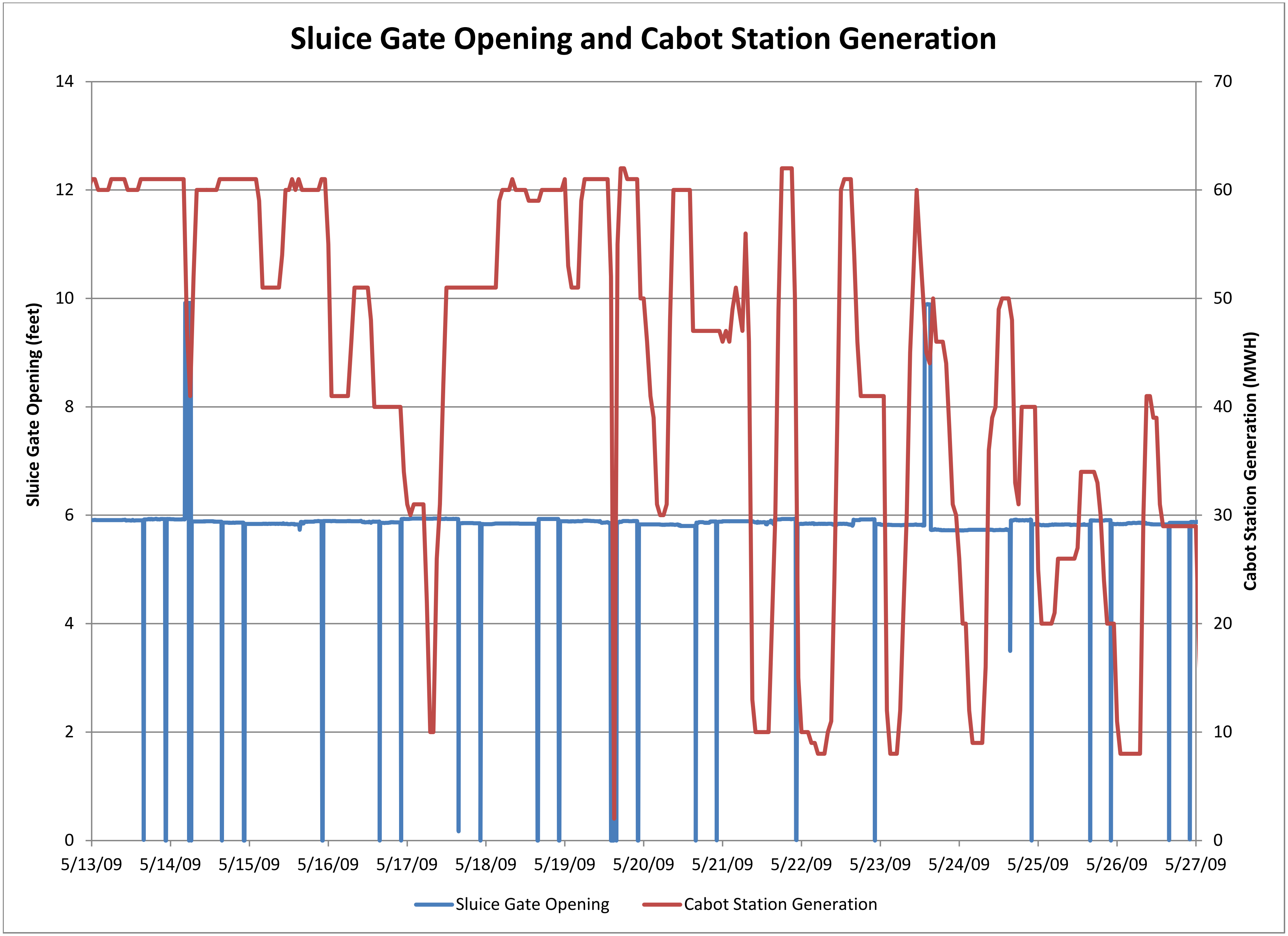

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/27/08
5/28/08
5/29/08
5/30/08
5/31/08
6/1/08
6/2/08
6/3/08
6/4/08
6/5/08
6/6/08
6/7/08
6/8/08
6/9/08
6/10/08
Sluice Gate Opening
Cabot Station Generation

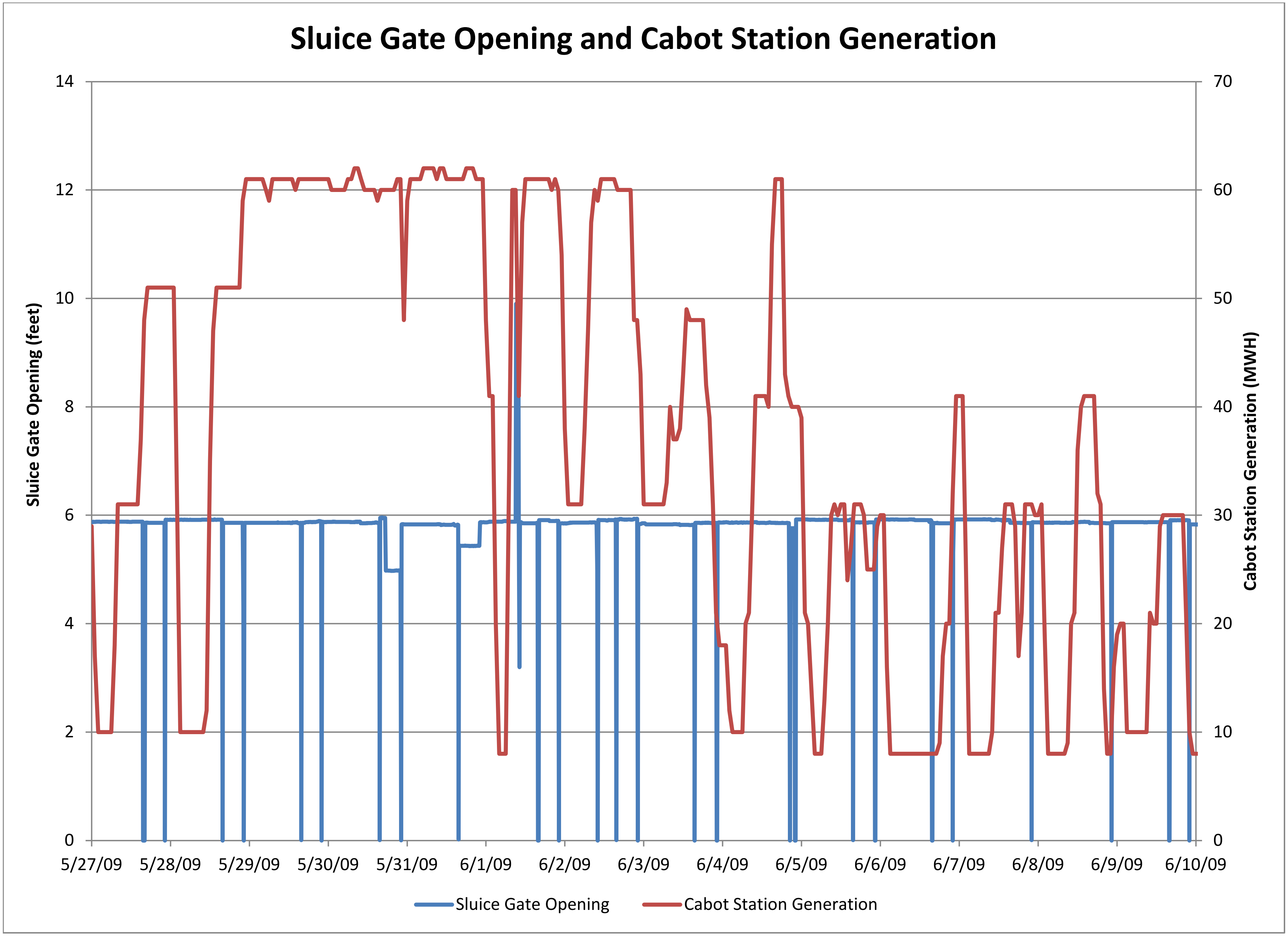


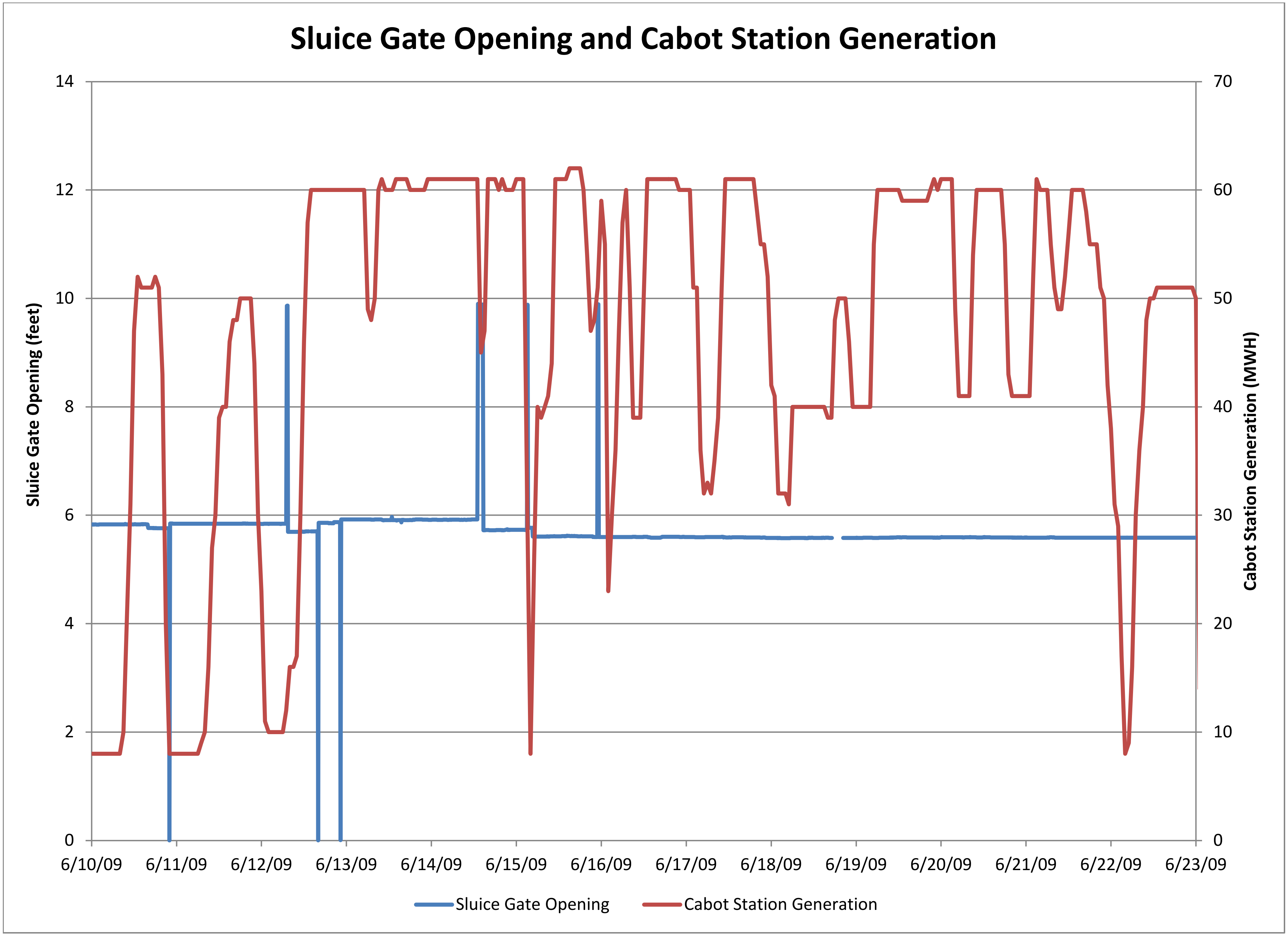
Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
6/10/08
6/11/08
6/12/08
6/13/08
6/14/08
6/15/08
6/16/08
6/17/08
6/18/08
6/19/08
6/20/08
6/21/08
6/22/08
6/23/08
Sluice Gate Opening
Cabot Station Generation


Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/15/09
4/16/09
4/17/09
4/18/09
4/19/09
4/20/09
4/21/09
4/22/09
4/23/09
4/24/09
4/25/09
4/26/09
4/27/09
4/28/09
4/29/09
Sluice Gate Opening
Cabot Station Generation

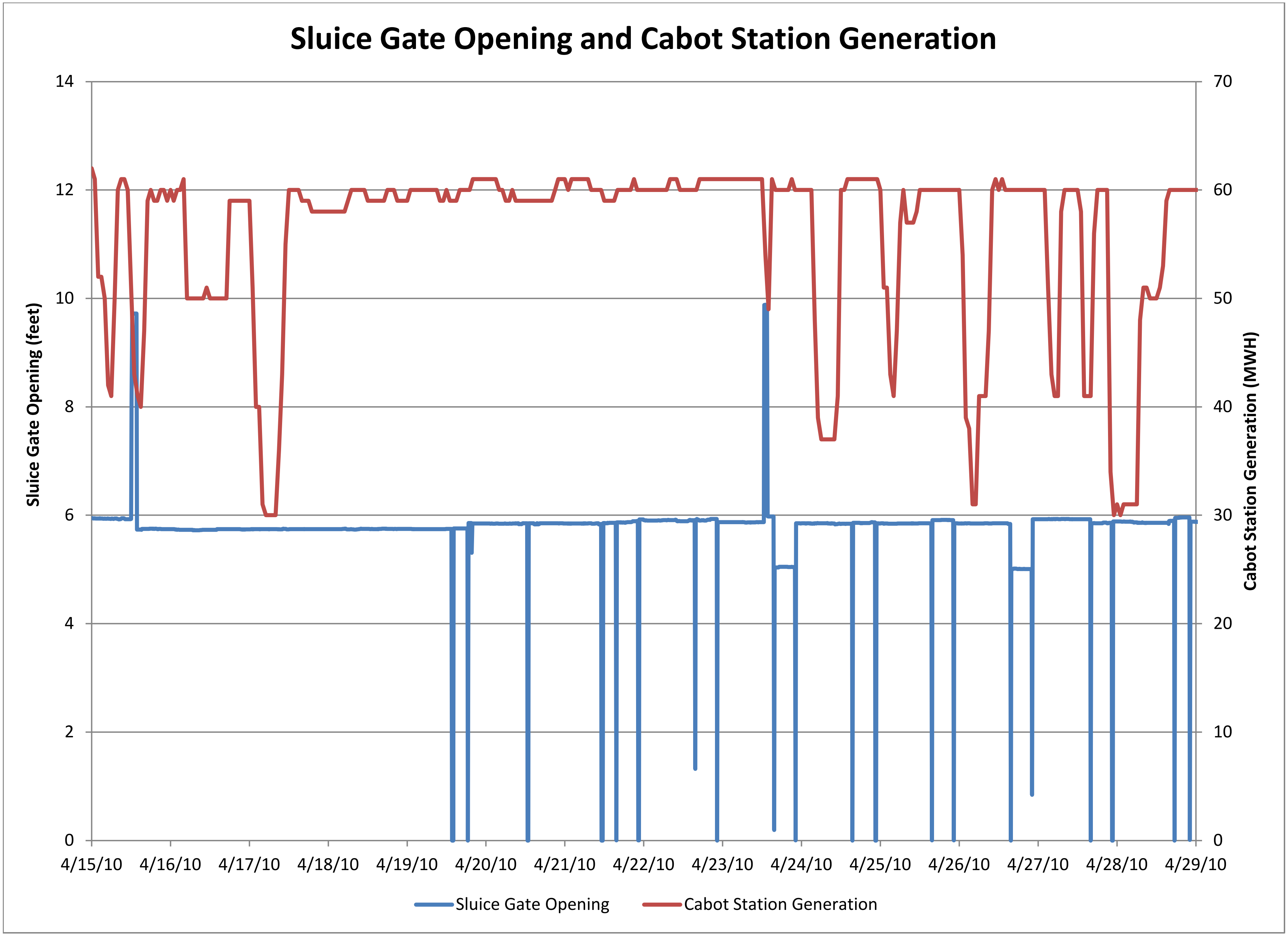

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/09
4/30/09
5/1/09
5/2/09
5/3/09
5/4/09
5/5/09
5/6/09
5/7/09
5/8/09
5/9/09
5/10/09
5/11/09
5/12/09
5/13/09
Sluice Gate Opening
Cabot Station Generation

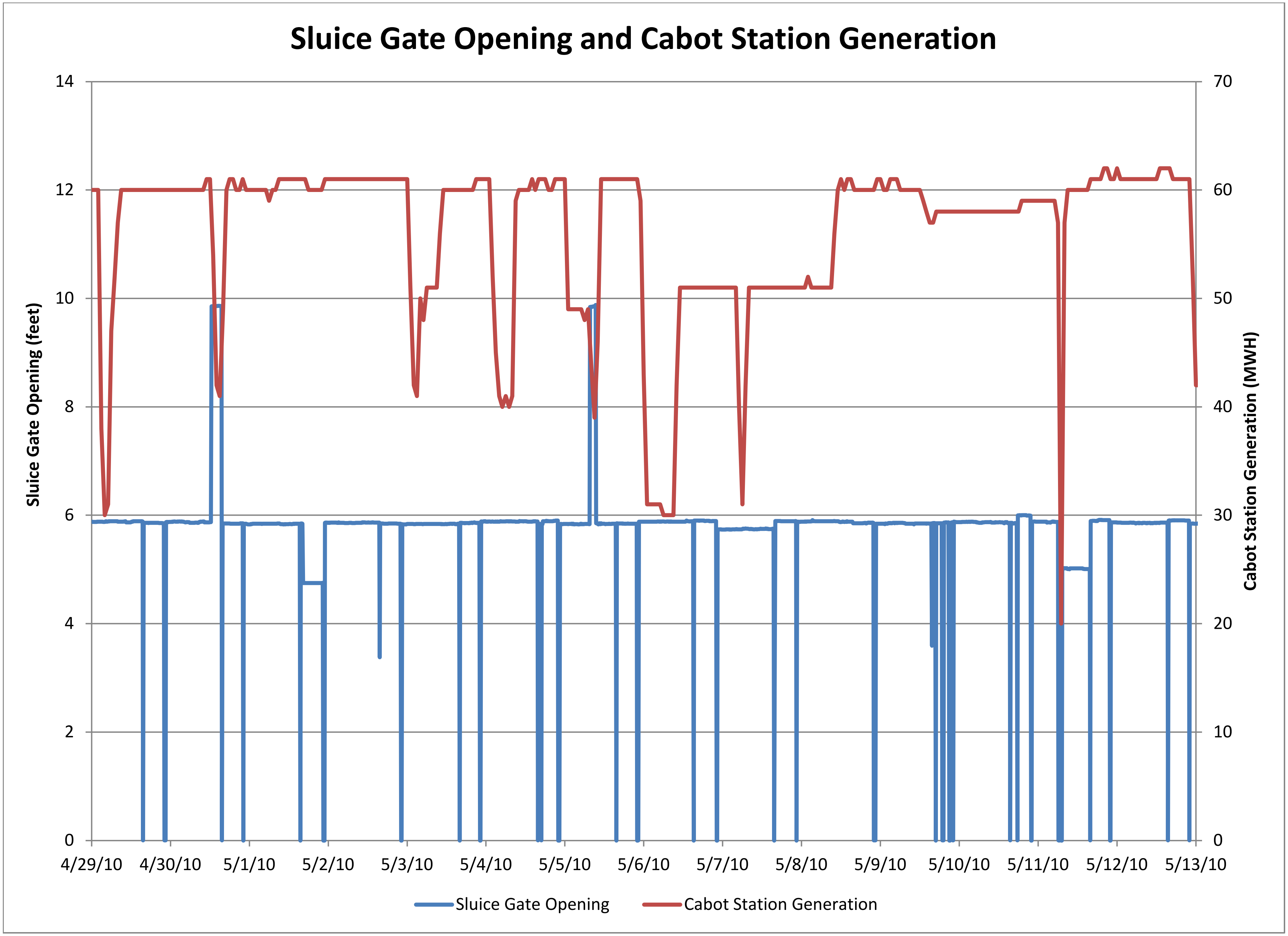

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/13/09
5/14/09
5/15/09
5/16/09
5/17/09
5/18/09
5/19/09
5/20/09
5/21/09
5/22/09
5/23/09
5/24/09
5/25/09
5/26/09
5/27/09
Sluice Gate Opening
Cabot Station Generation

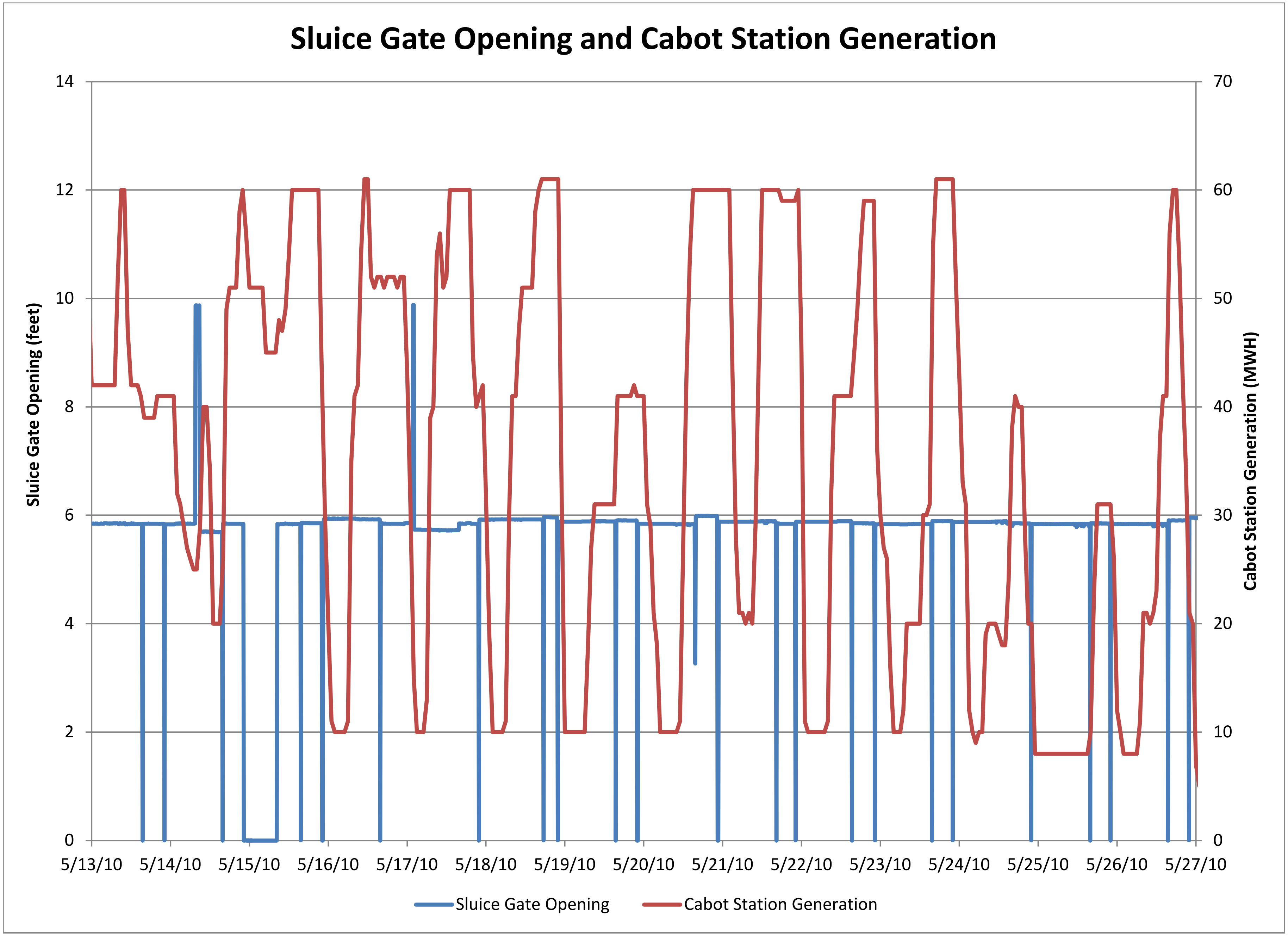

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/27/09
5/28/09
5/29/09
5/30/09
5/31/09
6/1/09
6/2/09
6/3/09
6/4/09
6/5/09
6/6/09
6/7/09
6/8/09
6/9/09
6/10/09
Sluice Gate Opening
Cabot Station Generation



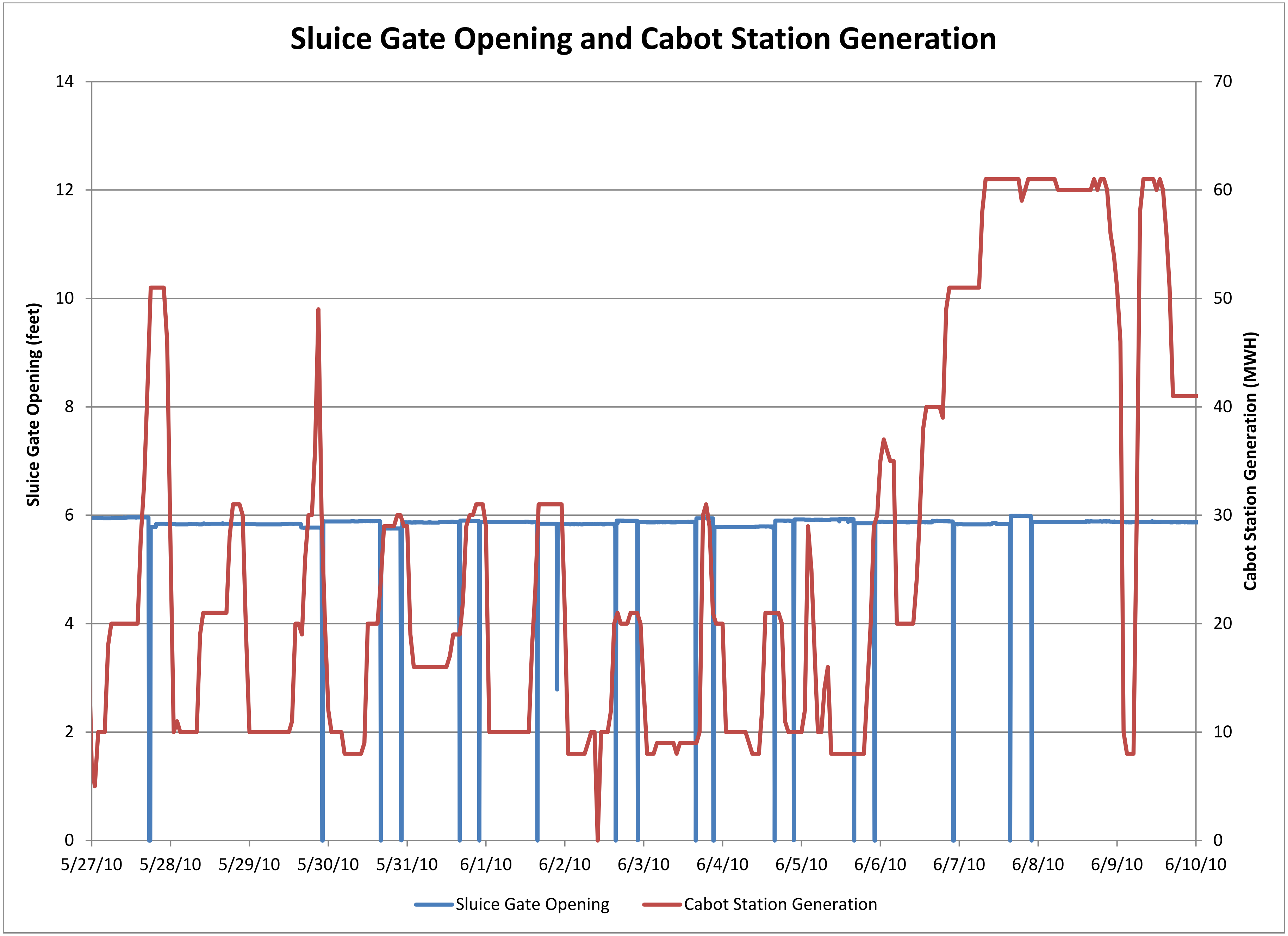
Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
6/10/09
6/11/09
6/12/09
6/13/09
6/14/09
6/15/09
6/16/09
6/17/09
6/18/09
6/19/09
6/20/09
6/21/09
6/22/09
6/23/09
Sluice Gate Opening
Cabot Station Generation

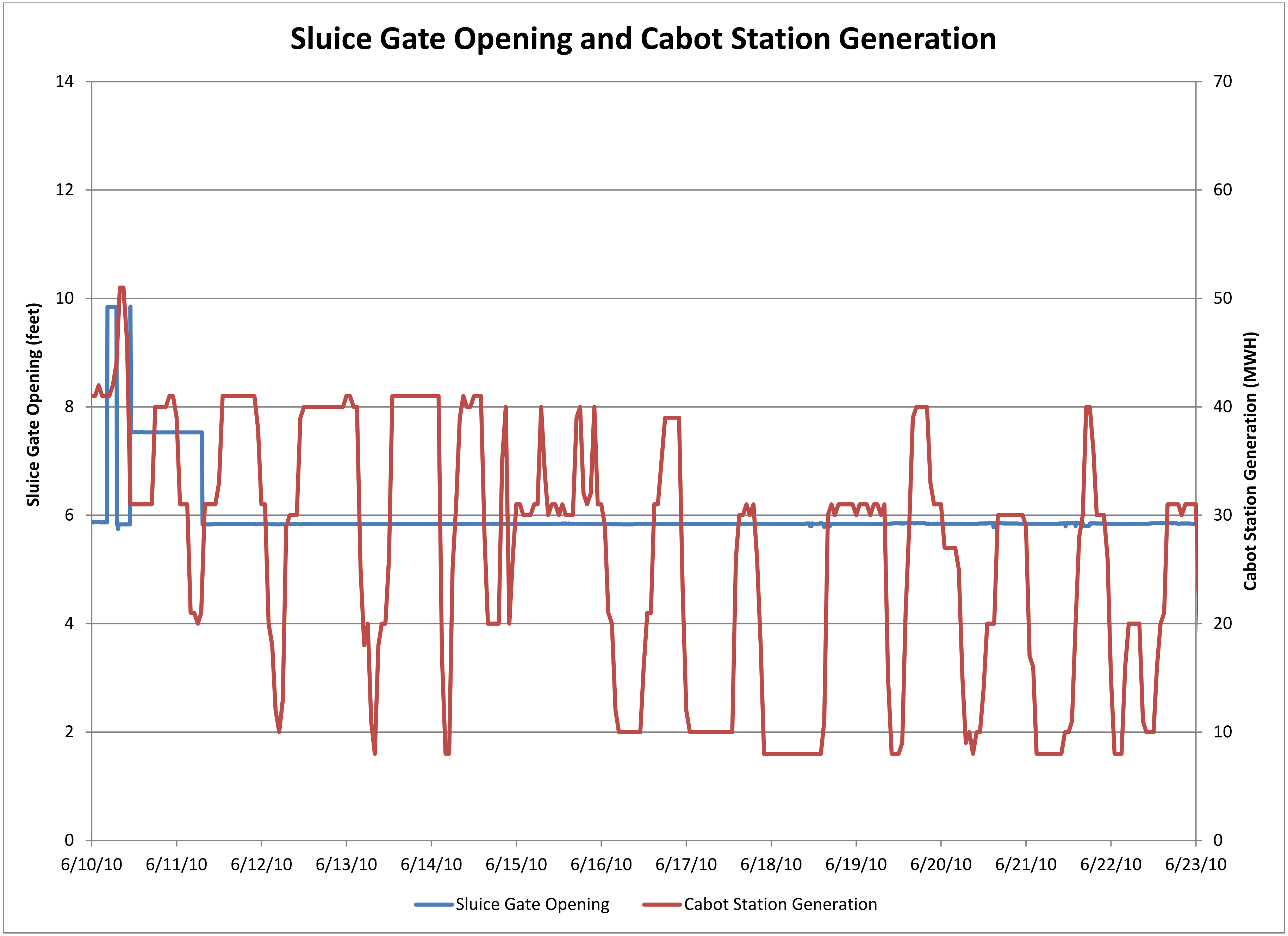

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
4/15/10
4/16/10
4/17/10
4/18/10
4/19/10
4/20/10
4/21/10
4/22/10
4/23/10
4/24/10
4/25/10
4/26/10
4/27/10
4/28/10
4/29/10
Sluice Gate Opening
Cabot Station Generation

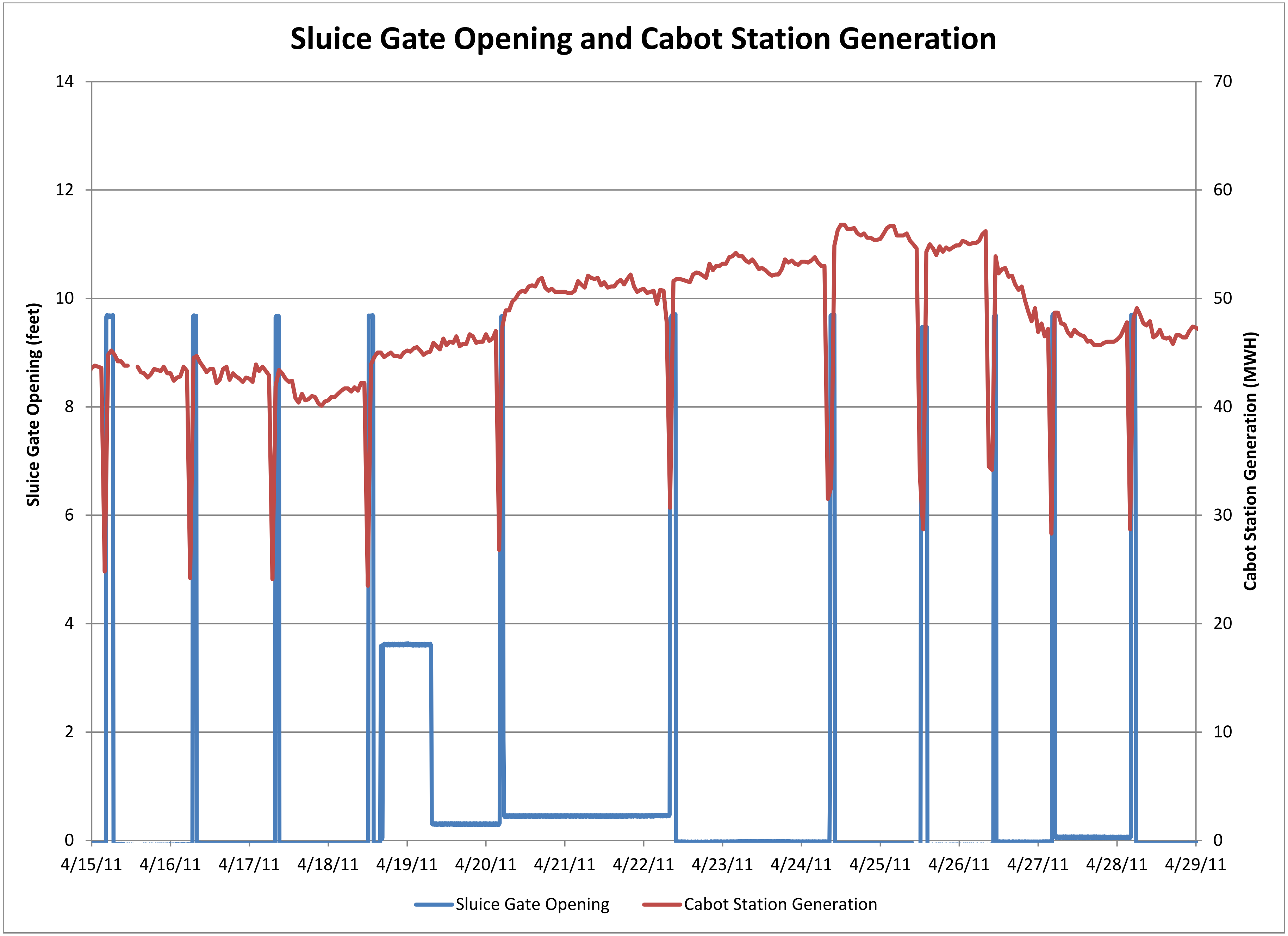

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/10
4/30/10
5/1/10
5/2/10
5/3/10
5/4/10
5/5/10
5/6/10
5/7/10
5/8/10
5/9/10
5/10/10
5/11/10
5/12/10
5/13/10
Sluice Gate Opening
Cabot Station Generation

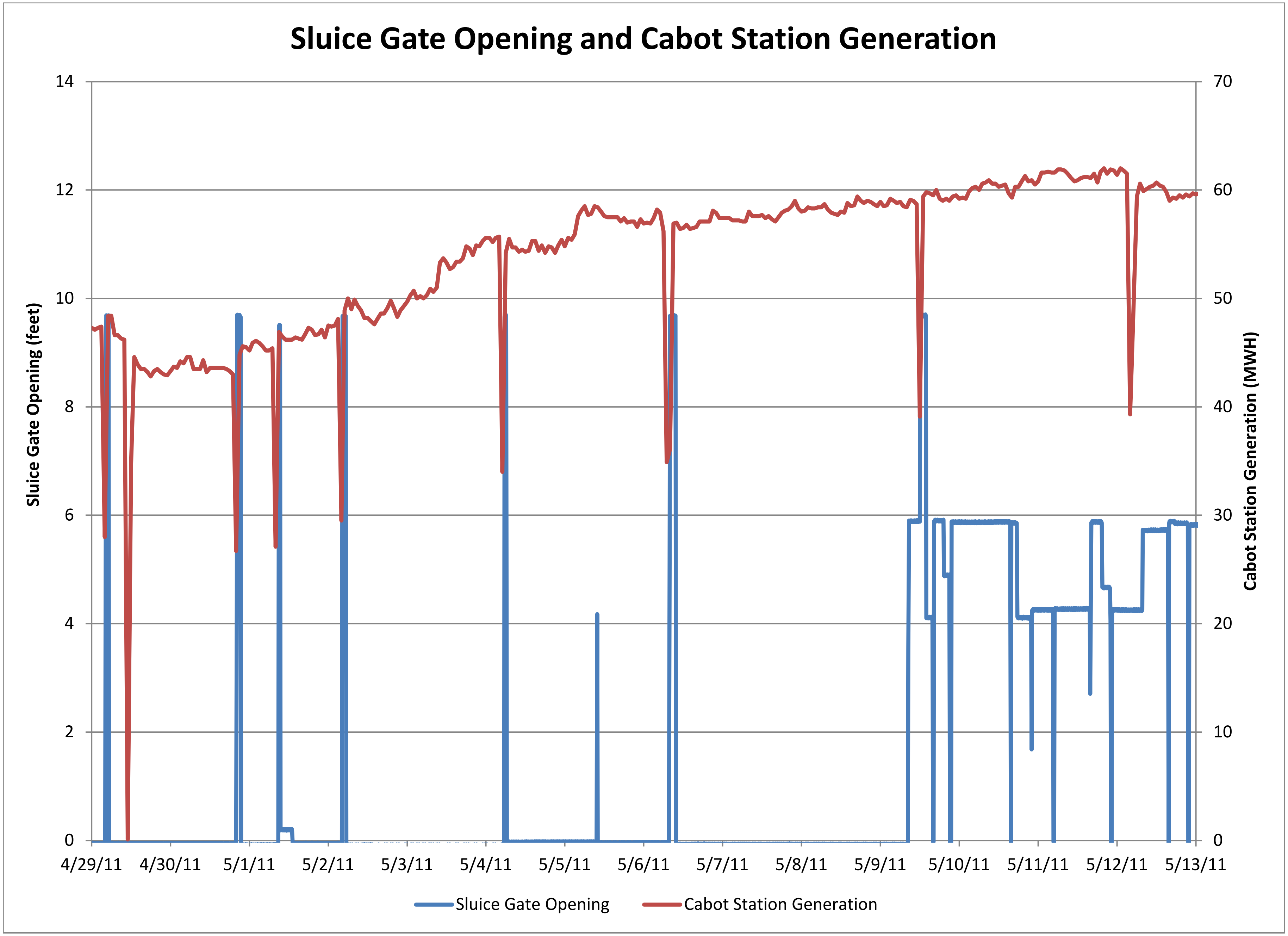


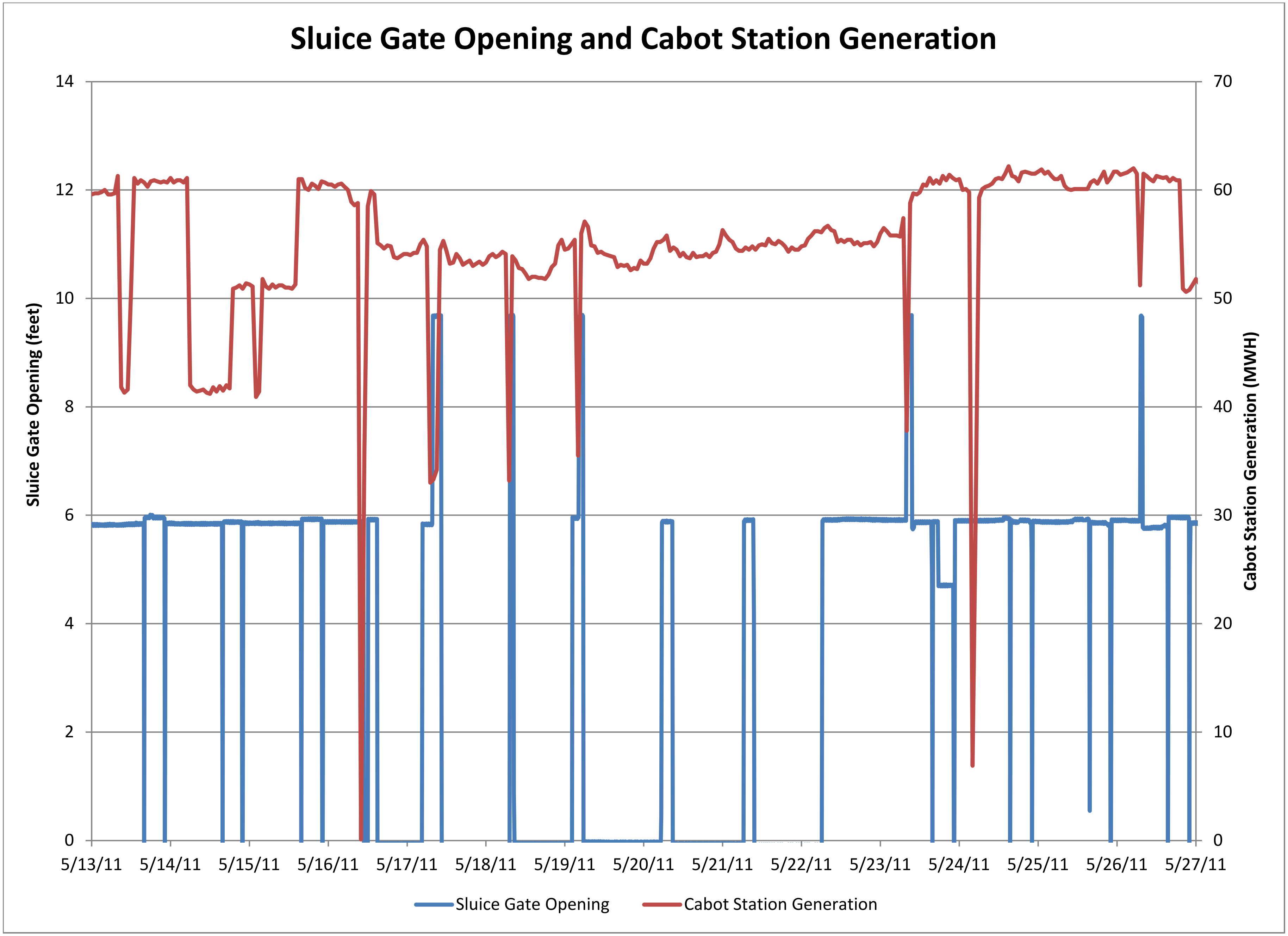
Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/13/10
5/14/10
5/15/10
5/16/10
5/17/10
5/18/10
5/19/10
5/20/10
5/21/10
5/22/10
5/23/10
5/24/10
5/25/10
5/26/10
5/27/10
Sluice Gate Opening
Cabot Station Generation

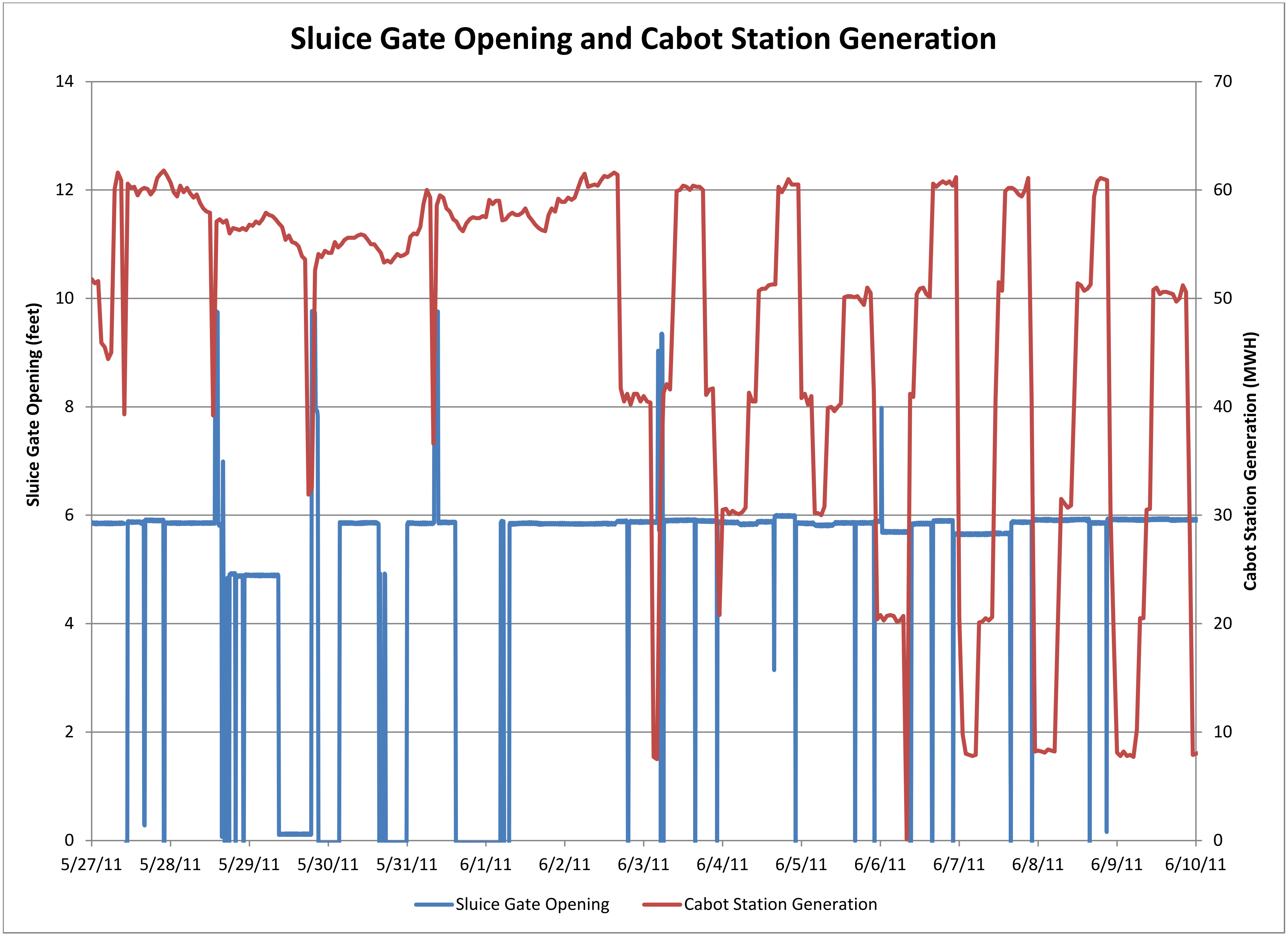

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
5/27/10
5/28/10
5/29/10
5/30/10
5/31/10
6/1/10
6/2/10
6/3/10
6/4/10
6/5/10
6/6/10
6/7/10
6/8/10
6/9/10
6/10/10
Sluice Gate Opening
Cabot Station Generation

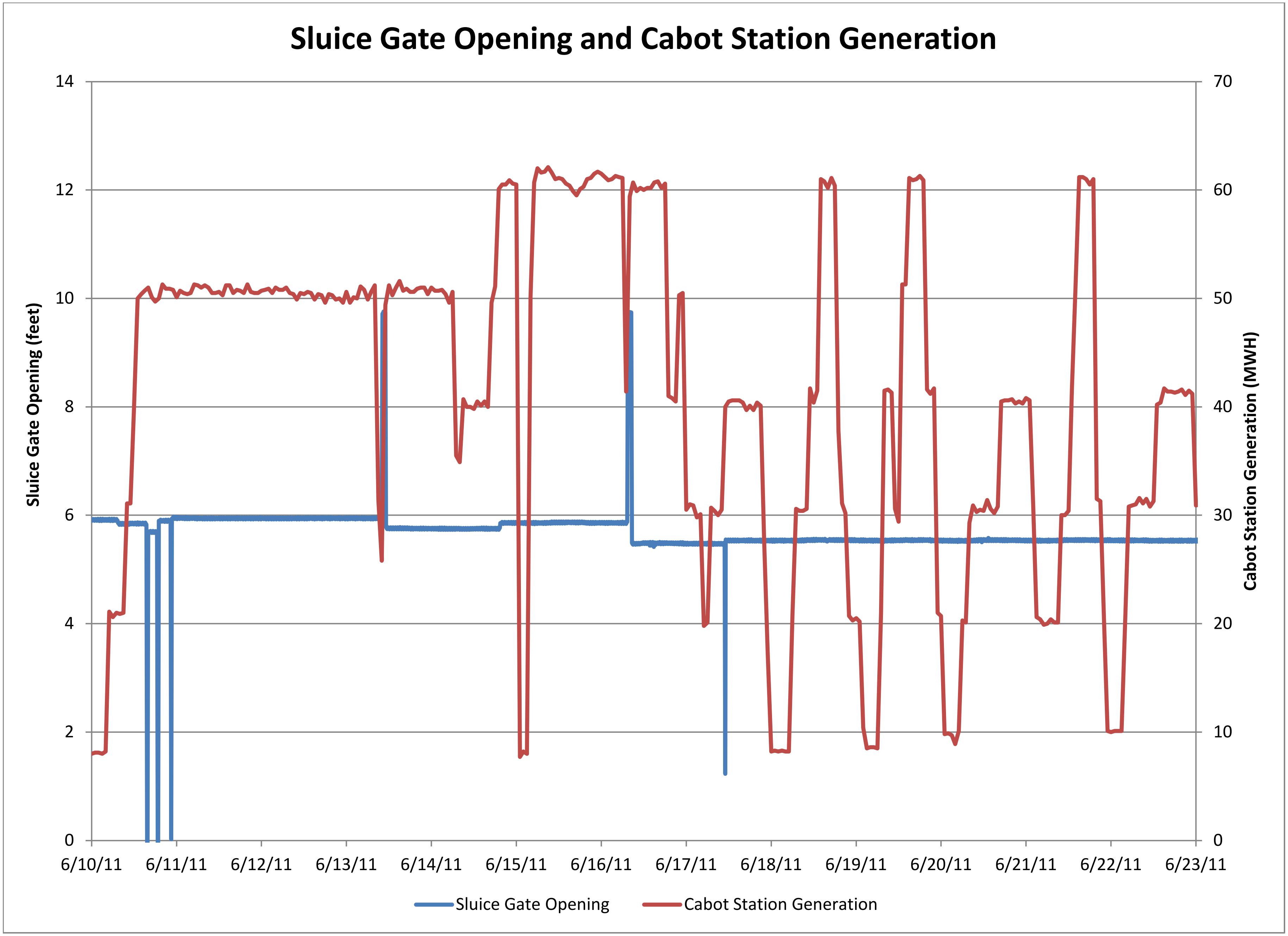

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
6/10/10
6/11/10
6/12/10
6/13/10
6/14/10
6/15/10
6/16/10
6/17/10
6/18/10
6/19/10
6/20/10
6/21/10
6/22/10
6/23/10
Sluice Gate Opening
Cabot Station Generation

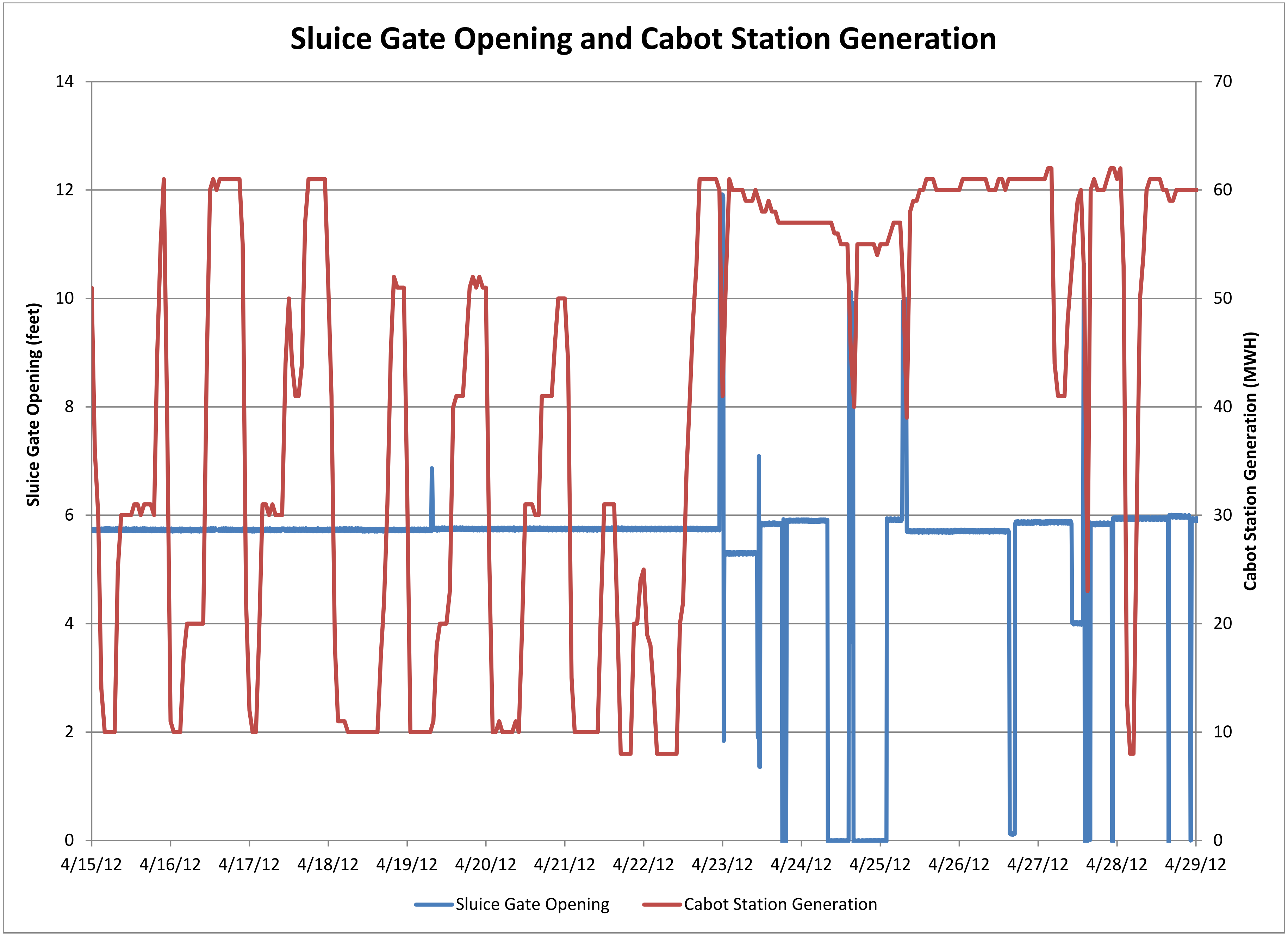

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/15/11
4/16/11
4/17/11
4/18/11
4/19/11
4/20/11
4/21/11
4/22/11
4/23/11
4/24/11
4/25/11
4/26/11
4/27/11
4/28/11
4/29/11
Sluice Gate Opening
Cabot Station Generation


Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/11
4/30/11
5/1/11
5/2/11
5/3/11
5/4/11
5/5/11
5/6/11
5/7/11
5/8/11
5/9/11
5/10/11
5/11/11
5/12/11
5/13/11
Sluice Gate Opening
Cabot Station Generation

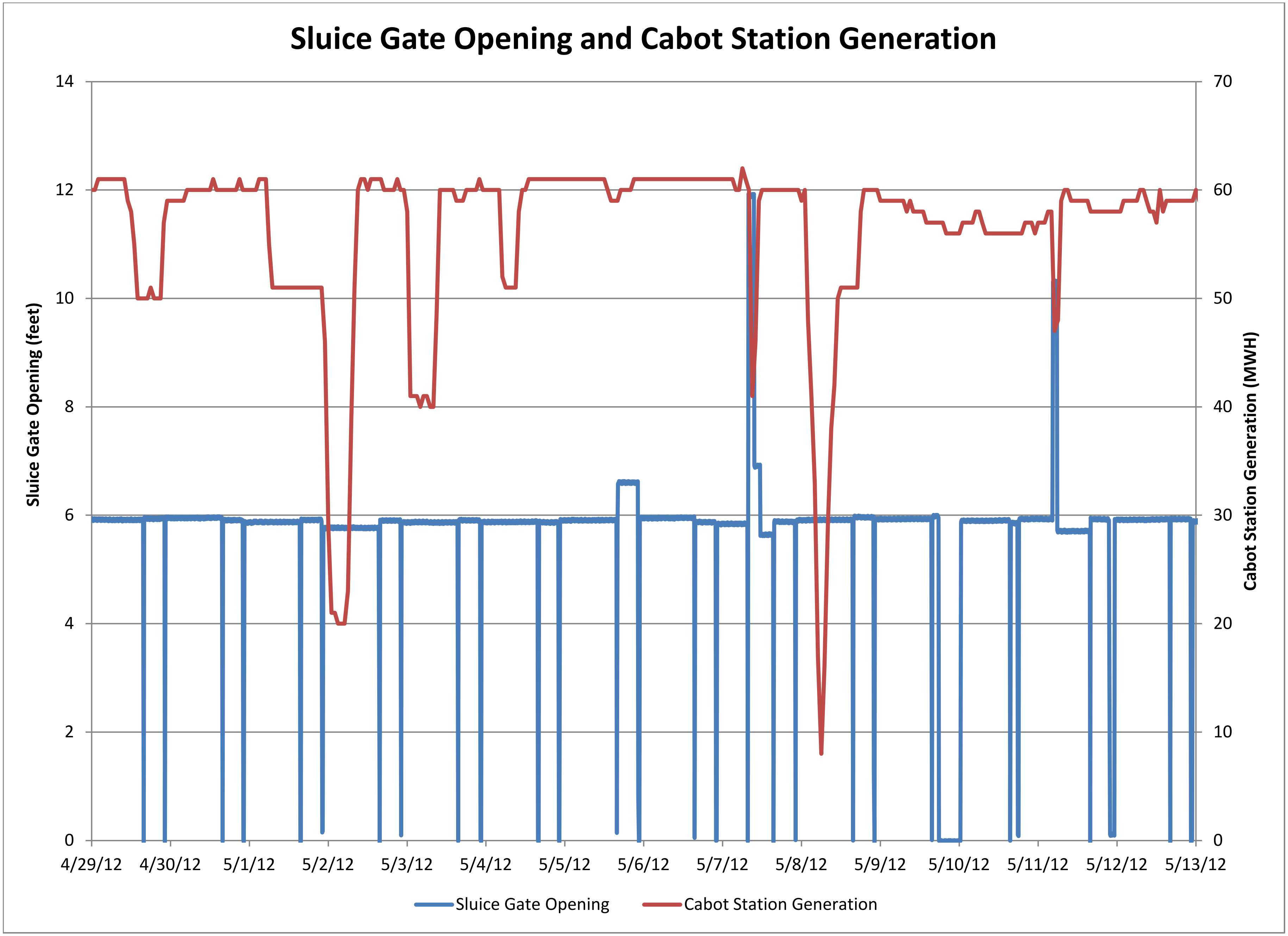

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/13/11
5/14/11
5/15/11
5/16/11
5/17/11
5/18/11
5/19/11
5/20/11
5/21/11
5/22/11
5/23/11
5/24/11
5/25/11
5/26/11
5/27/11
Sluice Gate Opening
Cabot Station Generation


Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/27/11
5/28/11
5/29/11
5/30/11
5/31/11
6/1/11
6/2/11
6/3/11
6/4/11
6/5/11
6/6/11
6/7/11
6/8/11
6/9/11
6/10/11
Sluice Gate Opening
Cabot Station Generation

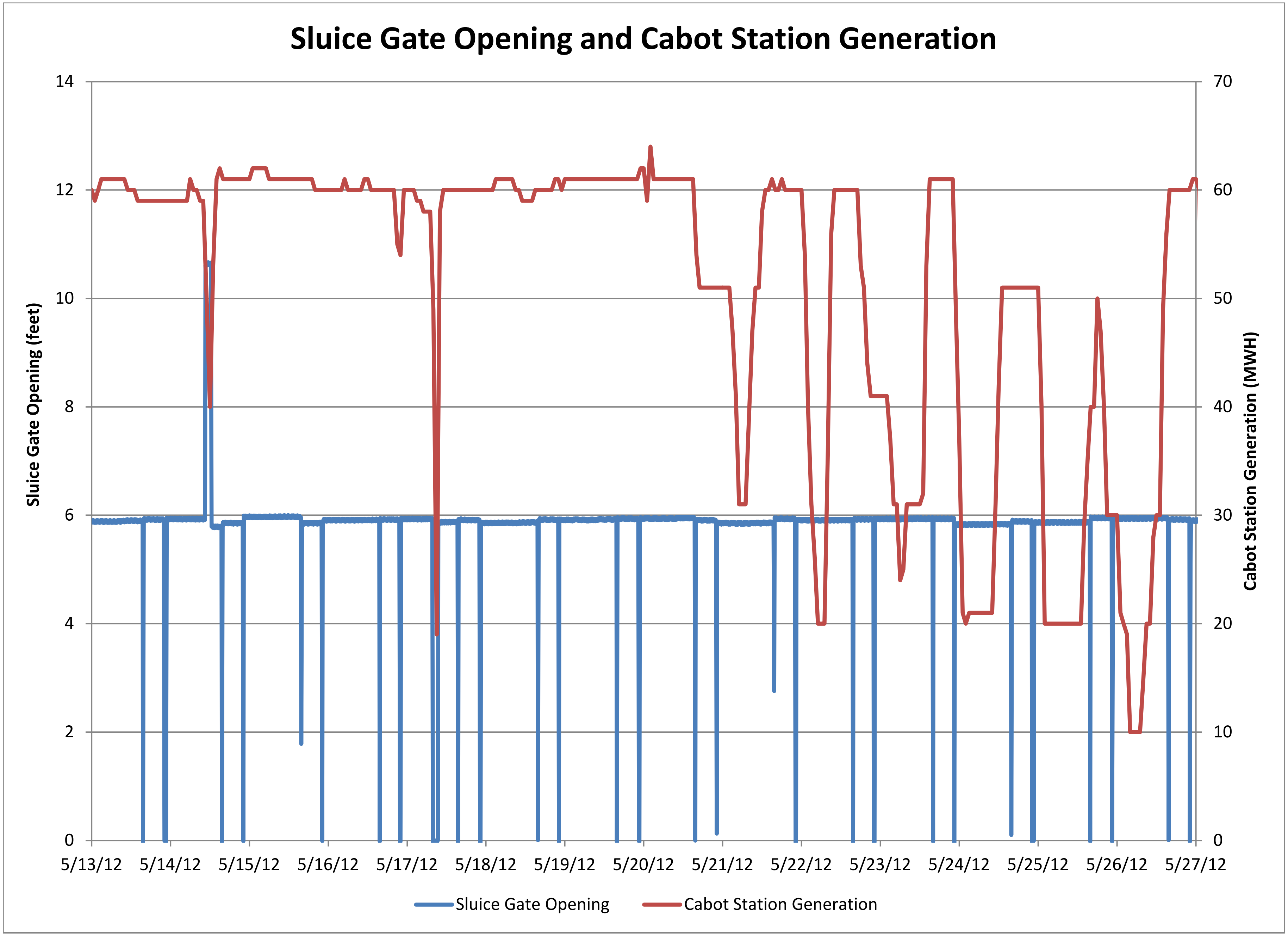

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
6/10/11
6/11/11
6/12/11
6/13/11
6/14/11
6/15/11
6/16/11
6/17/11
6/18/11
6/19/11
6/20/11
6/21/11
6/22/11
6/23/11
Sluice Gate Opening
Cabot Station Generation

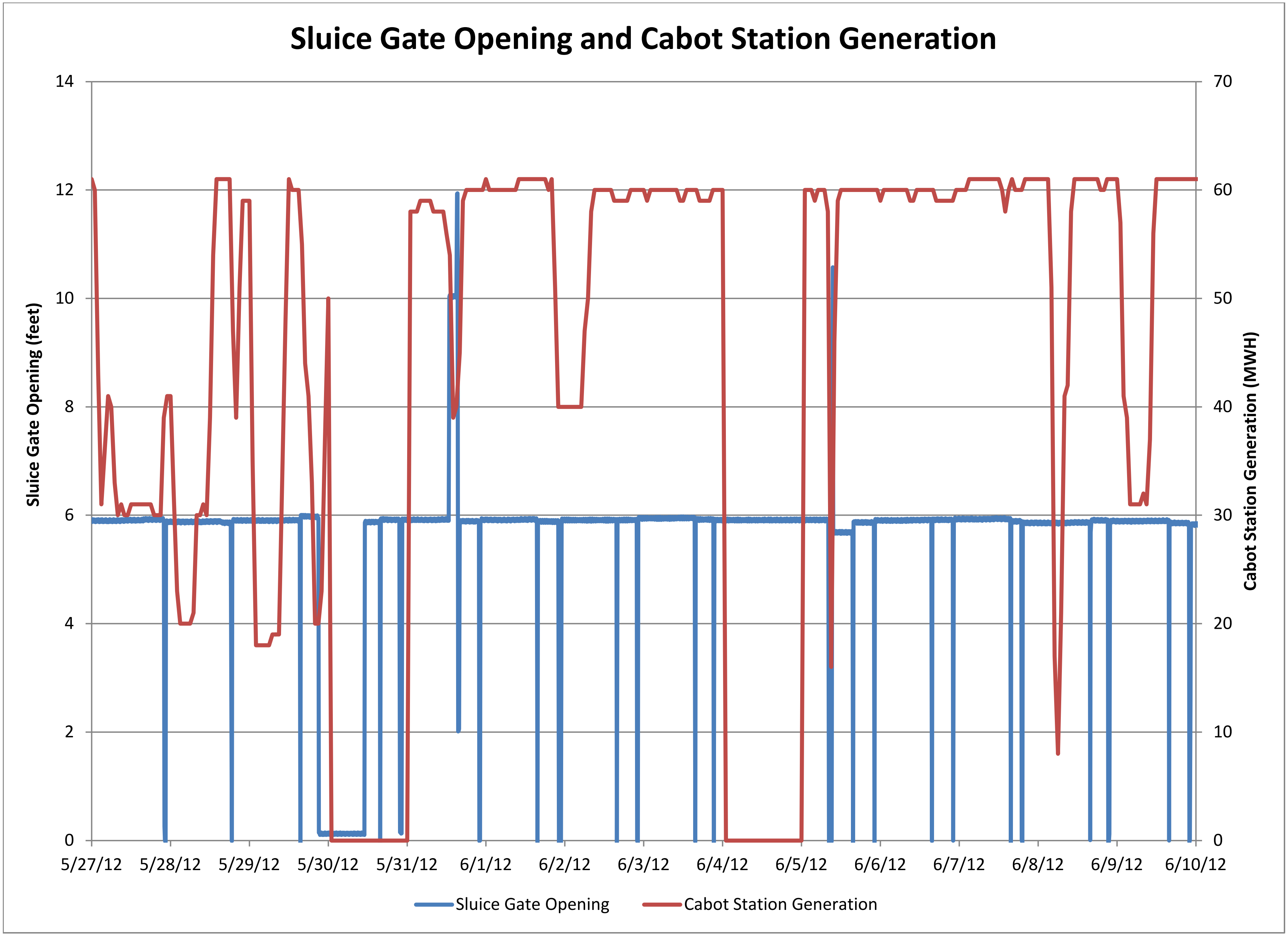


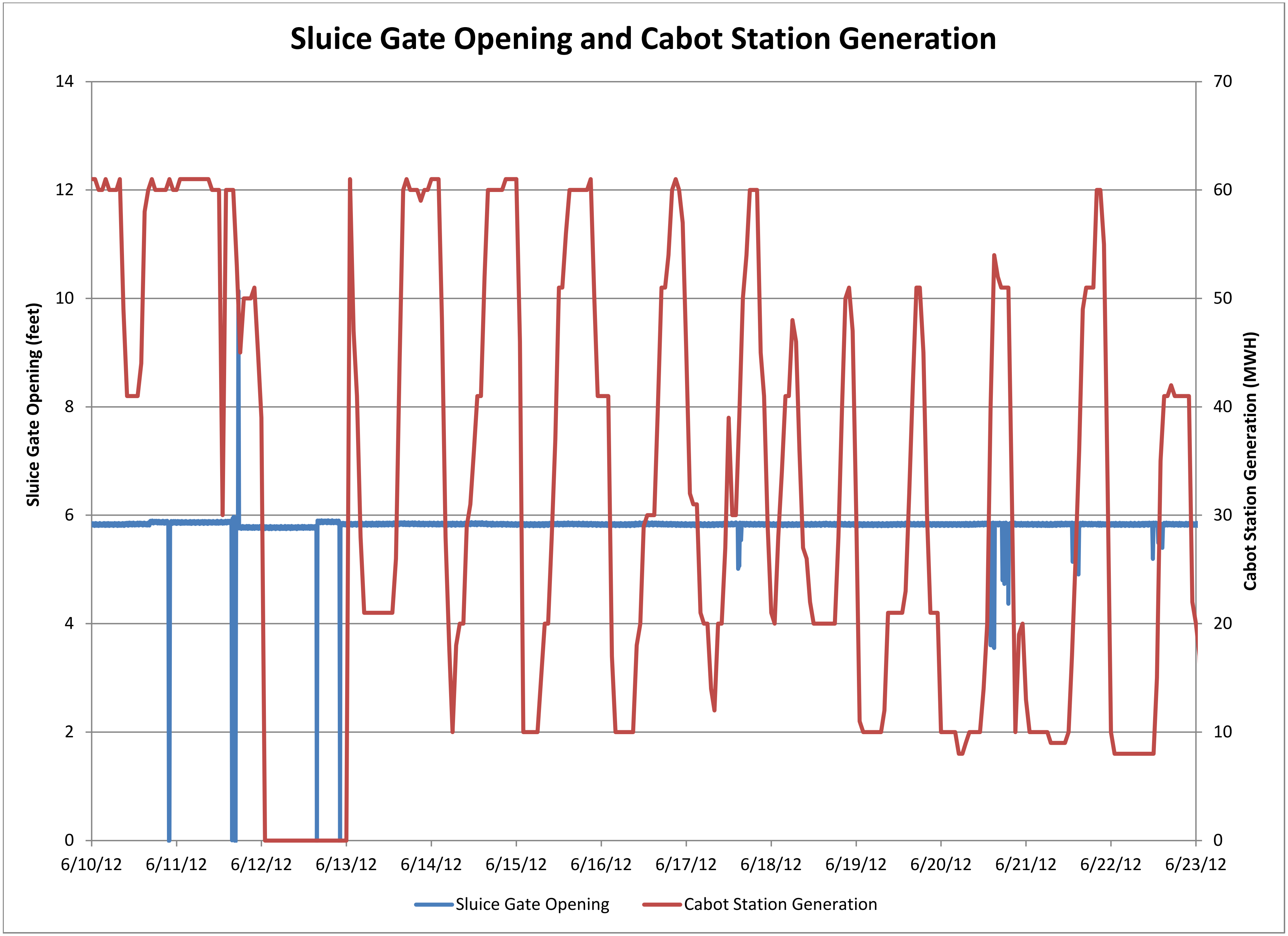
Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/15/12
4/16/12
4/17/12
4/18/12
4/19/12
4/20/12
4/21/12
4/22/12
4/23/12
4/24/12
4/25/12
4/26/12
4/27/12
4/28/12
4/29/12
Sluice Gate Opening
Cabot Station Generation



Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
4/29/12
4/30/12
5/1/12
5/2/12
5/3/12
5/4/12
5/5/12
5/6/12
5/7/12
5/8/12
5/9/12
5/10/12
5/11/12
5/12/12
5/13/12
Sluice Gate Opening
Cabot Station Generation

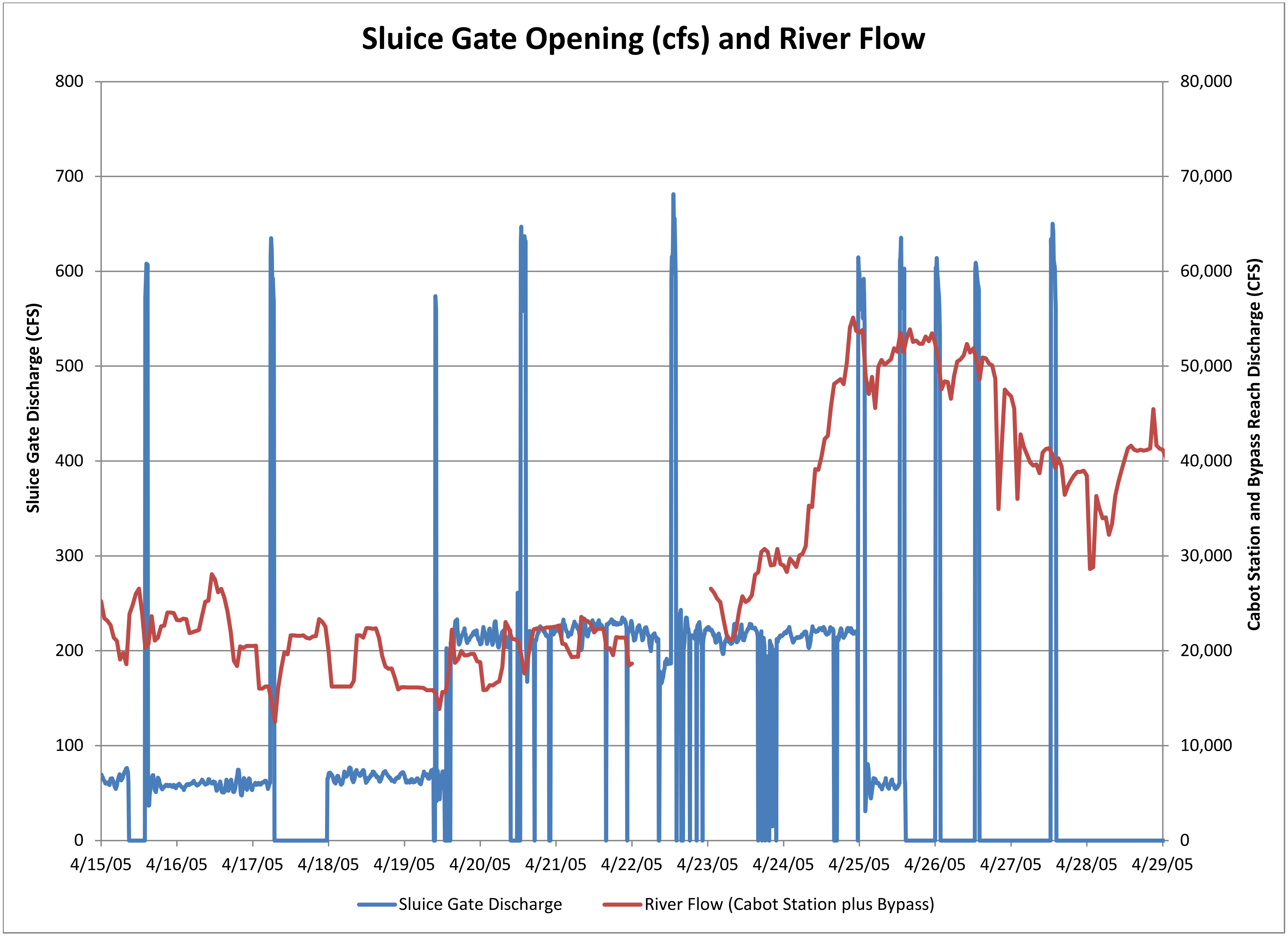

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
0
2
4
6
8
10
12
14
0
10
20
30
40
50
60
70
5/13/12
5/14/12
5/15/12
5/16/12
5/17/12
5/18/12
5/19/12
5/20/12
5/21/12
5/22/12
5/23/12
5/24/12
5/25/12
5/26/12
5/27/12
Sluice Gate Opening
Cabot Station Generation

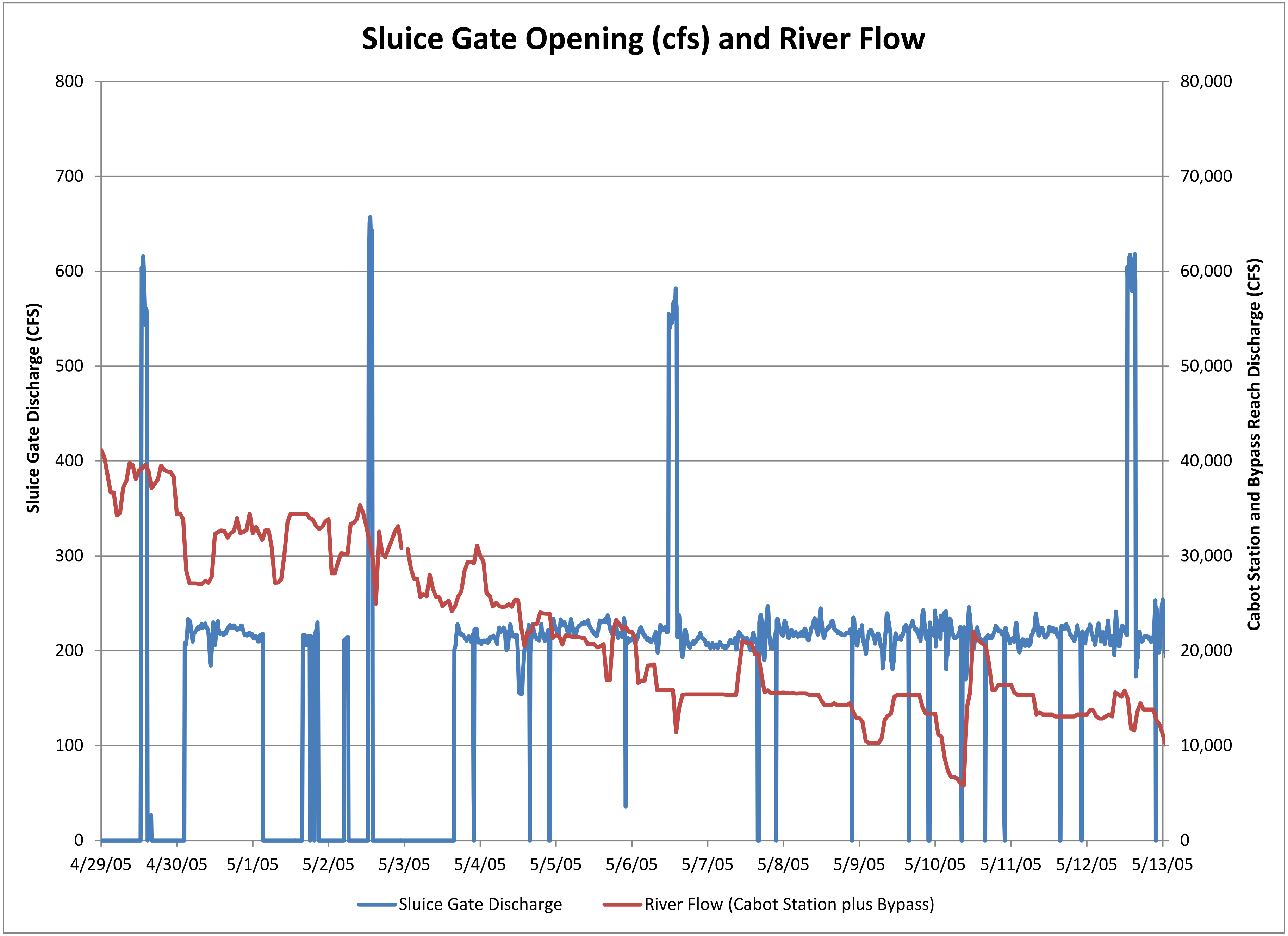

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
5/27/12
5/28/12
5/29/12
5/30/12
5/31/12
6/1/12
6/2/12
6/3/12
6/4/12
6/5/12
6/6/12
6/7/12
6/8/12
6/9/12
6/10/12
Sluice Gate Opening
Cabot Station Generation

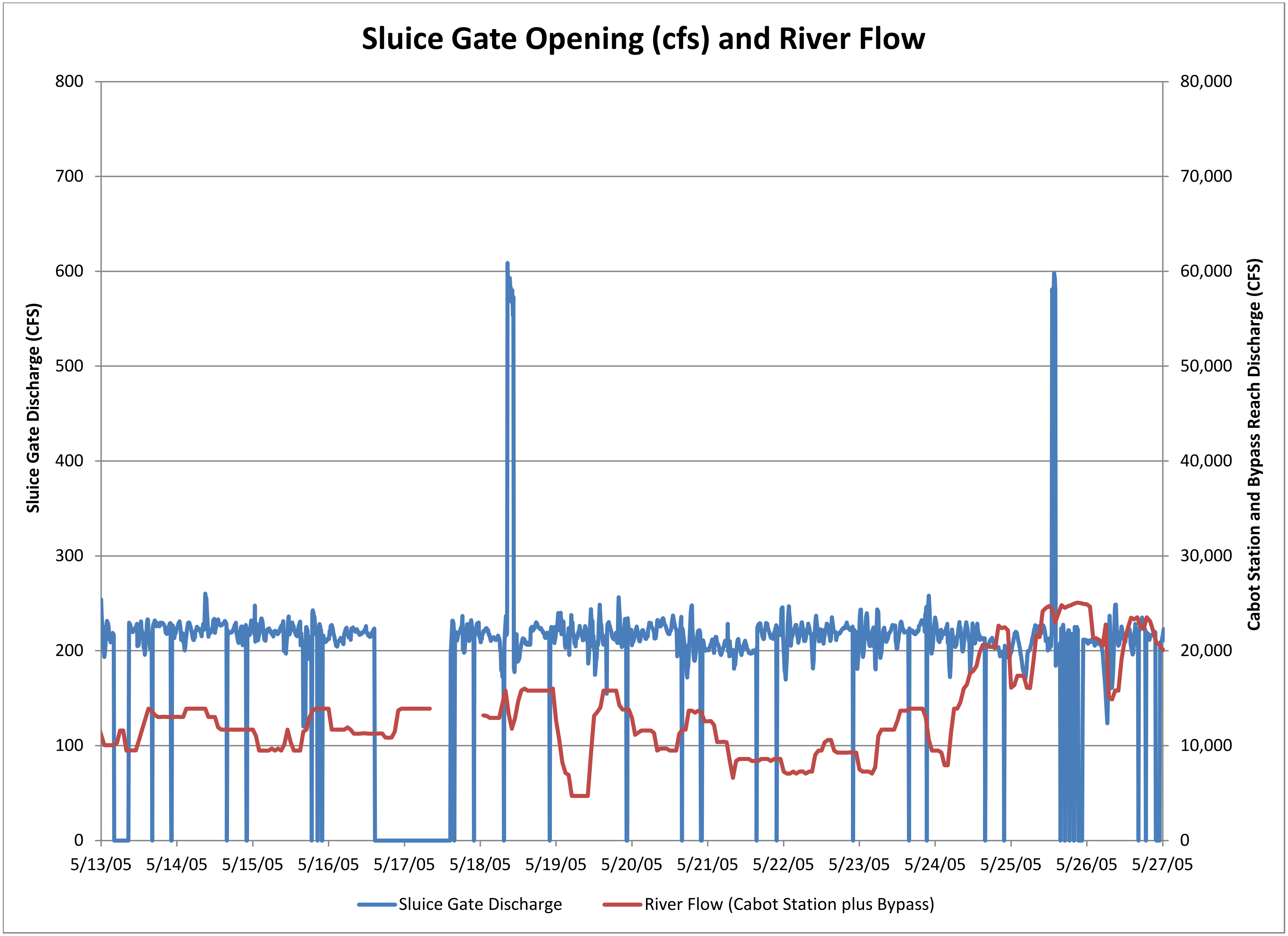

Sluice Gate Opening and Cabot Station Generation
Sluice Gate Opening (feet)
Cabot Station Generation (MWH)
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
6/10/12
6/11/12
6/12/12
6/13/12
6/14/12
6/15/12
6/16/12
6/17/12
6/18/12
6/19/12
6/20/12
6/21/12
6/22/12
6/23/12
Sluice Gate Opening
Cabot Station Generation

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

APPENDIX D – BI-WEEKLY CHARTS OF SLUICE GATE DISCHARGE VS. RIVER DISCHARGE

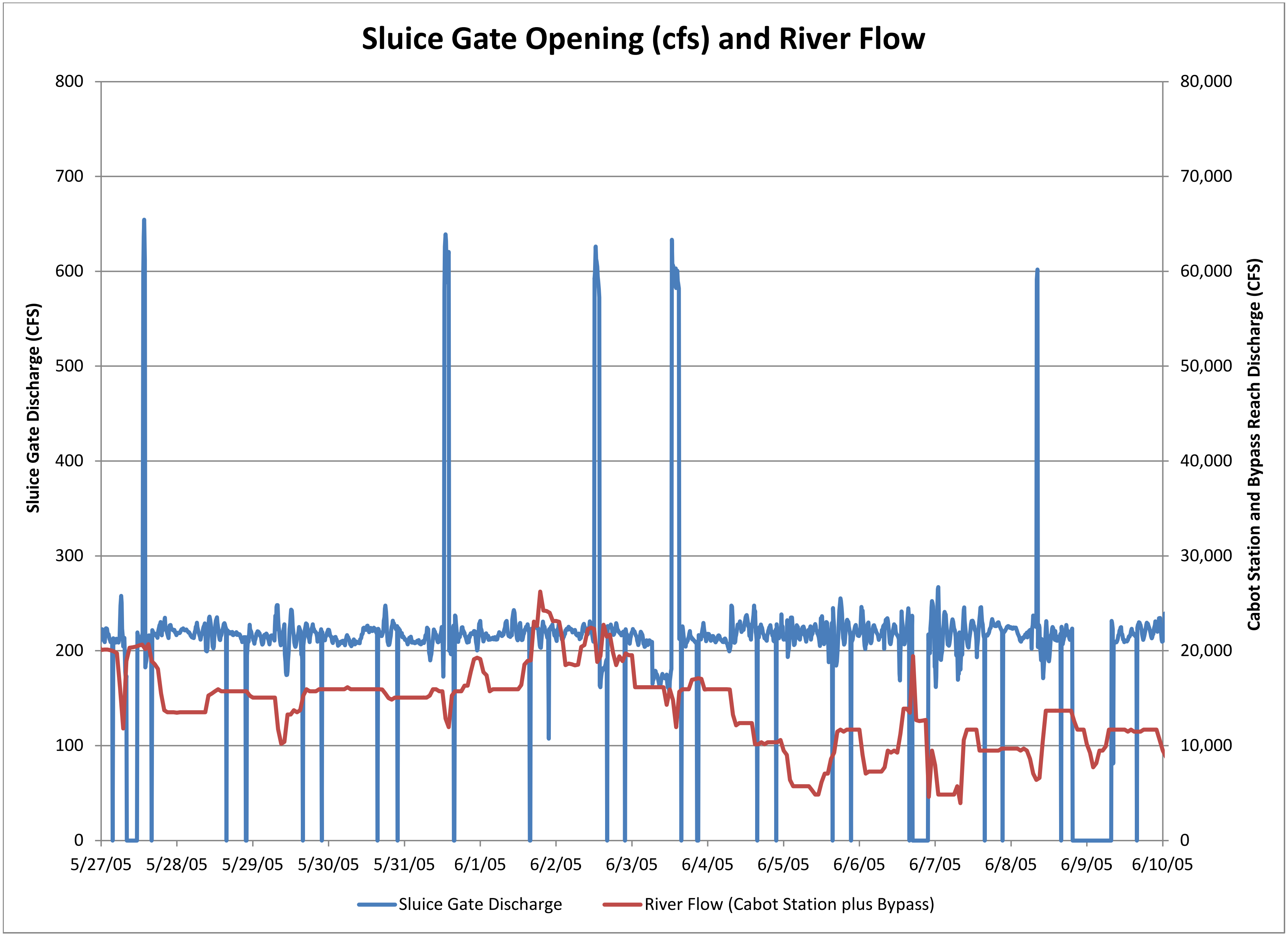

Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
800
700
600
500
400
300
200
100
0
Cabot Station and Bypass Reach Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/15/05
4/16/05
4/17/05
4/18/05
4/19/05
4/20/05
4/21/05
4/22/05
4/23/05
4/24/05
4/25/05
4/26/05
4/27/05
4/28/05
4/29/05
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)

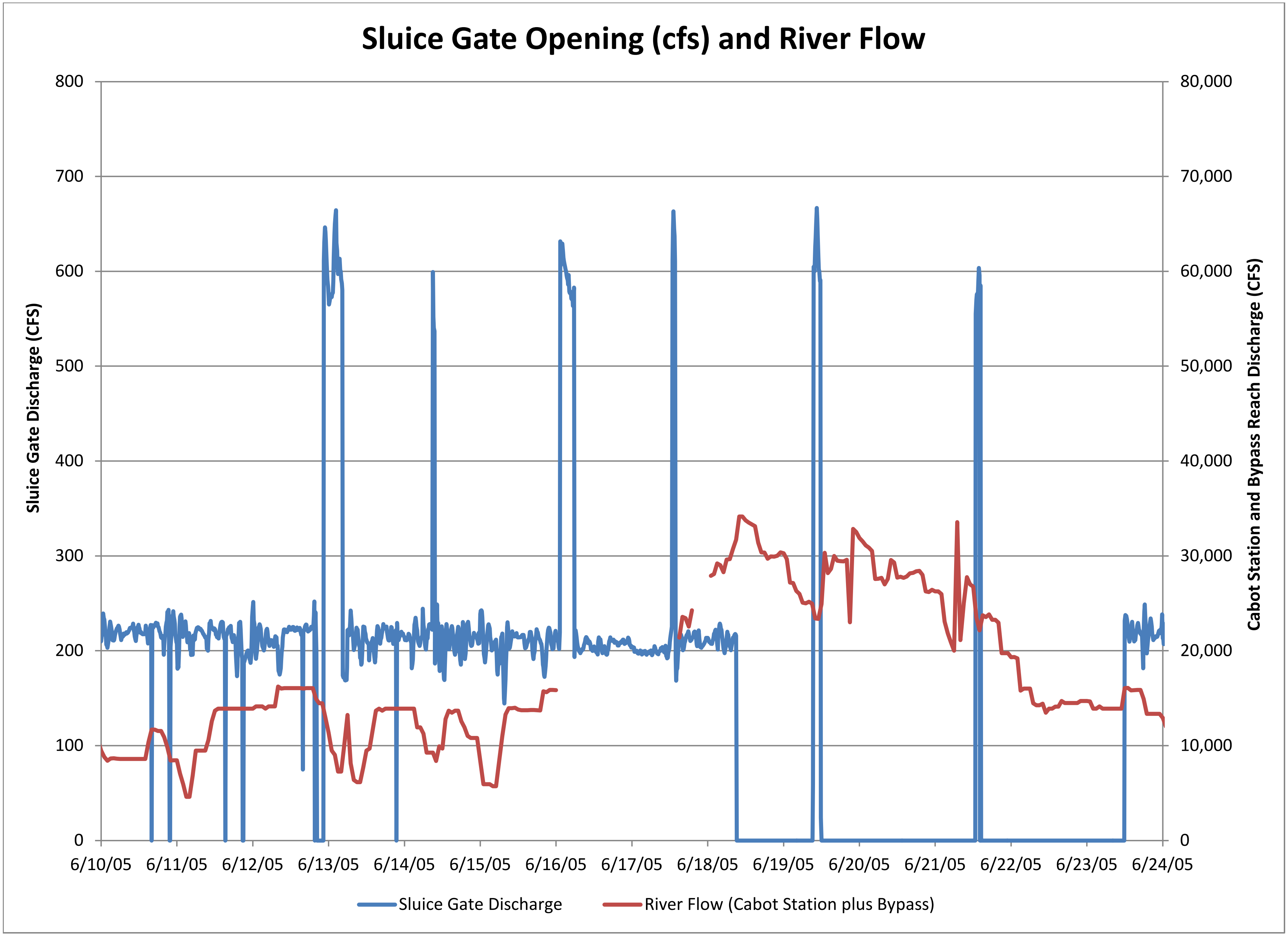

Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
800
700
600
500
400
300
200
100
0
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/29/05
4/30/05
5/1/05
5/2/05
5/3/05
5/4/05
5/5/05
5/6/05
5/7/05
5/8/05
5/9/05
5/10/05
5/11/05
5/12/05
5/13/05
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)

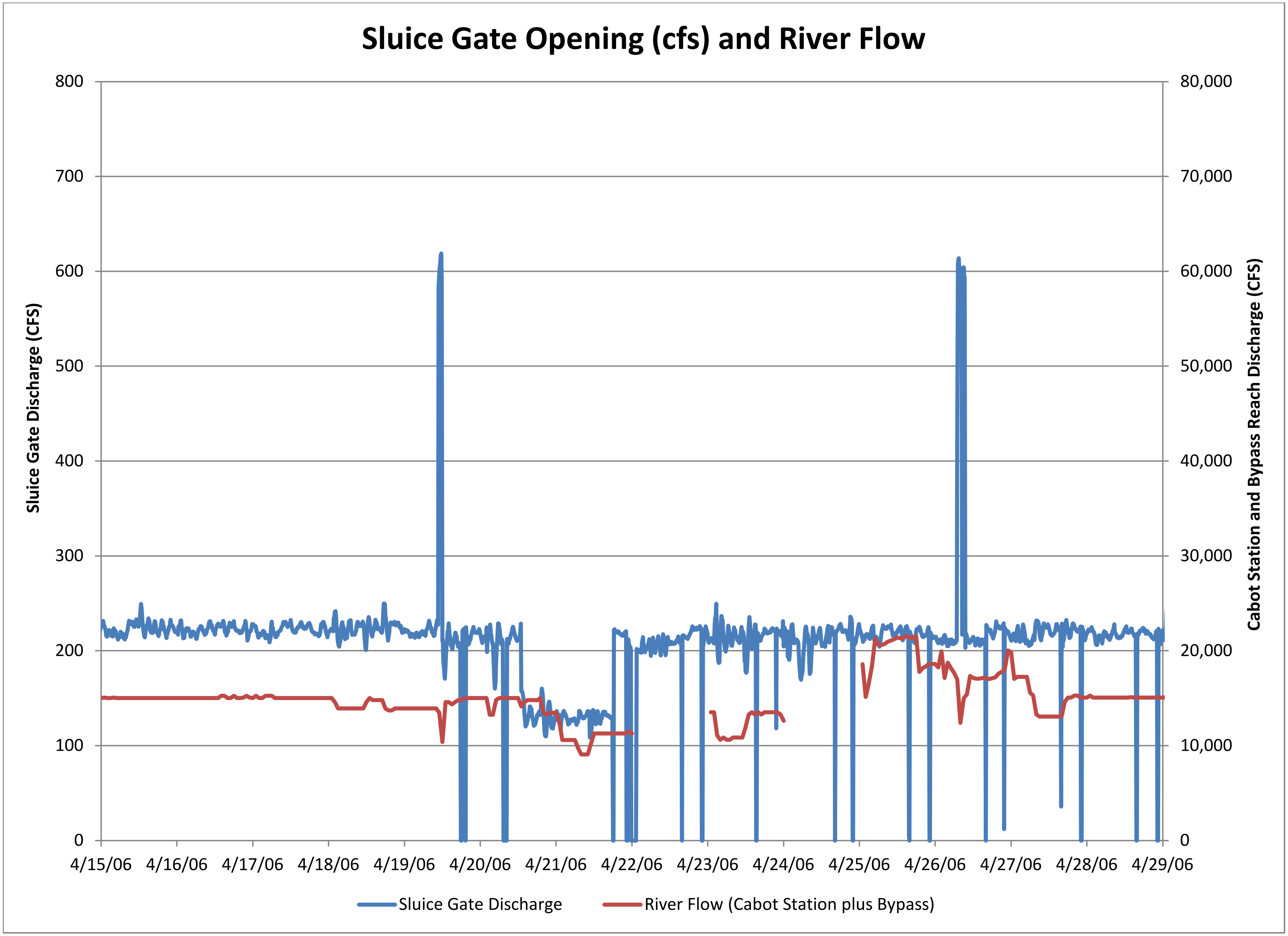


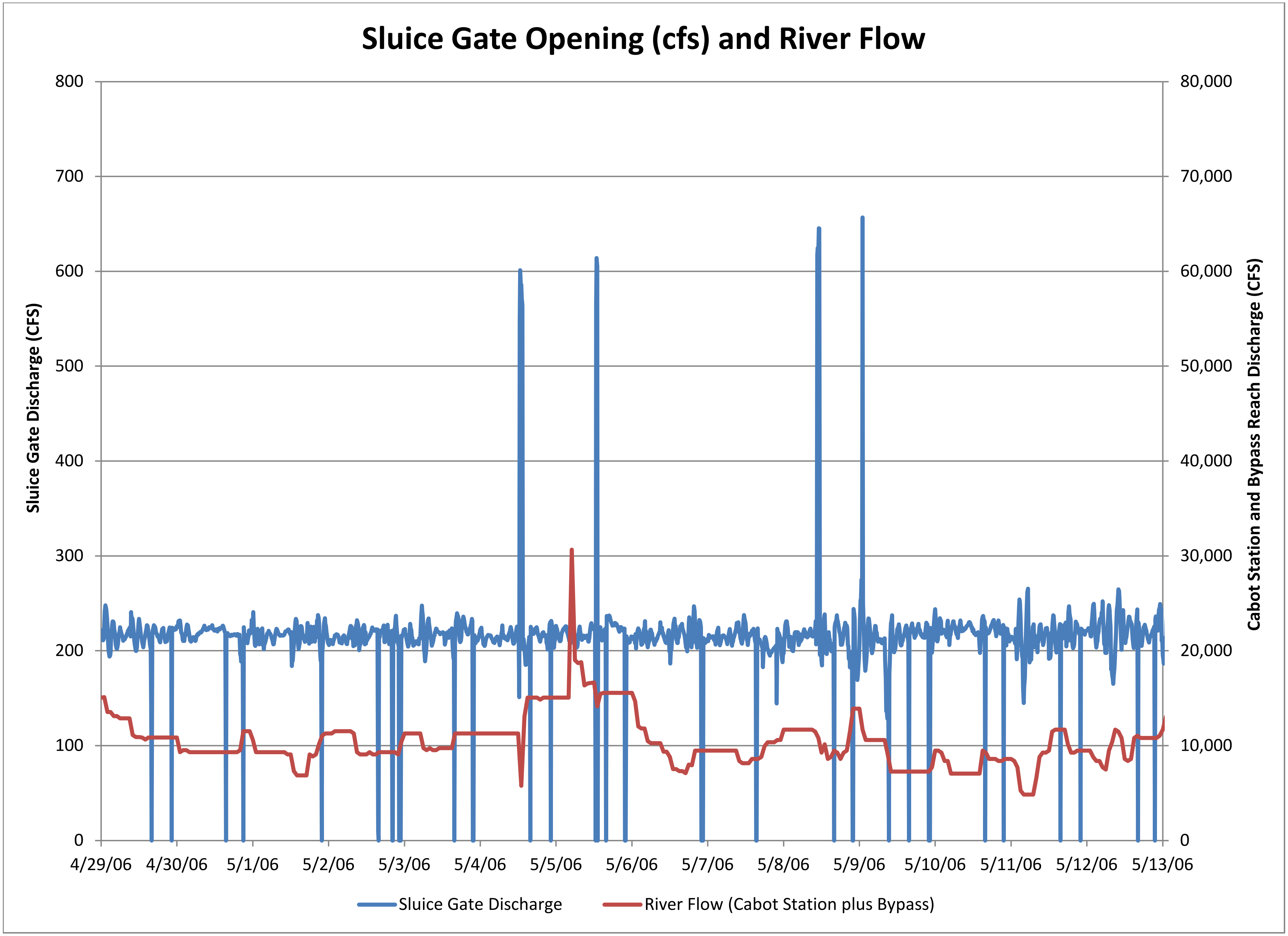
Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
800
700
600
500
400
300
200
100
0
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/13/05
5/14/05
5/15/05
5/16/05
5/17/05
5/18/05
5/19/05
5/20/05
5/21/05
5/22/05
5/23/05
5/24/05
5/25/05
5/26/05
5/27/05
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)

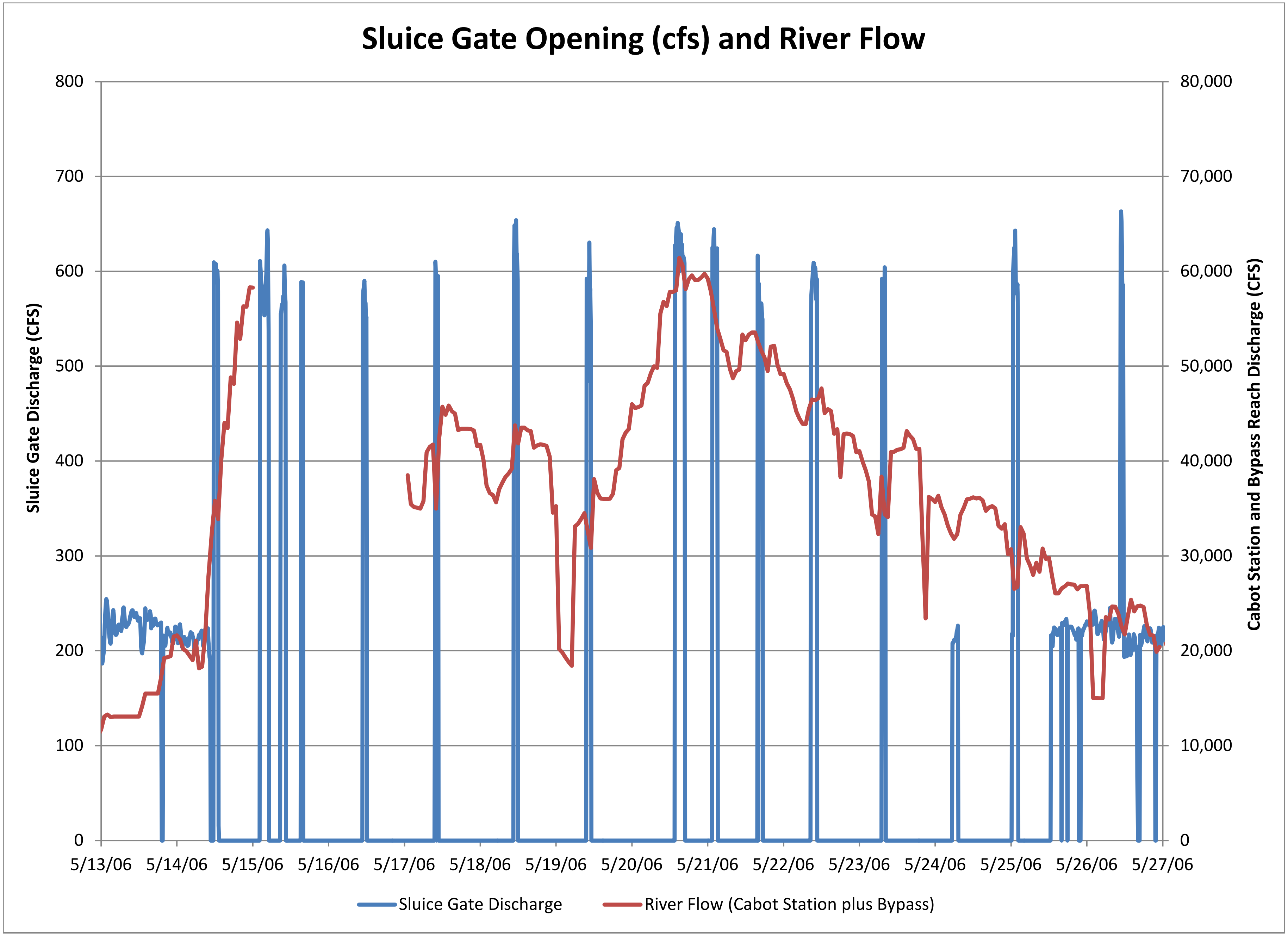
Document Accession #: 20140916-5028   Filed Date: 09/16/2014

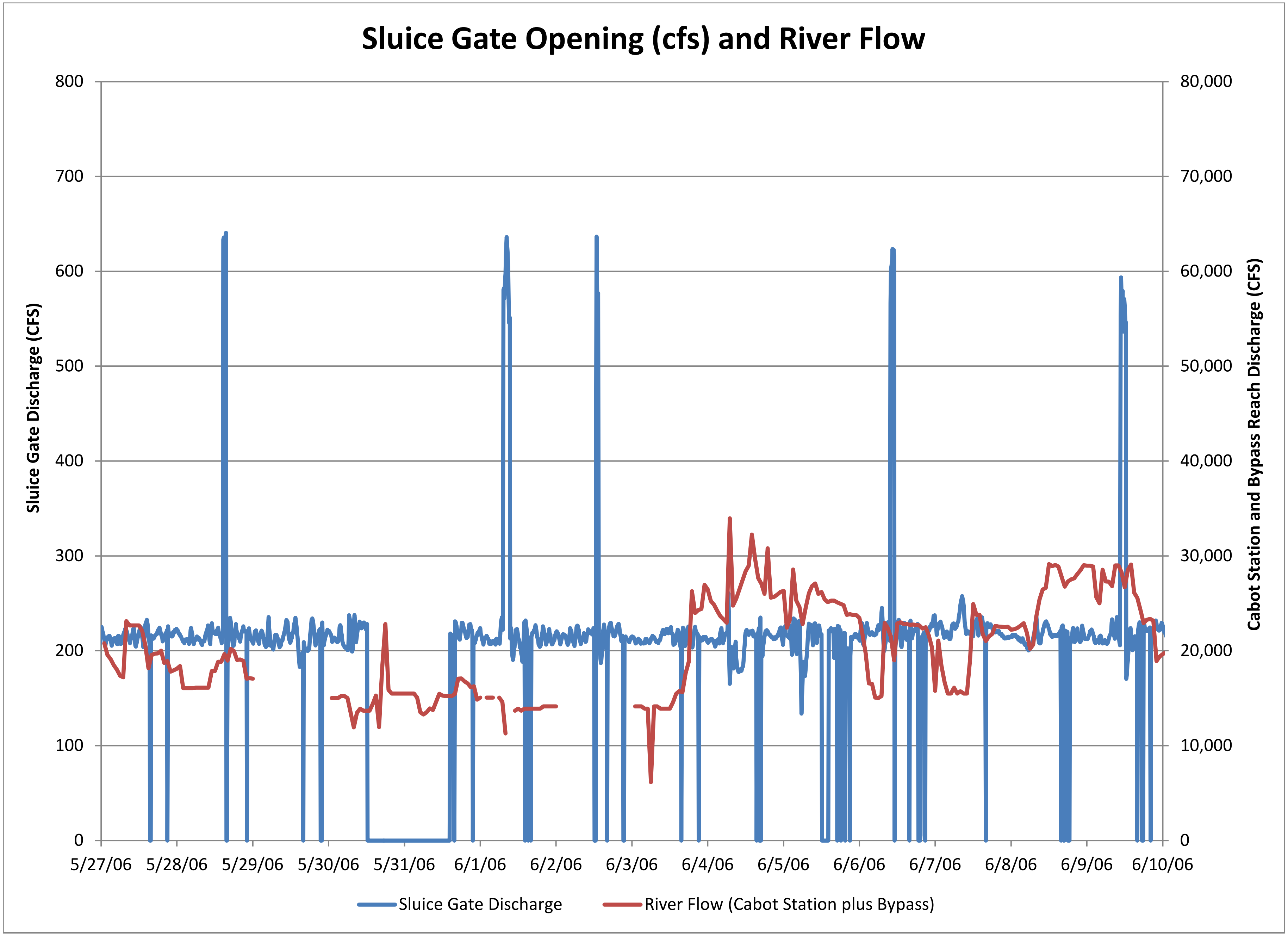


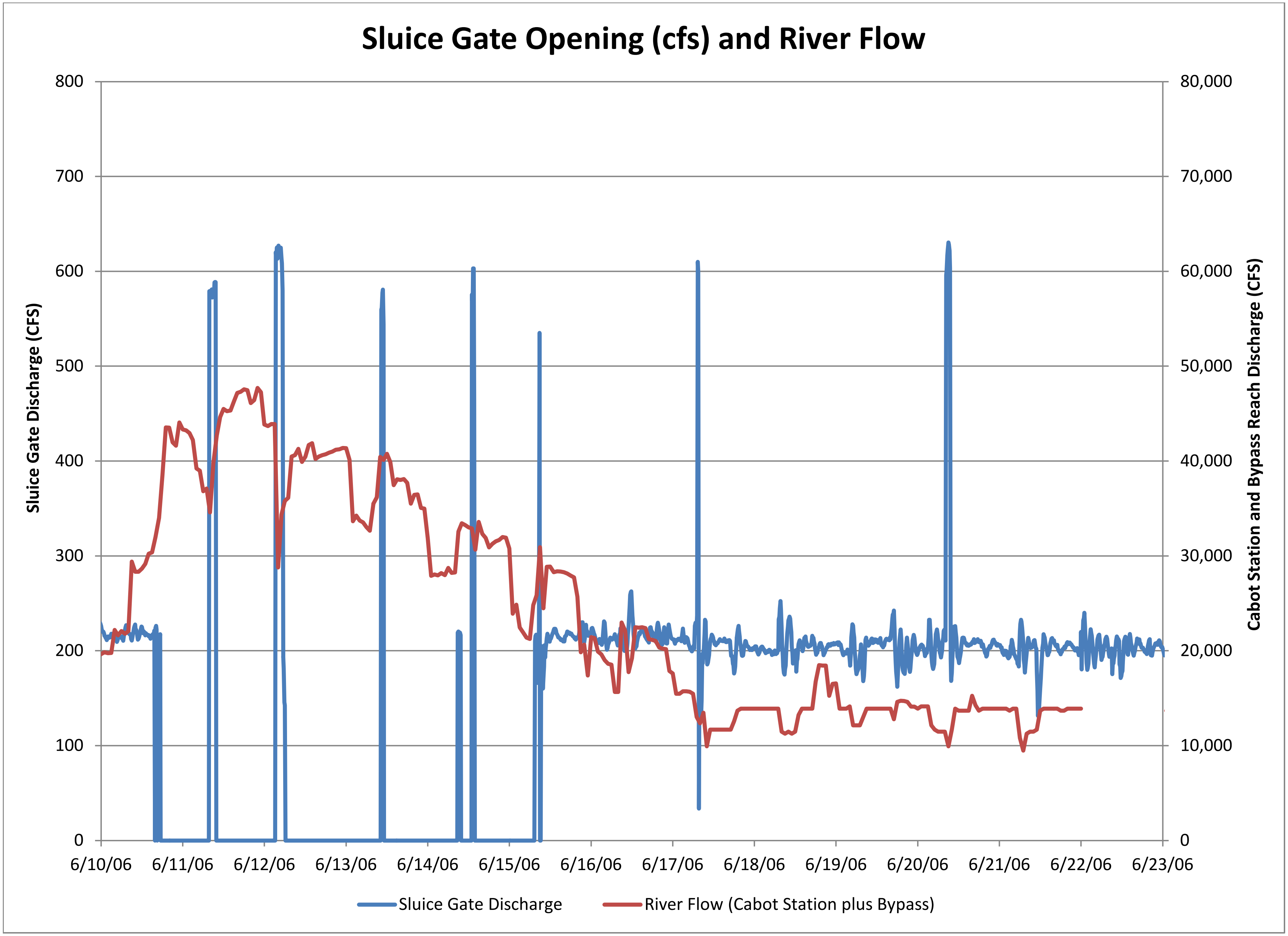

Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
0
100
200
300
400
500
600
700
800
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
6/10/05
6/11/05
6/12/05
6/13/05
6/14/05
6/15/05
6/16/05
6/17/05
6/18/05
6/19/05
6/20/05
6/21/05
6/22/05
6/23/05
6/24/05
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
800
700
600
500
400
300
200
100
0
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/15/06
4/16/06
4/17/06
4/18/06
4/19/06
4/20/06
4/21/06
4/22/06
4/23/06
4/24/06
4/25/06
4/26/06
4/27/06
4/28/06
4/29/06
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
800
700
600
500
400
300
200
100
0
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
4/29/06
4/30/06
5/1/06
5/2/06
5/3/06
5/4/06
5/5/06
5/6/06
5/7/06
5/8/06
5/9/06
5/10/06
5/11/06
5/12/06
5/13/06
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
800
700
600
500
400
300
200
100
0
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/13/06
5/14/06
5/15/06
5/16/06
5/17/06
5/18/06
5/19/06
5/20/06
5/21/06
5/22/06
5/23/06
5/24/06
5/25/06
5/26/06
5/27/06
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
800
700
600
500
400
300
200
100
0
Cabot Station and Bypass Reach Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
5/27/06
5/28/06
5/29/06
5/30/06
5/31/06
6/1/06
6/2/06
6/3/06
6/4/06
6/5/06
6/6/06
6/7/06
6/8/06
6/9/06
6/10/06
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
800
700
600
500
400
300
200
100
0
Cabot Station and Bypass Reach Discharge (CFS)
80,000
70,000
60,000
50,000
40,000
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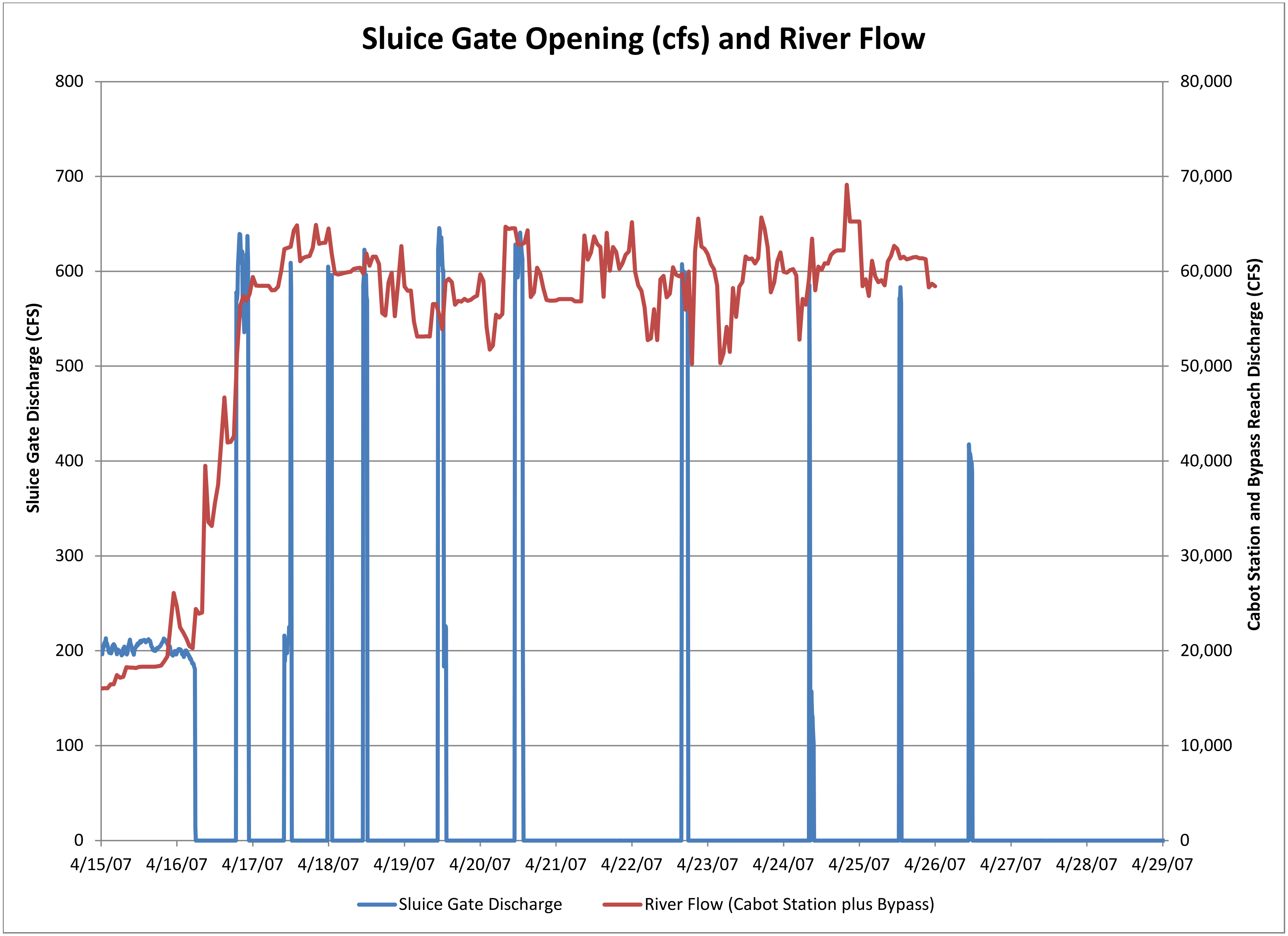
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
800
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80,000
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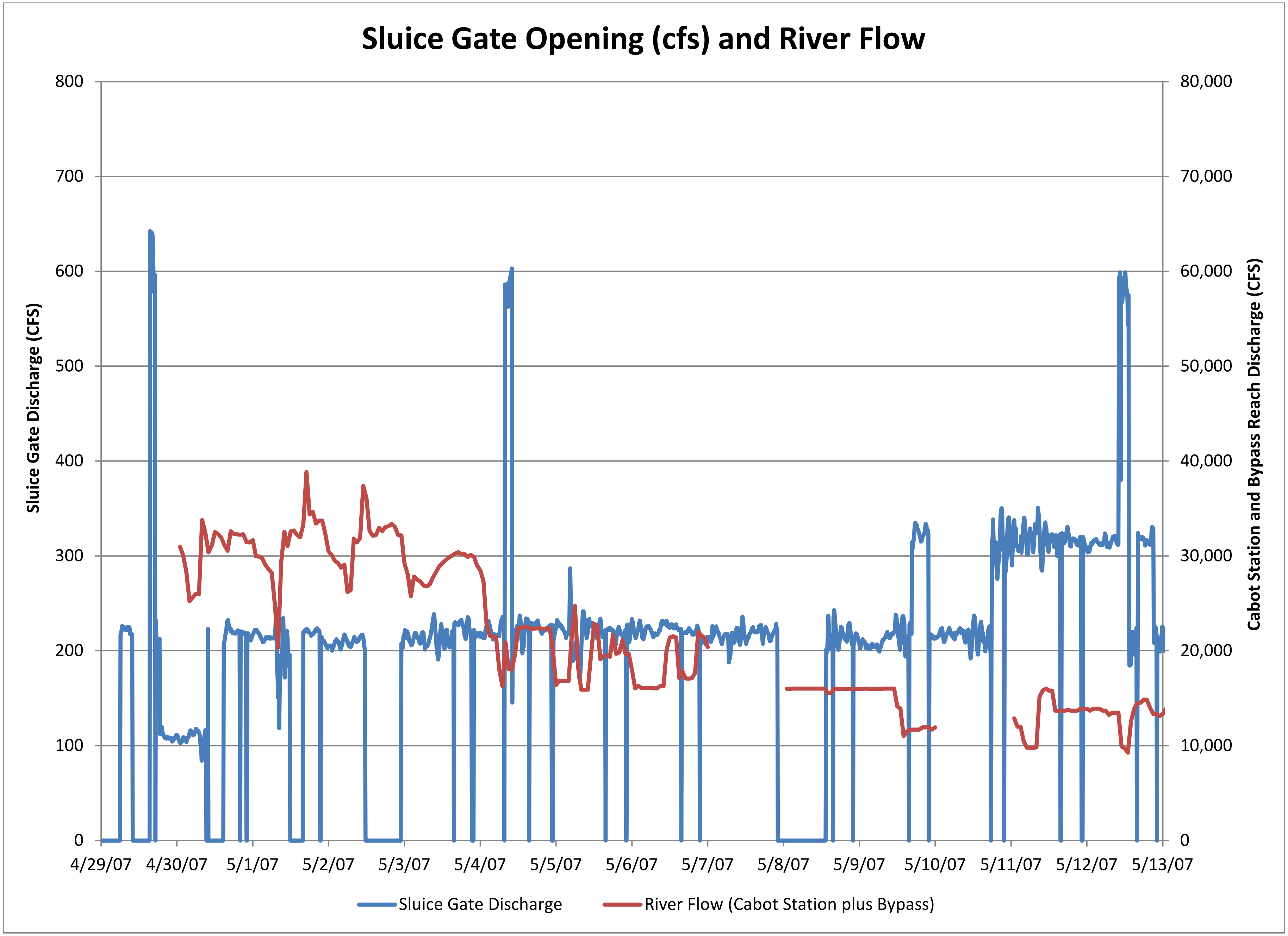
4/29/07
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)



Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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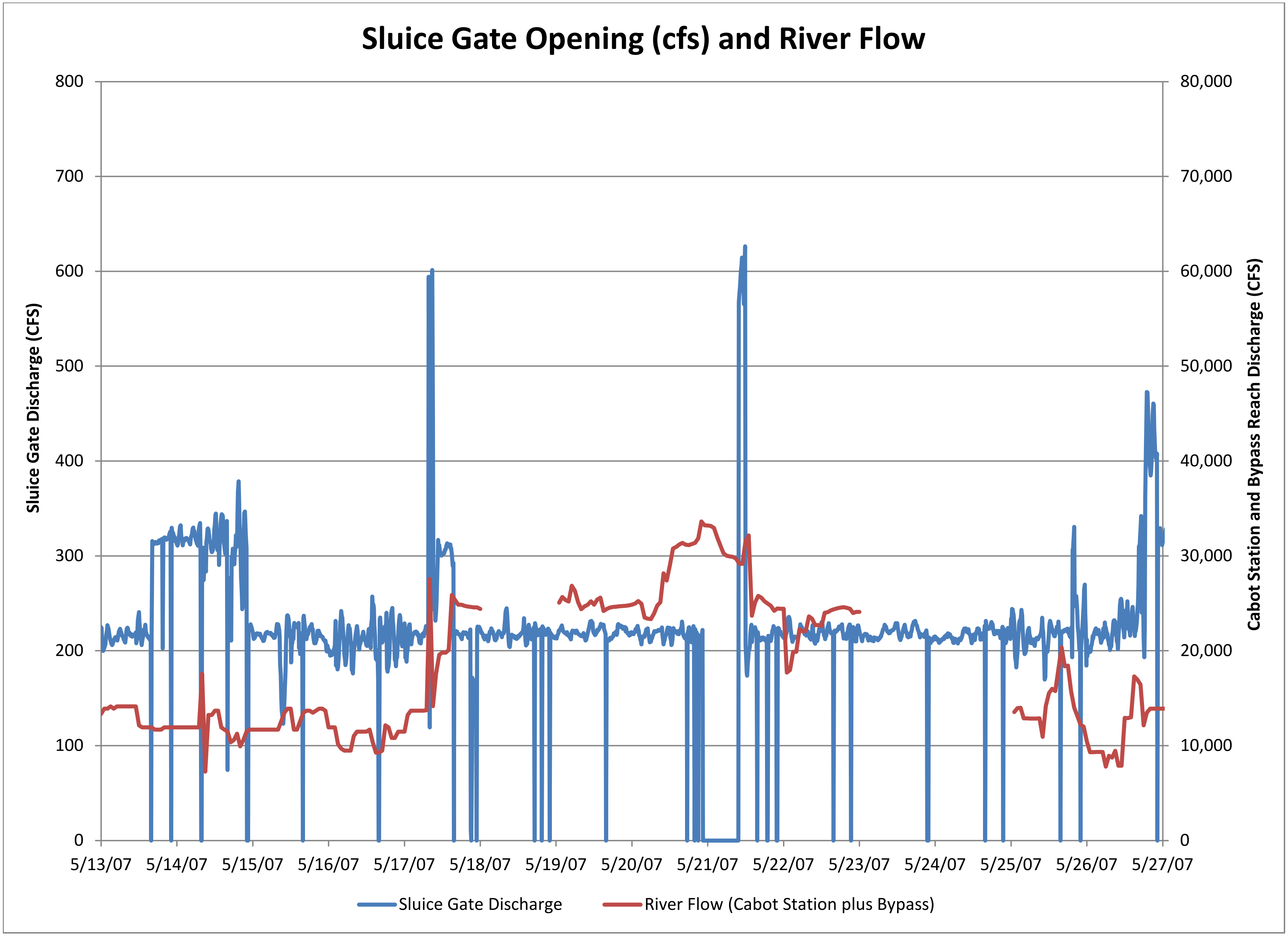
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
800
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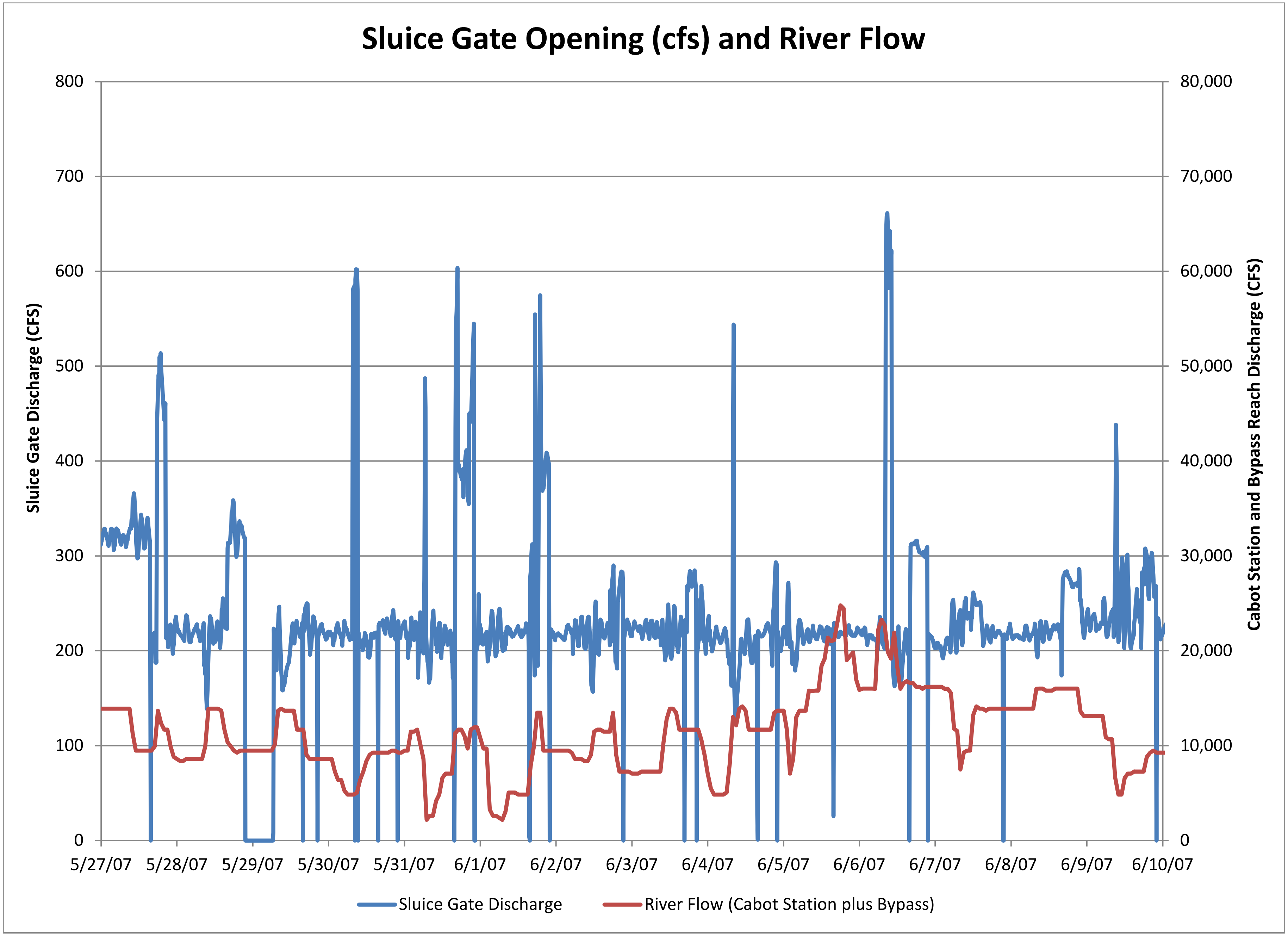
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
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Cabot Station and Bypass Reach Discharge (CFS)
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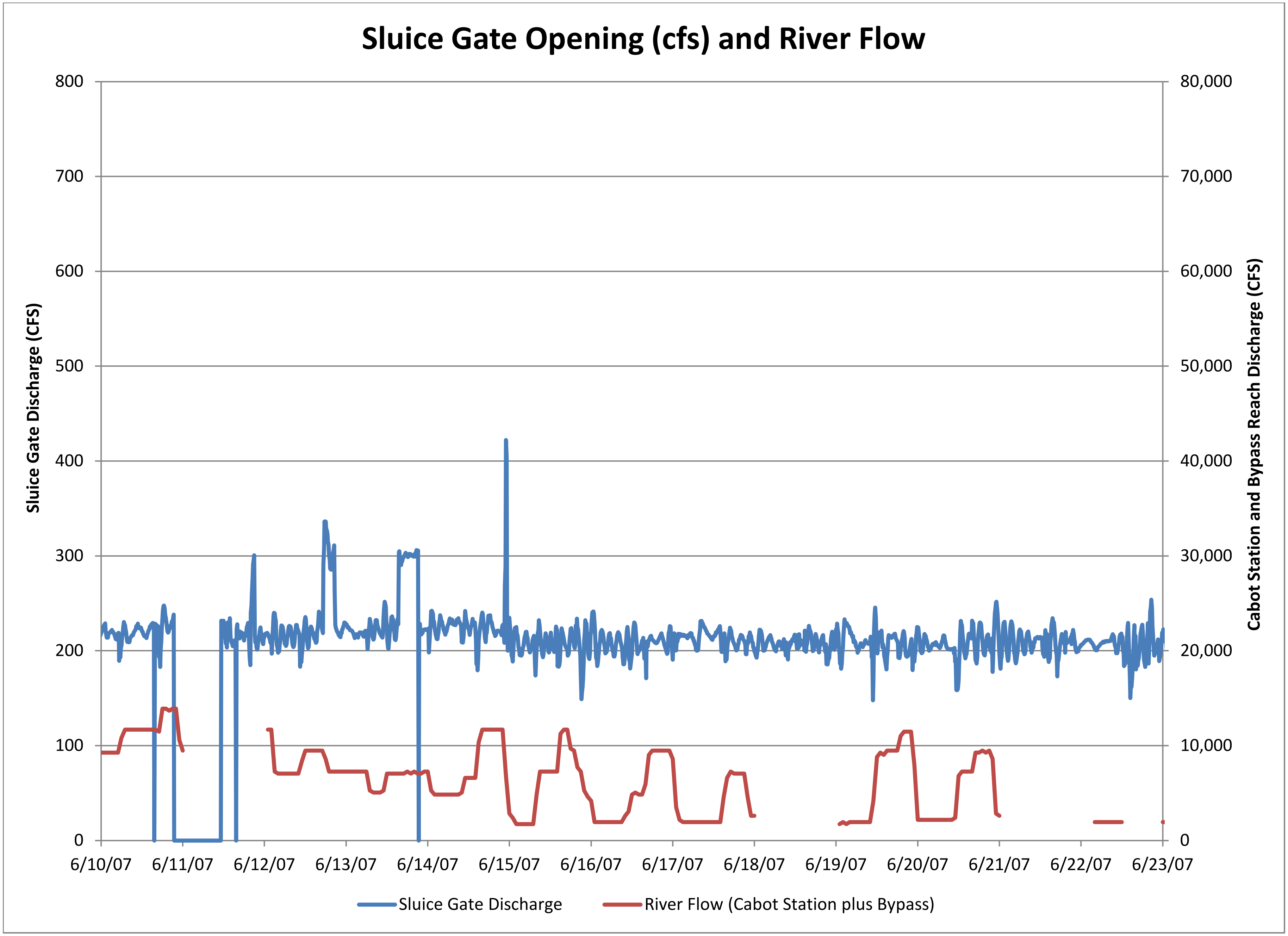
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)



Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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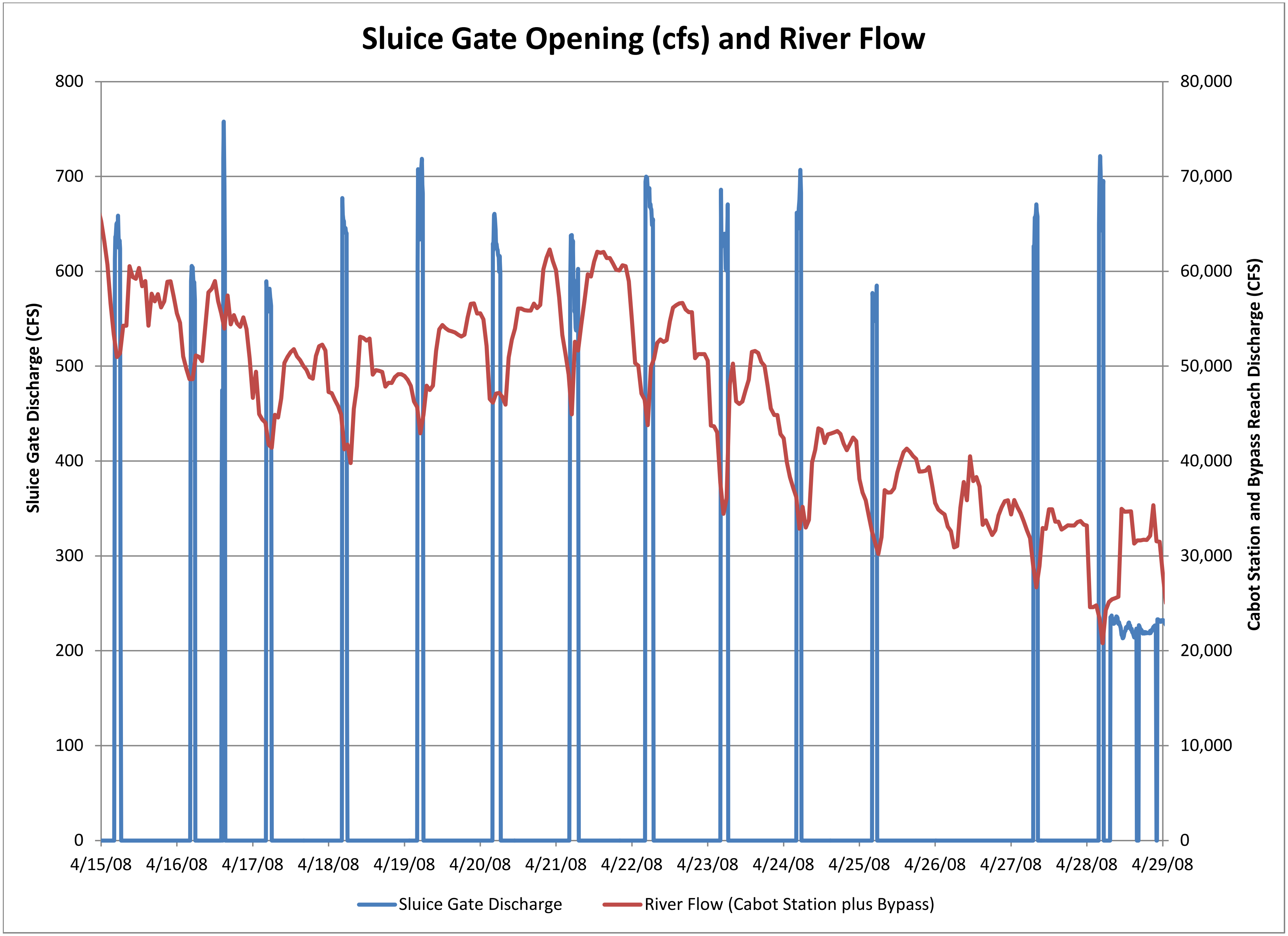
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)



Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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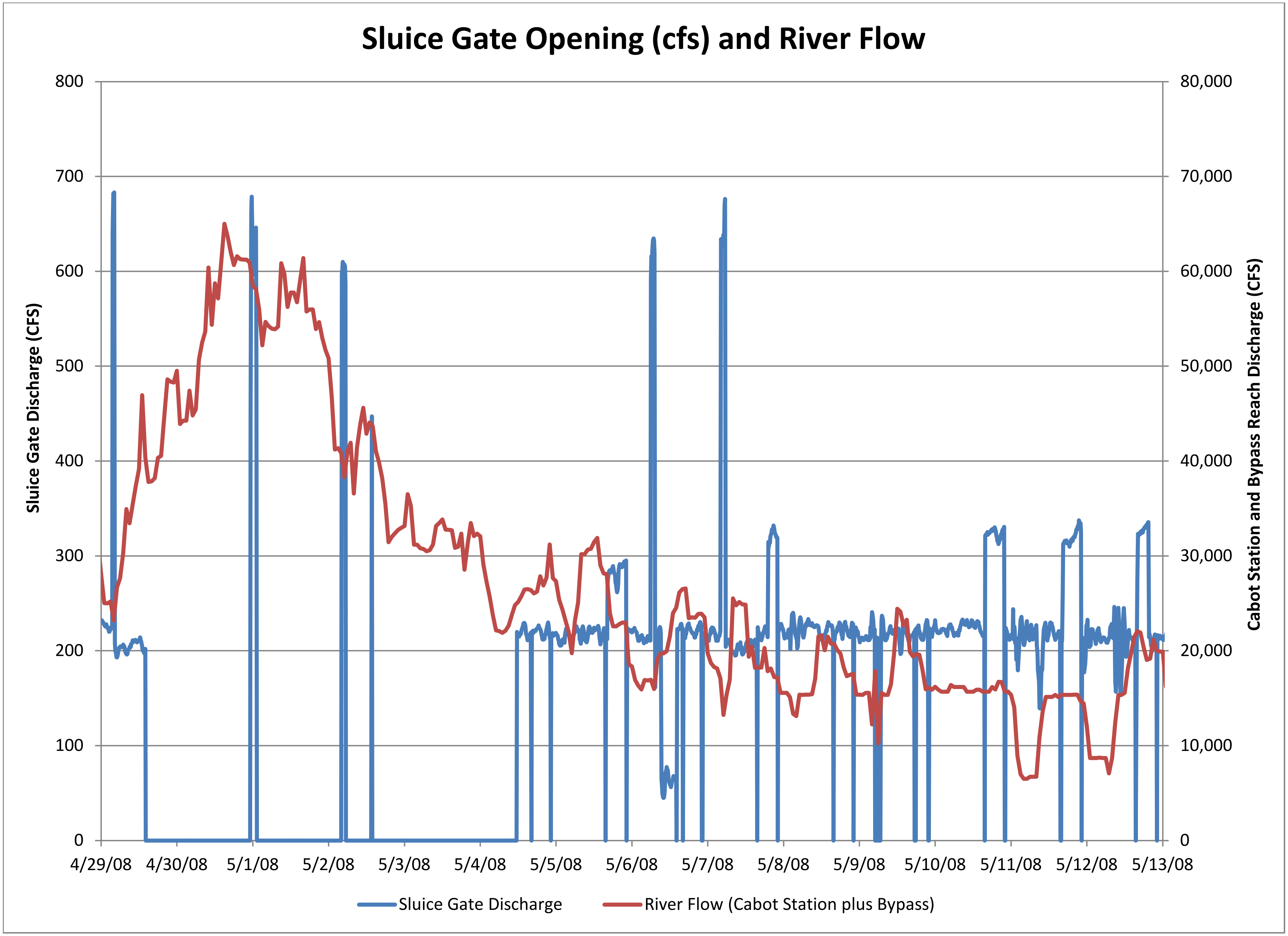
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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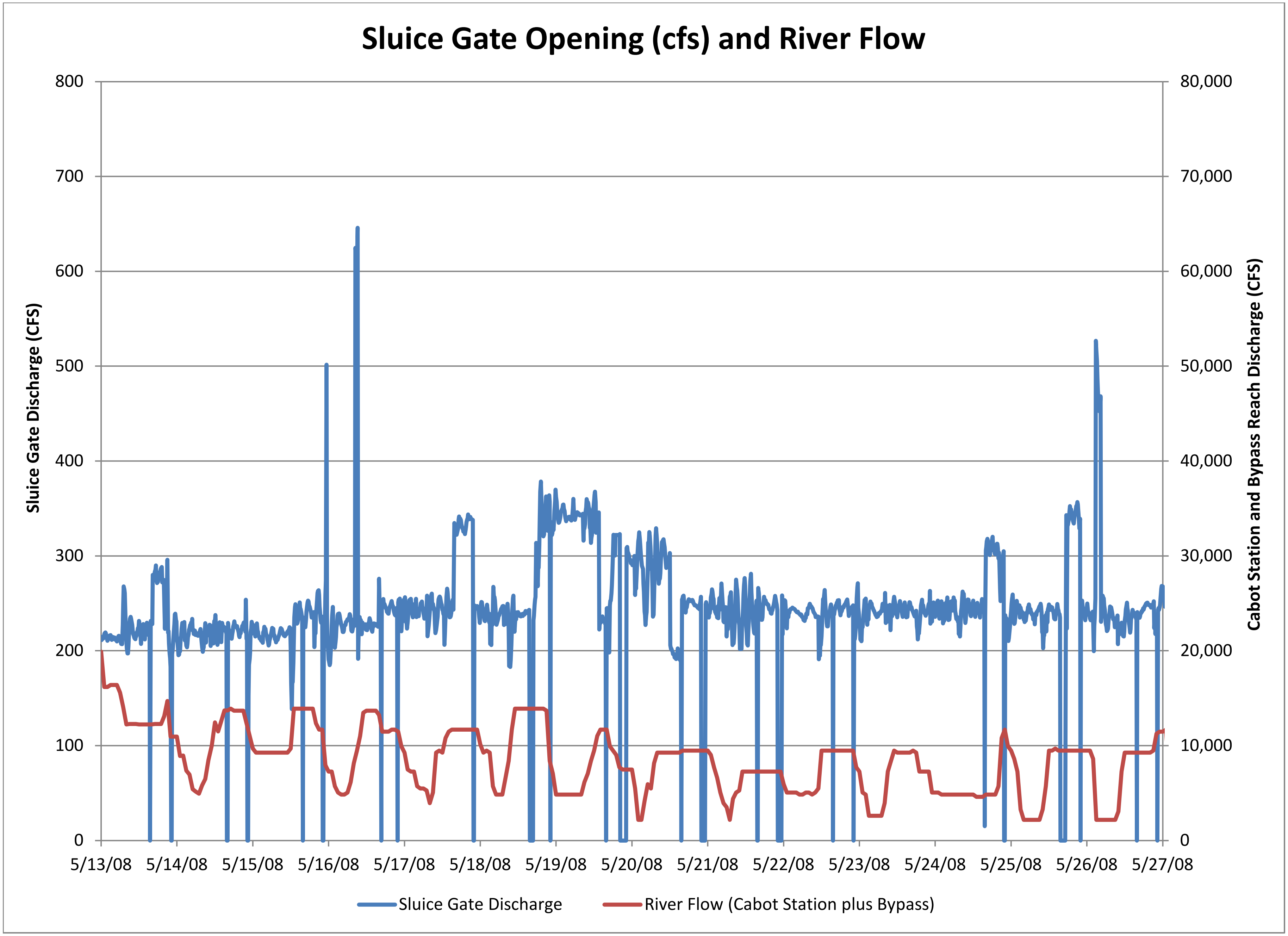
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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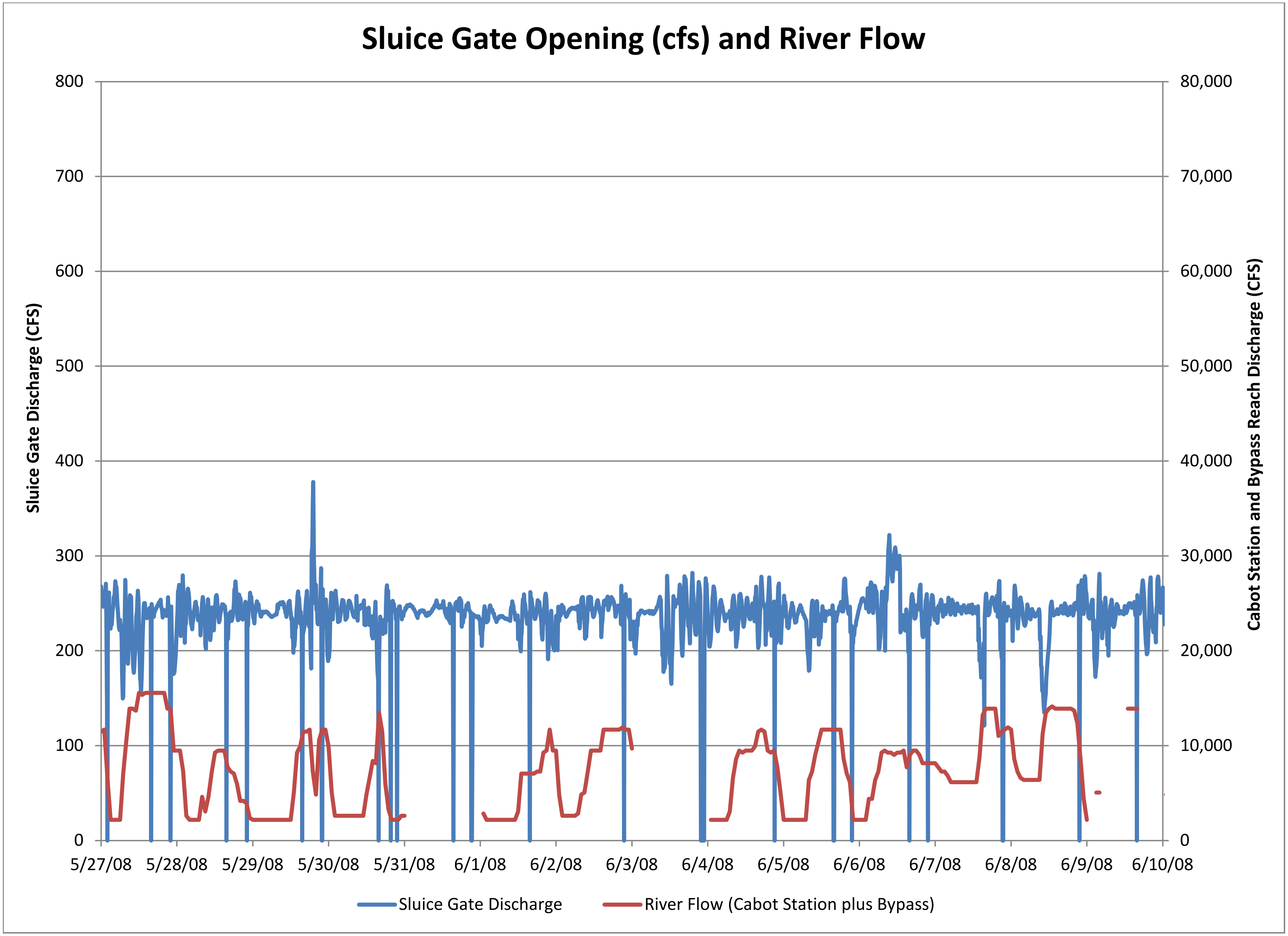
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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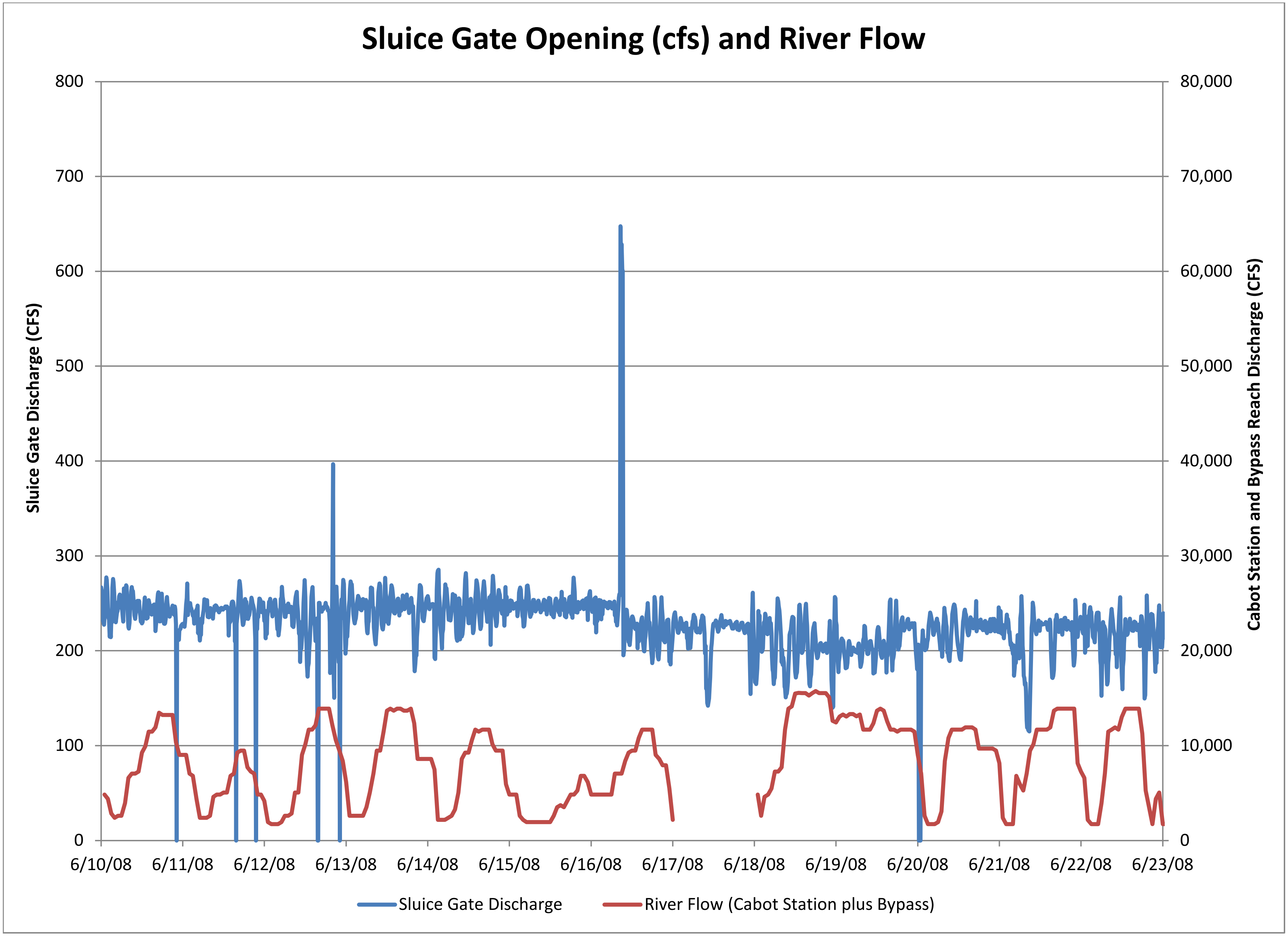
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)



Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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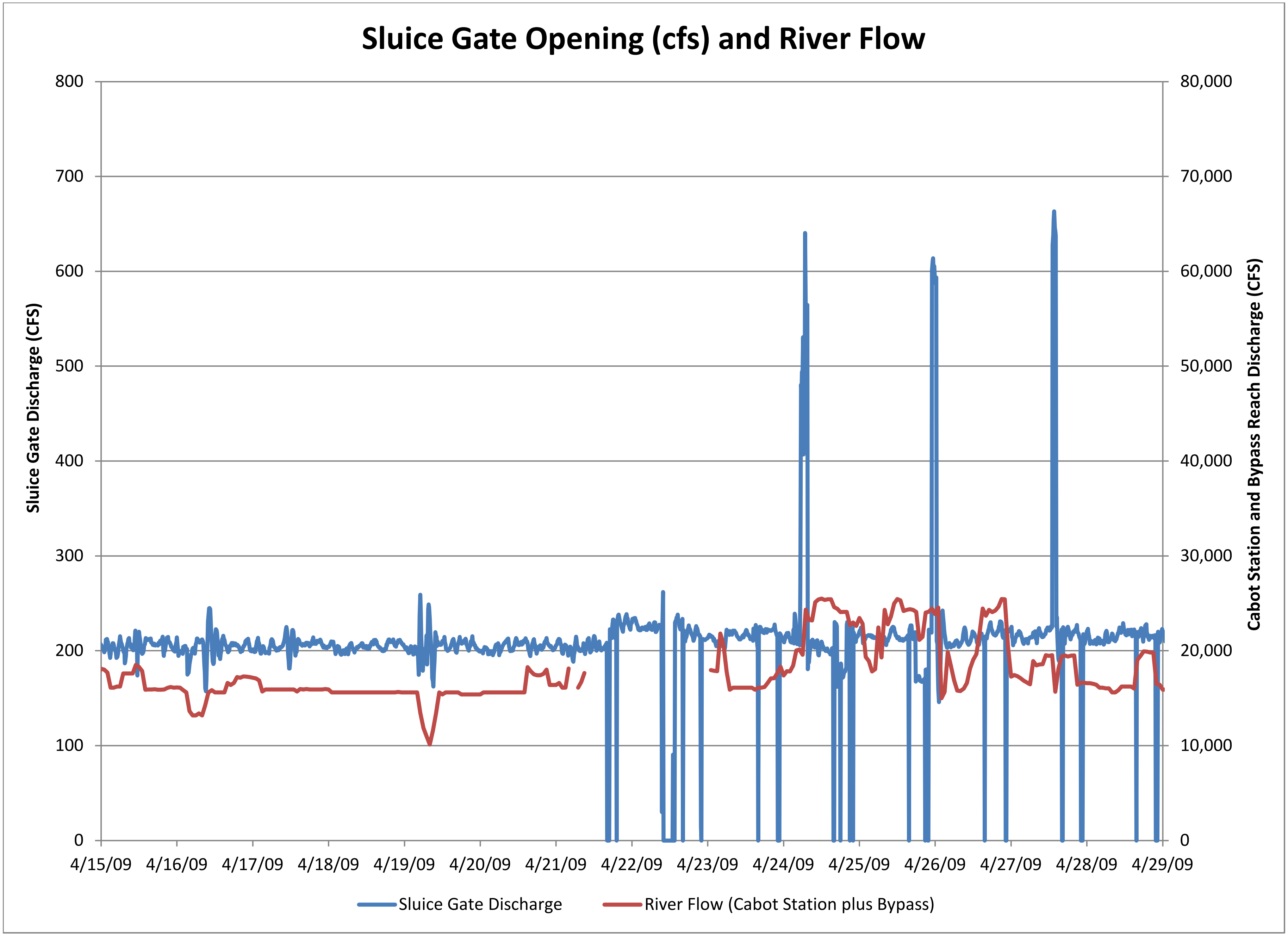
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)



Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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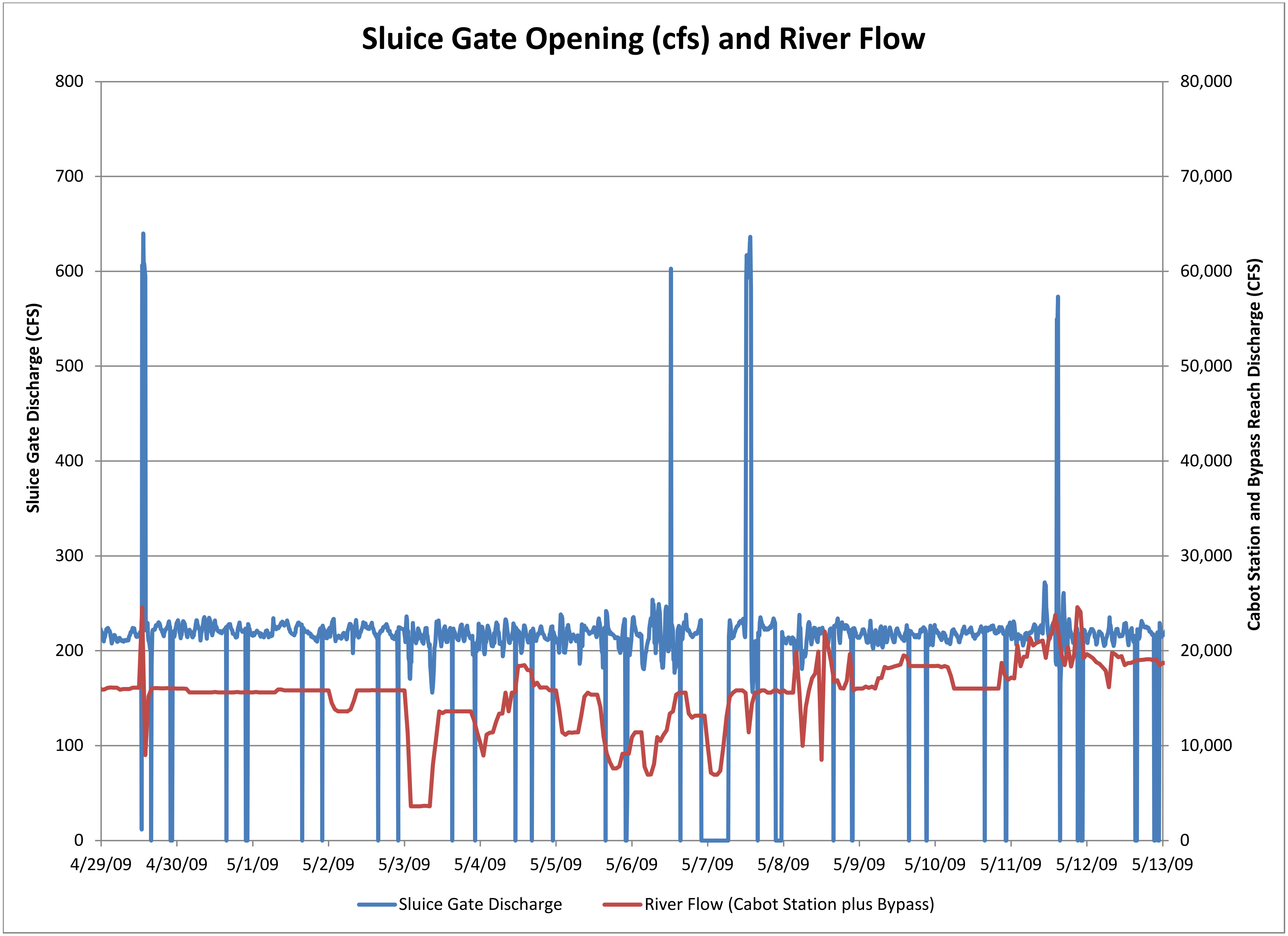
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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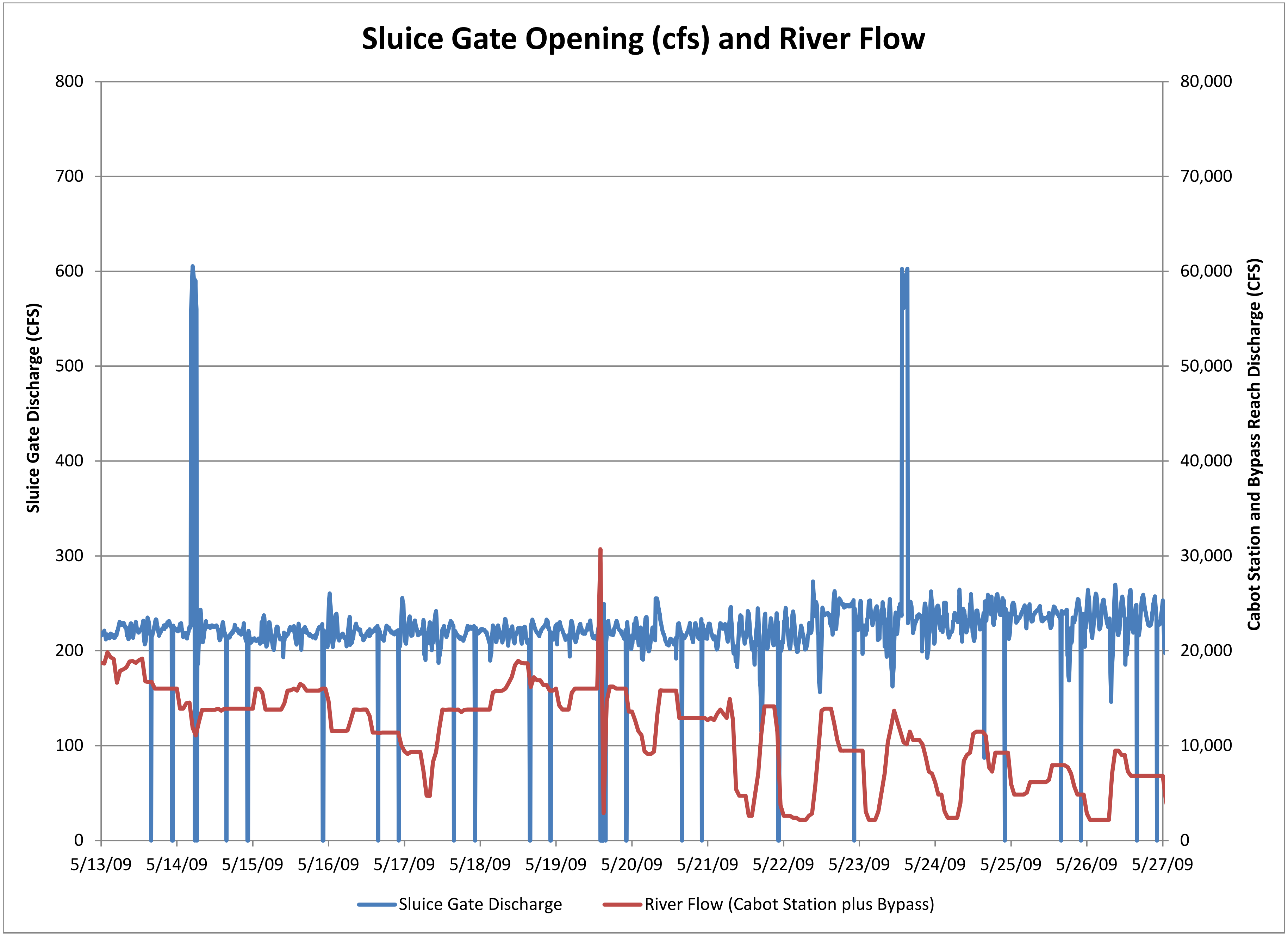
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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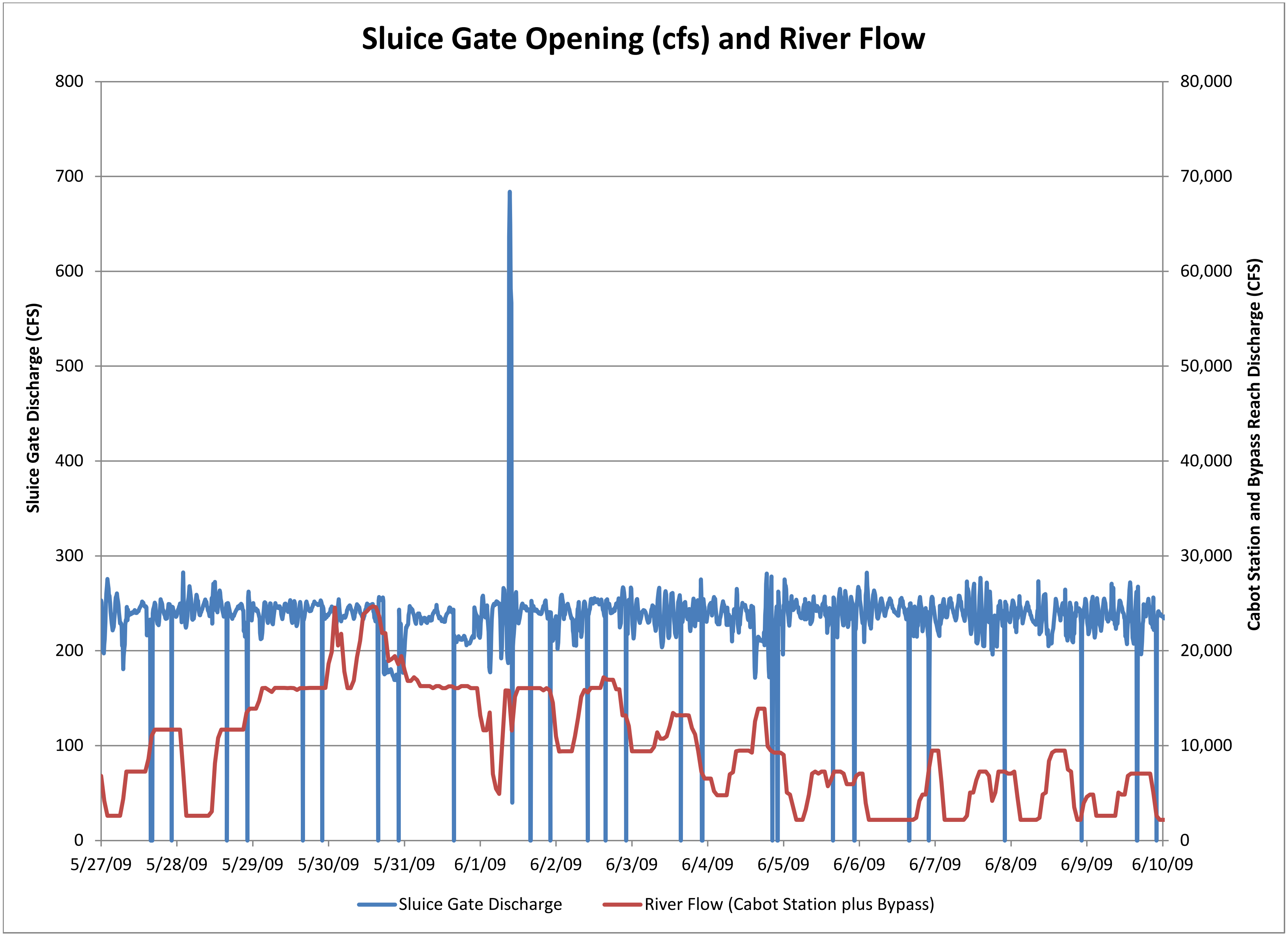
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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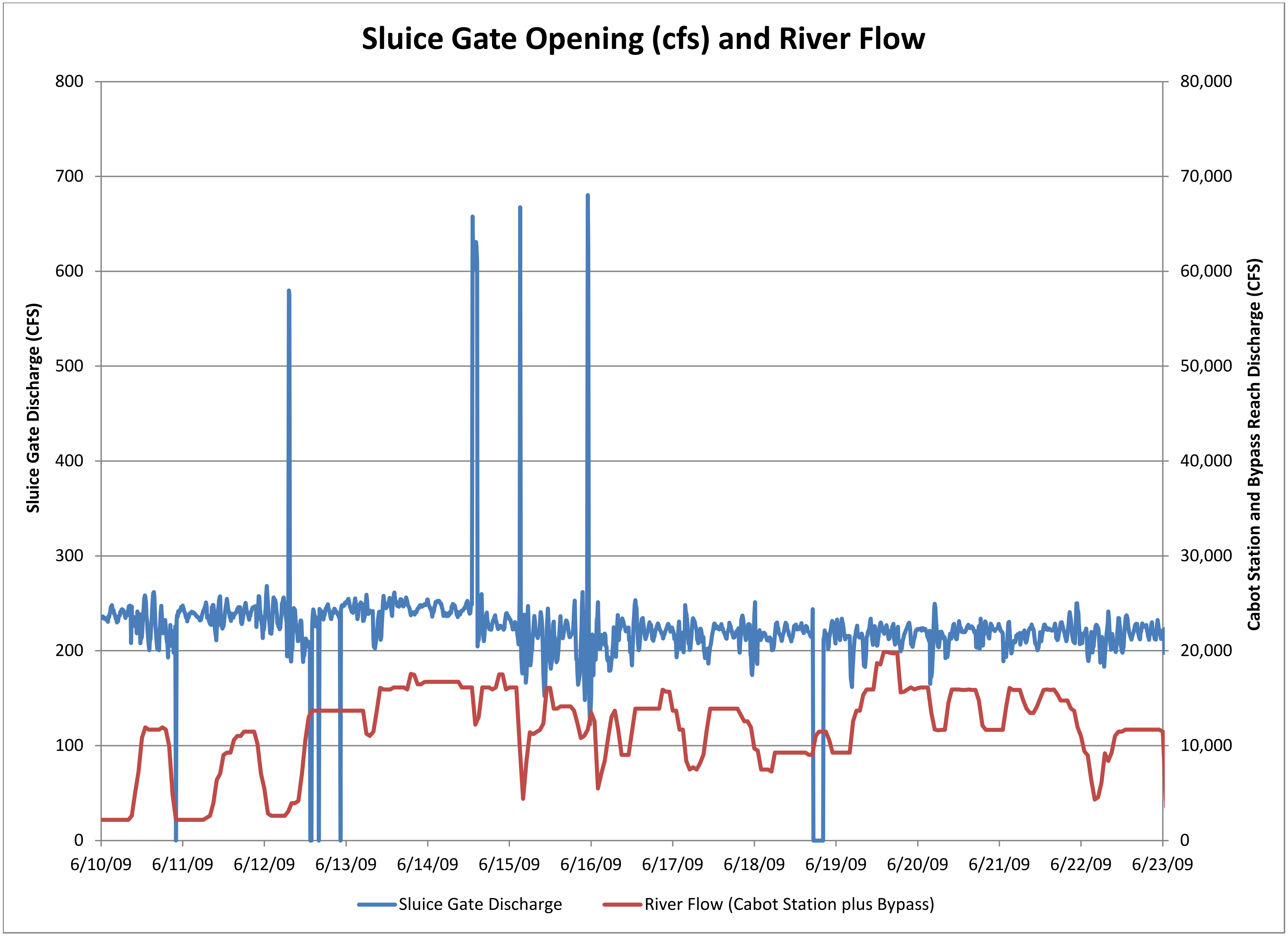
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)



Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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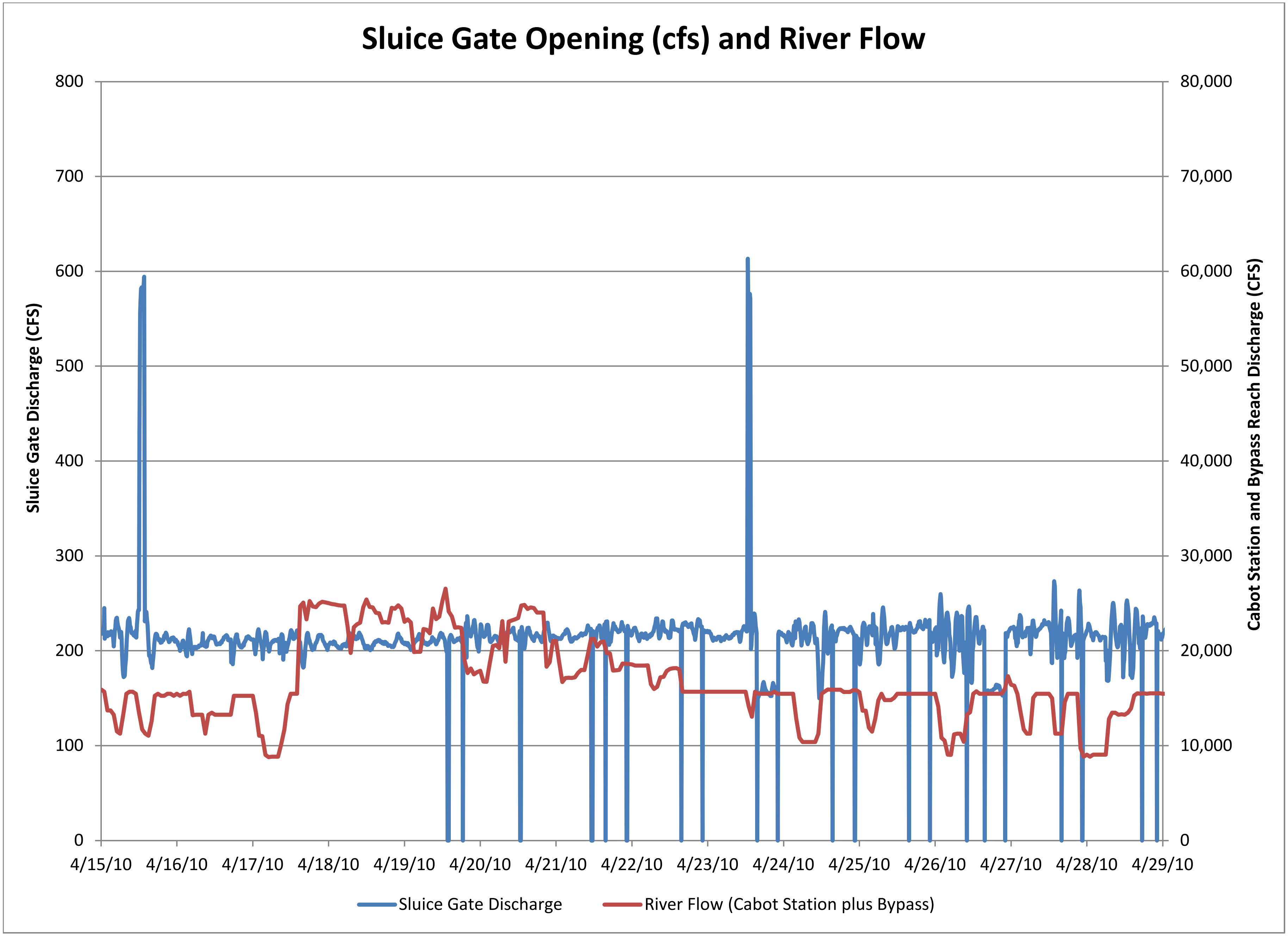
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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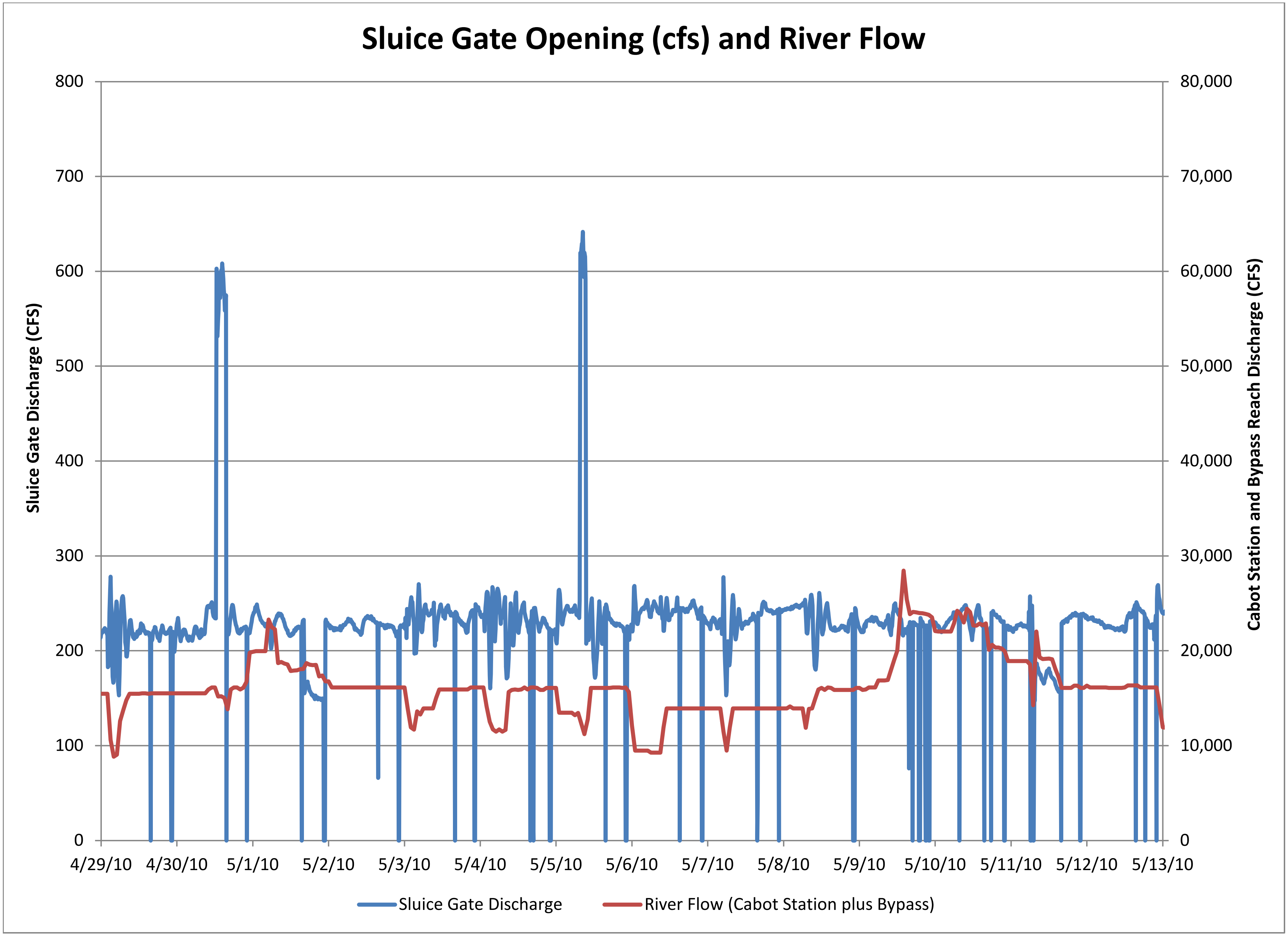
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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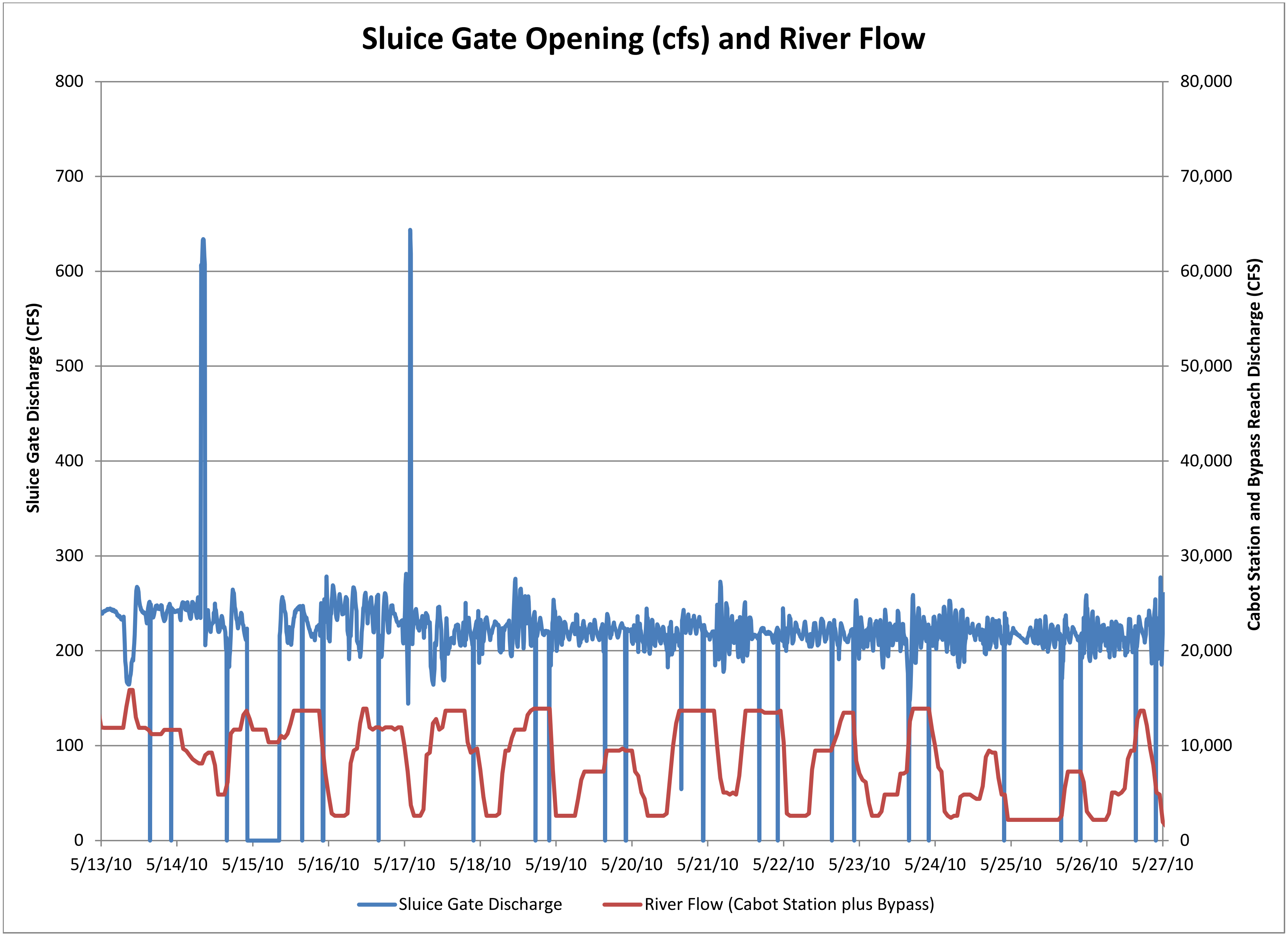
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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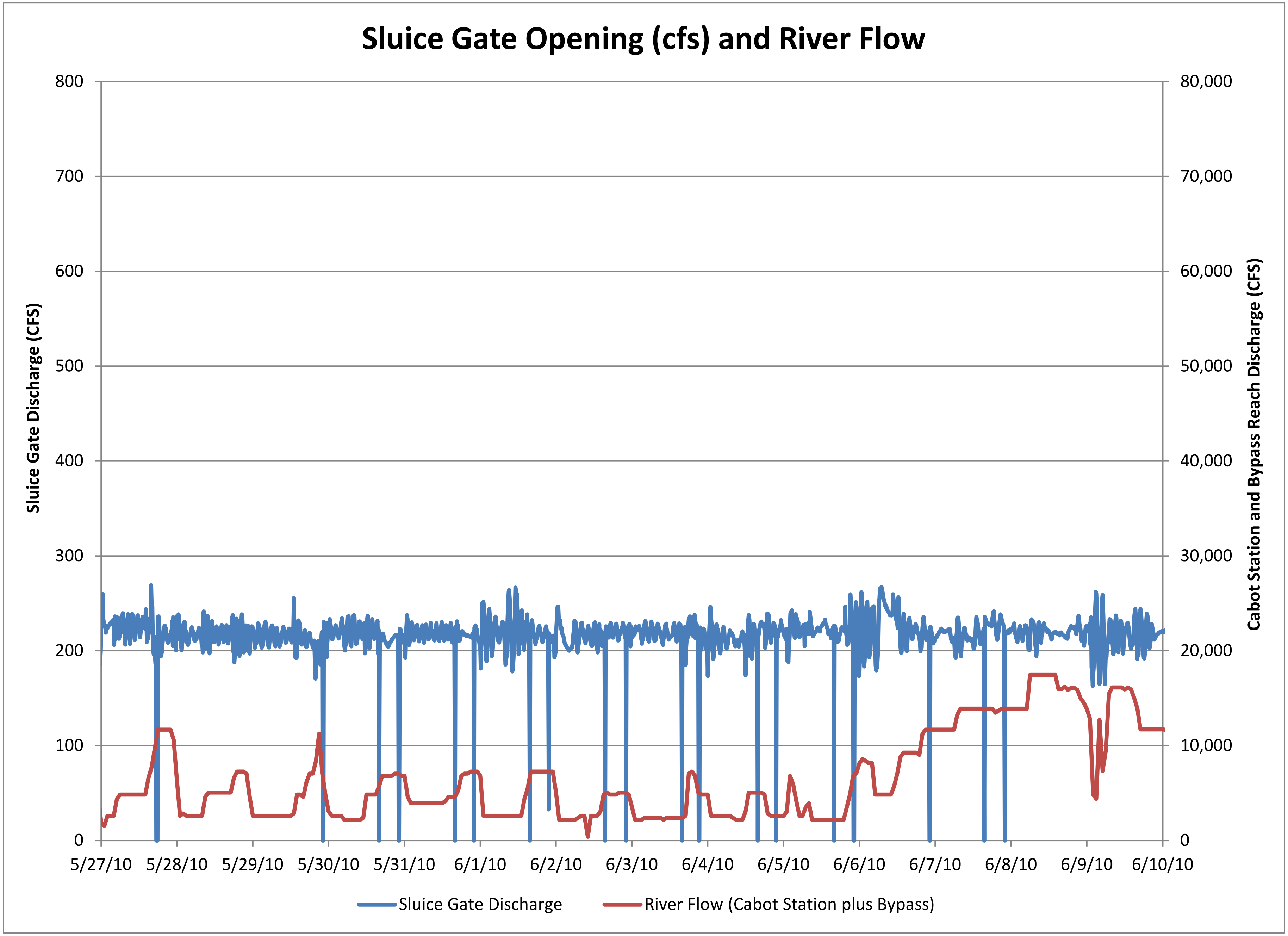
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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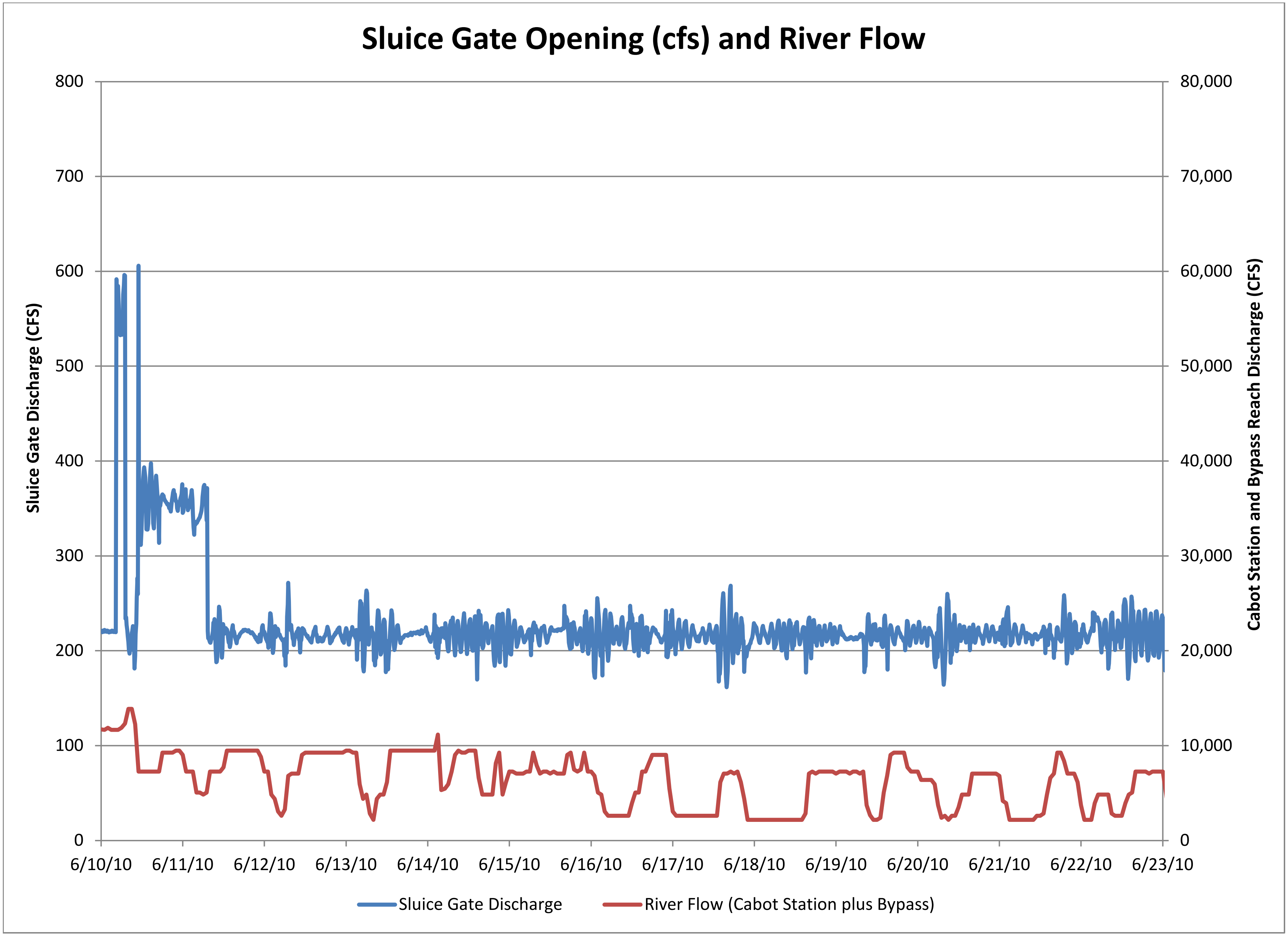
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
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Cabot Station and Bypass Reach Discharge (CFS)
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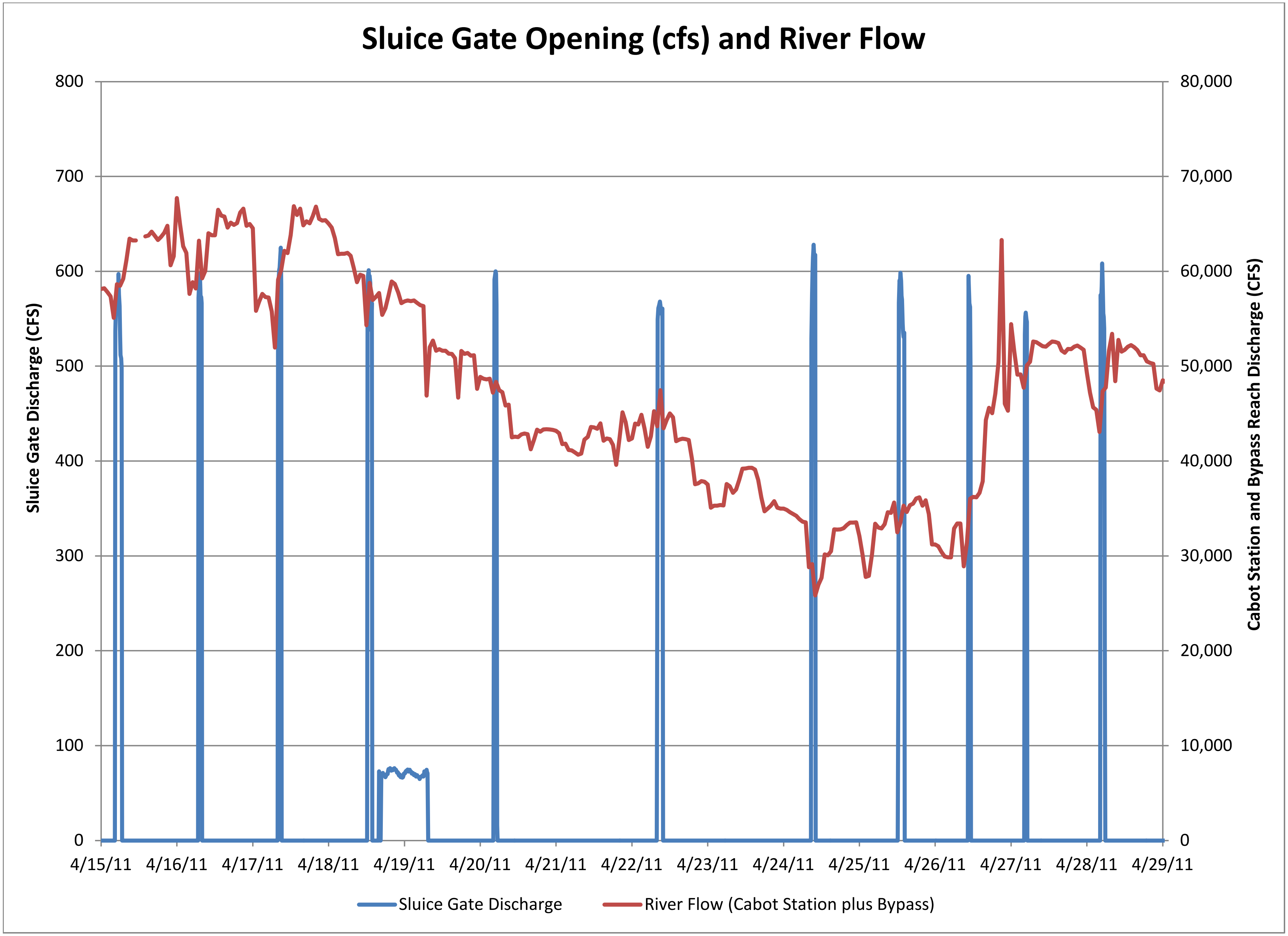
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)



Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)

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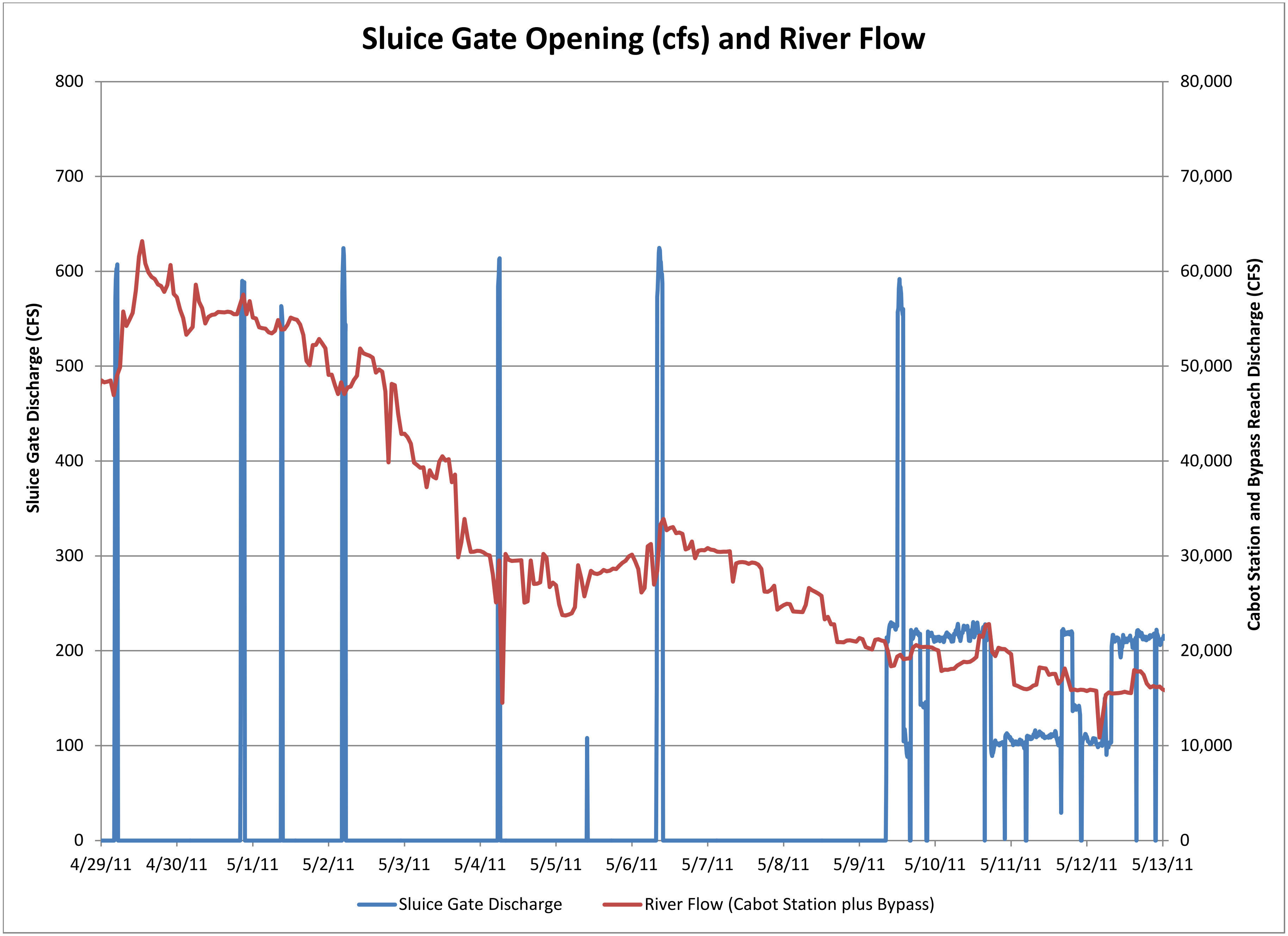

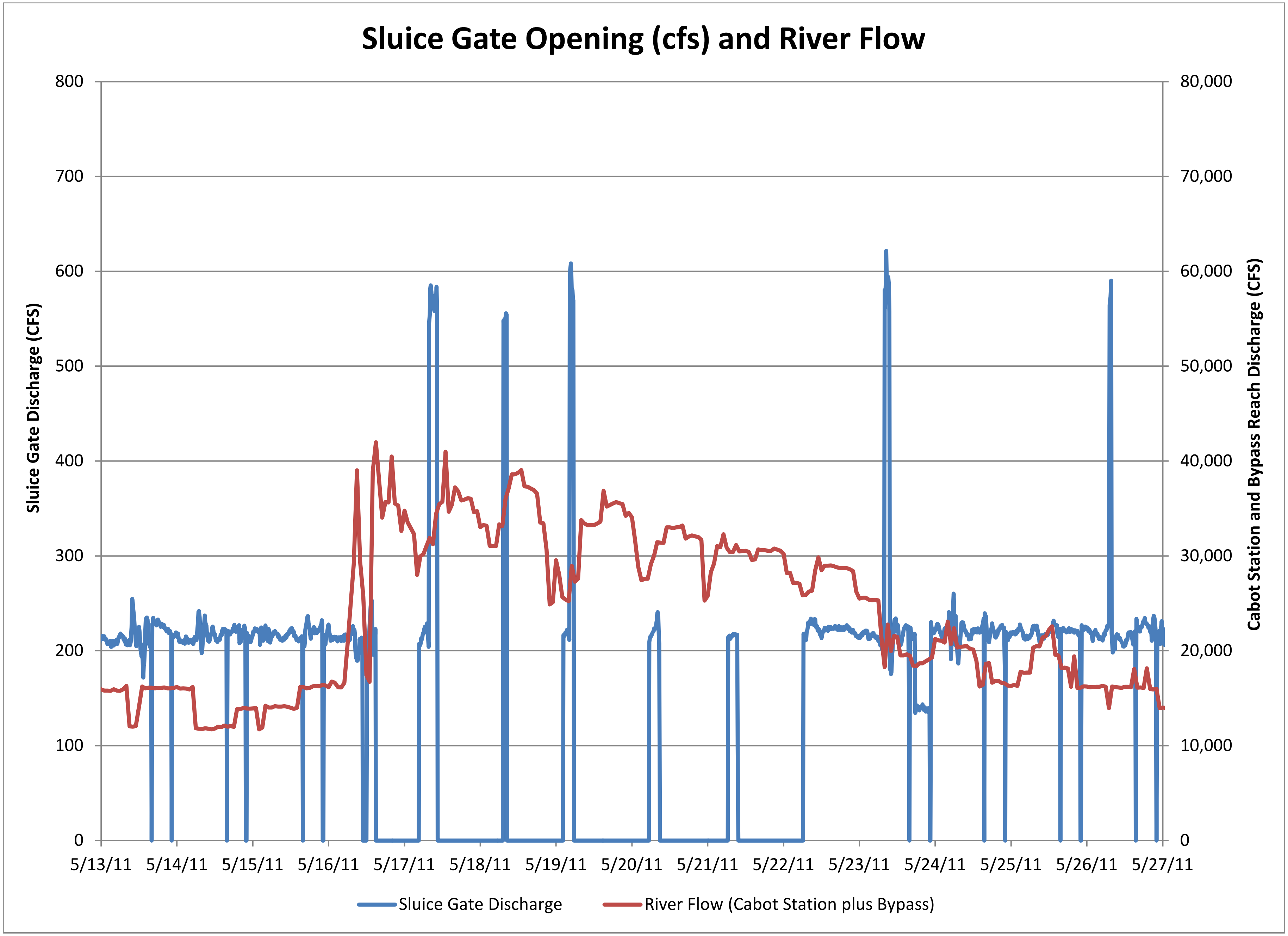
Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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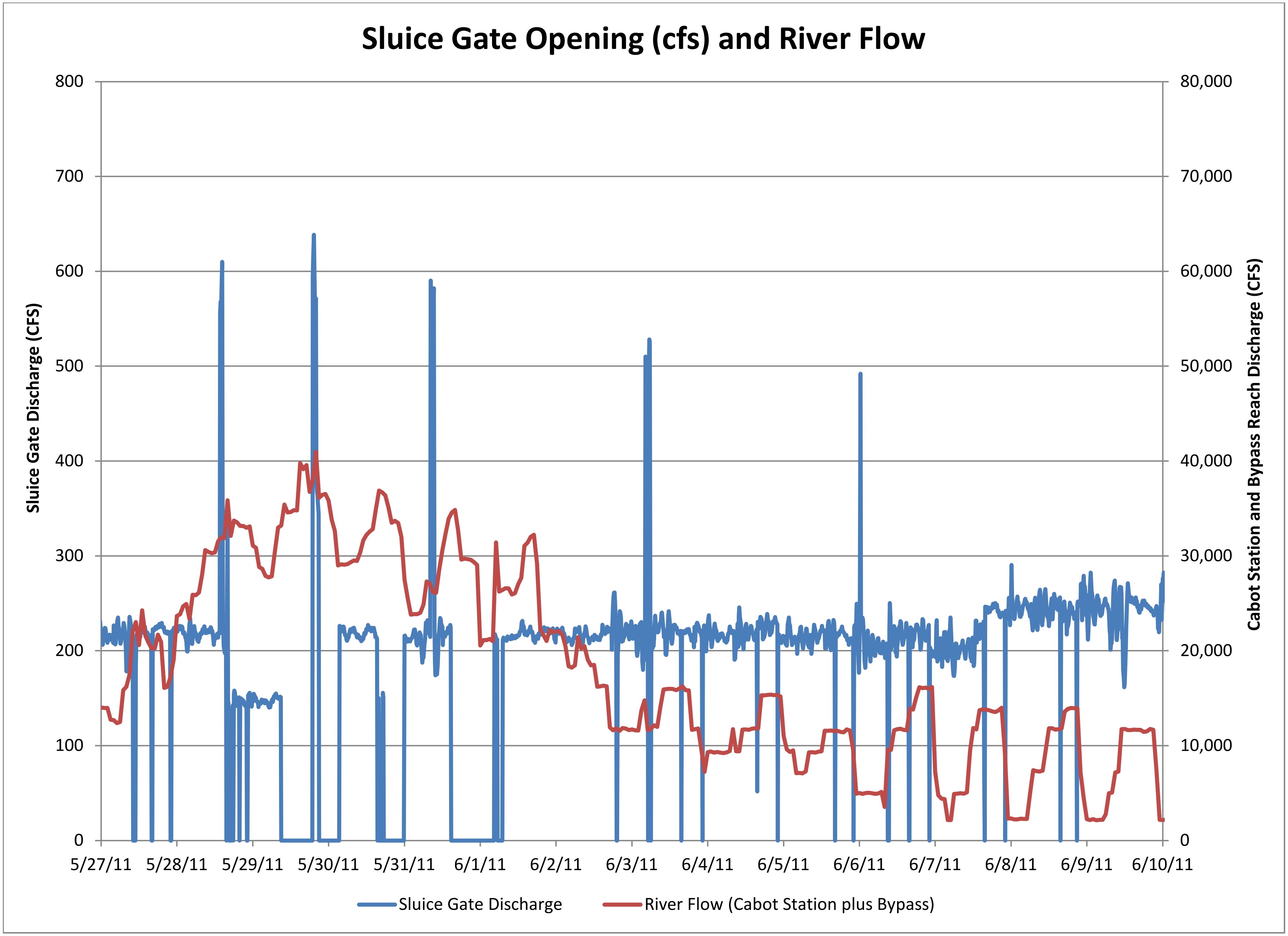
Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)


Sluice Gate Opening (cfs) and River Flow
Sluice Gate Discharge (CFS)
Cabot Station and Bypass Reach Discharge (CFS)
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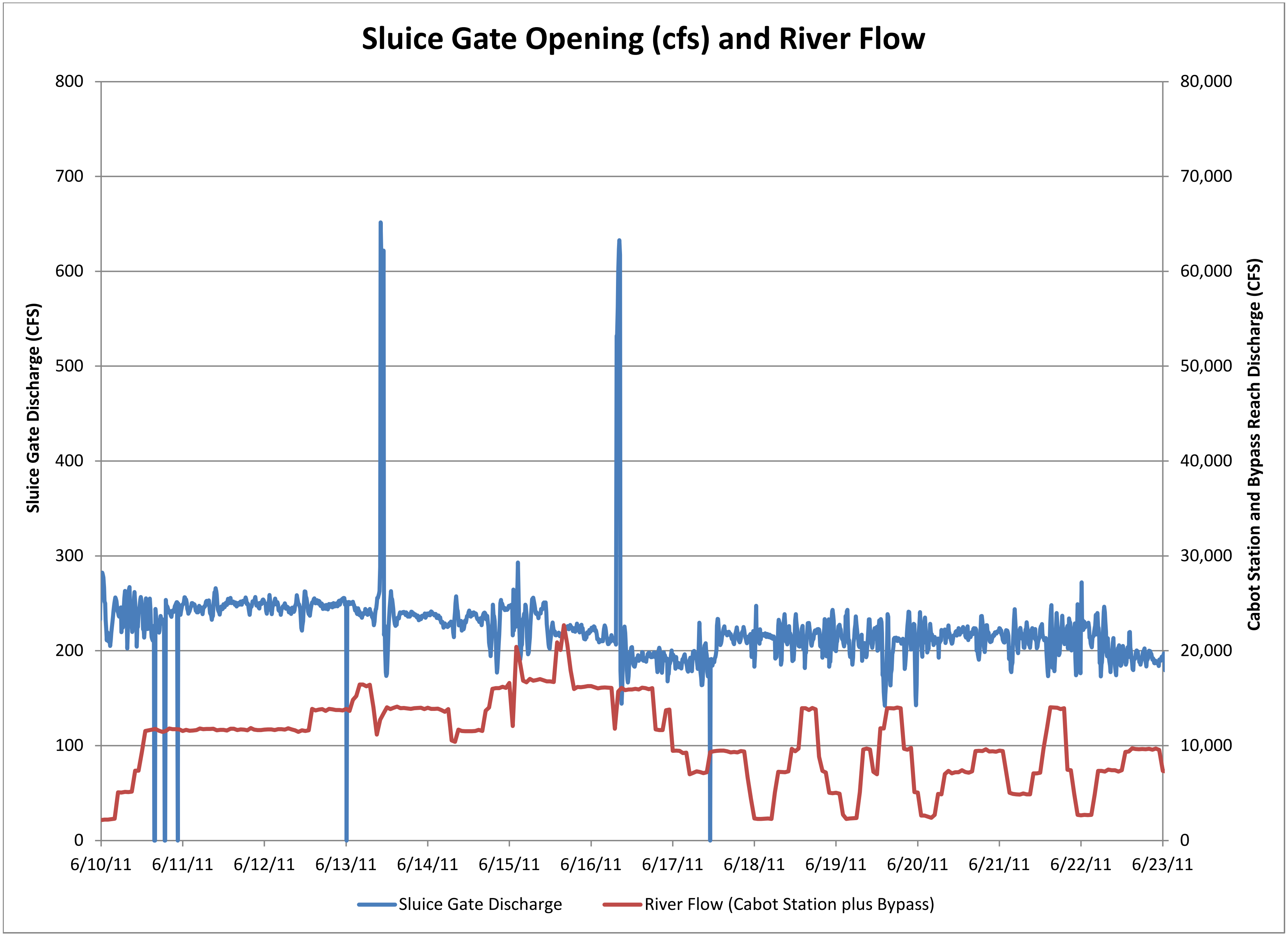

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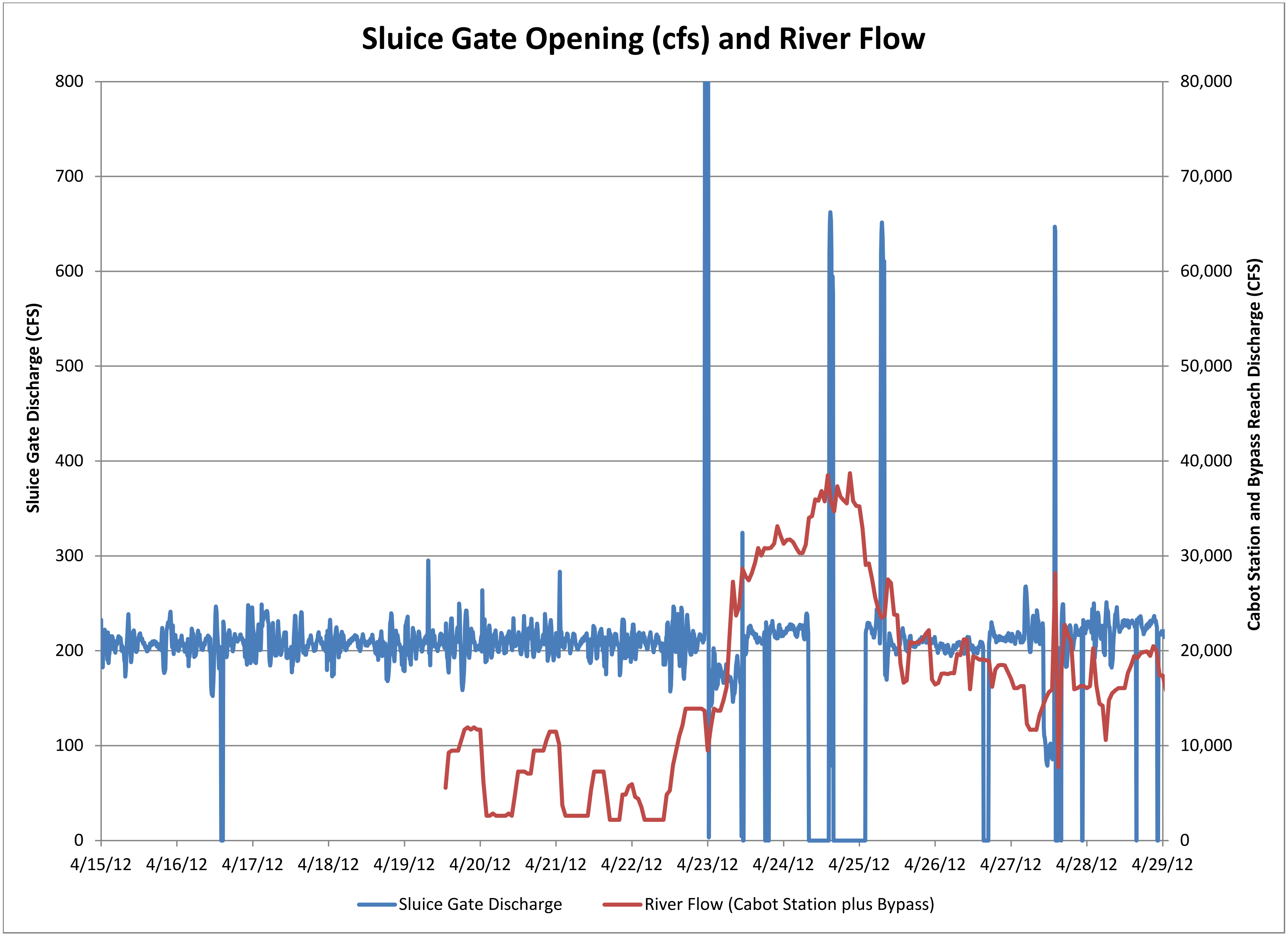

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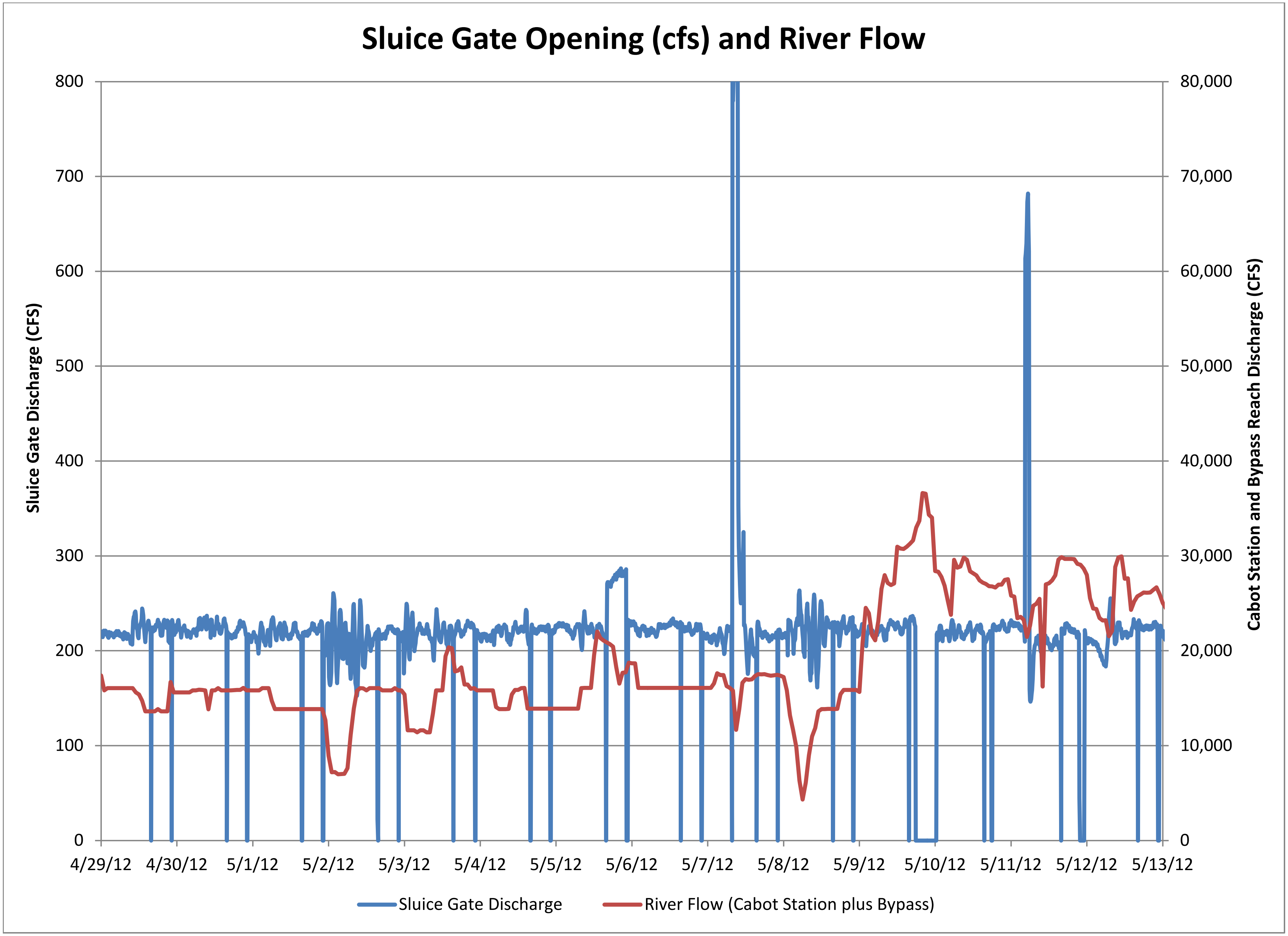
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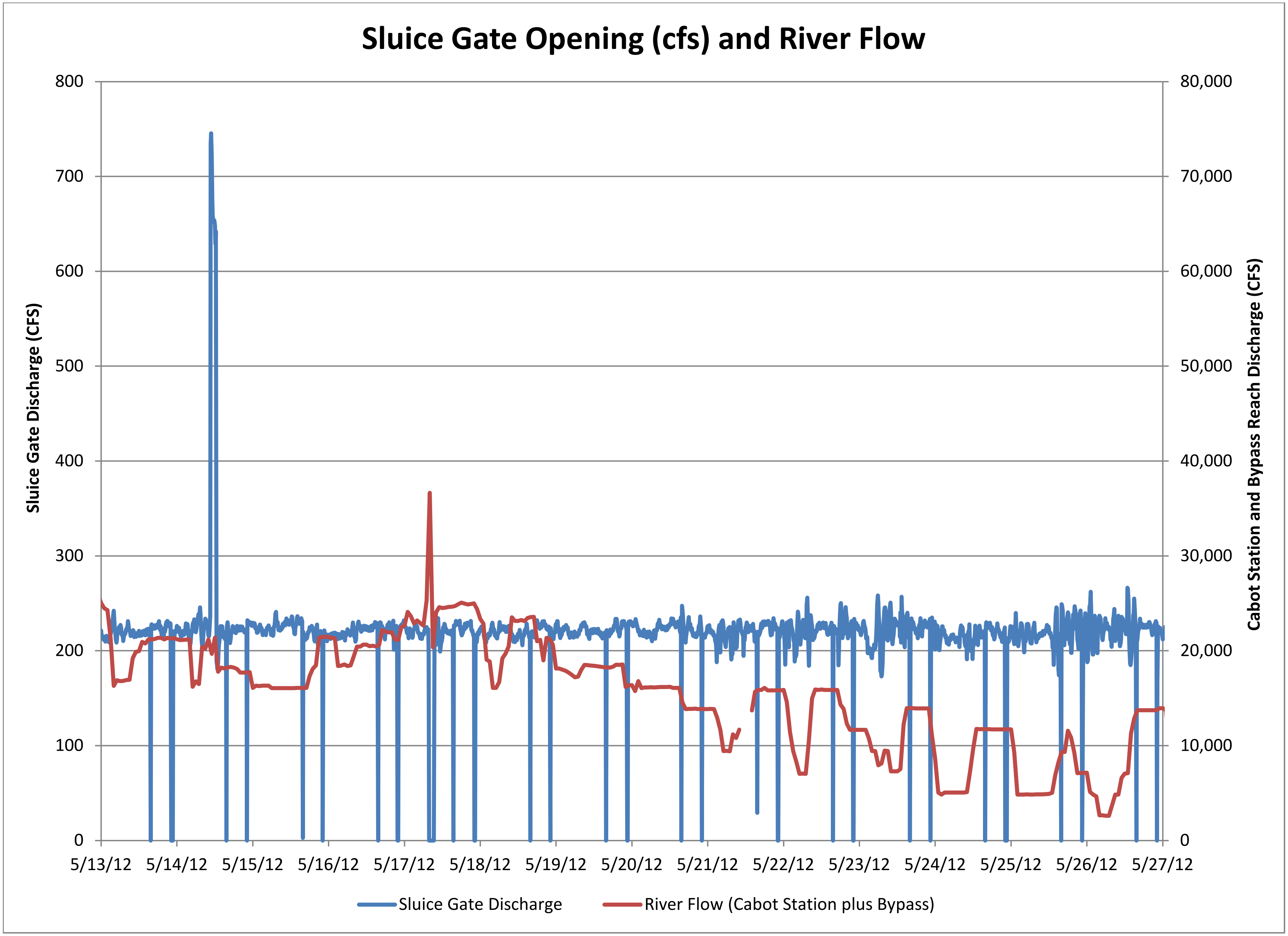
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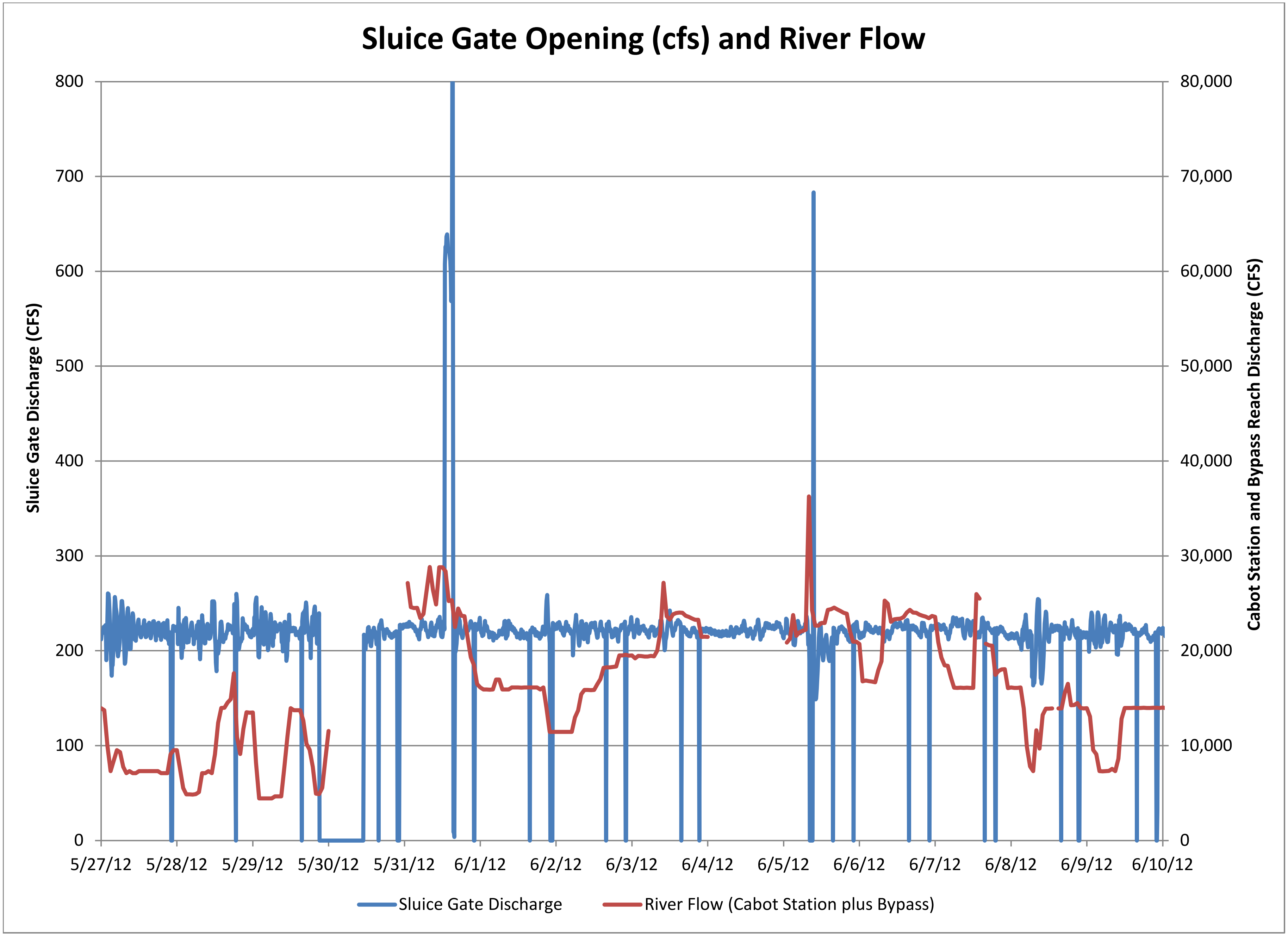

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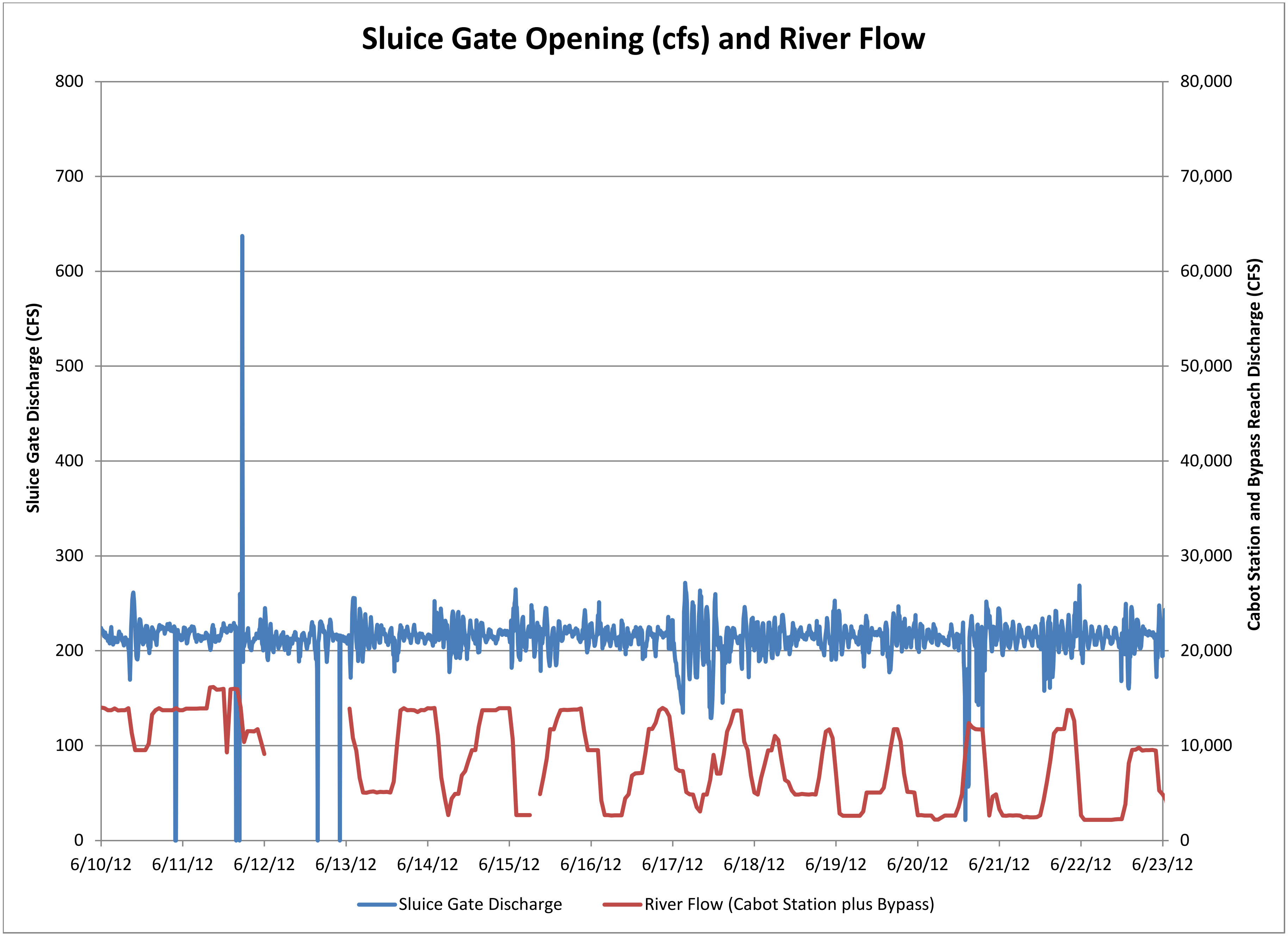
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Sluice Gate Discharge
River Flow (Cabot Station plus Bypass)

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.13

IMPACTS OF THE TURNERS FALLS PROJECT AND NORTHFIELD MOUNTAIN PROJECT ON LITTORAL ZONE FISH HABITAT AND SPAWNING HABITAT

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

Study 3.3.13 is designed to:

- assess the timing and location of fish spawning in the littoral zone;
- delineate, qualitatively describe, and map shallow-water habitat types subject to inundation and exposure due to project operations; and
- evaluate potential impacts of impoundment fluctuation on nest abandonment, spawning fish displacement, and egg dewatering.

No consultation was recommended by the Federal Energy Regulatory Commission (FERC) in its February 21, 2014 Study Plan Determination Letter (SPDL). FERC concluded that the study could be affected by the closure of Vermont Yankee and thus modified the study schedule to conduct the field work in 2015.

1.2 Study Progress Summary

<u>Task 1: Literature Review</u>

As defined in the FERC approved study plan, a desktop literature review will be performed to determine typical spawning habitat-types and periods when resident species typically spawn, prior to conducting the field investigation. Because the field study will not be conducted until the 2015 field season, it is anticipated that the literature review will be conducted in late 2014 and early 2015.

<u>Task 2: Field Surveys</u>

Field surveys will be conducted during the 2015 field season.

<u>Task 3: Reporting</u>

A final report will be completed in March 2016 per the FERC's SPDL.

1.3 Variances from Study Plan and Schedule

No variances have occurred to date.

1.4 Remaining Activities

- Conduct literature review in late 2014/early 2015.
- Conduct field surveys during 2015 field season.
- Prepare and file study report by March 2016.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.14

AQUATIC HABITAT MAPPING OF TURNERS FALLS IMPOUNDMENT

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt
Gomez and Sullivan Engineers

SEPTEMBER 2014

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

1.1 Study Summary

Study 3.3.14 is a habitat field study to delineate aquatic littoral and demersal habitat in terms of substrate and cover in the Turners Falls Impoundment (Impoundment). The purpose of the study is to map the distribution and abundance of aquatic habitat, evaluate the types of habitats that occur, and identify any potential effects of operations on the habitat. The quantified spatial data generated by this survey will help provide a framework for the upcoming data analysis efforts relative to operations and impoundment modeling.

No consultation was recommended by the Federal Energy Regulatory Commission (FERC) in its February 21, 2014 Study Plan Determination Letter. FERC concluded that the study would not be affected by the closure of Vermont Yankee and thus did not modify the study schedule.

1.2 Study Progress Summary

<u>Task 1: Field Survey</u>

Field surveys were initiated during the week of August 25, 2014 to conduct the delineation phase of field efforts. Subsequent to that effort, a desktop analysis will be conducted to identify transect locations to be surveyed during the microhabitat quantified data collection phase, anticipated to occur in early September 2014.

<u>Task 1a: Delineation</u>

Delineation of habitat within the approximately 20-mile-long Impoundment was conducted by boat traveling through the littoral zone parallel to shore, during a period of relatively stable Impoundment levels so that observations of depth relative to substrate and cover were observed under consistent conditions, to the extent practical. The prevailing water elevation at the beginning of the survey was documented by bench-marked survey. Staff gages were established throughout the study area so that changes in water elevation during the survey could be accounted for. The field crew recorded habitat attributes and geo-referenced each boundary where a pronounced change in substrate and/or depth occurred.

<u>Task 1b: Microhabitat</u>

Delineation results will be used to aid in selection of transect locations to be surveyed in the field.

Transect data will be gathered within representative littoral habitats with distribution and number of transects dictated by the variability detected during the delineation phase. Verticals will be located along each transect. Elevations for top of bank, normal high water, upper elevation of Impoundment (if different than normal high water), normal Impoundment elevation, toe of bank, and low Impoundment elevation will be recorded at the verticals. The upper, normal and lower Impoundment elevations will be determined in concert with Study No. 3.1.2 *Northfield Mountain/Turners Falls Operation Impacts on Existing Erosion and Potential Bank Instability*.

Additional verticals will be established at intervals where micro-changes in slope, substrate embeddedness, or cover are encountered. Elevations will be surveyed in NGVD 1929 datum (also the project datum) so that data can be integrated with other project operation data for analysis. The locations of all transects will be geo-referenced and transect headpins will be blazed.

Task 2: Analysis and Report

Geospatial mesohabitat data will be transferred to a GIS format and used to develop both visual maps depicting distribution and tabular information quantifying the abundance and distribution of habitat features in the study area. A summary report will be developed that will include survey methods, GIS maps showing the mesohabitat spatial distribution in the impoundment, and a discussion of observations. The report will provide a narrative discussion of habitat use by fish and aquatic macroinvertebrates native to the study area. It is anticipated that data gathered during Study No. 3.3.17 Assess the Impacts of Project Operations of the Turners Falls Project and Northfield Mountain Project on Tributary and Backwater Area Access and Habitat will also be used to develop the habitat map and discussion for this summary report. The final report will be completed in the 2nd quarter of 2015.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances.

1.4 Remaining Activities

- Microhabitat mapping will be conducted in September 2014.
- Data quality control review in the 4th quarter of 2014.
- Prepare and file study report by the 2nd quarter of 2015.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.15

ASSESSMENT OF ADULT SEA LAMPREY SPAWNING WITHIN THE TURNERS FALLS PROJECT AND NORTHFIELD MOUNTAIN PROJECT AREA

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight

GDF SUEZ

Prepared by:

Kleinschmidt

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to identify sea lamprey spawning sites and evaluate the effects of project-related water level and flow changes on spawning habitat, behavior, redd condition, and spawning success. In its February 21, 2014 Study Plan Determination Letter (SPDL), the Federal Energy Regulatory Commission (FERC) concluded that the study could be affected by the closure of Vermont Yankee and thus modified the study schedule.

1.2 Study Progress Summary

The study will be conducted in 2015 as described in the Revised Study Plan (RSP). Preliminary evaluations and range testing of proposed monitoring locations was conducted on July 15 and 16, 2014. The objective of the preliminary evaluations was to investigate the feasibility of using radio telemetry methods to monitor strategic locations as identified in the RSP. The evaluation included those proposed monitoring locations that span large distances (i.e. wide sections of the river) to ensure that the proposed monitoring regime is adequate to document tagged study fish as they migrate through the study area. The range testing was conducted using a Lotek SRX 400 receiver and 4-element yagi antenna and a test tag with the following parameters:

- Frequency 149.320
- Width - 12mm
- Length - 40mm
- Mass - 8g
- Apparent mass in water - 3.5g

The test tag was deployed using a fishing pole and float to set the depth of the tag at approximately 5 feet. Water quality data were collected at the time of the testing including temperature, dissolved oxygen (DO), pH and conductivity. Conductivity in particular affects the radio signal transmitted by the tag and will affect the range of the monitoring system. The conductivity of the Connecticut River was 139 µS/L at the time of testing (July 15) and 88 µS/L within the Deerfield confluence (July 16).

Range testing was conducted at the following location:

- Shearer Farms (RM 127.5),
- NMPS Intake (RM 127),
- NMPS Gill Bank (RM 126.5),
- Turners Falls Impoundment (RM 122),
- Station No. 1 Tailrace (RM 121),
- Rawson Island (RM 120.5),
- Cabot Station Tailrace (RM 120)
- Deerfield River Confluence (RM 119.5), and
- Montague Wastewater (RM 119.5)

The analysis of the range testing is ongoing but a preliminary review revealed that the monitoring stations as proposed in the RSP will be adequate to monitor shad movement through the study area with one exception. An additional monitoring station at the Shearer Farms location will be necessary to monitor the full width of the river. This location will be monitored with two Lotek SRX 400 receivers and yagi antennas.

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Though the monitoring location proposed at the Red Cliffe Canoe Club (RM 86.5, upstream of Holyoke Dam) was not tested in the evaluation, given the width of the river at the location (~1200 ft), it is anticipated that an additional receiver station, one on each side of the river, will be required to monitor the full width of the river. This area will be monitored using two Lotek SRX 400 receivers and yagi antennas.

Radio noise information is being collected in 2014 at Cabot Station to help determine which frequencies are best suited for use in the study. The exact frequencies used in the study will be based on availability and the results of the noise testing, and in cooperation with the TransCanada studies. Data collection for this effort is ongoing and it is anticipated that analysis of the data will be completed prior to purchasing tags.

Reporting

A final report will be completed in March 2016 per FERC's SPDL.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances.

1.4 Remaining Activities

- Conduct study and associated analysis in 2015.
- Final study report.

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Relicensing Study 3.3.16

HABITAT ASSESSMENT, SURVEYS, AND MODELING OF SUITABLE HABITAT FOR STATE-LISTED MUSSEL SPECIES IN THE CT RIVER BELOW CABOT

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

biodrawversity

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

This study has two objectives:

1. Delineate, through field surveys, populations of state-listed mussels and suitable habitat from Cabot Station downstream to the Route 116 Bridge. Characterize the distribution, abundance, demographics, and habitat use of these populations. Surveys will identify and map potential habitat for state-listed species based on habitat preference of each species.

2. Develop binary Habitat Suitability Index (HSI) curves for all state-listed mussel species found to occur in the 35-mile reach downstream from Cabot Station, using species-specific data from the Connecticut River and other rivers in the Northeast, along with relevant publication and expert review. These HSI curves will be used in the Instream Flow Incremental Methodology (IFIM) to evaluate the potential effects of Project operations on state-listed mussel species.

Preceding the 2014 fieldwork, a study plan and scientific collection permit application was submitted to the Massachusetts Natural Heritage and Endangered Species Program (NHESP), and NHESP issued the permit on May 15, 2014. A habitat assessment (Task 2) was completed in June 2014, and results were discussed with NHESP on July 16, 2014 to reach agreement on mussel survey locations. This conversation occurred between Ethan Nedeau (Biodrawversity), Peter Hazelton (NHESP), and Jesse Leddick (NHESP) and resulted in agreement on areas where the survey would occur.

1.2 Study Progress Summary

<u>Task 1: Finalize Study Plan and Attain Collection Permit</u>

The study plan for the 2014 fieldwork was completed in April 2014, a collection permit application was submitted to NHESP in early May 2014, and NHESP issued the permit on May 15, 2014.

<u>Task 2: Mussel Survey and Habitat Assessment</u>

A habitat assessment was completed in June 2014 on multiple trips, including an excursion specifically for this purpose, and three excursions to complete odonate fieldwork (Study 3.3.10) during which additional habitat information was collected for this study. Habitat assessment results were discussed with NHESP on July 16, 2014, and this discussion culminated in concurrence on approximately 25 mussel survey locations between Cabot Station and the Route 116 Bridge. These sites were surveyed in July and early August of 2014 using SCUBA and snorkeling methods as described in the study plan. No live state-listed mussels were detected in this entire reach; one relic yellow lampmussel shell was found near Second Island.

<u>Task 3: Develop Binary HSI Criteria for State-Listed Mussel Species Documented in the Project Area</u>

Development of the binary HSI criteria, including input from regional scientists on proposed criteria, will be developed in cooperation with NHESP in the 4th quarter of 2014. FirstLight will consult with NHESP during the selection process to determine an appropriate panel of experts for this study. These criteria will be used in the habitat modeling for Reach 3 (IFIM Study).

<u>Task 4: Effects of Flow Regime on State-listed Mussels</u>

This task will depend on the IFIM study, and will occur in 2015.

Task 5: Report

A report based on Tasks 2 and 3 will be prepared in the 1st quarter of 2015. A comprehensive report that includes an evaluation of the flow regime on state-listed mussels will be prepared by March 2016.

1.3 Variances from Study Plan and Schedule

To date, there has been no variance from the study plan. To date, no state-listed mussels have been found in the survey area, and therefore some of the parameters described in the study plan have not been collected (e.g., shell lengths, microhabitats, locations of state-listed mussels).

1.4 Remaining Activities

HSI criteria will be developed in the 4th quarter of 2014. A final report for Tasks 2 and 3 will be prepared by the 1st quarter of 2015. The report may be modified based on the IFIM study and results specific to Task 4.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.17

ASSESS THE IMPACTS OF PROJECT OPERATIONS OF THE TURNERS FALLS PROJECT AND NORTHFIELD MOUNTAIN PROJECT ON TRIBUTARY AND BACKWATER AREA ACCESS AND HABITAT

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to evaluate access to tributary and backwaters to (1) identify potential barriers to, or constrictions of, fish access; (2) assess the adequacy of current minimum flow requirements for the areas downstream of Turners Falls Dam within the bypass reach relative to backwaters and tributary access; and (3) determine the need for enhancement or mitigation measures. FirstLight has proposed to assess the impacts of water level fluctuations due to project operations on aquatic habitat access through bathymetric mapping, habitat measurements [e.g., substrate depth, and velocity (where potential barriers are observed)], collection of water quality parameters (e.g., water temperature, dissolved oxygen, turbidity, and pH), river bed surveys, visual inspection, GIS/GPS mapping, and hydraulic/habitat modeling. The assessment will be performed during the spring, summer, and fall of 2014.

No consultation on this study was required.

1.2 Study Progress Summary

Task 1: Field Data Collection

Field data collection has been conducted in accordance with the Revised Study Plan (RSP) except as indicated in section 1.3 *Variances from Study Plan and Schedule*. The springtime survey was conducted on 5/21, 5/22, between 6/4 and 6/6, and on 6/10 and 6/11, 2014. The summertime survey was conducted on 8/5 and between 8/11 through 8/13, 2014. All field data were reviewed to assure quality and archived daily. Additional summertime surveys will be conducted in September 2014 and the fall survey is scheduled for the week of October 6, 2014.

Task 2: Evaluation of Fluctuation Range

The evaluation of the fluctuation will begin once the field data collection is complete in the fall of 2014.

Task 3: Data Analysis and Reporting

Data analysis has not yet begun and will commence upon completion of field data collection in the fall of 2014. The report is anticipated to be complete during the 1st quarter of 2015.

1.3 Variances from Study Plan and Schedule

The RSP states that surveys will be performed at each tributary to *delineate the perimeter of the inundated tributary confluence area with a sub-meter accuracy GPS. Aerial imagery may also be used to delineate tributary confluence areas.* During the spring survey the field crew found that delineation of the perimeter of the tributaries was hindered by extensive mud deposits, which made access to the perimeter difficult. Further, collection of sub-meter GPS data and mapping using aerial imagery was confounded by the dense canopy over the tributaries which reduced the accuracy and connectivity of the Trimble GPS and obscured the tributary in aerial photos. The study team met to discussed these challenges and it was decided that the upstream extent of the confluence would be delineated with sub-meter GPS and LiDAR data would be used to define the elevation at the upstream extent to calculate and map the perimeter using GIS. FirstLight acquired LiDAR data in July, 2014 that extends from Vernon Dam to Holyoke Dam in support of this analysis. The LiDAR data will be used in conjunction with field data to map the confluence perimeters.

1.4 Remaining Activities

- Perform final assessment in fall 2014.
- Compile and analyze data for Final report submission in the 1st quarter of 2015.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.3.18

IMPACTS OF THE TURNERS FALLS CANAL DRAWDOWN ON FISH MIGRATION AND AQUATIC ORGANISMS

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

Study 3.3.18 is designed to quantify the impacts of the annual Turners Falls Project canal drawdown on emigrating and resident fishes, freshwater mussels, sea lamprey juveniles and mudpuppies in the canal. The study is intended to facilitate the collection of information necessary to conduct effect analyses. The study will commence as soon as practicable after canal dewatering and will be conducted on the day following the drawdown (Monday 9/29/14) and again on the day before the canal is rewatered (Friday 10/3/14). The consultation record on Study 3.3.18 includes the following:

In the Federal Energy Regulatory Commission's (FERC) February 21, 2014 Study Plan Determination Letter (SPDL) relative to Study 3.3.18, it states "*During the power canal's drawdown, dissolved oxygen concentrations within zone 7 may be affected by a number of variables including temperature and biological oxygen demand (section 5.9(b)(5)). FirstLight did not provide any information that would indicate if the rate and turnover of flow through the pool in zone 7 is sufficient to maintain adequate dissolved oxygen levels during the canal drawdown. Therefore, to understand the potential effects project operations may have on dissolved oxygen, it is appropriate to monitor dissolved oxygen in within the zone 7 pool (section 5.9(b)(6)) during the canal drawdown. As such, we recommend that FirstLight consult with FWS, NMFS, and MADFW on two appropriate locations for measuring dissolved oxygen within the zone 7 pool*".

On June 3, 2014, FirstLight met at the Northfield Mountain Visitors Center with FERC (via phone), National Marine Fisheries Service (NMFS) (via phone), United States Fish and Wildlife Service (USFWS), Massachusetts Division of Fish and Wildlife (MADFW), The Nature Conservancy (TNC), and Connecticut River Watershed Council (CRWC) to discuss the study. At the meeting the group discussed proposed dissolved oxygen (DO) sampling sites with the agencies and all parties agreed to proposed sites.

On July 17, 2014, FirstLight sent a letter (see Appendix A) via email to the agencies and other stakeholders with proposed locations of quadrats for sea lamprey and mussel survey.

On July 29, 2014, FirstLight received email responses from its July 17, 2014 letter from the USFWS on July 29, 2014 (Appendix A), and from Massachusetts Natural Heritage and Endangered Species Program (NHESP) on July 31, 2014 (Appendix A) commenting on proposed quadrat locations and size of the quadrats.

On August 15, 2014 (Appendix A), FirstLight sent a letter via email to agencies and other stakeholders responding to the USFWS and NHESP comment letters.

1.2 Study Progress Summary

An amended study plan was developed based on the consultation described above. Field efforts will occur in September/October 2014, as indicated above. Based on the consultation with the agencies, it was agreed that the dissolved oxygen in Section 7 will be sampled from the two bridges that cross the canal in that section and additional quadrats were added especially on the Western bank. Changes are documented in the modified study plan (see Appendix B).

The study schedule is outlined in the modified study plan.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances.

1.4 Remaining Activities

- Conduct the field study in 2014.
- Complete report.

Appendix A
Consultation Record

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

July 17, 2014

VIA EMAIL

John Warner, US Fish & Wildlife Service
Melissa Grader, US Fish & Wildlife Service
Ken Sprankle, US Fish & Wildlife Service
Caleb Slater, MA Division of Fish & Wildlife
Jessica Pruden, National Marine Fisheries Service
Bill McDavitt, National Marine Fisheries Service
Alex Haro, USGS Conte Lab

Re: FirstLight, Relicensing of the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485), Study No. 3.3.18- *Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms*

Dear All,

FirstLight Hydro Generating Company (FirstLight) is currently in the process of relicensing its Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485) with the Federal Energy Regulatory Commission (FERC). On August 14, 2013 FirstLight filed its Revised Study Plan (RSP). The purpose of this letter is to consult with the resource agencies and Conte Lab researchers about the final number and placement of quadrats that will be used to determine the distribution and relative abundance of juvenile sea lamprey (ammocoetes) and mussels as required in Study No. 3.3.18- *Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms.*

Study No. 3.3.18 is a study to quantify the impacts of the annual Turners Falls Project canal drawdown on emigrating and resident fishes, freshwater mussels and mudpuppies in the canal. The study will commence as soon as practicable after dewatering and will be completed on the day following the drawdown, 9/30/14. A crew of experienced biologists will conduct a meander survey in unwetted areas, and a backpack electrofishing and/or seine survey in wetted areas. Areas of the canal with appropriate soft sediment habitat will be sampled using 1-m by 1-m quadrats to determine counts of ammocoetes and mussels. Figure 1 displays the locations of the proposed quadrats. These were positioned in areas either along the banks or the hard bottom of the canal where sampling is possible without sinking in the soft sediments. Sample locations may be modified in the field if bottom sediments have shifted. When the canal is drawn down we may find out that some areas have been covered with the muck that makes some

John S. Howard
Director FERC Compliance
Chief Dam Safety Engineer

FirstLight Power Resources, Inc.
99 Millers Falls Road
Northfield, MA 01360
Tel. (413) 659-4489/ Fax (413) 422-5900/
E-mail: john.howard@gdfsuezna.com

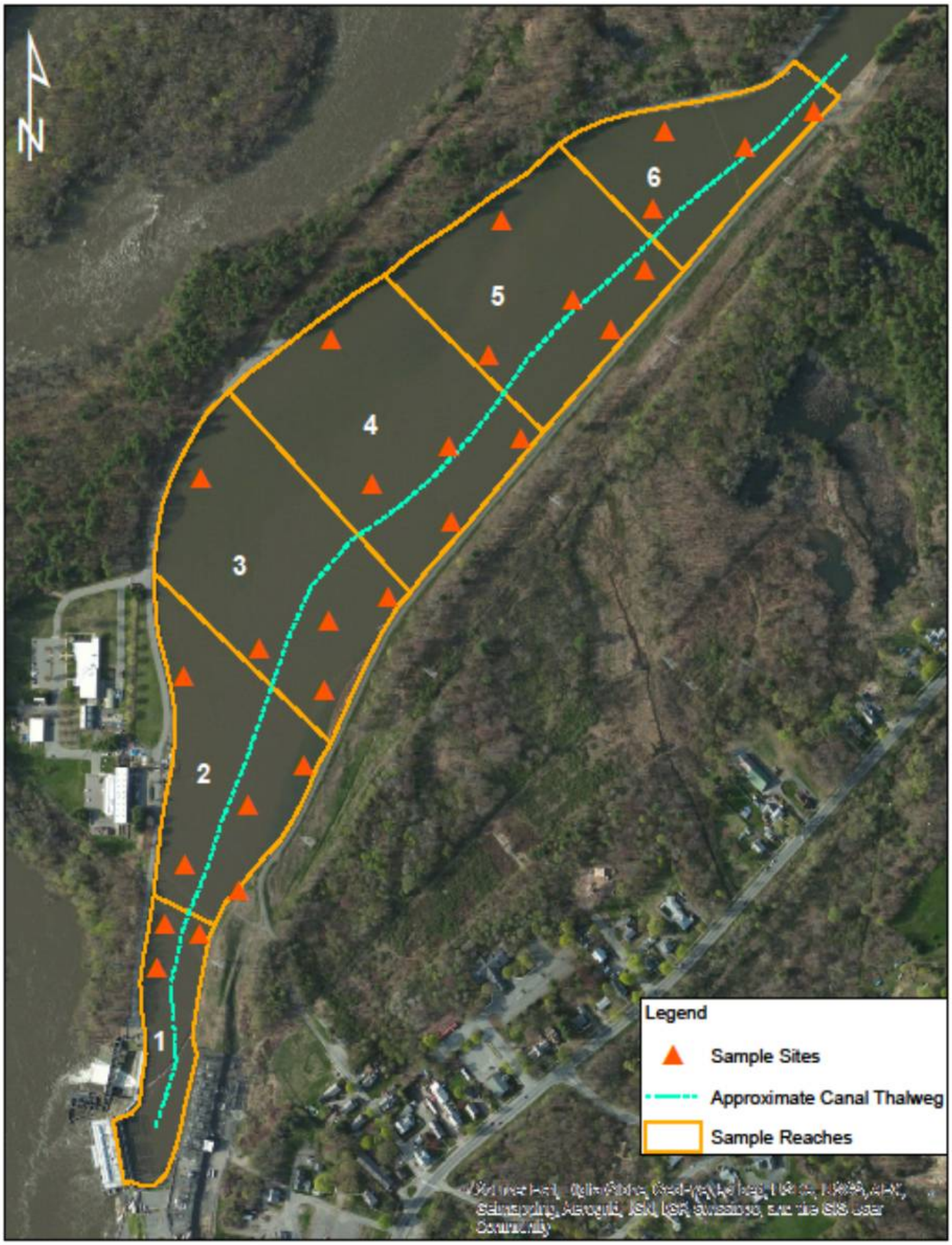
places inaccessible. Please respond by August 1, 2014 to confirm that the number of quadrats and proposed locations will address your concerns about the study's potential impacts to ammocoetes and mussels. If no response is received, we will assume that the proposed locations are approved.

Sincerely,

John Howard

Cc: Ken Hogan, FERC (via email)

Attachment: Figure 1



FIRSTLIGHT POWER RESOURCES

FirstLight GDF SUEZ

Proposed Study Plan

0 250 500 1,000 Feet

Sample locations for Canal Drawdown Survey

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Path: W:\gis\maps\Study_Plans\Drawdown\SampleLocations.mxd

Mark Wamser

From: Warner, John <john_warner@fws.gov>
Sent: Tuesday, July 29, 2014 11:33 AM
To: firstlight@gomezandsullivan.com
Cc: Ken Sprankle; Melissa Grader; Caleb Slater; William McDavitt - NOAA Affiliate; Jessica Pruden; Alexander Haro; Ken Hogan; Howard, John; Mark Wamser; Chris Tomichek; Stira, Robert; lkhitrik@gomezandsullivan.com
Subject: Re: FirstLight, Relicensing. Study No. 3.3.18- Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms

The U. S. Fish and Wildlife Service received your email dated July 17, 2014, regarding requested input for Study No. 3.3.18 - Impacts of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms design plans. The Service has reviewed the draft plan and has the following comments:

1) The FERC Study Plan Determination (February 2014) requires a survey immediately following the drawdown as your email notes and a second later survey to compare data, which is not mentioned. The plan should be amended to add a second drawdown assessment.

2) The six study zones defined in the figure provided in your July 17 email are reasonable to the extent that they would reflect a transition in potential habitats and biota from upstream to downstream. However, the zones will not clearly distinguish differences in the impacts on habitat between the western bank/zone, the channel area, and the eastern bank/zone.

The figure of possible quadrat sites indicates that the "western zone" of the canal area would have relatively fewer quadrat samples than the thalweg area, and the relatively narrow eastern bank area. The west bank has a large shallow shelf which represents a higher elevation (and first dewatering) and softer sediments that merit additional sampling effort.

We recommend that either: (a) 10 sites be selected within each of three zones (western bank/mud flat area, thalweg, eastern bank) distributed across the 6 upstream/downstream zones noted here; or (b) more specifically have zones be re-drawn to make different zones for the eastern thalweg and bank area and the western mudflat area and divide those zones into upstream and downstream segments (not all upstream downstream segments include the western mudflat area).

3) The proposed plan indicates that softer sediment areas would be avoided. These softer sediments represent suitable habitat for juvenile lamprey in particular, and therefore, avoiding sampling them potentially could under-represent impacts to them from canal drawdowns. Rather than avoid these areas, sampling of the large area of potentially softer sediments can be done either by using plastic snowshoes, or by laying down planks over soft areas to distribute weight and allow access. These approaches should be considered so that all habitats can be adequately sampled.

4) The quadrat sample size of one square meter is relatively small and the expected patchiness of organism occurrence and associated variability in counts may be quite high, potentially reducing usefulness of the data and any inferences. An increase in quadrat size to two square meters (from one) would be a relatively minor increase in effort but would in effect double the sample size area with anticipated benefits in helping to reduce the degree of variability among nearby site values.

5) The description of seine and backpack surveys would appear to be sufficient to obtain data including relative abundance and allow comparisons among areas and over time (early and late survey).

Please contact me or Ken Sprankle if you have any questions on these comments. Thank You.

- John Warner

Mark Wamser

From:	Leddick, Jesse (FWE) <jesse.leddick@state.ma.us>
Sent:	Thursday, July 31, 2014 4:06 PM
To:	John_Warner@fws.gov; Ken_Sprankle@fws.gov; Melissa_Grader@fws.gov; Slater, Caleb (MISC); William.McDavitt@noaa.gov; jessica.pruden@noaa.gov; aharo@usgs.gov; Hazelton, Peter (FWE); Marold, Misty-Anne (FWE); Andrea Donlon; 'Don Pugh'
Cc:	kenneth.hogan@ferc.gov; john.howard@gdfsuezna.com; mwamser@gomezandsullivan.com; Chris.tomichek@kleinschmidtusa.com; Robert.Stira@gdfsuezna.com; lkhitrik@gomezandsullivan.com
Subject:	RE: FirstLight, Relicensing. Study No. 3.3.18 - MA NHESP/DFW Comments

John,

In response to the letter submitted by FirstLight dated July 17, 2014 re: Study No. 3.3.18 - *Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms*, the Natural Heritage and Endangered Species Program of the MA Division of Fisheries and Wildlife would like to offer the following comments:

1. The random allocation of sample sites shown on the map entitled “Sample locations for Canal Drawdown Survey” shows a majority of samples occurring along the eastern bank of the canal in Zones 1-6. Though these sites were chosen using random selection, they may not adequately represent the proportions of available habitat within the canal. The western bank of the canal (especially through Zones 3-5) contains a relatively shallow shelf which is likely to dominate dewatered habitat during a canal drawdown compared with the relatively steep and rocky eastern bank. However, there are few sample locations in this area and such a bias may cause surveyors to miss or misinterpret abundances and densities of aquatic organisms in this habitat. We recommend that the number and location of sample sites be selected using a stratified random approach in order to incorporate and better represent the proportion of various habitat types within the canal (e.g. east bank to depth x, west bank to depth x, and canal thalweg below depth x, where depth x is a depth at which the canal thalweg is defined).

2. Revised Study Plan 3.3.18 states that up to 10 randomly selected 1m^2 quadrats will be sampled in each Zone. However, the current proposal provides only 5 (or fewer) sample sites allocated to each Zone. We believe that a greater effort of sampling is needed to adequately assess drawdown effects on stranded benthic species (i.e. larval sea lamprey and freshwater mussels) and request that an average of 10 sites be used per Zone. Larger zones may therefore have more than 10 sample sites depending on total Zone size, and smaller Zones may have fewer. Such an allocation of sample sites would give better resolution to the data to assess drawdown effects.

3. While 1 m^2 quadrats have been specified in the Revised Study Plan, this size of sample unit may be too small to effectively represent the available habitat in the canal even with an increase to 10 sample sites per Zone. Given the same search area, larger sample units (i.e. quadrats) are more cost effective to set up than using smaller units for the same total search area. This is discussed in depth in *A Guide to Sampling Freshwater Mussel Populations* by Dave Strayer & Dave Smith, 2003. Using the current proposed methods (27 x 1m^2 quadrats) only 0.001% of the canal area (0.243km^2) would be surveyed. Alternatively, with n = 27 4m^2 quadrats (i.e. 2m x 2m), 0.04% of the canal would be surveyed with little additional cost, and likely a greater probability of detection through random placement. We believe that increased quadrat size should be considered in addition to an increase in samples for each Zone to better assess drawdown effects on mussels and ammocoete sea lamprey.

4. In *Appendix G- 2011 Cabot Station Drawdown Juvenile American Shad Stranding Survey* included with the Revised Study Plan, the abundance of all freshwater mussels are pooled and apparently were not identified to species. We request that mussels found as part of quadrat surveys be identified to species and that average and variances of species counts be reported for each Zone, with habitat type and species included. Similar mean measurements and variances should be reported for ammocoete sea lamprey.

Thank you for the opportunity to comment. Please contact me or Dr. Peter Hazelton, the Division's Aquatic Biologist, if you have any questions or if we can provide additional information.

Best regards,

Jesse Leddick
Endangered Species Review Biologist
Natural Heritage & Endangered Species Program
Massachusetts Division of Fisheries & Wildlife
100 Hartwell Street, Suite 230, West Boylston, MA, 01583
Phone: 508-389-6386 | Fax: 508-389-7890

---------- Forwarded message ----------
From: <firstlight@gomezandsullivan.com>
Date: Thu, Jul 17, 2014 at 9:12 AM
Subject: FirstLight, Relicensing. Study No. 3.3.18- Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms
To: John_Warner@fws.gov, Ken_Sprankle@fws.gov, Melissa_Grader@fws.gov, Caleb.Slater@state.ma.us, William.McDavitt@noaa.gov, jessica.pruden@noaa.gov, aharo@usgs.gov
Cc: kenneth.hogan@ferc.gov, john.howard@gdfsuezna.com, mwamser@gomezandsullivan.com, Chris.tomichek@kleinschmidtusa.com, Robert.Stira@gdfsuezna.com, lkhitrik@gomezandsullivan.com

Dear All,
Attached please find consultation letter for Study No. 3.3.18- Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms.

Thank you.

If you have any questions, comments or request please email to
FirstLight@gomezandsullivan.com

August 15, 2014

VIA EMAIL

John Warner, US Fish & Wildlife Service
Melissa Grader, US Fish & Wildlife Service
Ken Sprankle, US Fish & Wildlife Service
Caleb Slater, MA Division of Fish & Wildlife
Jesse Leddick, MA Natural Heritage
Jessica Pruden, National Marine Fisheries Service
Bill McDavitt, National Marine Fisheries Service
Alex Haro, USGS Conte Lab

Re: FirstLight, Relicensing of the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485), Study No. 3.3.18- *Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms*

Dear All,

FirstLight Hydro Generating Company (FirstLight) is currently in the process of relicensing its Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485) with the Federal Energy Regulatory Commission (FERC). On July 17, 2014 FirstLight emailed a letter to resource agencies and Conte Lab researchers about the final number and placement of 1-m by 1-m quadrats that will be used to determine the distribution and relative abundance of juvenile sea lamprey (ammocoetes) and mussels as required in Study No. 3.3.18- *Impact of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms.* John Warner and Jesse Leddick replied to the letter and requested more quadrats in the western bank of the canal, especially in Zones 3-5. Other requests include: identifying mussels found as part of quadrat surveys to species; reporting average and variances of species counts for each Zone, with habitat type and species included; reporting similar mean measurements and variances for ammocoete sea lamprey; describing the second survey to occur the day prior to rewatering the canal; and increasing the size of the 1-m by 1-m quadrats to 2-m by 2-m.

FirstLight considered your comments about the locations of the quadrats and as recommended have added additional quadrats on the western bank particularly in Zones 3-5 (Figure 1). These new sampling locations follow the recommendations that along the western bank, thalweg and eastern bank each have at least 10 quadrat locations. We plan to identify the mussels found in the quadrat sampling to species and

John S. Howard
Director FERC Compliance
Chief Dam Safety Engineer

FirstLight Power Resources, Inc.
99 Millers Falls Road
Northfield, MA 01360
Tel. (413) 659-4489/ Fax (413) 422-5900/
E-mail: john.howard@gdfsuezna.com

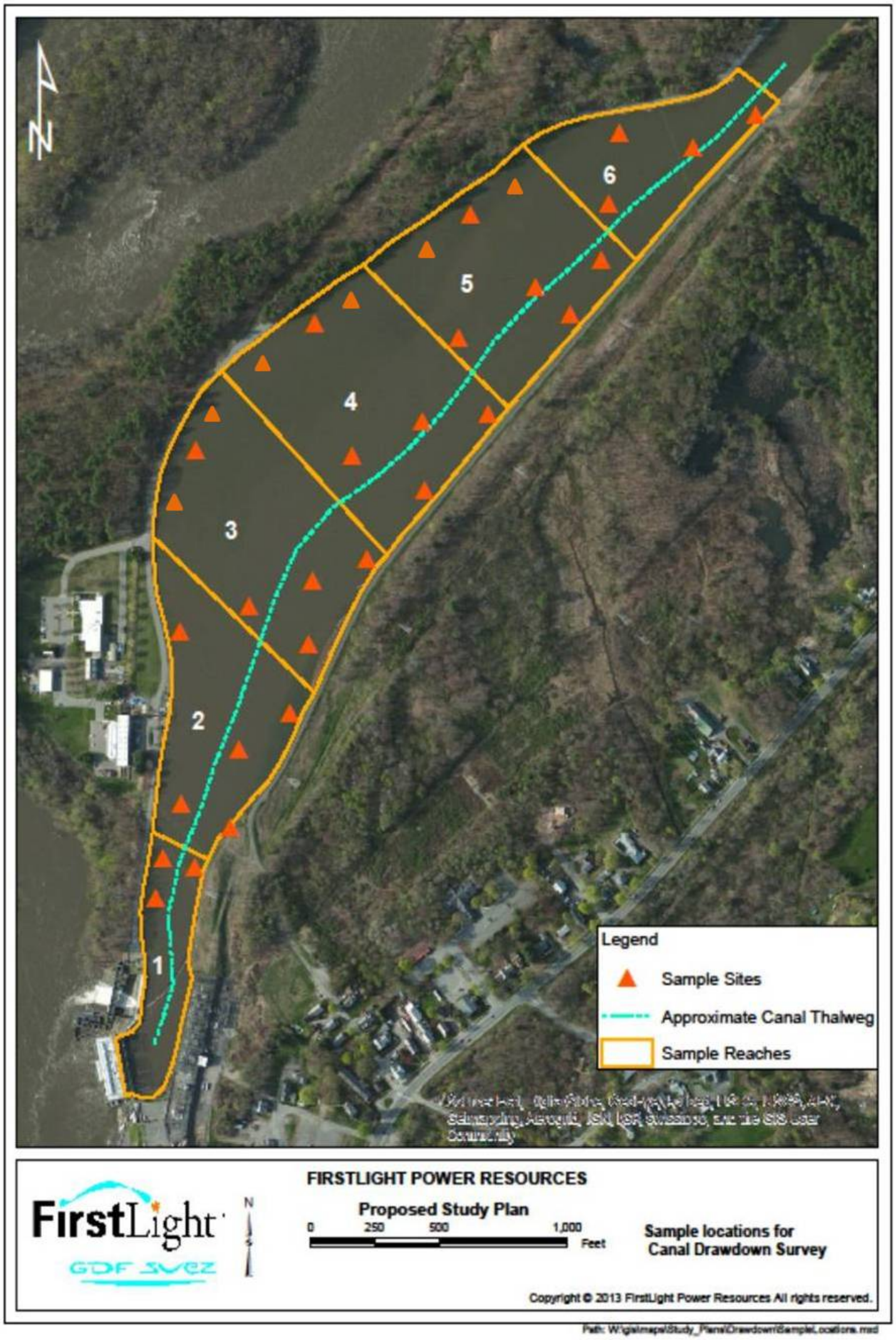
will report the average and variances of species counts by Zone including habitat type for mussels and ammocoete sea lamprey. As indicated in the SPDL, FirstLight plans to conduct a second survey, the same as the first survey, the day before the canal is rewatered on Friday October 3, 2014. However Firstlight does not plan to increase the quadrat size from 1-m by 1-m to 2-m by 2-m as FERCs Study Plan Determination Letter approved the use of 1-m by 1-m quadrats as set forth in the Revised Study Plan.

Sincerely,

John Howard

Cc: Ken Hogan, FERC (via email)
Don Pugh, TU (via email)
Andrea Donlon, CRWC (via email)

Attachment: Figure 1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Legend
Sample Sites
Approximate Canal Thalweg
Sample Reaches
FirstLight
GDF SUEZ
FIRSTLIGHT POWER RESOURCES
Proposed Study Plan
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Feet
Sample locations for
Canal Drawdown Survey
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Appendix B
Modified Study Plan

3.3.18 Impacts of the Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms

General Description of Proposed Study

In the study request letter from the USFWS, a study to quantify the impacts of the annual Turners Falls Project canal drawdown on emigrating and resident fishes, freshwater mussels and mudpuppies in the canal was requested. Similar requests were also received from the MADFW, NHFGD, NOAA, CRWC, and TU. The stakeholder's indicate that the study request is intended to facilitate the collection of information necessary to conduct effect analyses and to develop reasonable and prudent conservation measures, along with PME measures.

Historically, FirstLight has conducted informal annual surveys of the canal during drawdown events. In 2011, a more extensive survey was conducted and documented in a memo report as explained below under the Existing Information discussion. FirstLight will conduct a similar survey during the 2014 drawdown event, with additional data collection aimed to fulfill the stakeholder's objectives as described below.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to identify and evaluate potential measures to reduce adverse effects due to dewatering for the annual canal drawdown events. The objectives are to:

- Assess whether juvenile shad and American eel abundance in the canal increases leading up to the time of its closure, due to delays in downstream passage (e.g., is fish accumulation occurring).
- Evaluate level of mortality for juvenile sea lamprey from exposure of burrow habitats in the canal.
- Conduct a survey of fish and aquatic organisms (e.g., freshwater mussels and mudpuppies) during the 2014 canal drawdown to document species presence, estimate relative densities, determine status (stranded, alive, dead), and map wetted areas.
- Evaluate measures to minimize aquatic organism population impacts of the canal drawdown.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The CRASC developed *A Management Plan for American Shad in the Connecticut River Basin* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Maximize outmigrant survival for juvenile and spent adult shad.

The ASMFC Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, has the stated goal of "*Protect, enhance, and restore Atlantic coast migratory stocks and critical habitat of American shad in order to achieve levels of* *spawning stock biomass that are sustainable, can produce a harvestable surplus, and are robust enough to withstand unforeseen threats,"* and includes the following objectives:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

2. To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g. turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

The USFWS seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Turners Falls Project. General goals include the following:

1. Ensure that PME measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Turners Falls Project.

Specific to diadromous fishes, the USFWS goal is to minimize current and potential negative project operation effects on diadromous fishes, including juvenile shad, adult silver eels, and sea lamprey ammocetes.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Historically, FirstLight has observed stranding of juvenile American shad during annual canal drawdown events. In 2011, FirstLight's consultant and staff from Conte Lab conducted a more formal survey to include delineation of the canal into seven distinct zones. Each zone was visually surveyed for juvenile shad and other species, which were counted or estimated depending on numbers present. Any pool areas were documented with photos and represented on aerial photos. A summary report was developed and is provided in Appendix G of this RSP. While no shad were observed, probably because of a flood event prior to the drawdown, a variety of species were documented, including centrarchid and cyprinid species, sea lamprey, carp, perch, mussels, chain pickerel, and American eel. Numbers observed varied by zone and by species.

FirstLight believes that Study Nos. 3.3.4 and 3.3.5 will further address the concerns regarding whether outmigrating shad and American eels are impacted by the annual drawdown events.

Project Nexus (18 CFR § 5.11(d)(4))

Previous studies at Cabot Station have documented that juvenile American shad and American eel migrate through the project area during the canal drawdown period. During normal operations (where canal water level elevations are stable), downstream migrants are able to utilize the Cabot bypass facility; however, as the canal water level is drawn down, the bypass is no longer available, and the only routes of egress are through the turbines at Cabot Station and Station No. 1.

Once the canal has been drawn down, much of the canal bed still has a well defined channel with water flowing, although some isolated shallow pools remain until the canal is refilled. During this period, fish (including lamprey ammocoetes), amphibians, and benthic invertebrates may be prone to desiccation, predation or other sources of mortality.

The annual canal drawdown was formerly conducted in July. In response to ISO-NE's request that FirstLight conduct the drawdown outside of the June through August period, FirstLight moved the drawdown to September, which coincides with the part of the migration period for some diadromous species.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

FirstLight believes that, with modifications, the 2011 survey methods are adequate to meet study objectives for documenting the species (fish, freshwater mussels, and mudpuppies) present in the canal during a drawdown event, estimating their relative densities, determining physical status (stranded, alive, dead), and developing a map of wetted areas. Additional efforts, described below, will be included to determine the level of mortality of juvenile sea lamprey and mussels due to exposure of burrowing habitat at the downstream end of the canal. Data collected during the 2014 canal drawdown event will be used to inform the selection of potential mitigation measures to be evaluated for minimizing the adverse effects of the drawdown events on aquatic organisms in 2015. FirstLight believes that Study Nos. 3.3.3 and 3.3.5 will address the concerns regarding whether outmigrating shad and American eels are impacted by the annual drawdown events.

Due to the iterative process of conducting survey methods that will be used by FirstLight and stakeholders to identify and evaluate potential mitigation measures, the Study Schedule section below identifies an estimated time line of activities to incorporate a consultation process into this study.

Task 1: Conduct Aquatic Organism Survey of Canal During 2014 Drawdown

Similar to the 2011 survey, the survey will be conducted by segmenting the canal into approximately seven distinct zones (see map in Appendix G) and surveying each of the dewatered zones for observations of fish, mussels, and mudpuppies. The surveys will commence as soon as practicable after dewatering has been completed to avoid potential interference from avian predation of stranded fish. FirstLight proposes to conduct the study on the day following the drawdown, since post-drawdown predation and scavenging by birds and mammals could bias survey results. A second survey will be conducted the day before the canal is refilled to provide information on the extent of the effects associated with the duration of the drawdown. A field crew of experienced biologists will systematically traverse each of the zones in a meander survey fashion recording observations of estimated number of each species encountered. For each species observed, an assessment of the number of stranded, dead and alive individuals will be estimated. Additional information on the general location of species observations and predominant substrate type will be recorded on standardized field data sheets, as well as relevant weather conditions (air temperature, cloud cover estimate, precipitation, etc.).

For areas that remain sufficiently wetted (greater than 6 inches depth) in Zones 1-6 after the drawdown is completed, backpack electrofishing and/or beach seine techniques will be employed to determine relative abundance of fish in these areas. Standardized backpack electrofishing techniques will be utilized as habitat conditions permit and beach seines may be used in those areas not suited for backpack electrofishing (greater than 3 feet depth). For backpack electrofishing, a single backpack operator with a dip net will be accompanied by one or two additional netters and each sampling event will be standardized by time, such that results can be reported as the number of fish collected per 500 seconds of sampling. Beach seines will be used in appropriate areas where water depth is such that the net wall can extend from the surface to the bottom of the water column, and where the bottom contour is smooth to avoid net hang-ups. Beach seines will be performed with two people, each holding a pole at the end of the wing and towing the net through the wetted area until a specified, pre-determined area has been covered. At the conclusion of the seine sampling event, the wings of the net will be brought together and the bag

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will be hauled to an appropriate area where the nets content can be sorted for identification and enumeration.

Based on observations during previous drawdown events, leakage through the gatehouse and canal bathymetry allows the majority of Zone 7 to remain sufficiently wetted (see photos below). This leakage combined with the egress through the Keith Drainage Tunnel, appears to provide adequate flow and depth to support aquatic species over the short term. As such, the survey for aquatic organisms in Zone 7 will be focused on the exposed, higher elevation areas only.

Photos (taken during 2011 drawdown survey) depicting typical conditions in Zone 7 during canal drawdown event.

Areas in Zones 2-6 (includes the areas of previous observations of juvenile sea lamprey) with appropriate soft sediment habitat will be further scrutinized to determine the distribution and relative abundance of juvenile sea lamprey (ammocoetes) and mussels. Up to 10 randomly selected 1-m by 1-m quadrats will be sampled in each zone and counts of ammocetes and mussel by species will be recorded. The quadrats will be stratified by bank and channel with 10 each on the east bank, west bank and thalweg (Figure 3.3.18-1).. The physical status (stranded, alive, dead) of the individuals will also be recorded. These data will be used to extrapolate counts for the entire area of suitable habitat within each zone.

The location of sufficiently wetted areas or pools will be GPS-located for subsequent map generation (including Zone 7). Based on observations during previous drawdown events, a large pool typically remains in the Cabot forebay area for the duration of the drawdown period. A GPS unit will be utilized to record the location and extent of the pool for inclusion on the map of wetted areas. Water quality parameters (temperature, dissolved oxygen, turbidity) will be also measured and recorded in the pools. Water temperature will be continuously monitored in Zone 7 with a long-term temperature logger at a location selected in consultation with resource agencies for the duration of the drawdown event. Dissolved oxygen will be measured in Zone 7 during the two drawdown surveys. These measurements will be taken from the 2 bridges that cross the canal in that Zone.

Results for aquatic organism sampling will be reported in units of standardized time of effort for electrofishing and also by unit area for the seining and quadrat sampling. A comparison of data collected during the two surveys will be compared. Water quality information, fish survey and quadrat data will be summarized in tabular format and included with the graphical canal representation in a report for stakeholder review.

Task 2: Identify and Assess Potential Measures

This task will consist of consulting with agencies and other stakeholders to identify and evaluate potential measures that may reduce adverse effects on fish and mussels in the canal during drawdown conditions. Potential measures may include, but not be limited to, assessment of the need for annual drawdowns; assessment of drawdown timing and frequency; and placement of temporary weirs or baffles in select areas of the canal to enlarge pools that remain during drawdown events or create additional pools to keep specific habitat areas wetted for the duration of the drawdown event. The evaluation will compare the merits and drawbacks of each measure, as well as develop an order-of-magnitude cost estimate. Should FirstLight and stakeholders reach an agreement on appropriate measure(s) to evaluate in the field then engineering design will proceed in Task 3. Stakeholders will also be consulted for development of a study design to assess the effectiveness of the selected measure that will be tested in the field.

Task 3: Design Selected Measure(s)

Upon agreement between FirstLight and stakeholders on appropriate measure(s), if any, to reduce adverse effects on aquatic organisms during drawdown events, engineering design (if applicable) of the selected measure(s) will be developed in consultation with Stakeholders in 2015. Following design, the selected measure will be tested in the field during the 2015 drawdown event.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to conduct a drawdown survey and design potential measures, if feasible, to reduce the impacts of the annual drawdown events on aquatic organisms present in the canal. The total estimated cost for the proposed study is approximately $80,000 - $100,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

- FirstLight to conduct Task 1 field surveys – September 2014
- Distribute summary report of results Task 1 and initial list of potential measures to be evaluated under Task 2 – First Quarter of 2015
- Hold meeting with Stakeholders to review Task 1 summary, seek to reach consensus on measure(s) to be field evaluated, and metrics for determining relative success of measure(s) to reduce effects of drawdowns – First Quarter of 2015
- Prepare conceptual design, if applicable, of measure(s) to be evaluated and submit to Stakeholders for review – April – May 2015
- Finalize conceptual design in consultation with Stakeholders, including meetings as determined appropriate – June 2015
- Construct test materials for placement and testing – July – August 2015
- Install and test – September 2015
- Distribute summary report of 2015 results for Stakeholder review – January 2016
- Hold meeting with Stakeholders to review results of testing and conclusions – February – March 2016

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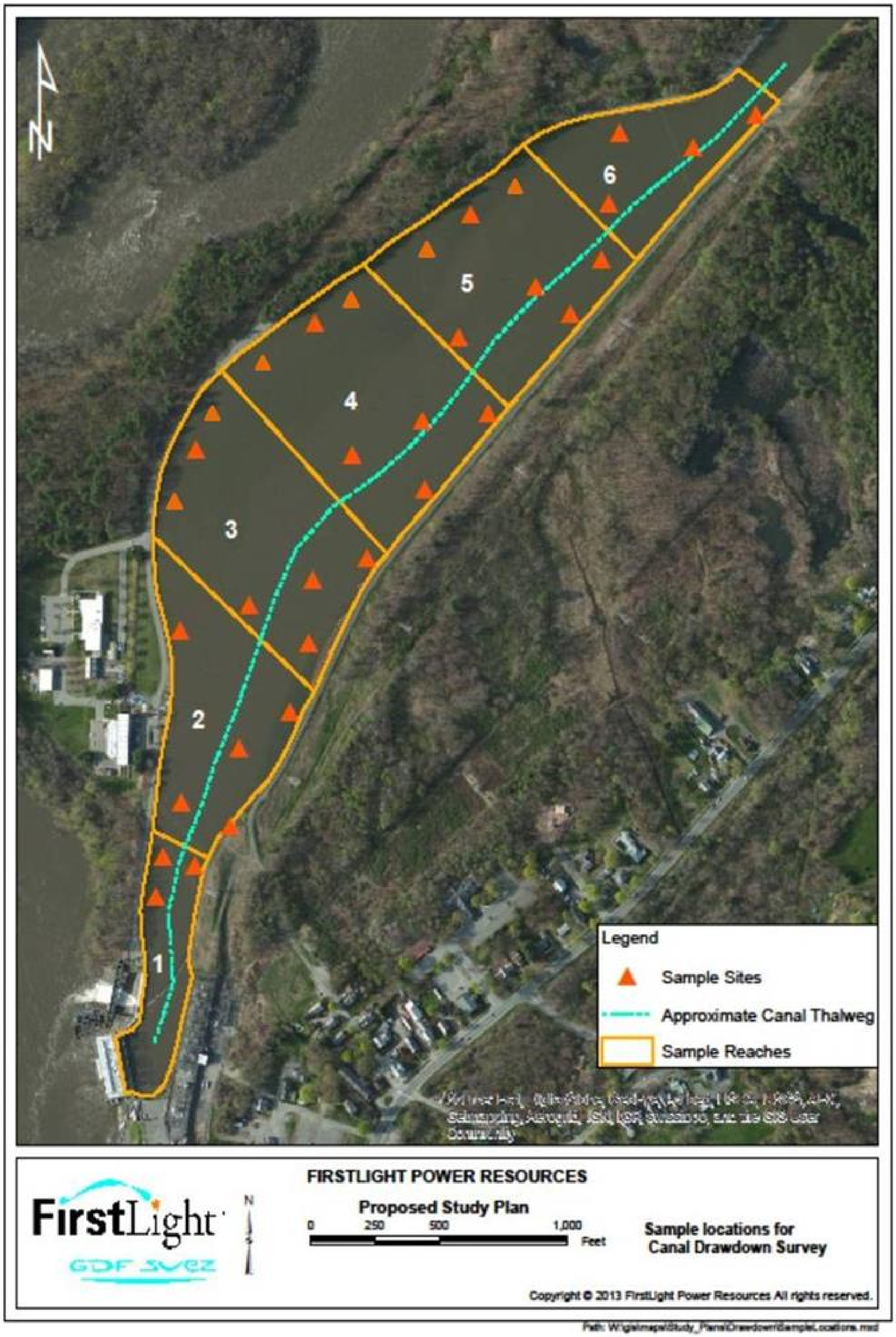

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Document Accession #: 20140916-5028 Filed Date: 09/16/2014

Relicensing Study 3.3.19

EVALUATE THE USE OF AN ULTRASOUND ARRAY TO FACILITATE UPSTREAM MOVEMENT TO TURNERS FALLS DAM BY AVOIDING CABOT STATION TAILRACE

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight™
GDF SUEZ

Prepared by:

Kleinschmidt

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The objective of the study is to establish a high frequency sound (ultrasound) array across the Cabot Station tailrace and determine the effect of the ensonified field on upstream migrating radio-tagged shad moving past Cabot Station. This would be accomplished by monitoring the movements and passage of shad and the time shad spend in the tailrace area.

This study will be conducted in 2016 pending the results of Study No 3.3.1 (Conduct Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station) and Study No. 3.3.2 (Evaluate Upstream and Downstream Passage of Adult American Shad),which include telemetry studies and analysis of historic fish passage data. The location of the proposed array would be in the area of the identified shortnose sturgeon spawning grounds; it would be operated during the sturgeon and shad spawning seasons, which overlap.

To date, no consultation has been required for this study.

<u>Reporting</u>

A final report will be completed in March 2017 per the Federal Energy Regulatory Commission's (FERC) February 21, 2014 Study Plan Determination Letter (SPDL).

1.2 Study Progress Summary

Per FERC's SPDL, it recommended that FirstLight evaluate Study No. 3.3.2 *Evaluate Upstream and Downstream Passage of Adult American Shad* results, consider recommendations from stakeholders, and make any necessary modifications to this study's proposed methodology. FERC requested that the amended study should address stakeholder comments and recommendations. FirstLight plans on filing an updated study plan after completion of Study No. 3.3.2, which is slated to be conducted in 2015.

1.3 Variances from Study Plan and Schedule

To date there are have been no variances.

1.4 Remaining Activities

- File an amended study plan after completion of Study No. 3.3.2 after consultation with stakeholders.
- Conduct the field study in 2016.
- Complete report.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.4.1

BASELINE STUDY OF TERRESTRIAL WILDLIFE AND BOTANICAL RESOURCES

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to characterize and describe the terrestrial and botanical resources that use representative upland habitats within and adjacent to the Turners Falls and Northfield Mountain Project boundary. Baseline information is being collected on terrestrial and wildlife resources in the Turners Falls Impoundment, the Bypass Reach, and below Cabot Station. Surveys are being completed by biologists visually assessing habitats along and above the shoreline from boat and/or walking on FirstLight and public lands throughout the 2014 growing season. Surveys will be completed by September 30, 2014.

To date field data has been collected to:

- Inventory overall existing upland wildlife habitats;
- Inventory vegetative cover classes;
- Evaluate the presence of targeted rare, threatened and endangered (RTE) species or associated habitats; and
- Inventory the nature and extent of invasive and exotic vegetation species.

1.2 Study Progress Summary

<u>Task 1: Literature Review</u>
Prior to the survey, biologists reviewed existing information to identify representative communities and potentially suitable habitat for RTE species. Using GIS and other available sources, a GIS specialist developed preliminary field maps to assist field survey efforts.

<u>Task 2: Wildlife and Habitat Type Mapping</u>

General habitat field notes were recorded, including: dominant vegetation cover classes; unique or unusual habitat types; observations of avian, reptile, amphibian, and mammal species; and locations of invasive plant species. Ongoing wildlife surveys were completed using visual encounter survey methods, while simultaneously completing botanical meander surveys along the shoreline. Visual encounter surveys were augmented with incidental observations of wildlife signs (i.e., tracks, scat, den areas, nests, etc.). More intensive searches were performed for individual species where suitable or unique habitats were identified (i.e., river islands, confluences with tributaries, vernal pools and wetland habitats). The locations of significant sightings and observations were documented through the use of GPS and geo-referenced photographs and were entered into the Project GIS data base. Data collected will be compiled into a Project area species list and maps.

<u>Task 3: Vegetation Type Mapping</u>

Botanical surveys are ongoing to determine the species composition, structure, and distribution of vegetative communities within the Project. Data collected to date (August 15, 2014) include percent cover and dominant species within the herbaceous, shrub, and tree stratums along with the general distribution and juxtaposition of vegetative communities. Modified timed-meander surveys involve walking a meandering path through each habitat parallel to the shoreline and recording species present until a period of time passes where no new species are observed. Surveyors compiled a list of all plants found within each respective habitat and are maintaining an overall census list of all plant species identified within the Survey Area. Vegetation communities are being classified using the Natural Heritage and Endangered Species Program (NHESP) Classification of the Natural Communities of Massachusetts (Swain & Kersey, 2011). Sample vegetation plots are being established to collect quantitative information using NHESP Quantitative Community Characterization Form (NHESP Form 3) to characterize representative habitats. Geo-referenced photographs were taken to document site conditions at the time of the survey.

Task 4: Invasive Plant Survey

The Massachusetts Invasive Plant Advisory Group (MIPAG) species list of invasive plants was utilized to identify targeted invasive species when conducting botanical meander surveys. Surveyors used methods adapted from the United States Forest Service (USFS) Invasive Species Program, Invasive Species Inventory and Mapping Data Recording Protocols. These adapted methods focus on presence, location, extent, abundance and other site characteristics to provide site infestation information.

Biologists used a Trimble (GPS) at sub-foot accuracy to delineate the boundary of each infestation of the invasive plant. Areas containing only occasional invasive species were characterized with a GPS center point and radius necessary to enclose the population. For areas where invasive species were ubiquitous or impractical to map, surveyors characterized the invasive species population qualitatively using estimates of aerial coverage and percent of species present. As land disturbances favor establishment of invasive plants over native plant communities, survey efforts for invasive species were focused on disturbed lands, areas of vegetation management, access roads, and recreational trails which can be vectors for invasive species propagation. All sampling areas containing invasive botanical species were documented with geo-referenced photos.

Task 5: Data Analysis and Reporting

Data analysis and reporting is in development. A final report will be complete in the 2nd quarter of 2015.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances from the approved RSP.

1.4 Remaining Activities

Field data collection is scheduled to be completed by September 30, 2014. Following the completion of field work a technical report will be prepared for this study. The study report will include:

- Maps illustrating the classification of wildlife habitat in the study area;
- Documentation of the presence and distribution of wildlife;
- Final maps of vegetation-type polygon boundaries in the study area;
- A table of vegetation types and the percent of the study area occupied by each vegetation type;
- A technical discussion that includes a description of vegetation at the Project; and
- Maps of the location, extent and abundance of invasive plant species in the study area.

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Relicensing Study 3.4.2

EFFECTS OF NORTHFIELD MOUNTAIN PROJECT-RELATED LAND MANAGEMENT PRACTICES AND RECREATION USE ON TERRESTRIAL HABITATS

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to collect baseline information to understand the potential effects of land management practices and recreational use on wildlife and botanical resources within the Northfield Mountain Project area. Information collected to date (August 15, 2014) includes:

- Field data to describe existing wildlife and botanical habitats occurring in the Northfield Mountain Project boundary;
- Wetland resources inventory, including verification of National Wetland Inventory (NWI) mapped wetlands;
- Mapping and baseline inventory of vernal pools;
- Distribution of invasive plant species within Project-related land management and recreation areas;
- Information to identify potential effects of Project-related land management and maintenance practices and the use of Project-related recreation areas within the Project boundary on existing wildlife and botanical resources (e.g., clearing of vegetation).

For the purposes of this study, the Northfield Mountain Project area includes the lands around Project facilities (e.g., lands around the Upper Reservoir, parking areas, access roads) and recreational areas (e.g., picnic areas, trails, and hiking areas) on Northfield Mountain.

Field surveys are scheduled to be completed by September 30, 2014. The following is lists dates of field data collection surveys:

- April 14-25, 2014 -Vernal pool surveys
- May 12-16, 2014 - Wildlife, botanical, wetland, invasive species surveys
- June 16-20, 2014 - Wildlife, botanical, wetland, invasive species surveys
- July 14-18, 2014 - Wildlife, botanical, wetland, invasive species surveys
- August 11-15, 2014 - Wildlife, botanical, wetland, invasive species surveys

To date, there has been no consultation record.

1.2 Study Progress Summary

<u>Task 1: Literature Review</u>

A pre-survey review identified areas of representative plant communities, land use classes, recreational areas and trails, invasive species infestations, and potentially suitable habitat for protected species of interest as identified in Section 4.7 of the Pre-Application Document (PAD). Using GIS and other sources, preliminary field maps were produced to assist field surveys.

Prior to field investigations, researchers and biologists reviewed the practices and locations of FirstLight Project-related land use management activities (e.g., areas routinely mowed, vegetation management areas, access roads) and recreational uses (e.g., trails, climbing areas, skiing & snow shoeing) at the Northfield Mountain Project.

<u>Task 2: Wildlife and Habitat Type Mapping</u>

General habitat field notes have been recorded including: dominant vegetation cover classes; unique or unusual habitat types; observations of avian, reptile, amphibian, and mammal species; and locations of invasive plant or wildlife sign (i.e., tracks, scat, den areas, nests, etc.). More intensive searches were performed for individual species in suitable or unique habitats (i.e., wetlands, vernal pools, cliffs, ravines). Wildlife surveys were completed using visual encounter surveys methods concurrently with botanical time-meander surveys. Visual encounter surveys were augmented with incidental observations of outcroppings and cliffs, ravines, vernal pools, wetland habitats). The locations of significant sightings and observations were documented through use of GPS and geo-referenced photographs and were entered into the GIS data base. Data collected will be compiled into a Project area species list.

Task 3: Vegetation Cover Type Mapping

Botanical surveys are ongoing to determine the species composition, structure, and distribution of vegetative communities within the Project. Data collected to date (August 15, 2014) include percent cover and dominant species within the herbaceous, shrub, and tree strata along with the general distribution and juxtaposition of vegetative communities. Modified timed-meander surveys involved walking a meandering path through each habitat and recording species present until a period of time passed (usually 1 to 2 hours) where no new species were added to the vegetation list. Surveyors compiled a list of all plant species found within each habitat, and are maintaining an overall census list of all plant species identified within the Project Area. Vegetation communities were classified using the NHESP Classification of the Natural Communities of Massachusetts (Swain & Kersey, 2011). Sample vegetation plots were established to collect quantitative information using NHESP Quantitative Community Characterization Form (NHESP Form 3) to characterize representative habitats. Geo-referenced photographs were taken to document site conditions at the time of the survey.

Task 4: Invasive Plant Survey

The Massachusetts Invasive Plant Advisory Group (MIPAG) list of invasive plant species was utilized to identify targeted invasive species when conducting botanical meander surveys. Surveyors used methods adapted from the United States Forest Service (USFS) Invasive Species Program, Invasive Species Inventory and Mapping Data Recording Protocols. These adapted methods focus on presence, location, extent, abundance and other site characteristics to provide site infestation information.

Biologists used a Trimble (GPS) at sub-foot accuracy to delineate the boundaries of infested areas of invasive plants. Areas containing only individual or smaller stands of invasive plants were characterized with a GPS center point and radius necessary to enclose the population. For areas where invasive species are ubiquitous or impractical to map, surveyors characterized the invasive species population qualitatively using estimates of aerial coverage and percent of species present. As land disturbances favor establishment of invasive plants over native plant communities, survey efforts for invasive species were focused on disturbed lands, areas of vegetation management, access roads, and recreational trails which can be vectors for invasive species propagation. All sampling areas containing invasive botanical species were photo-documented with geo-referenced photos.

Task 5: Land Management Practices and Recreation Uses

Task 5 is in progress. Land management practices and recreational uses within the study area have been identified and documented. Field data collection is scheduled to be completed by September 30, 2014. Results from the wildlife and botanical field surveys will be used to analyze the relationship between Project operations and recreational uses, and wildlife and botanical resources. Practices which need to be changed to avoid or minimize impacts will be identified as appropriate.

Task 6: Data Analysis and Reporting

Field studies will not be completed until September 30, 2014. Data analysis and reporting is in development. A report will be completed in the 2nd quarter of 2015.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the FERC approved RSP.

1.4 Remaining Activities

Field data collection is scheduled to be completed by September 30, 2014. Following the completion of field work a technical report will be prepared in the 2nd quarter of 2015.

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Relicensing Study 3.5.1

BASELINE INVENTORY OF WETLAND, RIPARIAN AND LITTORAL HABITAT IN THE TURNERS FALLS IMPOUNDMENT, AND ASSESSMENT OF OPERATIONAL IMPACTS ON SPECIAL-STATUS SPECIES

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

Kleinschmidt   Gomez and Sullivan Engineers   NEE

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

This study contains multiple elements. In addition to conducting an inventory of wetlands, riparian and littoral zone resources in the Turners Falls Impoundment (Impoundment), this study contains provisions for assessing Project impacts on state-listed plant species in the Impoundment, bypass reach and downstream of Cabot Station to the Sunderland Bridge, and assessing Project impacts on state-listed invertebrate species that utilize riparian areas downstream of Cabot Station.

The study goals are to characterize and describe the wildlife and botanical resources within the Project Area and assess the potential impacts of Project-related water level fluctuations on identified resources. 2014 field studies are ongoing and field data collected to date (August 15, 2014) have included:

- Field verification of National Wetland Inventory (NWI) mapped wetland types;
- Field data collection on submerged aquatic vegetation (SAV) and emergent aquatic vegetation (EAV) beds;
- Field data collection on the presences, abundance and extent of invasive species;
- Initial field visits and collection of baseline information on the locations and population parameters of Massachusetts state-listed rare plant species in the Impoundment and the 13+ miles of riverine habitat below Cabot Station to the Route 116 Bridge in Sunderland;
- Initial data collection on suitable habitat locations for state-listed invertebrate species including the cobblestone tiger beetle and the Puritan tiger beetle.

The Study Areas that have been investigated to date include the following:

- Impoundment: survey areas within the river and areas up to 200 feet from shore where the Project boundary is along the shoreline, extending from the base of Vernon Dam to the Turners Falls Dam.
- The approximate 13+ miles of shoreline and riverine habitat below the Turners Falls Dam to the Route 116 Bridge in Sunderland. Riparian areas are being surveyed up to the top of bank in this segment of the study area.
- From the base of the Vernon Dam to the Turners Falls Dam, and from the confluence of the Deerfield River to just downstream of the vicinity of Rainbow Beach is being investigated for potential cobblestone and Puritan tiger beetle habitat.

To the extent possible, field surveys have been conducted under low flow and low water level conditions. Field surveys are scheduled to be completed by mid October, 2014.

Biologists consulted via telephone with Jessie Leddick, Endangered Species Review Biologists with Natural Heritage and Endangered Species Program (NHESP) on sensitive plant survey efforts to date (August 15, 2014) and proposed survey methods and schedule to complete Task 3. NHESP approved and lead RTE project botanists, Steve Johnson PhD, discussed via telephone survey parameters (i.e., survey windows and time per unit area) and methods with NHESP Conservation botanists Karro Frost.

1.2 Study Progress Summary

<u>Task 1: Literature Review</u>

Prior to the field reconnaissance surveys, biologists reviewed existing information to identify areas of representative communities and potentially suitable habitat for protected species of interest. Using GIS and other available sources of information, preliminary field maps were produced to assist field surveys. Pre-survey, biologists will review life histories of wildlife and phenology of listed plants for known listed species at the Project.

Task 2: Riparian and Littoral Zone Botanical Survey

Botanical assessments are being completed to determine the species composition, structure, and distribution of vegetative communities. Botanical field inventories have included timed-meander surveys, which involved walking a meandering path parallel to the shoreline through each representative habitat type and recording species present until a period of time (typically 30 to 60 minutes in non state-listed RTE habitats) passes where no new species were added to the vegetation list. SAV and EAV beds are being surveyed from a boat and kayaks. SAV and EAV bed perimeters are being surveyed or are being located with a center GPS point with a radius that encompasses the entire bed.

Surveyors are compiling a census list of plants found within each habitat and are collecting an overall list of all plant species identified within the Project Area. General health of communities and overall site quality conditions are also being assessed during the meander surveys. Vegetation communities have been classified using NHESP Classification of the Natural Communities of Massachusetts (Swain & Kersey, 2011). Sample vegetation plots are being established to collect quantitative information at the different habitats and provide species composition of habitat types. A Massachusetts NHESP Quantitative Community Characterization Form (Massachusetts NHESP Form 3) is being completed for each representative habitat, and geo-referenced photographs have been taken to document site conditions at the time of the survey.

Task 3: Sensitive Plant Survey

A sensitive-plant survey and biological evaluation of the locations and population parameters of 10 state-listed rare plant species are being completed in the Impoundment and from the Turners Falls Dam downstream to the Route 116 Bridge in Sunderland, MA. NHESP approved botanist Steven Johnson PhD, is assisting with field surveys and providing technical expertise with this task. A data release agreement (DRA) with NHESP was completed in November 2013 to gather initial environmental occurrence (EO) of sensitive plants within the study area.

Initial river reconnaissance to identify potential suitable habitat for state-listed species at both NHESP historic EO's and at new sites that have potential habitat for these 10 targeted state-listed plant species (but were otherwise unoccupied at the time of the survey) was completed in June 2014. An application for a scientific collection permit was submitted to the Massachusetts Wildlife Division of Fisheries and Wildlife (MDFW) on June 30, 2014.

Table 1.2 illustrates identification periods of the NHESP targeted species based on each plants specific phenology.

Table: 1.2. RTE Plant Identification Periods

	May	June	July	Aug	Sept	Oct
Salix exigua						
Prunus pumila var. depressa						
Alnus viridis						
Deschampsia cespitosa ssp. glauca						
Eragrostis frankii						
Eleocharis intermedia						
Eleocharis diandra						
Eleocharis ovata						
Symphyotrichum transcantii						
Oligoneuron album						

Identifiable condition

Flowering, or mature fruit present

Identification periods for ten RTE target species within the project boundary. ID periods are based on NHESP fact sheets. Continued ground surveys are scheduled for August through September 2014.

A survey to gather presence/ absence data on state-listed plants at identified potential habitat and historic EO is scheduled to occur over the weeks of August 18 – September 19 2014. This schedule was selected to coincide with the period when most plants are more readily identifiable. During the presence / absence survey, botanists will select preliminary transects which will later be used to collect additional fine scale data and complete biological evaluations on representative populations. Following the presence / absence surveys, maps will be generated showing locations of suitable but otherwise unoccupied, occupied RTE plant habitat, historic EO and proposed plant survey transects. Using these maps FirstLight will consult with NHESP for concurrence on final selection of plant transects.

<u>Task 4: Invasive Plant Survey</u>

Invasive species likely to occur in the study area were selected from the Massachusetts Invasive Plant Advisory Group (MIPAG) invasive species list; a total of nine aquatic species were selected. The riparian and aquatic invasive plant surveys are in the process of being completed along the perimeter of the Impoundment downstream to Route 116 on both sides of the river, up to the limit of project-influenced stream banks. Aquatic invasive plant species are being located by boat and on foot. Surveyors used methods adapted from the United States Forest Service (USFS) Invasive Species Program, Invasive Species Inventory and Mapping Data Recording Protocols. These adapted methods focus on presence, location, extent, abundance and other site characteristics to provide site infestation information.

Biologists used a Trimble GPS at sub-foot accuracy to delineate the boundary of each infestation of invasive plant communities. Areas containing only single occurrences or small stands of invasive species were characterized with a GPS center point and radius necessary to enclose the population. For areas where invasive species are ubiquitous or impractical to map along the shoreline, surveyors characterized the invasive species population qualitatively using estimates of aerial coverage and percent of species present. As land disturbances favor establishment of invasive plants over native plant communities, survey efforts for invasive species were focused on disturbed lands, areas of vegetation management, access roads, and recreational trails which can be vectors for invasive species propagation. All sampling areas containing invasive botanical species were documented with geo-referenced photos.

Task 5: Mapping Wetlands and Waters of the United States

Within the Impoundment and up to 200 feet from the Impoundment shoreline, NWI mapped wetlands are being field verified and described. A team of wetland scientists is completing the field assessments and mapping. Information collected is being transferred to the GIS database to provide the foundation for the development of a map of the location, type, extent and photo of each wetland feature within the study area.

Task 6: Project Water Level Fluctuation Assessment

Data collected during this study, along with the results of hydraulic modeling (Study 3.2.2), will be used to evaluate the effect of Project-related water level fluctuations on known populations of Puritan and cobblestone tiger beetles habitat.

Task 6a: Tiger Beetle Habitat Field Evaluation

High river flows inundated historic tiger beetle habitat for prolonged periods of time during the 2014 survey period. As a result of higher than average flows, Tiger beetle surveys have been delayed from an original projected survey window of early July 2014 to mid -late August 2014. Initial site reconnaissance is scheduled to be completed by August 22, 2014. Once initial tiger beetle habitat reconnaissance is completed FirstLight will consult with Tiger beetle expert, and NHESP approved biologist Chris Davis, as to the number and placement of transects needed to collect fine scale data to analyze Project operations effects on tiger beetle habitat. Following initial surveys, and consultation with Mr. Davis, FirstLight will provide NHESP and the United States Fish and Wildlife Service (USFWS) with a period to comment on transect data locations. It is anticipated that initial habitat reconnaissance and presence/absent surveys will be completed between August 15 and September 5, 2014. Following the initial surveys and consultation with agencies on the placement of transects, biologist will collect fine scale information as outlined in the Modified Revised Study Plan (RSP).

Task 6b: Water Level Fluctuation Evaluation

The fine-scale needed to enable analysis of the localized flow velocity and dynamics within near-bank habitats is being assessed using field data collection and hydraulic modeling to measure water level fluctuations, velocity and other factors across a range of flows. Hydraulic modeling will include a combination of models at key locations including a HEC-RAS model, IFIM-related hydraulic model, and water level loggers. The HEC-RAS modeling is in process.

Task 7: Data Analysis

As field studies will not be completed until mid October, 2014, data analysis is in development.

Task 8: Reporting

A report will be completed in the 2nd quarter of 2015.

1.3 Variances from Study Plan and Schedule

Higher than normal river flows inundated habitats for prolonged periods of time during the 2014 survey period. Because of the high spring river flow, field studies originally scheduled to begin in early May were delayed until early June when river flows were both safer and low enough to expose habitats. As a result of higher than average flows, Tiger beetle surveys have been delayed from an original projected survey window of early July 2014 to mid -late August 2014.

1.4 Remaining Activities

Field data collection is scheduled to be completed by mid October 2014. Following the completion of field work a technical report will be completed.

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Relicensing Study 3.6.1

RECREATION USE/USER CONTACT SURVEY

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers   TRC

SEPTEMBER 2014

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1.1 Study Summary

FirstLight is conducting a study to determine the existing recreational use and demand at the Turners Falls Project and Northfield Mountain Pumped Storage Project (Projects) and an assessment for the need to enhance recreation opportunities and access at the Projects. Data is being collected using on-site visitor counts and intercept surveys at formal and informal public recreation areas at the Projects and mail surveys of adjacent residential landowners. Data from the *Recreation Facilities Inventory and Assessment* (Study No. 3.6.2)*,* the *Whitewater Boating Evaluation* (Study No. 3.6.3), the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats* (Study No. 3.6.4)*,* and the *Recreation Study at Northfield Mountain, including Assessment of Sufficiency of Trails for Shared Use* (Study No. 3.6.7) will also be used to determine the sufficiency of existing recreation facilities in meeting recreation demand at the Projects and to assess the need to enhance recreation opportunities and access at the Projects.

The recreation use/user contact survey is being conducted to assess the amount of existing recreation use at the Projects. The study interviews will be used to determine user opinions and goals with regard to recreation sites and access at the Projects.

1.2 Study Progress Summary

<u>Task 1: Study Preparation</u>

FirstLight developed a field data collection schedule and trained field staff during December of 2013 and January of 2014. FirstLight trained additional field staff during the summer of 2014. FirstLight developed a mail questionnaire/survey to ascertain recreational use by residential abutters. FirstLight has obtained and reviewed readily available municipal (town recreation departments and open space committees) and non governmental organization (NGO) recreation plans for information regarding recreation use within the Projects' boundaries. FirstLight also requested and received permission to install traffic counters on Massachusetts Division of Fish and Wildlife (MADFW) boat ramps. FirstLight also consulted with the Northfield Open Space Committee in connection with Study No. 3.6.4.

<u>Task 2: Field Work</u>

Field work was initiated in January 2014. Staff is currently conducting calibration counts at each formal Project recreation facility on five (5) days per month, which includes three (3) randomly selected weekdays and two (2) randomly selected weekend days. For months containing a three-day holiday weekend, an additional calibration count is being conducted on one (1) holiday weekend day. Spot counts are being conducted at each formal Project recreation facility on five (5) days per month, which includes three (3) randomly selected weekdays and two (2) randomly selected weekend days. For months containing a three-day holiday weekend, an additional spot count is being conducted on one (1) holiday weekend day. User contact surveys are being administered to one member of each recreation group encountered during the calibration and spot counts.

Traffic counters were installed at selected recreation sites prior to Memorial Day 2014. Data from the counters is being retrieved on Fridays and Mondays to differentiate between weekday and weekend traffic and use.

On July 30, 2014 the residential abutters' survey was mailed to the 211 residences abutting the Turners Falls and Northfield Mountain Projects. On August 22, 2014 reminder postcards were sent to the 211 residences. As of September 1, 2014, 38% of the surveys had been completed and returned.

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Task 3: Data Entry and Statistical Analysis

All data being collected is entered into electronic spreadsheets for statistical analysis and will continue until the completion of the study at the end of 2014. Data analysis will be completed by the 2nd quarter of 2015.

Task 4 Report Writing

A final report will be completed during the 4th quarter of 2015.

1.3 Variances from Study Plan and Schedule

In the Federal Energy Regulatory Commission's (FERC) September 13, 2013 Study Plan Determination Letter, it made some recommendations regarding Study 3.6.1, including certain modifications to the recreation user survey. Specifically staff recommended that Question 11, which asked users to indicate which activities they participate or have participated in at the Projects be modified to add the qualifier "in the past five years"; Question 15, which asked users to rate amenities, be modified to include "toilets and restrooms" and "river access"; and that a Likert-type question about satisfaction with the number of recreational facilities at the Projects be added to the survey. FERC staff also recommended that Question 13 of the Northfield Mountain trail user survey, which asked users to provide their opinion on a variety of issues about the trails be modified to add the variable of "Hours of Operation" and that it conclude with an open-ended inquiry into how any rated variables be could be improved. Inadvertently, these recommended modifications to the surveys were not made until August 2014. As a result, the surveys administered for the period January through late August 2014 did not include these modified questions. Beginning the last week of August 2014 the field staff conducting the surveys were directed to administer the revised recreation user and Northfield Mountain trail surveys that includes the modified questions recommended by FERC staff.

For a number of reasons, FirstLight believes that this variance from the study plan will not in any way limit the value of the survey information collected through late August 2014. Nor will this variance affect the usefulness of the survey results to provide an accurate assessment of recreation user perceptions of the availability and condition of recreation opportunities and facilities at the Projects.

First and foremost, with the implementation of the modified surveys in August, 2014, there are still over four months during which revised on-site surveys can be administered and collected. During the period January through June 2014, over 600 on-site surveys were obtained. Assuming surveys are collected at approximately the same rate through the remainder of the year, it is anticipated that several hundred modified surveys will be collected as part of the study. From the period January through June, 2014, approximately 79 trail surveys were obtained. Assuming trail surveys are collected at approximately the same rate, it is anticipated that approximately more than 50 of the modified trail surveys will be collected through the remainder of the year.

In addition, several of the questions that are in the original, unmodified surveys that were administered from January to August are open-ended questions that respondents could use to provide their views on the availability and condition of facilities at the Projects. From the initial 600 recreation user surveys collected through June, over 100 respondents took the opportunity to make specific comments about restrooms and project access. From the initial 79 trail surveys collected through June, the vast majority took the opportunity to respond to at least one of the open-ended questions. Roughly five percent used the open-ended questions to provide their comments about the hours of operation of the trails. Given the amount of data already collected and the number of responses to the open-ended questions on both surveys, it is expected that data collected from the modified surveys over the period late August through

December 2014 will provide sufficient data to evaluate user perception, including the questions inadvertently omitted from the surveys administered until late August.

The recreation use/user contact survey also stated that the Western Massachusetts Climbers Coalition would be consulted with regarding appropriate locations for the collection of data from rock climbers. FirstLight used information from the WMCC's website to determine appropriate locations for collection of data from rock climbers, but FirstLight did not consult with WMCC regarding the four locations it selected before beginning to collect data from rock climbers. FirstLight has scheduled a meeting with WMCC for September 19, 2014 to discuss appropriate locations for continued collection of data.

The recreation use/user contact survey also stated that a mail survey would be mailed in the spring to residential abutters. The mail survey was mailed to residential abutters on July 30, 2014. The follow-up reminder cards were mailed two weeks later. The study plan states that it is assumed that approximately 25-40% of the targeted mail surveys would be completed and returned. As noted above, as of September 1, 2014, approximately 38% of the surveys had been returned.

1.4 Remaining Activities

Field work associated with the recreational use counts and user surveys will be completed prior to the end of December 2014. FirstLight will consult with the MA Environmental Police and local police regarding recreational use in the Turners Falls Impoundment, bypass, and further downstream prior to the end of 2014.

Data entry will continue until all the collected information has been compiled. Statistical analysis will begin upon completion of the data entry in 2015.

Data from the other pertinent relicensing studies will be reviewed and assimilated into a final report.

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Relicensing Study 3.6.2

RECREATION FACILITIES INVENTORY AND ASSESSMENT

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Initial Study Report Summary

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers   TRC

SEPTEMBER 2014

EXECUTIVE SUMMARY

FirstLight Hydro Generating Company (FirstLight), a subsidiary of GDF SUEZ North America, Inc., is the current licensee of the Northfield Mountain Pumped Storage Project (FERC No. 2485) and the Turners Falls Hydroelectric Project (FERC No. 1889). FirstLight has initiated with the Federal Energy Regulatory Commission (FERC, the Commission) the process of relicensing the two Projects using FERC's Integrated Licensing Process (ILP). The current licenses for the Northfield Mountain and Turners Falls Projects were issued on May 14, 1968 and May 5, 1980, respectively, and both licenses expire on April 30, 2018. In accordance with the ILP schedule, FirstLight filed its Proposed Study Plan (PSP) on April 15, 2013 and its Revised Study Plan (RSP) on August 14, 2013. Included in the RSP was Study No. 3.6.2 *Recreation Facilities Inventory.*

The recreation facilities inventory for FirstLight's two Projects was conducted over the course of multiple field visits between October, 2011 and February, 2013. The purpose of the inventory was to identify the existing recreation sites and facilities within the Turners Falls and Northfield Mountain Project boundaries. A summary of the results of the inventory was included in the Preliminary Application Document (PAD).

The survey identified 19 formal recreation sites that are located partially or wholly within the FERC Project boundary for one or both of the Projects. Of these formal sites, 10 are recreation sites that are owned and managed by FirstLight as Project Recreation Sites pursuant to the Projects' recreation plans and included in FirstLight's Form 80 recreational survey. Five (5) of the formal recreation sites that provide access to the Projects are operated by the Commonwealth of Massachusetts. Of the 24 sites included in the inventory, the remaining sites are either formal recreation sites, operated by others and open to the public, a portion of which lies within the Project boundaries, or informal recreation sites that receive significant use and that provide access to the Projects. The formal sites maintained by entities other than FirstLight, and all of the informal sites described herein are referred to in this report as Non Project Recreation Sites.

Formal recreation sites located at the Projects were found to provide a wide array of year-round recreational opportunities for the public, including boating, fishing, camping, picnicking, hiking, biking, walking, skiing, and sightseeing. Formal facilities located at the Projects also provide educational opportunities.

All of the formal recreation sites within the Project boundaries were found to be meeting their intended function. Most of the facilities at these sites were given a condition rating of 4, indicating the facilities were in good condition, and functioning as intended. A few facilities were given a rating of 3 indicating the facility was in need of some maintenance, but that the facility was functioning. Only one facility was given a condition rating of less than 3, indicating the need for facility equipment repairs or replacement.

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

1 INTRODUCTION 1-1

2 SUMMARY OF FIELD CONDITIONS 2-1

3 SUPPORT DATA AND FIELD EQUIPMENT 3-1

4 FIELD SURVEYS 4-1

5 RESULTS AND ANALYSIS 5-1

Site 1: Governor Hunt Boat Launch/Picnic Area 5-1
Site 2: Ashuelot River Informal Campsite 5-2
Site 3: Fort Hill Rail Trail 5-3
Site 4: Pauchaug Wildlife Management Area (WMA) 5-4
Site 5: Pauchaug Boat Launch 5-5
Site 6. Schell Bridge Informal Site 5-7
Site 7: Informal Multi-Use Site 5-8
Site 8: Bennett Meadow Wildlife Management Area (WMA) 5-9
Site 9: Munn's Ferry Boat Camping Recreation Area 5-10
Site 10: Informal Munn’s Ferry Access Site 5-12
Site 11: Boat Tour and Riverview Picnic Area 5-13
Site 12: Northfield Mountain Visitor Center 5-15
Site 13: Northfield Connector Bikeway 5-18
Site 14: Cabot Camp Access Area 5-19
Site 15: Barton Cove Nature Area and Campground 5-21
Site 16: Barton Cove Canoe and Kayak Rental Area 5-24
Site 17: State Boat Launch 5-26
Site 18: Canalside Trail Bike Path 5-28
Site 19: Unity Park 5-29
Site 20: Gatehouse Fishway Viewing Area 5-31
Site 21: Turners Falls Branch Canal Area 5-32
Site 22: Turners Falls Station No. 1 Fishing Access 5-33
Site 23: Cabot Woods Fishing Access 5-34
Site 24: Turners Falls Canoe Portage 5-35

6 REFERENCES 6-1

APPENDIX A RECREATION SITE INVENTORY ASSESSMENT FORMS 6-1

LIST OF TABLES

Table 1: Site ID, Facility Name, Ownership and Management of Recreation Facilities in the Project Area 4-3

LIST OF FIGURES

FIGURE 1. RECREATION FACILITIES INVENTORY SURVEY FORM 3-2
FIGURE 2. TURNERS FALLS AND NORTHFIELD MOUNTAIN PROJECTS PUBLIC RECREATION FACILITIES 4-2
FIGURE 3. GOVERNOR HUNT BOAT LAUNCH/PICNIC AREA 5-2
FIGURE 4. ASHUELOT RIVER INFORMAL CAMPSITE 5-3
FIGURE 5. FORT HILL RAIL TRAIL 5-4
FIGURE 6. PAUCHAUG WILDLIFE MANAGEMENT AREA 5-5
FIGURE 7. PAUCHAUG BOAT LAUNCH 5-6
FIGURE 8. PAUCHAUG BOAT LAUNCH 5-6
FIGURE 9. SCHELL BRIDGE INFORMAL SITE 5-7
FIGURE 10. INFORMAL MULTI-USE SITE 5-8
FIGURE 11. BENNETT MEADOW WILDLIFE MANAGEMENT AREA 5-9
FIGURE 12. MUNN'S FERRY BOAT CAMPING RECREATION AREA 5-10
FIGURE 13. MUNN'S FERRY BOAT CAMPING RECREATION AREA 5-11
FIGURE 14. MUNN'S FERRY BOAT CAMPING RECREATION AREA 5-11
FIGURE 15. INFORMAL MUNN’S FERRY ACCESS SITE 5-12
FIGURE 16. BOAT TOUR AND RIVERVIEW PICNIC AREA 5-14
FIGURE 17. BOAT TOUR AND RIVERVIEW PICNIC AREA 5-14
FIGURE 18. BOAT TOUR AND RIVERVIEW PICNIC AREA 5-15
FIGURE 19. NORTHFIELD MOUNTAIN VISITOR CENTER 5-16
FIGURE 20. NORTHFIELD MOUNTAIN VISITOR CENTER 5-17
FIGURE 21. NORTHFIELD MOUNTAIN VISITOR CENTER 5-17
FIGURE 22. NORTHFIELD MOUNTAIN VISITOR CENTER 5-18
FIGURE 23. NORTHFIELD CONNECTOR BIKEWAY 5-19
FIGURE 24. CABOT CAMP ACCESS AREA 5-20
FIGURE 25. CABOT CAMP ACCESS AREA 5-20
FIGURE 26. CABOT CAMP ACCESS AREA 5-21
FIGURE 27. BARTON COVE NATURE AREA AND CAMPGROUND 5-22

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

FIGURE 28. BARTON COVE NATURE AREA AND CAMPGROUND 5-23
FIGURE 29. BARTON COVE NATURE AREA AND CAMPGROUND 5-23
FIGURE 30. BARTON COVE NATURE AREA AND CAMPGROUND 5-24
FIGURE 31. BARTON COVE CANOE AND KAYAK RENTAL AREA 5-25
FIGURE 32. BARTON COVE CANOE AND KAYAK RENTAL AREA 5-25
FIGURE 33. BARTON COVE CANOE AND KAYAK RENTAL AREA 5-26
FIGURE 34. STATE BOAT LAUNCH 5-27
FIGURE 35. STATE BOAT LAUNCH 5-27
FIGURE 36. CANALSIDE TRAIL BIKE PATH 5-28
FIGURE 37. CANALSIDE TRAIL BIKE PATH 5-29
FIGURE 38. UNITY PARK NORTH 5-30
FIGURE 39. FISHWAY VIEWING AREA 5-31
FIGURE 40. TURNERS FALLS BRANCH CANAL AREA 5-32
FIGURE 41. TURNERS FALLS STATION NO. 1 FISHING ACCESS 5-33
FIGURE 42. TURNERS FALLS STATION NO. 1 FISHING ACCESS 5-34
FIGURE 43. CABOT WOODS FISHING ACCESS 5-35
FIGURE 44. TURNERS FALLS CANOE PORTAGE 5-36
FIGURE 45. TURNERS FALLS CANOE PORTAGE 5-37

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

LIST OF ABBREVIATIONS

ADA	Americans with Disabilities Act
ATV	all-terrain vehicles
cfs	cubic feet per second
CT	Connecticut
ft	feet
FERC	Federal Energy Regulatory Commission
FirstLight	FirstLight Hydro Generating Company
GIS	Geographic Information Systems
GPS	Global Positioning System
ILP	Integrated Licensing Process
MA	Massachusetts
NH	New Hampshire
NOI	Notice of Intent
Northfield Mountain	Northfield Mountain Pumped Storage Hydroelectric Project
PAD	Pre-Application Document
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SPDL	Study Plan Determination Letter
the Commission	Federal Energy Regulatory Commission
the Impoundment	Turners Falls Impoundment
the Project	Northfield Mountain Pumped Storage and Turners Falls Hydroelectric Projects
USGS	United States Geological Survey
USACE	United States Army Corps of Engineers
Vernon	Vernon Hydroelectric Project
VT	Vermont
WMA	Wildlife Management Area

1 INTRODUCTION

FirstLight Hydro Generating Company (FirstLight), a subsidiary of GDF SUEZ North America, Inc., is the current licensee of the Northfield Mountain Pumped Storage Project (FERC No. 2485) and the Turners Falls Hydroelectric Project (FERC No. 1889). FirstLight has initiated with the Federal Energy Regulatory Commission (FERC or the Commission) the process of relicensing the two Projects using FERC's Integrated Licensing Process (ILP). The current licenses for the Northfield Mountain and Turners Falls Projects were issued on May 14, 1968 and May 5, 1980, respectively, and both licenses expire on April 30, 2018.

As part of the ILP, FERC conducted a public scoping process during which various resource issues were identified. On October 31, 2012, FirstLight filed its Pre-Application Document (PAD) and Notice of Intent (NOI) with FERC. The PAD included FirstLight's preliminary list of proposed studies. On December 21, 2012, FERC issued Scoping Document 1 (SD1) and preliminarily identified resource issues and concerns. On January 30 and 31, 2013, FERC held scoping meetings for the two Projects. FERC issued Scoping Document 2 (SD2) on April 15, 2013.

FirstLight filed its Proposed Study Plan (PSP) on April 15, 2013 and, per the Commission regulations, held a PSP meeting at the Northfield Visitor Center on May 14, 2013. Thereafter, FirstLight held ten resource-specific study plan meetings to allow for more detailed discussions on each PSP and on studies not being proposed.[1] On June 28, 2013, FirstLight filed with the Commission an Updated PSP to reflect further changes to the PSP based on comments received at the meetings. On or before July 15, 2013, stakeholders filed written comments on the Updated PSP. FirstLight filed a Revised Study Plan (RSP) on August 14, 2013 with FERC addressing stakeholder comments. Included in the RSP was Study No. 3.6.2 *Recreation Facilities Inventory.*

The recreation facilities inventory for FirstLight's two Projects was conducted over the course of multiple field visits between October, 2011 and February, 2013. The purpose of the inventory was to identify the existing recreation sites and facilities within the Turners Falls and Northfield Mountain Project boundaries. A summary of the results of the inventory was included in the PAD (FirstLight, 2012)

[1] The ten meetings were held on May 14, 15, 21, and 22, and June 4, 5, 11, 12, and 14 and August 8, 2013.

2 SUMMARY OF FIELD CONDITIONS

Field work associated with this study was conducted between October, 2011 and February, 2013. During this period, survey work was conducted during the fall, summer and winter seasons, more specifically in October, 2011; July 2012; and February 2013. Conditions during the October, 2011 field visit were affected by Hurricane Irene, which dropped unprecedented amounts of precipitation in the Project area in late August, 2011. This storm produced extremely high flows on the Connecticut River throughout the Project area, and even by October 15-17 when the first site visits were conducted, the river was not boatable due to high flows. As a result, inventory surveys conducted during the October 15-17, 2011 field visit were conducted by vehicle. Some recreation site conditions, such as erosion, observed during the October, 2011 surveys may have been affected by the extreme precipitation and river flows resulting from Hurricane Irene. All sites where erosion was observed during the October, 2011 surveys were revisited and reassessed during one of the later field visits. The weather conditions during the other two field visits were fairly typical for the season, with no unusual or extreme weather events that would be expected to significantly change observed conditions for the recreation sites or facilities that were included in the inventory. Similarly river flow and Turners Fall Impoundment (Impoundment) conditions through the latter two field survey periods were generally as would be expected during these seasons, with no extreme flow or Impoundment elevation events occurring during the periods when the recreation facility inventory was being conducted by boat and vehicle.

3 SUPPORT DATA AND FIELD EQUIPMENT

Prior to initiation of field inventory activities, existing information on the number and location of public recreation facilities at the Projects were reviewed. Data reviewed included current FERC License Exhibit R (recreation plan) information, previously filed FERC Form 80s, and the Recreation Management Plan (WMECO, 1981) for the Turners Falls Project.

Field equipment used for the inventory and site condition survey was limited to a Trimble GPS unit and on later visits an IPAD was used to record the location of the various recreation facilities and sites. In addition, field crews used a previously developed standardized survey form (Figure 1) to evaluate each existing recreation facility to determine general condition.[2] Information that was gathered during the inventory included whether the site was accessible by water, vehicle, or foot; who owned and managed each site; whether it was a formal or informal site; the number and types of facilities available at the site, if the site provided any universally accessible facilities (generally consistent with the Americans with Disabilities Act (ADA)); the amount of available parking at the site; observed recreation activities; available services, and the general aesthetics of the site.

[2] The standardized survey form was also included as Figure 3.6.2-2 to the RSP.

FirstLight
Site Visit/Inventory Forms

Inspector:______________________ Date: _____________ Time: ____________ Photo No: ________

Project: ________________ Site Name/Code: __________________ Weather: _________________

Owner: ____ Telephone: __________________

Address: ____

City: ______________________ State: _____ Zip Code: ____________

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal____ Launch_____ Marina_____
Hiking______ Ski Area_______

Access:

_____	Water access	
_____	Paved access	______ # of lanes
_____	Unpaved access (conventional motor vehicle)	______ # of lanes
_____	Unpaved access (4WD vehicle)	______ # of lanes
_____	ORV access (ATV)	______ width
_____	Foot access	______ width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	_____	_____	_____	_____	_____	_____	_______________
Management	_____	_____	_____	_____	_____	_____	_______________

Operations:

Staffed ____ Private____ Seasonal_____ Commercial_____ Fee_____ Open/Closed ____

General Area:
Is the area associated with other facilities or activities?________________________________
Potential/need for expansion/enhancement? ____
Topography: ____________________________ Ground cover: ___________________________
Erosion/Soils: ___________________________ Compaction: ___________________________
Approximate Shoreline Footage: ____________ Bank Fishing (Yes/No):________________
ADA compliant? Obstacles?_________________ Rentals?________________________________

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush	______	________	________	__________________________
Composting	______	________	________	__________________________
Vault	______	________	________	__________________________
Pit	______	________	________	__________________________
Portable	______	________	________	__________________________
Wilderness	______	________	________	__________________________

Site Facilities:

#	Type	Repairs	Material Code	Other Info
_____	Picnic Tables	_________	________	__________________________________
_____	Grills	_________	________	__________________________________
_____	Firepit/ring	_________	________	__________________________________
_____	Trails (specify use)	_________	________	Length?_________________________
_____	Shelter	_________	________	__________________________________
_____	Potable Water	_________	________	__________________________________
_____	Dumping Station	_________	________	__________________________________
_____	Boat Ramp	_________	________	__________________________________
_____	Launching Lanes	_________	________	__________________________________
_____	Playground	_________	________	__________________________________
_____	Showers	_________	________	__________________________________
_____	Benches	_________	________	__________________________________
_____	Interpretive. Displays:	_________	________	__________________________________
_____	Other: __________	_________	________	__________________________________

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking	__________	__________	______________
Camping	__________	__________	______________
Walking/hiking	__________	__________	______________
Swimming	__________	__________	______________
Beach Activities	__________	__________	______________
Launching boats	__________	__________	______________
Fishing	__________	__________	______________
_________________	__________	__________	______________

Parking Lots:		Surface Code	Dimensions
# ADA spaces	__________	__________	__________
# regular spaces	__________	__________	__________
# Vehicle & trailer spaces	__________	__________	__________

# of vehicles in lot __________ Space delineated__________ Curbs__________

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:	_________	________	_______	________
Float: :	_________	________	_______	________

Beach Area Substrate: ___________________________ Swim Area Substrate: __________________

Dimensions of beach: _________________ Lifeguards ______ Buoyed swim area ________

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites	______	______	______	______
Access (foot, orv, car, boat)	______	______	______	______
# of sites	______	______	______	______
On site parking	______	______	______	______
Water front	______	______	______	______
ADA compliant	______	______	______	______
Utilities	______	______	______	______

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks____________ Total Slips _____________

Material code:	#1______	#2______	#3______	#4______	#5______
Dimensions:	#1______	#2______	#3______	#4______	#5______
# of slips:	#1______	#2______	#3______	#4______	#5______
ADA compliant:	#1______	#2______	#3______	#4______	#5______

Fishing Piers:

Number: __________________

Surface code: _________________

Combined Length of Piers_______________

ADA compliant: ______________________

Site Aesthetics:

Viewshed from site: __________

Viewshed from shoreline: ____________

1 – No noticeable development

2 – Very limited primitive development

3 – Five (5) or less buildings in view

4 – Six (6) to ten (10) buildings in view

5 – Ten (10) or more buildings in view

6 – Highly developed

Nature of abutting development/land use: ____

Audio perceptions from site: ____

Audio perceptions from shoreline: ____

Evidence of use at site: _____________________________

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: _________________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: ____

____

____

Sketch:

4 FIELD SURVEYS

The recreation facility inventory for FirstLight's two Projects was conducted over the course of multiple field visits. These visits occurred on October 15, 2011 through October 17, 2011; July 15, 2012 through July 16, 2012; and February 12, 2013 through February 13, 2013. An additional field visit was made on August 20- 21, 2014 to confirm the information recorded for some of the formal recreation sites. During the field visits, TRC traveled from Vernon Dam, in Vernon, Vermont along the river to Poplar Street in Montague, Massachusetts. The site visits were conducted both by boat and vehicle. At each formal recreation facility, a data sheet was completed, photos were taken, and a GPS point was recorded. Figure 2 shows the location of the recreation sites and facilities that were inventoried.

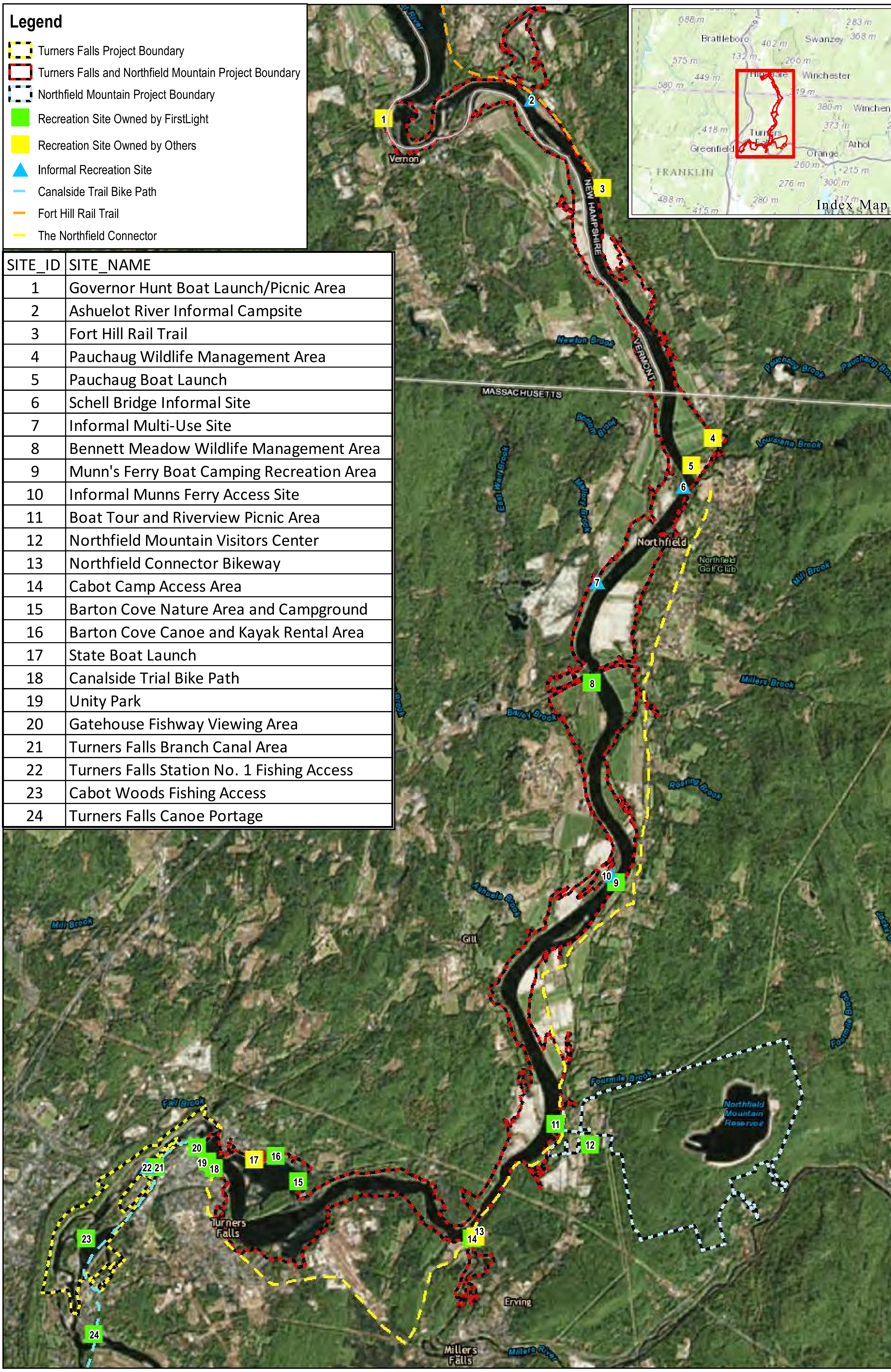
The inventory conducted for the two Projects included both formal and significant informal recreation sites. For purposes of this study, a formal recreation site is a site where improvements have been made, by FirstLight or the site's owner/manager to accommodate public recreation use at that site. Formal sites that are located within the FERC project boundary, and that are maintained and managed pursuant to Exhibit R of either the Turners Falls or Northfield Mountain Project licenses are considered Project Recreation Sites. Formal recreation sites within the Project boundary that are owned or managed by others and that are not included in the Projects' respective Exhibit Rs are considered Non Project Recreation Sites and are functioning as a non-project use of project lands. For purposes of this study, informal sites are sites within the FERC Project boundary, not associated with a formal recreation site, where no improvements have been made to accommodate recreational use, but where the site provides access to the Project and where there is evidence of regular recreational use of that site. Informal recreation sites are also considered Non Project Recreation Sites.

Table 1 provides a list of the recreation sites that were evaluated as part of the study inventory, including both Project and Non Project Recreation Sites. Table 1 also provides a summary of site ownership and management.

As part of the inventory, the functional and physical condition of each formal recreation site was also evaluated. The general condition of the site was observed by determining the need for major repairs to existing amenities and whether any potential safety concerns were noted. Staff also noted the existence of erosion along the Project shoreline associated with the existing sites. The survey utilized a numeric rating scale to assess the condition of the facilities at the formal recreation sites, as follows:

- Category 1 needs replacement, the items are non-functional such as missing pieces or are beyond repair;
- Category 2 needs repair, the items are damaged or are in a state of disrepair but can be restored to working order;
- Category 3 needs maintenance, the items are functional but may be more frequently used if they receive maintenance (this may include cleaning or repainting); and
- Category 4 good condition, these items are in good repair and are functioning as intended.

Survey sheets and the recorded data can be found in Appendix A.



SITE_ID	SITE_NAME
1	Governor Hunt Boat Launch/Picnic Area
2	Ashuelot River Informal Campsite
3	Fort Hill Rail Trail
4	Pauchaug Wildlife Management Area
5	Pauchaug Boat Launch
6	Schell Bridge Informal Site
7	Informal Multi-Use Site
8	Bennett Meadow Wildlife Management Area
9	Munn's Ferry Boat Camping Recreation Area
10	Informal Munns Ferry Access Site
11	Boat Tour and Riverview Picnic Area
12	Northfield Mountain Visitors Center
13	Northfield Connector Bikeway
14	Cabot Camp Access Area
15	Barton Cove Nature Area and Campground
16	Barton Cove Canoe and Kayak Rental Area
17	State Boat Launch
18	Canalside Trial Bike Path
19	Unity Park
20	Gatehouse Fishway Viewing Area
21	Turners Falls Branch Canal Area
22	Turners Falls Station No. 1 Fishing Access
23	Cabot Woods Fishing Access
24	Turners Falls Canoe Portage

FirstLight GDF SUEZ

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)
INITIAL STUDY REPORT SUMMARY
RELICENSING STUDY 3.6.2

0 0.5 1 2 Miles

Figure 2:
Public Recreation Facilities

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Path: w:\gis\studies\3_6_2\ISR\figure_2.mxd

Table 1: Site ID, Facility Name, Ownership and Management of Recreation Facilities in the Project Area

Site ID	Recreation Site Name	Site Ownership	Site Management	Formal/Informal Site	Site Relationship to Project Boundary
1	Governor Hunt Boat Launch/Picnic Area	TransCanada	TransCanada	Formal	A portion of the site along the river is within the Project boundary of both Projects. The entirety of the site is also located within the Project boundary of TransCanada's Vernon Hydroelectric Project.
2	Ashuelot River Informal Campsite	Private Ownership	N/A	Informal	Within the Project boundary of both Projects
3	Fort Hill Rail Trail	State of New Hampshire	State of New Hampshire	Formal	A portion of the trail is within the Project boundary of both Projects. Trail parking outside of the Project boundaries
4	Pauchaug Wildlife Management Area	Massachusetts, Division of Fisheries and Wildlife	Massachusetts, Division of Fisheries and Wildlife	Formal	Within the Project boundary of both Projects
5	Pauchaug Boat Launch	Commonwealth of Massachusetts	Commonwealth of Massachusetts	Formal	Within the Project boundary of both Projects
6	Schell Bridge Informal Site	Town of Northfield	N/A	Informal	Within in Project boundary of both Projects
7	Informal Multi-Use Site	FirstLight	N/A	Informal	Within the Project boundary of both Projects
8	Bennett Meadow Wildlife Management Area	FirstLight	Massachusetts Division of Fisheries and Wildlife	Formal	Within the Project boundary of both Projects
9	Munn's Ferry Boat Camping Recreation Area	FirstLight	FirstLight	Formal	Within the Project boundary of both Projects
10	Informal Munn's Ferry Access Site	Private Ownership	N/A	Informal	A portion of the site is within the Project boundary of both Projects
11	Boat Tour and Riverview Picnic Area	FirstLight	FirstLight	Formal	Within the Project boundary of both Projects
12	Northfield Mountain Visitor Center	FirstLight	FirstLight	Formal	Within the Project boundary of the Northfield Mountain Project
13	Northfield Connector Bike Path	Utilizes existing roadways.	Franklin Regional Council of Governments maintains the sign program.	Formal	A portion of the trail is within the Project boundary of both Projects
14	Cabot Camp Access Area	FirstLight	FirstLight	Formal	Within the Project boundary of both Projects.

Site ID	Recreation Site Name	Site Ownership	Site Management	Formal/Informal Site	Site Relationship to Project Boundary
15	Barton Cove Nature Area and Campground	FirstLight	FirstLight	Formal	Within the Project boundary of both Projects
16	Barton Cove Canoe and Kayak Rental Area	FirstLight	FirstLight	Formal	Within the Project boundary of both Projects
17	State Boat Launch	Commonwealth of Massachusetts	Commonwealth of Massachusetts	Formal	A portion of the site (launch and small part of parking lot) is within the Project boundary of both Projects.
18	Canalside Trail Bike Path	FirstLight	Massachusetts Department of Conservation and Recreation	Formal	Within the Project boundary of both Projects
19	Unity Park	FirstLight (Unity Park North) Town of Montague (Unity Park South)	FirstLight (Unity Park North) Town of Montague (Unity Park South)	Formal	The north side of the park (Unity Park North) is within the Project boundary of both Projects. A small portion of Unity Park South is within the Project boundary of both Projects.
20	Fishway Viewing Area	FirstLight	FirstLight	Formal	Within the Project boundary of both Projects
21	Turners Falls Branch Canal Area	FirstLight	FirstLight	Formal	Within the Project boundary of the Turners Falls Project
22	Turners Falls Station No. 1 Fishing Access	FirstLight	FirstLight	Informal	Within the Project boundary of the Turners Falls Project
23	Cabot Woods Fishing Access	FirstLight	FirstLight	Formal	Within the Project boundary of the Turners Falls Project
24	Turners Falls Canoe Portage	FirstLight	FirstLight	Formal	Take-out at Barton Cove is within the Project boundary; Put-in is outside of the Project boundary

N/A: Not Applicable

5 RESULTS AND ANALYSIS

The survey identified 24 formal and significant informal recreation sites that provide access to the Projects. Of these 19 are formal recreation sites that are located partially or wholly within the FERC Project boundary for one or both of the Projects. Of these formal sites, 10 are recreation sites that are owned and managed by FirstLight as Project Recreation Sites under the Projects' recreation plans. Five (5) of the formal recreation sites that provide access to the Projects are operated by the Commonwealth of Massachusetts. The remaining sites included in the inventory are either formal recreation sites, operated by others and open to the public, a portion of which lies within the Project boundaries, or informal recreation sites that receive significant use and that provide access to the Projects. The formal recreation sites at the Projects support a variety of recreation facilities, including but not limited to boat ramps, camp sites, picnic tables, benches, trails, and interpretive displays. In addition, 5 significant informal recreation sites located within the project boundary of one or both of the FirstLight Projects were also inventoried. Because the informal sites have no facilities or improvements, an assessment of facility condition was not made at any of the informal sites. However, general observations on use levels and condition of the informal sites were noted. Below is a brief description of each of the recreation sites at the FirstLight Projects included in the inventory and survey. The location of the sites is shown in Figure 2.

Site 1: Governor Hunt Boat Launch/Picnic Area

This site is located just downstream of the Vernon Project dam and is owned and managed by TransCanada, which owns the Vernon Project. While this recreation site is within the Vernon Project boundary, a portion of the site, along the shoreline is also located within the Turners Falls Project and Northfield Mountain Project boundaries.

Site Inventory

Recreational facilities at this site include a picnic area, which is located outside of the Project boundary for both the Turners Falls and Northfield Mountain Projects. The picnic area includes picnic tables, grills, and three portable toilets (1 ADA accessible). Within the Project boundary of both the Turners Falls and Northfield Mountain Projects, the site includes a single lane, concrete plank boat launch providing access to the Vernon Project tailwater area. In addition to picnicking and boat launching, recreation opportunities at the site include bank fishing and sightseeing. Parking for this site is accommodated by several informal parking areas that can accommodate approximately 7 vehicles and 3 vehicles with trailers.

Availability to Public

This site is open to the public seasonally (generally May-October) for day use recreation between the hours of 6:00 am and 9:30 pm. The site is not maintained for winter recreation use.

Site Condition Assessment

The site appears to see moderate use as evidenced by observed rod rests and a minor amount of litter. No recreation use related compaction or erosion was noted during the site visit. Overall the site is currently functioning as intended. The boat launch condition was rated as a Category 2 during the site visit. The remaining facilities are located outside of the Turners Falls and Northfield Mountain Project boundaries and were not rated.

Figure 3. Governor Hunt Boat Launch/Picnic Area

View of Site from Water: Boat Launch is to the right, picnic area (outside of Project) above on left.

Site 2: Ashuelot River Informal Campsite

The Ashuelot River informal campsite is located just downstream of where the Ashuelot River flows into the Connecticut River. The site is located within the Project boundary of both the Turners Falls and Northfield Mountain Projects on the east side of the Connecticut River in Hinsdale, New Hampshire and appears to be accessed from either the river or from a dirt track. The site is located on private property and FirstLight has a flowage easement over the property.

Site Inventory

This site has no formal facilities, but appears to be used for camping, picnicking and water access. At the time of the site visit, individuals using the site had constructed a crude table, stocked firewood and constructed a fire pit. There are no sanitation facilities at this site.

Availability to Public

This site is located on private property.

Site Condition Assessment

This site was not rated because it is an informal recreation area, located on private property.

Figure 4. Ashuelot River Informal Campsite

Informal Campsite

Site 3: Fort Hill Rail Trail

The Fort Hill Rail Trail is a multiple use trail, located in Hinsdale, New Hampshire. The trail is 9 miles long and travels from Route 63 along the Connecticut River to the old bridge on Route 119. A small portion (approximately 190 feet) of the trail crosses through the Turners Falls Project and Northfield Mountain Project boundaries, over the Ashuelot River. The trail is currently owned and maintained by the State of New Hampshire.

Site Inventory

Permitted uses of the trail include hiking, biking, horseback riding, snowshoeing, Nordic skiing, snowmobiling, and mushing. Parking for the trail in the vicinity of the Projects is provided at a compacted gravel parking lot located on Route 63 outside the Project boundaries. This lot was estimated to accommodate approximately 35 vehicles, though there were no markers or lines delineating the parking spaces, and there were no ADA marked parking spaces.

Availability to Public

The Fort Hill Rail Trail is open to the public year round. Though the trail is open for winter recreation use, the State of New Hampshire may or may not plow the parking lot located on Route 63 outside the Project boundaries. At the time of the winter site visit, the parking lot was unplowed.

Site Condition Assessment

The Route 63 parking lot and trail are functional for public use. The portion of the trail that lies within the Project boundary was observed to be in good condition and was rated at a Category 4. The trail appears to be receiving some unauthorized use by motorized vehicle use, possibly all-terrain vehicles (ATVs), in the vicinity of the Project boundaries.

Figure 5. Fort Hill Rail Trail

Ashuelot River Outlet to the Connecticut River

Site 4: Pauchaug Wildlife Management Area (WMA)

The Pauchaug WMA is located on the eastern side of the Connecticut River in Northfield, Massachusetts. This WMA is owned and managed by the Massachusetts Division of Fisheries and Wildlife (MADFW). This site is located within the Project boundaries of both the Turners Falls and Northfield Mountain Projects.

Site Inventory

The 161 acre site includes the Pauchaug Boat Launch (inventoried separately as Site 5), located upstream of the old Schell Bridge. The WMA site is open for hunting and is also used for walking/hiking, bird-watching, and bank fishing. The site is managed for wildlife and includes agricultural activity, which is used to maintain habitat for wildlife. The site has pheasant, which are stocked; woodcock, cottontail rabbit, gray squirrel, raccoon, waterfowl, and numerous nongame species. Pauchaug Brook is a stocked trout water. There are no formal parking areas or amenities within the WMA. Most visitors to the WMA use the Pauchaug Boat Launch Parking Area (Site 5), but some visitors use grassy areas outside the WMA gate for parking.

Availability to Public

There were no posted hours of operation for the WMA at the time of the site visit with the exception of hunting hours which are sunrise to sunset.

Site Condition Assessment

The site is currently functioning as intended and has no formal facilities or recreation site improvements to rate.

Figure 6. Pauchaug Wildlife Management Area

View of WMA

Site 5: Pauchaug Boat Launch

This site is owned and managed by the Commonwealth of Massachusetts as part of the Pauchaug WMA. The boat launch is located on state owned property on the eastern shore of the Connecticut River, upstream of the Schell Bridge in Northfield, Massachusetts. This site lies within the Project boundaries of both the Turners Falls Project and Northfield Mountain Projects.

Site Inventory

Facilities at this site include a hard surface boat launch with two launching lanes, parking, informational signage, and portable sanitation. The parking lot is delineated by curbing and can accommodate 32 vehicles with trailers. No ADA signs for parking spaces were observed at this site.

Availability to Public

The site is open to the public free of charge, year round and no hours of operation were noted during the site visit. It is not known if Massachusetts routinely plows the parking area in the winter.

Site Condition Assessment

The boat launch facility at this site is currently functioning as intended. However, during the site visit we were informed that at low Impoundment elevations accumulated silt at the site makes it difficult for large boats to launch. The condition of the boat launch was given a Category rating of 3 due to the need for removal of siltation on the ramp. The parking area was found to be functional and was given a Category rating of 4. While the site may be open in the winter, the portable sanitation is seasonal. There was no recreation related erosion or compaction noted at the time of the site visit.

Figure 7. Pauchaug Boat Launch

View looking up launch from the edge of the water

Figure 8. Pauchaug Boat Launch

Parking Area

Site 6. Schell Bridge Informal Site

This informal site is located where the old Schell Bridge crosses the western shore of the Connecticut River in Northfield, Massachusetts. This informal site is accessed from the West Northfield Road, which has been closed to through traffic. The site is partially within the Project boundary of the Turners Falls and Northfield Mountain Projects on property owned by the Town of Northfield.[3]

Site Inventory

There are no improvements or formal facilities at this site. The site was observed to be used for fishing and swimming. A rope swing had been hung from the old bridge.

Availability to Public

The site is on property owned by the Town of Northfield, and appears to be a traditional public use site.

Site Condition Assessment

Compaction and litter were observed during the site visit, but the condition of this site was not rated because it is an informal recreation area, located on private property.

Figure 9. Schell Bridge Informal Site

View of Site from Water

[3] On August 28, 2014, The Recorder reported that the state Department of Conservation and Recreation has announced that it plans to take ownership of the bicycle and pedestrian bridge that is planned to replace the long-closed automobile bridge spanning the Connecticut River.

Site 7: Informal Multi-Use Site

This informal multi-use site is located on the western shore of the Connecticut River, in Northfield, Massachusetts, upstream of the Route 10 Bridge. The site is located within the Project boundary of both the Turners Falls and Northfield Mountain Projects, on property owned by FirstLight.

Site Inventory

Uses at this site appear to be bank fishing, camping, and access to the river. Away from the shoreline (not visible in the photo) there was also an apparent flat camping area and a fire pit, and campers were observed using this location on at least one site visit. Access to and from the Impoundment appears to occur via informal trails up a relatively steep bank. While the site can be accessed from the water, it is unclear how users access the site from the land.

Availability to Public

Although this site is not a formal recreation site, it appears to receive public use..

Site Condition Assessment

Compaction was observed during the site visit, but the condition of this site was not rated because it is an informal recreation area,.

Figure 10. Informal Multi-Use Site

View of Informal Site from Water.

Site 8: Bennett Meadow Wildlife Management Area (WMA)

The Bennett Meadow WMA is located on the western shore of the Connecticut River just south of the Route 10 Bridge in Northfield, Massachusetts within the Project boundaries of both the Turners Falls and Northfield Mountain Projects. The Bennett Meadow WMA is owned by FirstLight and is jointly managed by FirstLight and the MADFW. This site is a Project Recreation Site.

Site Inventory

This WMA site does not have formal recreation facilities, but it does offer day use recreation opportunities such as hunting and walking/hiking on the existing agricultural roads. There is an active farming operation on the site that is used to enhance the area for wildlife and a willow cutting nursery, which is located to the west of the parking area. The parking area at the site is an open flat area with no delineation or curbing and is partially covered in grass.

Availability to Public

The WMA is open to the public year round from dawn till dusk; however, the site is not plowed in the winter.

Site Condition Assessment

There was no recreation related erosion or compaction noted at the time of the site visit. The site is currently functioning as intended and received a Category rating of 4 at the time of the site visit.

Figure 11. Bennett Meadow Wildlife Management Area

Access Road into the WMA

Site 9: Munn's Ferry Boat Camping Recreation Area

This water access only site is located on the east side of the river in Northfield, Massachusetts. The site is owned and managed by FirstLight and is available for overnight and day use. The camping and picnic areas are located within the Project boundary of both the Turners Falls and Northfield Mountain Projects. The site is a Project Recreation Site.

Site Inventory

The camping area includes four tent campsites each with a trash can, tent platform, picnic table, fire ring and grill. There is also a lean-to site with a trash can, picnic table, fire ring and grill. There are pit toilets available, which are not ADA accessible, a dock, and bank fishing opportunities.

Availability to Public

The site is open from Memorial Day to Columbus Day and is not maintained in the winter. Individuals must reserve a site prior to camping and pay a fee.

Site Condition Assessment

There was a minor amount of recreation related compaction and shore erosion noted while on site. The site and associated amenities are in good condition and functioning as intended. Overall the amenities at the site were rated a Category 4.

Figure 12. Munn's Ferry Boat Camping Recreation Area

Typical Picnic Table and Grill

Figure 13. Munn's Ferry Boat Camping Recreation Area

Camping Area

Figure 14. Munn's Ferry Boat Camping Recreation Area

Dock

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Site 10: Informal Munn's Ferry Access Site

This informal access site is on the western shore of the Connecticut River in Gill, Massachusetts across from the Munn's Ferry Boat Camping Recreation Area. A portion of the site lies within the Project boundary for both the Turners Falls and Northfield Mountain Projects. FirstLight has flowage rights for the property on which the informal site is located, but the property is owned by others.

Site Inventory

There are no formal or improved facilities at this site. The site appears to be used for seasonal bank fishing and takes advantage of the easy access to the site afforded by the abandoned ferry crossing. Individuals can park at the end of Munn's Ferry Road and walk to the shoreline. The Munn's Ferry Road is a public road that is plowed to the site in the winter; however, there did not appear to be winter use at the time of the site visit.

Availability to Public

The Town of Gill, Massachusetts has posted a sign at this site indicating that the site is available for day use only.

Site Condition Assessment

Signs of use, including minor compaction on a trail to the water and along the shoreline, were observed during the site visit. However, the condition of this site was not rated because it is an informal recreation site on private property.

Figure 15. Informal Munn's Ferry Access Site

View of the Access Trail from Parking Area

Site 11: Boat Tour and Riverview Picnic Area

This recreation site located off Pine Meadow Road in Northfield, Massachusetts is partially located within the Project boundaries of both the Turners Falls and Northfield Mountain Project, and partially within only the Northfield Mountain Project boundary. The site is owned and managed by FirstLight and is a Project Recreation Site

Site Inventory

Recreation facilities at this site include a picnic area and riverboat tour. The picnic area has 9 picnic tables with grills. There is also a pavilion at the site that can be rented for group events. The site includes restroom facilities which provide 1 men's, 1 women's, and 1 ADA accessible stall. There are two benches available near the boat dock. There is a formal parking lot available for those using the site and those who are boarding the riverboat. Access to the parking lot is via a paved road and the parking lot can accommodate 25 vehicles, with two ADA signed parking spaces. A second parking lot located closer to the rental pavilion holds approximately 29 vehicles.

The Quinnetukut II Riverboat has 44 seats and makes a 12 mile round trip through French King Gorge and Barton Cove. There is an on-board interpreter to narrate information on culture, wildlife, and natural history.

Availability to Public

This site provides day use recreation opportunities for picnicking, interpretive riverboat cruises, and bank fishing. The site is open from dawn to dusk free of charge, although there is a fee to rent the pavilion or cruise on the riverboat. The site opens Memorial Day Weekend and closes Columbus Day Weekend. The river boat operates from July to mid-October, Friday through Sunday, three trips per day, with the exception of the 4th of July and Labor Day.

Site Condition Assessment

The site was in good overall condition and functioning as intended at the time of the site visit. The amenities at the site received a Category rating of 4. There was a very minor amount of shoreline erosion that may have occurred from recreation users.

Figure 16. Boat Tour and Riverview Picnic Area

Overview of Picnic Area

Figure 17. Boat Tour and Riverview Picnic Area

Open Area and Rental Pavilion

Figure 18. Boat Tour and Riverview Picnic Area

Boat Tour Dock

Site 12: Northfield Mountain Visitor Center

This site is located within the Northfield Mountain Project boundary, off Millers Falls Road (Rt. 63) in Northfield, Massachusetts. The Visitor Center is owned and managed by FirstLight. Available opportunities include viewing indoor/outdoor interpretive displays, picnicking, and educational programs. FirstLight also offers both school and public educational programs at the Visitor Center. This site is a Project Recreation Site.

Site Inventory

The Visitor Center has restrooms, cross-country ski rental equipment, a lounge, and parking. The parking area is designed to accommodate 50 vehicles and has an additional 3 ADA spaces. The Center is accessible by ramp and has ADA accessible sanitation facilities. Amenities at the Center include 3 men's and 3 women's bathroom units, one of each being ADA accessible, a rental Yurt, numerous picnic tables, some grills, a fire ring, benches, trash cans and interpretive displays.

The Northfield Mountain trail system includes over 26 miles of trail, which are available for hiking, biking, horseback riding, snowshoeing, and cross-country skiing. The trail system begins at the Visitor Center near the parking lot. Most of the trails are located within the Northfield Mountain Project boundary, and the trails can be used to access the mountaintop observation area offering views of the Northfield Mountain Project's Upper Reservoir. There are two different trail types within the system. One type is very wide and can be used for double track cross-country skiing or skating in the winter and hiking, horseback riding, and mountain biking in the summer. During the winter these trails are typically groomed. The second type of trail is narrow and can be used for snowshoeing in the winter or hiking and mountain biking in the summer. The narrow trails are not typically groomed in the winter. On weekends in the winter, individuals can visit the Chocolate Pot. This is a spot located within the trail system where visitors can purchase hot chocolate, rest at the provided picnic tables or be warmed by an outdoor fire. There is a fee to use the trails in the winter.

Availability to Public

The Visitor Center is open year-round for day use activities from 9:00 am-4:30 pm Wednesday through Sunday. The Center is also open on certain holidays which are noted on the FirstLight web page. The Northfield Mountain trail system is also open year-round.

Site Condition Assessment

The Northfield Mountain Visitor Center facilities are currently functioning as intended and received a Category rating of 4 during the site visit.

Figure 19. Northfield Mountain Visitor Center

Northfield Mountain Mountaintop Observation Area

Figure 20. Northfield Mountain Visitor Center

Typical trail

Figure 21. Northfield Mountain Visitor Center

View of Visitor Center and Trailer/Bus Parking Area

Figure 22. Northfield Mountain Visitor Center

Parking Lot

Site 13: Northfield Connector Bikeway

The Northfield Connector Bikeway is an 11-mile shared roadway route connecting the Canalside Trail Bike Path with the Town of Northfield. There is a spur off the main route to the Northfield Mountain Trail System. The route travels along the shoulders of existing roads from the East Mineral Road Bridge along Dorsey Road, River Road, Pine Meadows Road, Ferry Road, and finally onto Route 63, in Northfield, Massachusetts. The bikeway is part of the public roadway and signage is maintained by the Franklin Regional Council of Governments. The bikeway (approximately 4,580 feet of trail) passes through the Project boundary of both the Turners Falls and Northfield Mountain Projects near the Visitor Center.

<u>Site Inventory</u>

Eleven mile designated bikeway traveling along the shoulder of existing public roads.

<u>Availability to Public</u>

Open to the public year round.

<u>Site Condition Assessment</u>

The bikeway is currently functioning as intended and has no formal facilities or recreation site improvements to rate.

Figure 23. Northfield Connector Bikeway

Northfield Connector Bike Path at Cabot Camp

Site 14: Cabot Camp Access Area

This area is located within the Project boundary of both the Turners Falls and Northfield Mountain Projects, at the end of Mineral Road in Montague, Massachusetts. The site is owned and managed by FirstLight and is open to the public for shoreline access and bank fishing.

Site Inventory

With the exception of a parking lot, there were no formal recreation facilities offered at the site. The large parking area is approximately 100 feet by 45 feet and provides parking for approximately 15 vehicles. The parking lot provides access to the Northfield Connector Bikeway from this area. There is a building at this site that is not open to the public.

Availability to Public

There are no posted seasons or hours of operation.

Site Condition Assessment

The parking lot was functioning as intended and received a Category rating of 4. There was some minor soil compaction noted along the shoreline during the site visit.

Figure 24. Cabot Camp Access Area

Cabot Camp Parking Area

Figure 25. Cabot Camp Access Area

Cabot Camp Building

Figure 26. Cabot Camp Access Area

Site 15: Barton Cove Nature Area and Campground

The Barton Cove Nature Area and Campground is located within the Project boundaries of both the Turners Falls and Northfield Mountain Projects, on Barton Cove Road in Gill, Massachusetts. The Nature Area and Campground are owned and managed by FirstLight. This site is a Project Recreation Site.

Site Inventory

The site has a set of flush toilets and two showers, along with a portable toilet. The site has grills, picnic tables, and a walking trail leading to an overlook. The paved parking area can hold 21 vehicles. There is an overflow area adjacent to the parking lot that can hold approximately 5 additional vehicles. The parking area is plowed in the winter and individuals use the site for ice fishing access and walking.

The Barton Cove Campground has 2 group campsites, 2 trailer sites, and 27 tent sites. One of the tent sites is considered ADA accessible. Each campsite has a picnic table, fire ring and garbage can. The two group sites also had grills and additional picnic tables. There are two vault toilets and additional portable restrooms located within the campground. There is water access from some of the sites and bank fishing is permitted. Even though the campground is closed and gated in the winter, some individuals still use the site for cross-country skiing and hiking.

Availability to Public

The Nature Area is open to the public, free of charge, for day-use activities including picnicking and bank fishing, year-round. The hours of operation at the Nature Area are from dawn to dusk. The campground is open Memorial Day to Labor Day and campers can have visitors until 9:00 pm. Quiet hours are from 10:00 pm to 8:00 am.

Site Condition Assessment

Overall, the Nature Area facilities were functioning as intended and received a Category rating of 4. There was a minor amount of litter noted during the site visit. Soil compaction was noted in the area of the picnic tables and along well used footpaths. The walkway to the overlook, including some sets of stairs, were currently functioning as intended; however, the condition of some structures were starting to show exposure to the elements and may require future replacement of some boards. Therefore this amenity received a Category rating of 2 at the time of the site visit.

Overall the campground was functioning as intended and was well maintained. At the time of the site visit the campground facilities were in good repair and functioning as intended. There were some areas of compaction and minor erosion outside of some campsites, where individuals have accessed the water. The facilities for the campground site received a Category rating of 4 during the site visit.

Figure 27. Barton Cove Nature Area and Campground

Typical Campsite within the Barton Cove Campground

Figure 28. Barton Cove Nature Area and Campground

Picnic Area within the Barton Cove Nature Area

Figure 29. Barton Cove Nature Area and Campground

Barton Cove Nature Area Parking Lot

Figure 30. Barton Cove Nature Area and Campground

Barton Cove Nature Area Overlook

Site 16: Barton Cove Canoe and Kayak Rental Area

This site is located, on the northern shore of the Connecticut River, within the Project boundaries of both the Turners Falls and Northfield Mountain Projects, off of Route 2 in Gill, Massachusetts. This site is owned and managed by FirstLight and offers day use opportunities such as paddling and picnicking. This site also serves as the administrative office for the Barton Cove Campground.

<u>Site Inventory</u>

There is a natural gravel carry-in canoe/kayak launch, a rental office, picnic tables, parking, and a portable sanitation facility. At the time of the site visit, there were 50 watercraft to rent, which included canoes and kayaks. The rentals include personal flotation devices (PFDs) and paddles or oars. The parking lot can hold 28 vehicles, although the spaces were not delineated and there was no ADA parking designated at the site during the inventory.

<u>Availability to Public</u>

The facility is open from Memorial Day Weekend to Labor Day Weekend and is gated in the off-season. The rental office is open on weekends from 9:00 am to 6:00 pm and Monday through Friday 9:00 am to 5:00 pm. Individuals can use the site free of charge; however, there is a fee to rent the canoes and kayaks.

<u>Site Condition Assessment</u>

There was no evidence of user impacts during the site visit. Overall the site was well maintained and functioning as intended. The facilities at this site received a Category rating of 4 during the site visit.

Figure 31. Barton Cove Canoe and Kayak Rental Area

Parking Lot and Entrance

Figure 32. Barton Cove Canoe and Kayak Rental Area

Rental Boats

Figure 33. Barton Cove Canoe and Kayak Rental Area

Rental Office

Site 17: State Boat Launch

This launch is located upstream of the Turners Falls Dam. A portion of this site is within the Project boundary of both the Turners Falls and Northfield Mountain Projects, off of Route 2 in Gill, Massachusetts. A portion of this site is owned by FirstLight, and a portion is owned by the Commonwealth of Massachusetts. The boat launch site is managed by the Commonwealth of Massachusetts, and is open to the public free of charge.

Site Inventory

The site offers boat launching and bank fishing opportunities. There is a hard surface boat ramp with two launching lanes, a dock, and portable sanitation facility (seasonal) at the site. There is a parking lot, which is delineated to handle 44 vehicles with trailers. There was a single ADA parking space for a vehicle and trailer, along with a single vehicle ADA parking space noted during the site visit.

Availability to Public

Hours of operation for the launch are 4:00 am to 10:00 pm, though exceptions can be made by special permit. The launch is closed during the winter (typically November through March).

Site Condition Assessment

The site and associated facilities were functioning as intended at the time of the site visit, and received a Category rating of 4.

Figure 34. State Boat Launch

State Boat Launch Parking Area

Figure 35. State Boat Launch

Launch Ramp

Site 18: Canalside Trail Bike Path

This hard surface trail begins within Unity Park and ends at McClelland Farm Road in northeast Deerfield, Massachusetts. The trail is 3.27 miles long, with approximately 1.5 miles within the Project boundary of both the Turners Falls and Northfield Mountain Projects. The portion of trail located within the Turners Falls Project runs along the Turners Falls Power Canal in Montague, Massachusetts, while the portion within both the Turners Falls and Northfield Project boundaries runs along the Connecticut River within Unity Park. The trail property is currently owned by FirstLight and is leased to and managed by the Massachusetts Department of Environmental Management (now Massachusetts Department of Conservation and Recreation).

Site Inventory

The trail is 3.27 miles long, with approximately 1.5 miles within the Turners Falls Project Boundary.

Availability to Public

The Canalside trail bike path is open year-round for non-motorized public use. The trail is not maintained in the winter but did appear to receive cross-country skiing use.

Site Condition Assessment

No user impacts were noted during the site visit. The trail is currently functioning as intended and received a Category rating of 4 at the time of the site visit.

Figure 36. Canalside Trail Bike Path

Beginning of Bike Path within Unity Park

Figure 37. Canalside Trail Bike Path

Typical Photo of Bike Trail

Site 19: Unity Park

Unity Park is located on either side of 1st Street in Montague, Massachusetts. The park is actually two parks that go by the same name. The portion of the park on the south side of 1st Street is owned and operated by the Town of Montague (Unity Park South). A small portion of the Unity Park South is within the Project boundary of both the Turners Falls and Northfield Mountain Projects, but it is not considered a Project Recreation Site. The portion of the park on the north side of 1st Street (Unity Park North) is all within both the Turners Falls and Northfield Mountain Project boundaries and is owned and operated by FirstLight as a Project Recreation Site.

Site Inventory

Unity Park North includes a large open space used for general recreation. There are picnic tables, trash receptacles, and charcoal grills along the river at the western end of the site. The park offers day use activities including walking, fishing, sightseeing, picnicking, and biking. The Canalside Trail Bike Path (Site 18) begins within the park adjacent to the easterly parking lot. There are two gravel parking lots both with un-delineated parking spaces. The easterly parking has space for 30 cars with no ADA delineation, the westerly parking has space for 25 vehicles with two sites signed for ADA parking.

Unity Park South is owned and operated by the Town of Montague. Amenities include a playground, parking, ball fields, a basketball court, benches, fitness trail, and picnic tables. It appeared that there were restroom facilities; however, the main building was locked. There are two parking areas associated with the town park. The basketball court lot had 23 parking spaces, 2 of which were signed ADA. The main lot by the playground had 65 parking spaces, 6 of which were signed ADA. The playground equipment had been improved since the original inventory.

Availability to Public

Unity Park North and Unity Park South are open year-round from dawn till dusk unless there is a scheduled event. However, the parking lots were not plowed at the time of the winter site visit.

Site Condition Assessment

The Unity Park North site facilities are in a state of good repair and are functioning as intended. The site receives a Category rating of 4 for the current amenities and no user impacts were noted during the site visit. The conditions of the facilities at Unity Park South were not rated because this site is located outside of the Project boundary and is not a Project Recreation Site.

Figure 38. Unity Park North

Canalside Bike Path within Unity Park North

Site 20: Gatehouse Fishway Viewing Area

This site is located within the Project boundaries of both the Turners Falls and Northfield Mountain Projects, off of 1st Street in Montague, Massachusetts. The fishway is managed by FirstLight and is located at the western end of Unity Park. This site is a Project Recreation Site.

Site Inventory

The fishway viewing facility provides the public an opportunity to view the fish using the fishway. The upper viewing platform is ADA accessible, and there is a closed-circuit TV feed from the viewing window to a TV monitor that enables those with limited mobility the opportunity to view the fish. There are several interpretive panels relating to anadromous fish. There are bathrooms available and there are benches outside near the entrance to the building. The facility is staffed with two seasonal employees during viewing times.

Availability to Public

The facility is open to the public during fish migration season, typically late-May to mid-June to watch migrating fish. Hours of operation are Wednesday through Sunday from 9:00 am to 5:00 pm.

Site Condition Assessment

The condition of the public viewing facilities could not be rated since the inside of the facility was not open during the inventory site visits.

Figure 39. Fishway Viewing Area

Access for the Fishway Viewing Area

Site 21: Turners Falls Branch Canal Area

This site is located within the Turners Falls Project boundary, off of Power Street in Montague, Massachusetts. This site is owned and managed by FirstLight and is open for fishing. This site is a Project Recreation Site.

Site Inventory

Four benches are available at this site. There is a large parking lot adjacent to the site that is associated with the building next door. It is unclear whether the parking lot is used by individuals accessing this site. The site was not ADA accessible at the time of the site visit due to the steepness of the slope. There are no restroom facilities at the site.

Availability to Public

This site is available to the public year-round. There are no posted hours of operation and the site is not maintained for winter use.

Site Condition Assessment

The site appears to be functioning as intended and the amenities appeared to be in functional condition. The site therefore received a Category rating of 4.

Figure 40. Turners Falls Branch Canal Area

Branch Canal Benches

Site 22: Turners Falls Station No. 1 Fishing Access

This informal site is located within the Turners Falls Project boundary, off of Power Street in Montague, Massachusetts. This site is on property owned by FirstLight and is open for fishing.

Site Inventory

There are no formal amenities at this site and access to the river is via numerous informal trails to the shoreline in this area. Some of the trails appear to be used frequently. There is a FirstLight parking lot at the power station that FirstLight allows anglers to use and that can hold approximately 6 vehicles, but the lot is not part of the recreation site. There are no sanitation facilities at this site.

Availability to Public

The site is available for angler use year round. There were no posted hours of operation at the time of the site visit. The parking lot remains plowed during the winter, but the site did not appear to receive winter use.

Site Condition Assessment

Site use was determined by compacted trails and shoreline areas, along with a minor amount of erosion which was observed. The condition of this site was not rated because it is an informal recreation site.

Figure 41. Turners Falls Station No. 1 Fishing Access

Informal Fishing Location

Figure 42. Turners Falls Station No. 1 Fishing Access

Overview of Parking Area

Site 23: Cabot Woods Fishing Access

This site is located within the Turners Falls Project boundary on Migratory Way in Montague, Massachusetts between the power canal and the bypass reach. This site is owned and managed by FirstLight and it is open to the public for day use activities such as fishing, hiking, and picnicking. This site is a Project Recreation Site.

<u>Site Inventory</u>

Recreation facilities provided at this site include 3 picnic tables, 2 parking lots, and numerous informal angler access trails. Combined the parking lots provide 17 parking spaces, and 3 ADA parking spaces. There are no restroom facilities at the site. The trail to the picnic area and picnic area itself are not ADA accessible due to the steep slope of the trail. The access road along the canal is open to the public and is used for sightseeing.

<u>Availability to Public</u>

The fishing access is open year-round from dawn to dusk. The site abuts a fence belonging to the U.S. Geological Survey's Conte Anadromous Fish Laboratory. The gate at the head of the road into the fishing access and Conte Fish Laboratory closes at 5:00 pm daily. However, the upper parking lot can be used when the gate is locked.

<u>Site Condition Assessment</u>

There was compaction of the soils in the vicinity of well used trails to the shoreline of the bypass reach and minor erosion noted at the time of the site visit. The erosion observed during the site visit conducted in October, 2011 may not have been a result of recreation use but from Hurricane Irene that had passed through the area six weeks before the site visit. Amenities at the site were in good, functioning condition and received a Category rating of 4.

Figure 43. Cabot Woods Fishing Access

Cabot Woods Trail and Picnic Area

Site 24: Turners Falls Canoe Portage

The Turners Falls canoe portage provides boaters with a means of circumventing the Turners Falls Dam. Boaters wishing to proceed downriver of Barton Cove are picked up by FirstLight and driven to just downstream of the Turners Falls Dam to a put-in located on Poplar Street in Montague City, where they can continue their trip. The primary facilities that comprise the canoe portage (take-out and put-in) are located on property owned by FirstLight. The vehicular portage is operated by FirstLight and is considered a Project Recreation Site.

<u>Site Inventory</u>

The canoe portage consists of a take-out area and put-in area. The portage take-out is at the Barton Cove Canoe and Kayak Rental Area (Site 16, described earlier in the summary). The portage put-in is located approximately 3.5 miles downstream of Turners Falls Dam, outside the Project boundary. Facilities associated with the put-in include a parking area and trash receptacle. The parking area is approximately 50 feet long by 30 feet wide and can hold approximately 4 vehicles. The parking area is not delineated and does not contain ADA signage. The slope to the shoreline is very steep and the portage trail to the shoreline is unimproved. There are no sanitation facilities at the site. The parking area is not maintained during the winter.

Availability to Public

Portage around the Turners Falls Dam for paddlecraft is available to the public at no charge seven days per week during the paddling season, typically mid-May through mid-November. The site is open from dawn till dusk.

Site Condition Assessment

The condition of the take-out site was assessed as part of the assessment of the Barton Cove Canoe and Kayak Rental Area (Site 16). The improved parking area at the put-in location was determined to be in functional condition. The portage trail at the put-in site is currently functional, but as there have been no improvements to the put-in, no condition assessment was made of this area.

Figure 44. Turners Falls Canoe Portage

View of Shoreline Approach from Top of Slope of Portage Put-In

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Figure 45. Turners Falls Canoe Portage

View of Parking Area for Put-In

6 REFERENCES

FirstLight Hydro Generating Company (FirstLight) (2012). Pre-Application Document (PAD) for FERC Project Nos. 2485 and 1889

FirstLight. (2013). Revised Study Plan for the Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485).

Western Massachusetts Electric Co. (WMECO). (1981). Exhibit R - Recreational Development Plan, Turners Falls Hydroelectric Project.

Appendix A
Recreation Site Inventory Assessment Forms

FirstLight
Site Visit/Inventory Forms

Inspector: HAS AMW Date: 10-16-11 Time: 807 Photo No: ______

Project: Vernon and/or Northfield Site Name/Code: Gov Hunt Picnic BL Weather: Cool, Sunny

Owner: Transcanada Telephone: ______

Address: ______

City: ______ State: ______ Zip Code: ______

Facility Type:

Campground____ Picnic Area X Day Use/Overlook____ Informal____ Launch X Marina____
Hiking____ Ski Area____

Access:

✓	Water access		
✓	Paved access	2	# of lanes
____	Unpaved access (conventional motor vehicle)	____	# of lanes
____	Unpaved access (4WD vehicle)	____	# of lanes
____	ORV access (ATV)	____	width
____	Foot access	____	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership							Transcanada
Management							

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? Vernon Dam
Potential/need for expansion/enhancement? formalized parking, boat launch, tree cutting
Topography: flat w/ steep slope Ground cover: grass @ picnic area, sand below
Erosion/Soils: yes, sand @ launch Compaction: ______
Approximate Shoreline Footage: 500 ft Bank Fishing (Yes/No): ______
ADA compliant? Obstacles? accessible portable toilet. obstacles - sand Rentals? no

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable	3			1 is ADA
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
5	Picnic Tables		FE/W	
5	Grills		FE	
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
1	Boat Ramp		S/CG	Informal - planks under water
1	Launching Lanes			Informal
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
	Other:			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Surface Code	Dimensions
# ADA spaces			
# regular spaces	7	S/CG	15 x 40 ft 15x25 ; 15x10
# Vehicle & trailer spaces	3	S/CG	40 x 54

# of vehicles in lot 0 Space delineated N Curbs N

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ____ Swim Area Substrate: ____

Dimensions of beach: ____ Lifeguards ____ Buoyed swim area ____

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities: hard surface under water

Hard surface ____ Gravel ____ Unimproved X Carry In ____ Launch/Load prep area: N

Docks/Piers/Floats Total Docks____________ Total Slips ____________

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: ________________

Surface code: ________________

Combined Length of Piers________________

ADA compliant: ________________

Site Aesthetics:

Viewshed from site: 6

Viewshed from shoreline: 6

1 – No noticeable development

2 – Very limited primitive development

3 – Five (5) or less buildings in view

4 – Six (6) to ten (10) buildings in view

5 – Ten (10) or more buildings in view

6 – Highly developed

Nature of abutting development/land use: Vernon Dam & Homes

Audio perceptions from site: Water, Cars

Audio perceptions from shoreline: Water, Cars

Evidence of use at site: G, rod rests

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: None

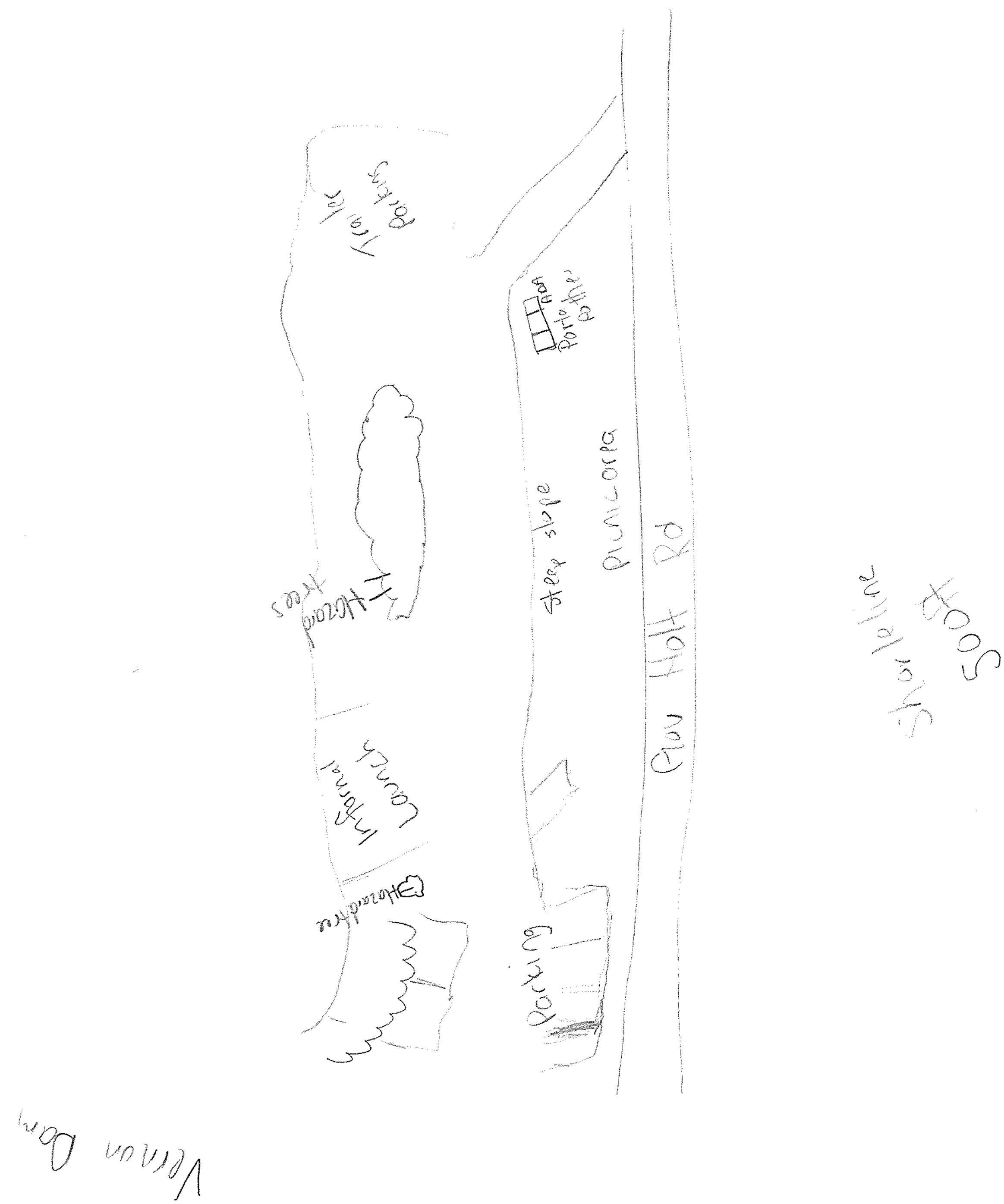
*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: No formal parking, launch informal, erosion from recent flooding

Hazard trees

FirstLight

Sketch:



Form Information

ProntoForm Name:	**Site Visit_Inventory Forms**
Submitter Name:	Daniel Sweeney (dsweeney@trcsolutions.com)
Submission Date:	Jul 16, 2012 10:14:01 AM EDT
Server Receive Date:	Jul 16, 2012 10:14:09 AM EDT
Reference Number:	20120716-182500594
Location:	42.77198569853117, -72.48674070469335, Hinsdale, NH, United States Jul 16, 2012 10:08:34 AM EDT [View Map]

Site Info

GENERAL SITE INFORMATION

Inspector:	Angela Whelpley
Date Time	Jul 16, 2012 9:59:10 AM EDT
Project	Turners Falls and Northfield
Site Name Code	informal campsite Ashuelot River
Weather	Sunny
GPS Point	42.77187488977124, -72.48675579211906, Hinsdale, NH, United States Jul 16, 2012 9:59:06 AM EDT [View Map]

Facility Type / Access

Facility Type	Informal
Facility Type	Campground Day Use Informal Picnic Area
Water Access	Yes
Paved Access	No
Paved Lanes	1
Unpaved Access	No
Unpaved Lanes	1
4WD Access	No
4WD Lanes	1
ATV Access	No
ATV Width (ft)	4
Foot Access	Yes
Foot Width (ft)	4

Ownership/Operations/Enhancments/ADA

Operations	informal
Is the area associated with other facilities or activities?	No
What facilities or activities?	Camping, fishing, hiking, picnicing
Potential need for enhancment or expansion?	No
Topography	Level
Ground Cover Type	Grass Native Plants
Compaction of Soils?	Minimal
Approximate Shoreline Footage	100

Fishing from Bank?	Yes
ADA compliant?	No
ADA potential obstacles	access

Sanitation

Sanitation facilities present?	No
Flush Unisex	0
Flush Female	0
Flush Male	0
Composting Unisex	0
Compost Female	0
Compost Male	0
Vault Unisex	0
Vault Female	0
Vault Male	0
Pit Unisex	0
Pit Female	0
Pit Male	0
Portable Unisex	0
Portable Female	0
Portable Male	0
Wilderness Unisex	0
Wilderness Female	0
Wilderness Male	0

Site Facilities

SITE FACILITIES
Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Picnic Tables	0
Repair Needed	No
Grills	0
Repair Needed	No
Fire Pits or Rings	1
Repair Needed	No
Material Code	NS
Trails	1
Repair Needed	No
Material Code	NS
Shelter	0
Repair Needed	No
Potable Water	0
Repair Needed	No
Dumping Station	0
Repair Needed	No
Boat Ramp	0
Repair Needed	No
Launching Lanes	0
Repair Needed	No
Playground	0
Repair Needed	No
Showers	0
Repair Needed	No
Benches	0
Repair Needed	No
Interpretive Displays	0

Repair Needed	No
Other Site Facility	bar, firewood, grass is mowed

Recreation Activities Observed

RECREATION ACTIVITIES OBSERVED	
Picnicking	No
Adults	0
Minors	0
Total Users	0
Camping	No
Adults	0
Minors	0
Total Users	0
Walking or Hiking	No
Adults	0
Minors	0
Total Users	0
Swimming	No
Adults	0
Minors	0
Total Users	0
Beach Activities	No
Adults	0
Minors	0
Total Users	0
Launching Boats	No
Adults	0
Minors	0
Total Users	0
Adults	0
Minors	0
Total Users	0
Adults	0
Minors	0
Total Users	0

Parking Lots/Beach/Swim Areas

PARKING LOTS

Surface codes; (A) asphalt, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (G) grass, (O) other/specify, (S) sand

Length (ft)	0
Regular Spaces	0
Length (ft)	0
Vehicle With Trailer Spaces	0
Length (ft)	0
Number of Vehicles in Lot	0
Parking Spaces Delineated	No
Curbs Present	No
BEACHES AND SWIMMING AREAS	
Beaches or Swimming Area Present	No
Length (ft)	0
Width (ft)	0
ADA Compliant	No
Length (ft)	0
Width (ft)	0
ADA Compliant	No
Beach Length (ft)	0

Beach Width (ft)	0
Buoyed Swim Area	No
Life Guards	No

Camping

Camping No
Utility Codes: (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

RV SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
CABIN SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
TENT SITES	1
Group Sites	0
Access	Foot ORV
On Site Parking	No
Waterfront	Yes
WILDERNESS SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No

Boat Launches/Docks/Fishing Piers

BOAT LAUNCH FACILITIES
Launch Material Codes: (C) concrete, (FE) metal, (P/F) plastic/fiberglass, (W) wood, (O) other/specify

Launch	No
Total Number of Docks, Piers, and Floats	0
Total Slips	0
Dock 1	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 2	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 3	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 4	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 5	
Length	0
Width	0
Slips	0

ADA Compliant	No
FISHING PIERS	
Number of Fishing Piers	0
Combined Length of Fishing Piers	0
ADA Compliant	No

Site Aesthetics

SITE AESTHETICS	
Viewshed From Site	1 - No noticable development
Nature of Abutting Development and Land Use	trail
Audio Perceptions from Site	plane
Audio Perceptions from Shore	plane

Site Use Codes: (C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Use at Site	C GD VR

Overcrowding Codes: (A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes

Notes:	Private property

TRC

Form Information

ProntoForm Name:	**Site Visit_Inventory Forms**
Submitter Name:	Daniel Sweeney (dsweeney@trcsolutions.com)
Submission Date:	Jul 15, 2012 5:44:03 PM EDT
Server Receive Date:	Jul 15, 2012 5:46:20 PM EDT
Reference Number:	20120715-182499170
Location:	474 Northfield Rd, Hinsdale, NH 03451-2517, United States Jul 15, 2012 5:43:28 PM EDT [View Map]

Site Info

GENERAL SITE INFORMATION

Inspector:	Angela Whelpley
Date Time	Jul 15, 2012 5:34:40 PM EDT
Take Photo	
Project	Turners Falls and Northfield
Site Name Code	Fort Hill Rail Trail
Weather	Overcast
GPS Point	472 Northfield Rd, Hinsdale, NH 03451-2517, United States Jul 15, 2012 5:34:38 PM EDT [View Map]

Facility Type / Access

Facility Type	Day Use
Facility Type	Day Use
Water Access	No
Paved Access	Yes
Paved Lanes	2
Unpaved Access	No
Unpaved Lanes	1
4WD Access	No
4WD Lanes	1
ATV Access	No
ATV Width (ft)	4
Foot Access	No
Foot Width (ft)	2

Ownership/Operations/Enhancments/ADA

Ownership	State
Management	State
Operations	Open_Closed
Is the area associated with other facilities or activities?	No
Potential need for enhancment or expansion?	No
Topography	Level
Ground Cover Type	Grass
Compaction of Soils?	Moderate
Approximate Shoreline Footage	0
Fishing from Bank?	No
ADA compliant?	No

Sanitation

Sanitation facilities present?	No
Flush Unisex	0
Flush Female	0
Flush Male	0
Composting Unisex	0
Compost Female	0
Compost Male	0
Vault Unisex	0
Vault Female	0
Vault Male	0
Pit Unisex	0
Pit Female	0
Pit Male	0
Portable Unisex	0
Portable Female	0
Portable Male	0
Wilderness Unisex	0
Wilderness Female	0
Wilderness Male	0

Site Facilities

SITE FACILITIES
Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Picnic Tables	0
Repair Needed	No
Grills	0
Repair Needed	No
Fire Pits or Rings	0
Repair Needed	No
Trails	1
Repair Needed	No
Material Code	G
Use, Notes, Length	9 miles
Shelter	0
Repair Needed	No
Potable Water	0
Repair Needed	No
Dumping Station	0
Repair Needed	No
Boat Ramp	0
Repair Needed	No

Launching Lanes	0
Repair Needed	No
Playground	0
Repair Needed	No
Showers	0
Repair Needed	No
Benches	0
Repair Needed	No
Interpretive Displays	0
Repair Needed	No

Recreation Activities Observed

RECREATION ACTIVITIES OBSERVED

Picnicking	No
Adults	0
Minors	0
Total Users	0
Camping	No
Adults	0
Minors	0
Total Users	0
Walking or Hiking	No
Adults	0
Minors	0
Total Users	0
Swimming	No
Adults	0
Minors	0
Total Users	0
Beach Activities	No
Adults	0
Minors	0
Total Users	0
Launching Boats	No
Adults	0
Minors	0
Total Users	0
Adults	0
Minors	0
Total Users	0
Adults	0
Minors	0
Total Users	0

Parking Lots/Beach/Swim Areas

PARKING LOTS

Surface codes; (A) asphalt, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (G) grass, (O) other/specify, (S) sand

Length (ft)	0
Regular Spaces	35
Surface Code	CG
Vehicle With Trailer Spaces	0
Length (ft)	0
Number of Vehicles in Lot	0
Parking Spaces Delineated	No
Curbs Present	No

BEACHES AND SWIMMING AREAS

Beaches or Swimming Area Present	No
Length (ft)	0
Width (ft)	0
ADA Compliant	No
Length (ft)	0
Width (ft)	0
ADA Compliant	No
Beach Length (ft)	0
Beach Width (ft)	0
Buoyed Swim Area	No
Life Guards	No

Camping

Camping	No
Utility Codes: (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)	
RV SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
CABIN SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
TENT SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
WILDERNESS SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No

Boat Launches/Docks/Fishing Piers

BOAT LAUNCH FACILITIES
Launch Material Codes: (C) concrete, (FE) metal, (P/F) plastic/fiberglass, (W) wood, (O) other/specify

Launch	No
Total Number of Docks, Piers, and Floats	0
Total Slips	0
Dock 1	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 2	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 3	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 4	
Length	0
Width	0

Slips	0
ADA Compliant	No
Dock 5	
Length	0
Width	0
Slips	0
ADA Compliant	No
FISHING PIERS	
Number of Fishing Piers	0
Combined Length of Fishing Piers	0
ADA Compliant	No

Site Aesthetics

SITE AESTHETICS	
View shed From Site	1 - No noticable development
Nature of Abutting Development and Land Use	road
Audio Perceptions from Site	cars
Audio Perceptions from Shore	cars

Site Use Codes: (C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Use at Site	unauthorized atv use

Overcrowding Codes: (A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes

Notes:	Crosses project boundary at ashuelot river

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, Amw Date: 10-16-11 Time: 13:09 Photo No: ________

Project: northfield Site Name/Code: Pauchaug ~~BK~~ WMA Weather: ________

Owner: State Telephone: ________

Address: ________

City: ________ State: ______ Zip Code: ________

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook X Informal____ Launch_____ Marina_____ Hiking______ Ski Area_______

Access:

______	Water access		
X	Paved access	2	# of lanes
______	Unpaved access (conventional motor vehicle)	______	# of lanes
______	Unpaved access (4WD vehicle)	______	# of lanes
______	ORV access (ATV)	______	width
______	Foot access	______	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership			X				
Management			X				

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? farm field

Potential/need for expansion/enhancement? formal pkg

Topography: flat Ground cover: grass

Erosion/Soils: ________ Compaction: ________

Approximate Shoreline Footage: ________ Bank Fishing (Yes/No): ________

ADA compliant? Obstacles? ________ Rentals? no

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

Site Facilities:

#	Type	Repairs	Material Code	Other Info
______	Picnic Tables	________	_______	____________________________
______	Grills	________	_______	____________________________
______	Firepit/ring	________	_______	____________________________
______	Trails (specify use)	________	_______	Length?______________________
______	Shelter	________	_______	____________________________
______	Potable Water	________	_______	____________________________
______	Dumping Station	________	_______	____________________________
______	Boat Ramp	________	_______	____________________________
______	Launching Lanes	________	_______	____________________________
______	Playground	________	_______	____________________________
______	Showers	________	_______	____________________________
______	Benches	________	_______	____________________________
______	Interpretive. Displays:	________	_______	____________________________
______	Other: __________	________	_______	____________________________

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking	_________	_________	____________
Camping	_________	_________	____________
Walking/hiking	_________	_________	____________
Swimming	_________	_________	____________
Beach Activities	_________	_________	____________
Launching boats	_________	_________	____________
Fishing	_________	_________	____________
________________	_________	_________	____________

Parking Lots:		Surface Code	Dimensions
# ADA spaces	_________	_________	_________
# regular spaces	_________	_________	_________
# Vehicle & trailer spaces	_________	_________	_________

\# of vehicles in lot _________ Space delineated_________ Curbs_________

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:	________	_______	______	_______
Float: :	________	_______	______	_______

Beach Area Substrate: ________________________ Swim Area Substrate: ________________

Dimensions of beach: _______________ Lifeguards ______ Buoyed swim area ________

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites	______	______	______	______
Access (foot, orv, car, boat)	______	______	______	______
# of sites	______	______	______	______
On site parking	______	______	______	______
Water front	______	______	______	______
ADA compliant	______	______	______	______
Utilities	______	______	______	______

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks____________ Total Slips ______________

Material code:	#1______	#2______	#3______	#4______	#5______
Dimensions:	#1______	#2______	#3______	#4______	#5______
# of slips:	#1______	#2______	#3______	#4______	#5______
ADA compliant:	#1______	#2______	#3______	#4______	#5______

Fishing Piers:

Number: __________________

Surface code: __________________

Combined Length of Piers________________

ADA compliant: ________________________

Site Aesthetics:

Viewshed from site: ____3____

Viewshed from shoreline: ____________

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: ______road______

Audio perceptions from site: ______cars______

Audio perceptions from shoreline: ______________________

Evidence of use at site: ____fire ruts____

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

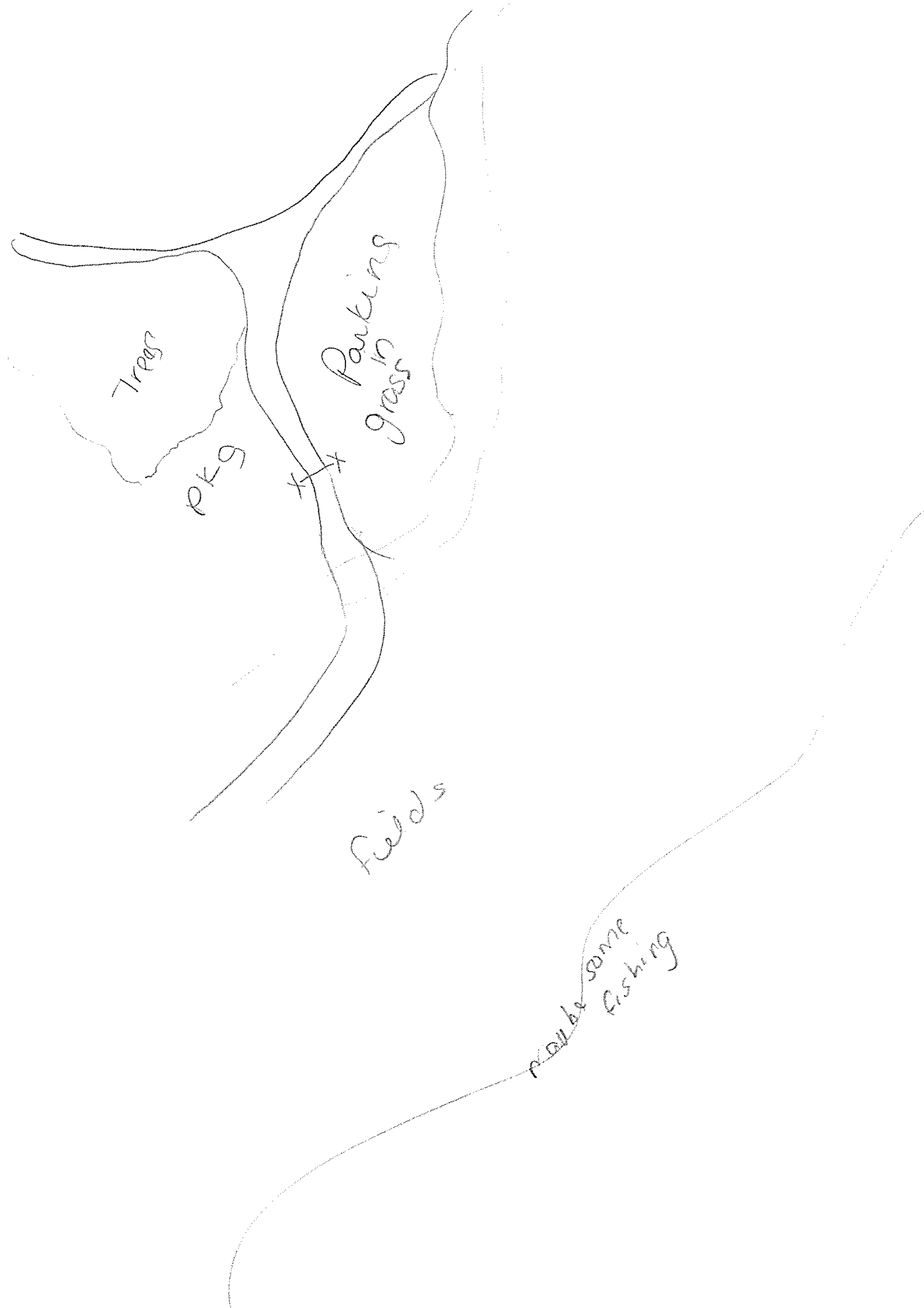
Evidence of Overcrowding: ______________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: ____

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-16-11 Time: 13:20 Photo No: ____

Project: Northfield Site Name/Code: Pauchaug ~~ft~~ BL Weather: Sunny

Owner: State Telephone: ____

Address: ____

City: ____ State: ____ Zip Code: ____

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal____ Launch √ Marina____ Hiking____ Ski Area____

Access:

X	Water access		
X	Paved access	2	# of lanes
	Unpaved access (conventional motor vehicle)		# of lanes
	Unpaved access (4WD vehicle)		# of lanes
	ORV access (ATV)		width
	Foot access		width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership			X				
Management			X				

Operations:

Staffed N Private N Seasonal____ Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? WMA

Potential/need for expansion/enhancement? dock

Topography: flat Ground cover: grass

Erosion/Soils: silted shoreline Compaction: no

Approximate Shoreline Footage: ≈400 Bank Fishing (Yes/No): Yes

ADA compliant? Obstacles? no dock Rentals? ____

Sanitation Facilities: (Yes/No) Yes seasonal

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable	1			ADA
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
1	Boat Ramp		C	
2	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
	Other:			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			
boat ramp	2		

Parking Lots:		Surface Code	Dimensions
# ADA spaces			
# regular spaces			
# Vehicle & trailer spaces	32	A	≈10 x 30

# of vehicles in lot 2 Space delineated Y Curbs Y

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface X Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks 0 Total Slips 6

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers: NO

Number: __________________

Surface code: __________________

Combined Length of Piers __________________

ADA compliant: __________________

Site Aesthetics:

Viewshed from site: 3

Viewshed from shoreline: 3

1 – No noticeable development

2 – Very limited primitive development

3 – Five (5) or less buildings in view

4 – Six (6) to ten (10) buildings in view

5 – Ten (10) or more buildings in view

6 – Highly developed

Nature of abutting development/land use: WMA

Audio perceptions from site: wind, cars, dogs

Audio perceptions from shoreline: " , "

Evidence of use at site: __________________

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: __________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: low water too much silt for big boats to use (A)

FirstLight

Sketch:

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-16-11 Time: 9:15 Photo No: Schell bridge abutment

Project: Northfield Site Name/Code: Schell informal Weather: Sun, wind

Owner: ______ Telephone: ______

Address: ______

City: ______ State: ______ Zip Code: ______

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal ✓ Launch____ Marina____ Hiking____ Ski Area____

Access:

______	Water access		
X	Paved access	1	# of lanes
______	Unpaved access (conventional motor vehicle)	______	# of lanes
______	Unpaved access (4WD vehicle)	______	# of lanes
______	ORV access (ATV)	______	width
______	Foot access	______	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership							
Management							

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? defunct rd + bridge

Potential/need for expansion/enhancement? ______

Topography: Steep to shore Ground cover: ______

Erosion/Soils: Shoreline - flooding Compaction: yes, trail around bridge

Approximate Shoreline Footage: ≈200' Bank Fishing (Yes/No): ______

ADA compliant? Obstacles? N, slope Rentals? N

Sanitation Facilities: (Yes/No) No

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities: None

#	Type	Repairs	Material Code	Other Info
______	Picnic Tables	________	_______	______________________________
______	Grills	________	_______	______________________________
______	Firepit/ring	________	_______	______________________________
______	Trails (specify use)	________	_______	Length?_______________________
______	Shelter	________	_______	______________________________
______	Potable Water	________	_______	______________________________
______	Dumping Station	________	_______	______________________________
______	Boat Ramp	________	_______	______________________________
______	Launching Lanes	________	_______	______________________________
______	Playground	________	_______	______________________________
______	Showers	________	_______	______________________________
______	Benches	________	_______	______________________________
______	Interpretive. Displays:	________	_______	______________________________
______	Other: __________	________	_______	______________________________

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring: none	# of Adults	# of Minors	Total # of users
Picnicking	_________	_________	_____________
Camping	_________	_________	_____________
Walking/hiking	_________	_________	_____________
Swimming	_________	_________	_____________
Beach Activities	_________	_________	_____________
Launching boats	_________	_________	_____________
Fishing	_________	_________	_____________
________________	_________	_________	_____________

Parking Lots: no		Surface Code	Dimensions
# ADA spaces	_________	_________	_________
# regular spaces	_________	_________	_________
# Vehicle & trailer spaces	_________	_________	_________

# of vehicles in lot _________ Space delineated_________ Curbs_________

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:	________	_______	______	_______
Float: :	________	_______	______	_______

Beach Area Substrate: _________________________ Swim Area Substrate: _________________

Dimensions of beach: ________________ Lifeguards ______ Buoyed swim area ________

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface ______ Gravel ______ Unimproved ______ Carry In ______ Launch/Load prep area: ______

Docks/Piers/Floats Total Docks______________ Total Slips ______________

Material code:	#1______	#2______	#3______	#4______	#5______
Dimensions:	#1______	#2______	#3______	#4______	#5______
# of slips:	#1______	#2______	#3______	#4______	#5______
ADA compliant:	#1______	#2______	#3______	#4______	#5______

Fishing Piers:

Number: ____________________

Surface code: ____________________

Combined Length of Piers________________

ADA compliant: ________________________

Site Aesthetics:

Viewshed from site: 5

Viewshed from shoreline: 5

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: old bridge - rd

Audio perceptions from site: water

Audio perceptions from shoreline: water

Evidence of use at site: C, G, O- urine smell

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

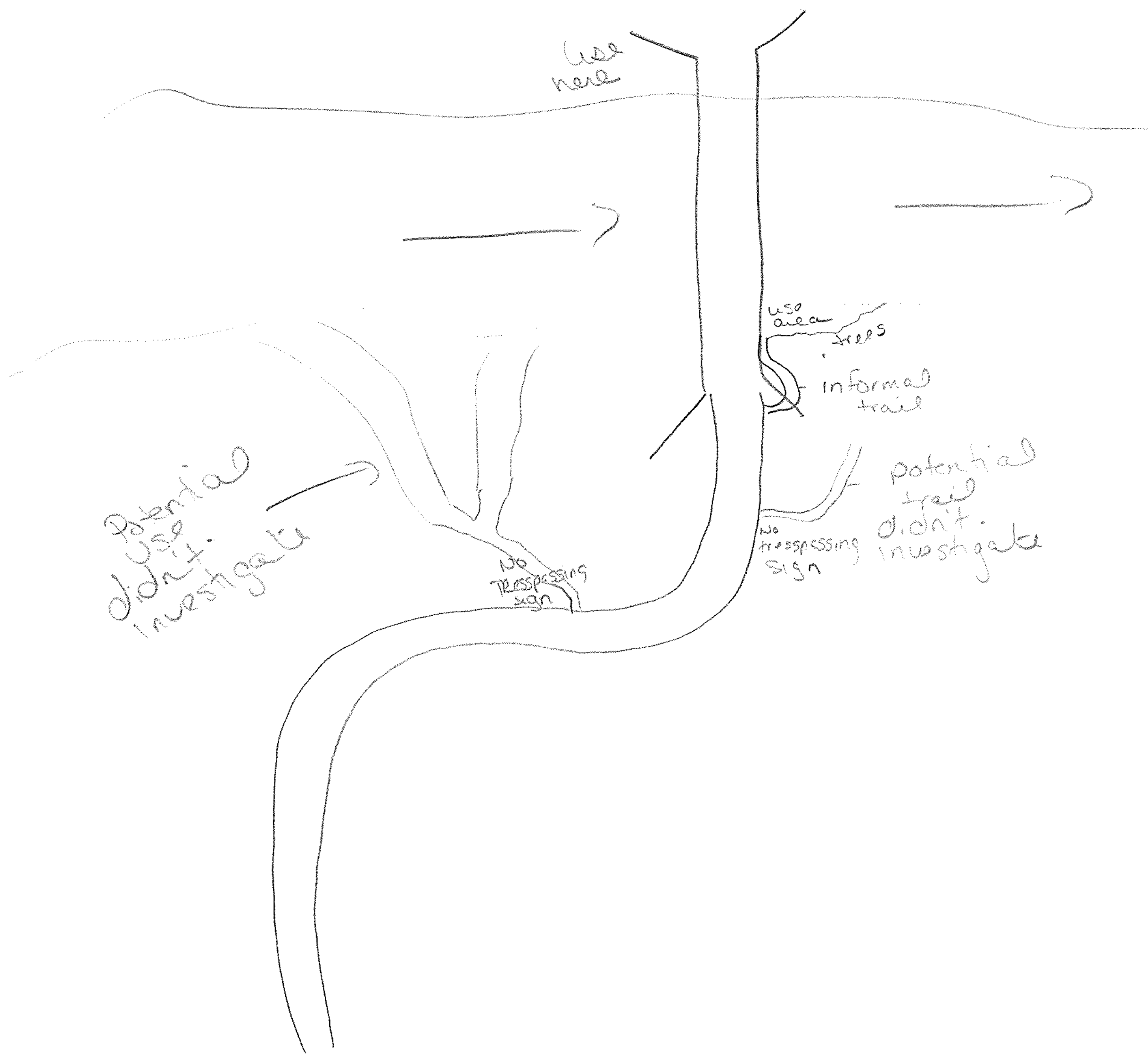
Evidence of Overcrowding: ______________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: Short walk in, could drive old rd bed

FirstLight

Sketch:



TRC

Form Information

ProntoForm Name:	**Site Visit_Inventory Forms**
Submitter Name:	Daniel Sweeney (dsweeney@trcsolutions.com)
Submission Date:	Jul 16, 2012 7:01:30 PM EDT
Server Receive Date:	Jul 16, 2012 7:01:48 PM EDT
Reference Number:	20120716-182507497
Location:	1518 Augusta Rd, Belgrade, ME 04917-3747, United States Jul 16, 2012 7:01:30 PM EDT [View Map]

Site Info

GENERAL SITE INFORMATION

Inspector:	Heather Seiders
Date Time	Jul 15, 2012 3:01:11 PM EDT
Project	Turners Falls and Northfield
Site Name Code	informal multiuse site
Weather	Overcast
GPS Point	

Facility Type / Access

Facility Type	Informal
Facility Type	Informal
Water Access	Yes
Paved Access	No
Paved Lanes	1
Unpaved Access	No
Unpaved Lanes	1
4WD Access	No
4WD Lanes	1
ATV Access	No
ATV Width (ft)	4
Foot Access	No
Foot Width (ft)	2

Ownership/Operations/Enhancments/ADA

Operations	informal
Is the area associated with other facilities or activities?	No
What facilities or activities?	Informal fishing
Potential need for enhancment or expansion?	No
Topography	Steep Slope
Ground Cover Type	Native Plants
Erosion of Soils?	Moderate
Compaction of Soils?	Moderate
Approximate Shoreline Footage	75
Fishing from Bank?	Yes
ADA compliant?	No

Sanitation

Sanitation facilities present?	No
Flush Unisex	0
Flush Female	0
Flush Male	0
Composting Unisex	0
Compost Female	0
Compost Male	0
Vault Unisex	0
Vault Female	0
Vault Male	0
Pit Unisex	0
Pit Female	0
Pit Male	0
Portable Unisex	0
Portable Female	0
Portable Male	0
Wilderness Unisex	0
Wilderness Female	0
Wilderness Male	0

Site Facilities

SITE FACILITIES
Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Picnic Tables	0
Repair Needed	No
Grills	0
Repair Needed	No
Fire Pits or Rings	0
Repair Needed	No
Trails	0
Repair Needed	No
Shelter	0
Repair Needed	No
Potable Water	0
Repair Needed	No
Dumping Station	0
Repair Needed	No
Boat Ramp	0
Repair Needed	No
Launching Lanes	0
Repair Needed	No
Playground	0
Repair Needed	No
Showers	0
Repair Needed	No
Benches	0
Repair Needed	No
Interpretive Displays	0
Repair Needed	No

Recreation Activities Observed

RECREATION ACTIVITIES OBSERVED

Picnicking	No
Adults	0

Minors	0
Total Users	0
Camping	No
Adults	0
Minors	0
Total Users	0
Walking or Hiking	No
Adults	0
Minors	0
Total Users	0
Swimming	No
Adults	0
Minors	0
Total Users	0
Beach Activities	No
Adults	0
Minors	0
Total Users	0
Launching Boats	No
Adults	0
Minors	0
Total Users	0
Other Activities 1	fishing
Adults	1
Minors	0
Total Users	0
Adults	0
Minors	0
Total Users	0

Parking Lots/Beach/Swim Areas

PARKING LOTS
Surface codes; (A) asphalt, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (G) grass, (O) other/specify, (S) sand

Length (ft)	0
Regular Spaces	0
Length (ft)	0
Vehicle With Trailer Spaces	0
Length (ft)	0
Number of Vehicles in Lot	0
Parking Spaces Delineated	No
Curbs Present	No
BEACHES AND SWIMMING AREAS	
Beaches or Swimming Area Present	No
Length (ft)	0
Width (ft)	0
ADA Compliant	No
Length (ft)	0
Width (ft)	0
ADA Compliant	No
Beach Length (ft)	0
Beach Width (ft)	0
Buoyed Swim Area	No
Life Guards	No

Camping

Camping	No

Utility Codes: (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

RV SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
CABIN SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
TENT SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No
WILDERNESS SITES	0
Group Sites	0
On Site Parking	No
Waterfront	No

Boat Launches/Docks/Fishing Piers

BOAT LAUNCH FACILITIES

Launch Material Codes: (C) concrete, (FE) metal, (P/F) plastic/fiberglass, (W) wood, (O) other/specify

Launch	No
Total Number of Docks, Piers, and Floats	0
Total Slips	0
Dock 1	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 2	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 3	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 4	
Length	0
Width	0
Slips	0
ADA Compliant	No
Dock 5	
Length	0
Width	0
Slips	0
ADA Compliant	No
FISHING PIERS	
Number of Fishing Piers	0
Combined Length of Fishing Piers	0
ADA Compliant	No

Site Aesthetics

SITE AESTHETICS

Viewshed From Site	2 - Very limited primitive development
Nature of Abutting Development and Land Use	farm fields
Audio Perceptions from Site	ag withdrawal pump
Audio Perceptions from Shore	ag withdrawal pump

Site Use Codes: (C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Use at Site	C E G UI

Overcrowding Codes: (A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Barton cove nature is plowed
VC is plowed

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-16-11 Time: 13:10 Photo No: ________

Project: Northfield Site Name/Code: Bennett meadow Weather: Cool/Cloudy

Owner: ______________________ Telephone: ______________

Address: ______________________

City: ______________ State: _____ Zip Code: __________

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal____ Launch_____ Marina_____ Hiking______ Ski Area_______

Access:

______ Water access
X Paved access — 2 # of lanes
______ Unpaved access (conventional motor vehicle) — ______ # of lanes
______ Unpaved access (4WD vehicle) — ______ # of lanes
______ ORV access (ATV) — ______ width
______ Foot access — ______ width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management			X				

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O
unplowed

General Area:

Is the area associated with other facilities or activities? farm, cutting nursery
Potential/need for expansion/enhancement? ______________
Topography: flat Ground cover: corn, grass
Erosion/Soils: ______________ Compaction: road
Approximate Shoreline Footage: See GIS Bank Fishing (Yes/No): ______________
ADA compliant? Obstacles? ______________ Rentals? no

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
1	Other: trashcan			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots: undeleneated		Surface Code	Dimensions
# ADA spaces			
# regular spaces			
# Vehicle & trailer spaces			

\# of vehicles in lot ______ Space delineated______ Curbs______

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface ______ Gravel ______ Unimproved ______ Carry In ______ Launch/Load prep area: ______

Docks/Piers/Floats Total Docks____________ Total Slips ____________

Material code:	#1______	#2______	#3______	#4______	#5______
Dimensions:	#1______	#2______	#3______	#4______	#5______
# of slips:	#1______	#2______	#3______	#4______	#5______
ADA compliant:	#1______	#2______	#3______	#4______	#5______

Fishing Piers:

Number: ____________________

Surface code: ____________________

Combined Length of Piers________________

ADA compliant: ________________________

Site Aesthetics:

Viewshed from site: ___________

Viewshed from shoreline: ____________

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: farm

Audio perceptions from site: Cars

Audio perceptions from shoreline: ________________________________

Evidence of use at site: G, C.

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

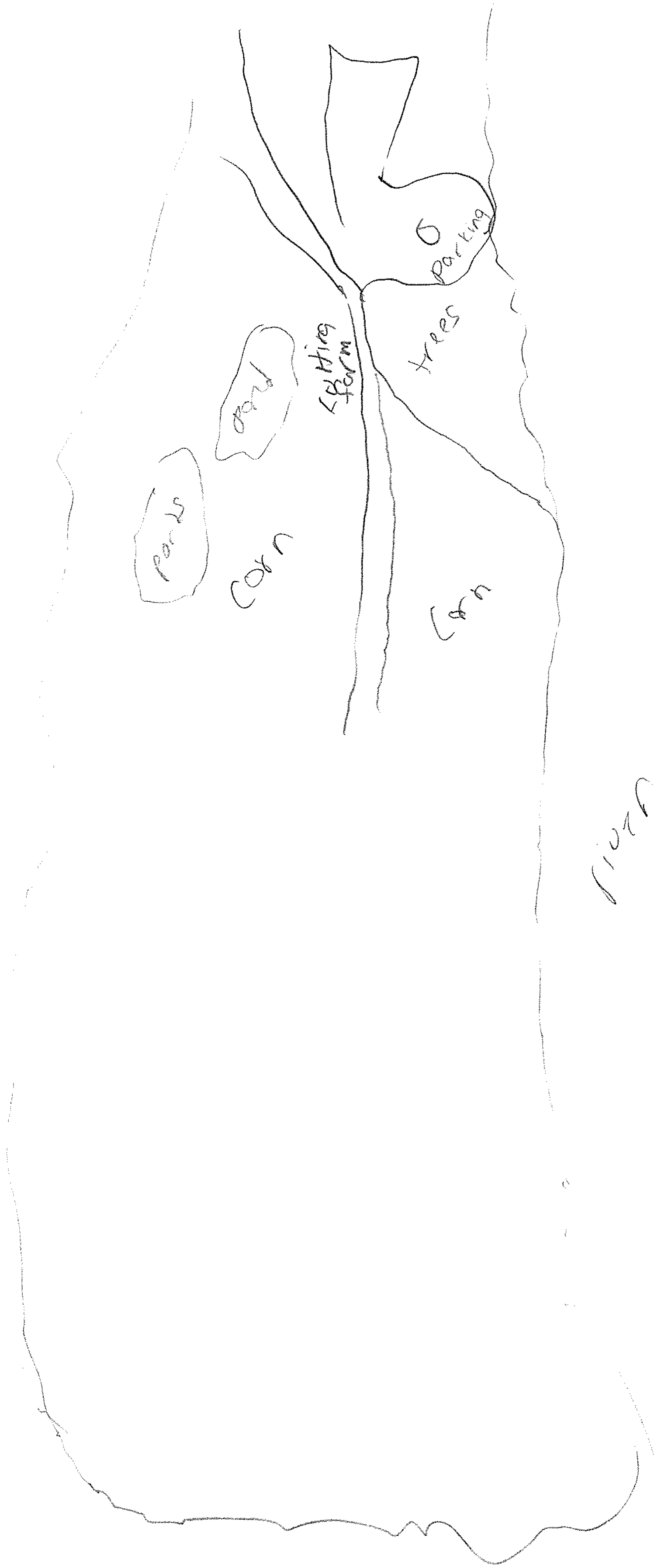
Evidence of Overcrowding: ____________________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: 1x/5yrs primitive encampments, hand dug ponds

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: HAS. AMW Date: 10-16-11 Time: 14:00 Photo No: ________

Project: Northfield Site Name/Code: Munn's Ferry Weather: ________

Owner: FirstLight Telephone: ________

Address: ________

City: ________ State: ________ Zip Code: ________

22/night camping
30/night shelter

Facility Type:

Campground X Picnic Area ____ Day Use/Overlook ____ Informal ____ Launch ____ Marina ____
Hiking ____ Ski Area ____

Access:

X	Water access		
____	Paved access	____	# of lanes
____	Unpaved access (conventional motor vehicle)	____	# of lanes
____	Unpaved access (4WD vehicle)	____	# of lanes
____	ORV access (ATV)	____	width
____	Foot access	____	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed N Private N Seasonal N Commercial N Fee X Open/Closed O

General Area:

Is the area associated with other facilities or activities? railroad nearby

Potential/need for expansion/enhancement? ________

Topography: gentle slope Ground cover: grass

Erosion/Soils: minor shore foot traffic Compaction: no

Approximate Shoreline Footage: 500-600 Bank Fishing (Yes/No): ________

ADA compliant? Obstacles? no, slope Rentals? shelter

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit		1	1	not ADA
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
7	Picnic Tables			
7	Grills			
5	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
7	Other: trashcan			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Surface Code	Dimensions
# ADA spaces			
# regular spaces			
# Vehicle & trailer spaces			

# of vehicles in lot ______ Space delineated ______ Curbs ______

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

FirstLight

Campground/Campsite:

	RV sites	~~Cabin~~ Lean-to sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)		boat	boat	
# of sites		1	5	
On site parking		n	n	
Water front		n	n	
ADA compliant		n	n	
Utilities		n	n	

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface ______ Gravel ______ Unimproved ______ Carry In ______ Launch/Load prep area: ______

Docks/Piers/Floats Total Docks 1 Total Slips ______ 25' ramp

Material code:	#1 A	#2	#3	#4	#5
Dimensions:	#1 20x8	#2	#3	#4	#5
# of slips:	#1 2	#2	#3	#4	#5
ADA compliant:	#1 n	#2	#3	#4	#5

Fishing Piers:

Number: ______

Surface code: ______

Combined Length of Piers ______

ADA compliant: ______

Site Aesthetics:

Viewshed from site: 3

Viewshed from shoreline: 3

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: homes

Audio perceptions from site: cars, water

Audio perceptions from shoreline: "

Evidence of use at site: C

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

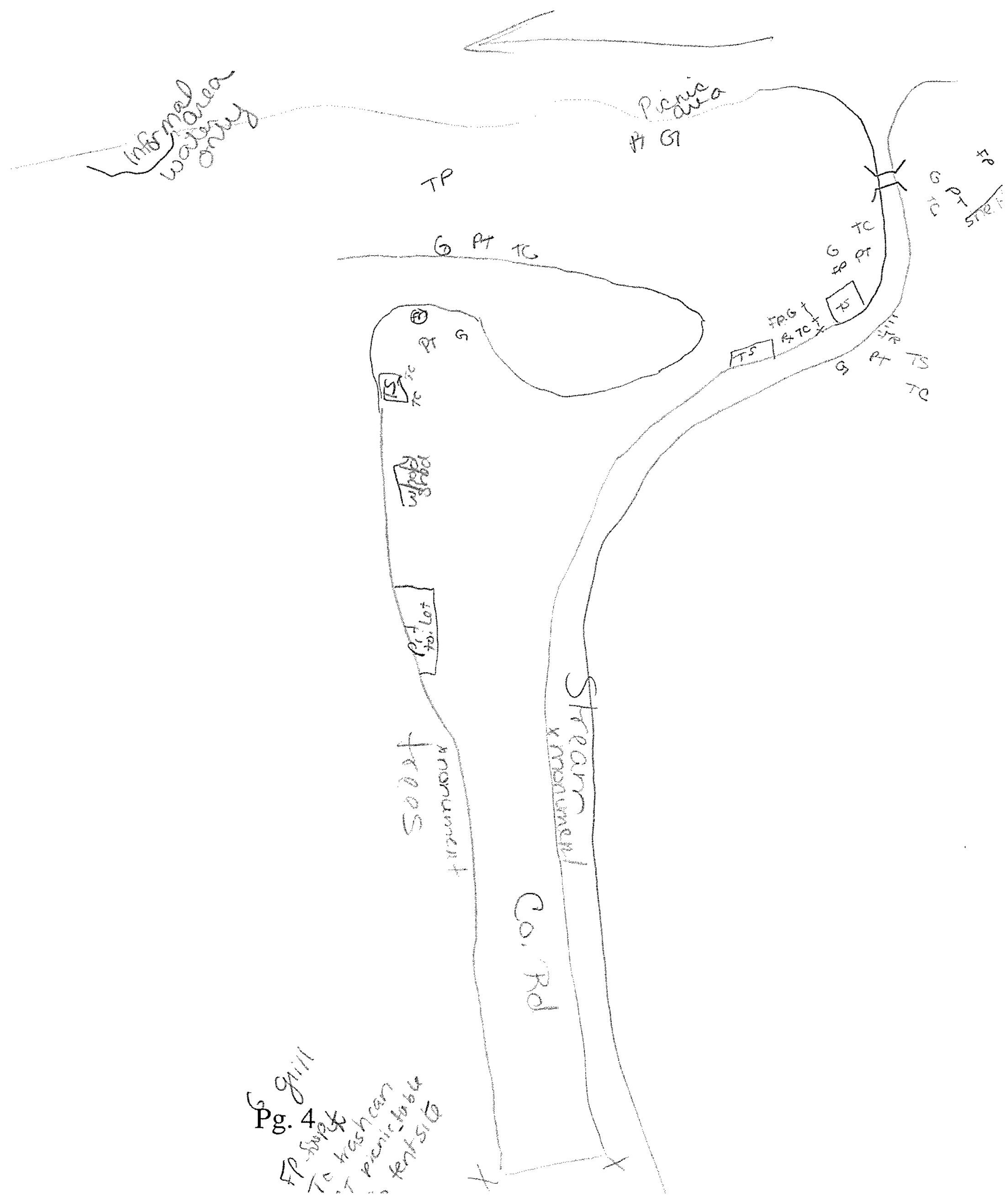
Evidence of Overcrowding: ______

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: provide wood by reservation, Kiddisland - Franklin Cty boat club used to lease

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-16-11 Time: 10 20 Photo No: ________

Project: Northfield Site Name/Code: Informal Munns Ferry Weather: Sunny

Owner: ____________________ Telephone: ____________

Address: ______________________________

City: ____________ State: _____ Zip Code: ________

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal X Launch_____ Marina_____ Hiking______ Ski Area_______

Access:

X	Water access		
X	Paved access	2	# of lanes
______	Unpaved access (conventional motor vehicle)	______	# of lanes
______	Unpaved access (4WD vehicle)	______	# of lanes
______	ORV access (ATV)	______	width
______	Foot access	______	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership							
Management							N/A

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? Old ferry crossing

Potential/need for expansion/enhancement? Could formalize, limited pkg

other landing erosion

Topography: gently slope Ground cover: grass- bamboo

Erosion/Soils: minor bank from Rec Compaction: trail

Approximate Shoreline Footage: ~50 Bank Fishing (Yes/No): ________

ADA compliant? Obstacles? No slope Rentals? NO

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities: none

#	Type	Repairs	Material Code	Other Info
______	Picnic Tables			
______	Grills			
______	Firepit/ring			
______	Trails (specify use)			Length?
______	Shelter			
______	Potable Water			
______	Dumping Station			
______	Boat Ramp			
______	Launching Lanes			
______	Playground			
______	Showers			
______	Benches			
______	Interpretive. Displays:			
______	Other: __________			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			
______________			

Parking Lots: Informal

		Surface Code	Dimensions
# ADA spaces	N		
# regular spaces	2	A	
# Vehicle & trailer spaces	N		

# of vehicles in lot 0   Space delineated /   Curbs /

Beach/Swim Area: (Yes/No) Informal

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______________ Swim Area Substrate: ______________

Dimensions of beach: ______________ Lifeguards ______ Buoyed swim area ________

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks_____________ Total Slips _____________

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: ___________________

Surface code: _________________

Combined Length of Piers_______________

ADA compliant: _______________________

Site Aesthetics:

Viewshed from site: 3

Viewshed from shoreline: 3

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: homes

Audio perceptions from site: mower birds, H2O

Audio perceptions from shoreline: same

Evidence of use at site: C, E

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

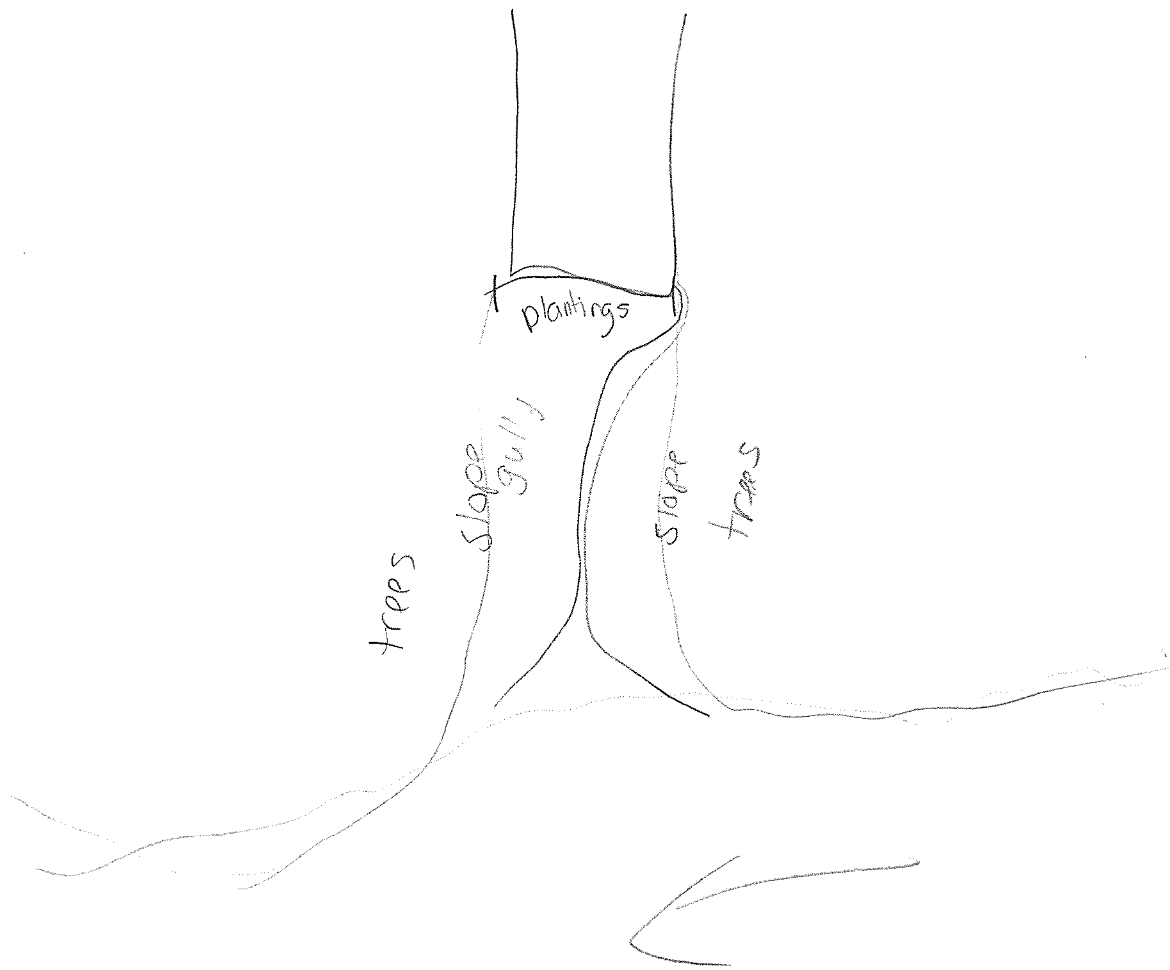
Evidence of Overcrowding: ______________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: Old ferry crossing, informal use

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-15-11 Time: 1538 Photo No: ______

Project: Northfield Site Name/Code: Riverview river boat / riverview Weather: cold, damp

Owner: ______ Telephone: ______

Address: ______

City: ______ State: ______ Zip Code: ______

Facility Type:

Campground____ Picnic Area X Day Use/Overlook X Informal____ Launch____ Marina____ Hiking____ Ski Area____

open dusk to dawn

Access:

X	Water access		
X	Paved access	2	# of lanes
	Unpaved access (conventional motor vehicle)		# of lanes
	Unpaved access (4WD vehicle)		# of lanes
	ORV access (ATV)		width
	Foot access		width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed N Private N Seasonal Y Commercial N Fee N for general use yes for pavilion Open/Closed O memorial day weekend to wkend after columbus

General Area:

Is the area associated with other facilities or activities? river boat, security cameras, pavilion site

Potential/need for expansion/enhancement? ______

Topography: Sloping to pic area Ground cover: grass

Erosion/Soils: no, one spot Compaction: no

Approximate Shoreline Footage: ≈ goes to 4mile brook Bank Fishing (Yes/No): Yes

ADA compliant? Obstacles? yes, slope Rentals? no

Sanitation Facilities: (Yes/No) Yes

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush	1 ADA	1	2 urinals + 1	
Composting				
Vault				
Pit				
Portable				
Wilderness				

Pavilion [illegible] 4 cars ~ max

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
0	Benches			
	Interpretive. Displays:			
	Other: garbage can			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Pavilion	Surface Code	Dimensions
# ADA spaces	2	0	A	
# regular spaces	25+	29	G	
# Vehicle & trailer spaces	0	0		
# of vehicles in lot	0	0		

Space delineated n | n Curbs n | y

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

FirstLight

Campground/Campsite: N

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

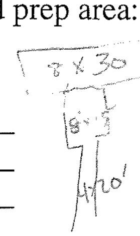
* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities: N

Hard surface ______ Gravel ______ Unimproved ______ Carry In ______ Launch/Load prep area: ______

Docks/Piers/Floats Total Docks 1 Total Slips 0

	#1	#2	#3	#4	#5
Material code:	Ft				
Dimensions:	8x30				
# of slips:	1				
ADA compliant:	Y				



used early for public fish net June

Fishing Piers: N

Number: ____________________

Surface code: ____________________

Combined Length of Piers ____________________

ADA compliant: ____________________

Site Aesthetics:

Viewshed from site: 3

Viewshed from shoreline: 3

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: Power canal

Audio perceptions from site: wind, cars

Audio perceptions from shoreline: V

Evidence of use at site: E

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

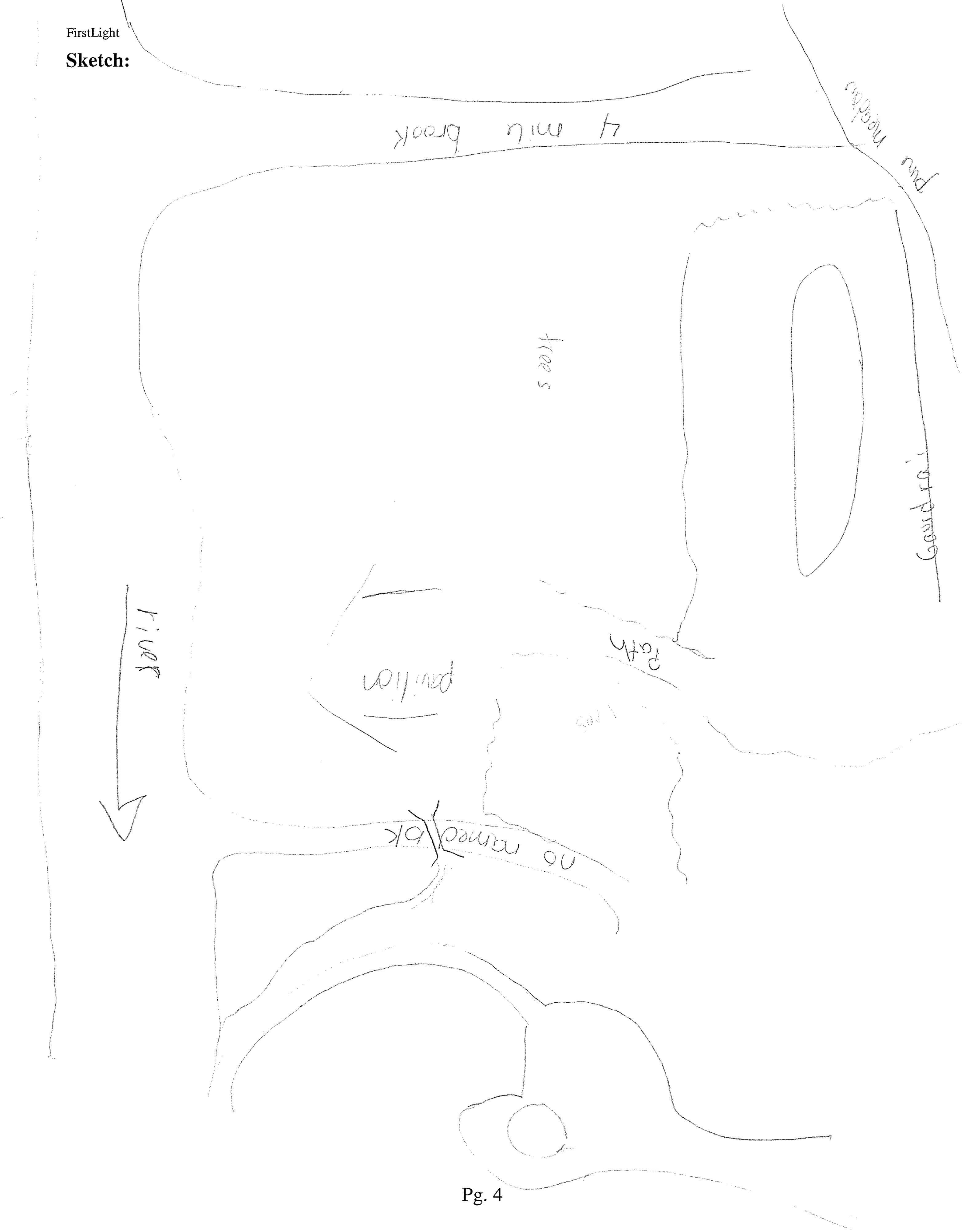
Evidence of Overcrowding: ____________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: ____________________

FirstLight

Sketch:



winter ... plus ...

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-15-12 14:19 N 1

Project: N rth ame/Co Visitor's Center Sunny

Owner: F... Telephone: ______

Address: ______

City: ______ State: ______ Zip Code: ______

Facility Type:

Campground____ Picnic Area____ Day Use/O____ @dam X Informal____ I
Hiking X Ski Area X

road ... is used for dbl trac + skating groomed w/ snowcat or Fullers feed snowmo was where pic area was supposed to be

Access:

______	Water access		
X	Paved access	2	# of lanes
______	Unpaved access (conventional motor vehicle)	______	# of lanes
______	Unpaved access (4WD vehicle)	______	# of lanes
______	ORV access (ATV)	______	width
______	Foot access	______	width

red trails narrow single track hiking

green, blue, black - very ... mowed in summer 1-2x

Ownership/Management

	Licensee	Federal	State	County	Local	Priva...	...
Ownership							
Management	X						

Operations:

Staffed X Private____ Seasonal____ Open

General Area:

Is the area associated with other facilities o... Visitor Ce... ails ... urt
Potential/need for expansion/enhancement?
Topography: flat to steep slope S
Erosion/Soils: ______ ex ... o ... s
Approximate Shoreline Footage: no
ADA compliant? Obstacles? yes Ski/Snowshoe, yurt
host large trail winter event for h... schools ≈ 2,000 peo

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush		3	3	1 ADA womens, 1 men's + 1 urinal
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
☒☒	Picnic Tables	w/ w+c ⟷	y	
:·	Grills		FE	
•	Firepit/ring		FE + O-fire bricks	
lots	Trails (specify use)			Length? See maps
	Shelter			
:	Potable Water			waterfoon' ns
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
:	Benches			
≈11	Interpretive. Displays:			VC very nice, reading movie
☒·	Other: trashcan		w/ FE	

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

: Chairs W

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking	0		
Camping	0		
Walking/hiking	yes - no count		
Swimming	0		
Beach Activities	0		
Launching boats	0		
Fishing	0		
wedding party			

Parking Lots: Visitor' Center lot

horse trailer lot
1 ADA
undelineated pkg
≈ 3 trailers

				Dimensions
# ADA spaces	3	A		
# regular spaces		A		
# Vehicle & trailer spaces				
# of vehicles in lot	4		y	Curbs n

Beach/Swim Area: (Yes/No)

	ber	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Ar ubstrate: ______

Dimensions of beach: ______ Lifeguards ______ ed swim area ______

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wil erness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks____________ Total Slips ____________

Material code:	#1______	#2______	#3______	#4______	#5______
Dimensions:	#1______	#2______	#3______	#4______	#5______
# of slips:	#1______	#2______	#3______	#4______	#5______
ADA compliant:	#1______	#2______	#3______	#4______	#5______

Fishing Piers:

Number: ________________

Surface code: ________________

Combined Length of Piers______________

ADA compliant: ____________________

Site Aesthetics:

Viewshed from site: 6

Viewshed from shoreline: ____________

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: Solar fa m, residences

Audio perceptions from site: dogs

~~Audio perceptions from shoreline~~: ______________________________

Evidence of use at site: ______________________

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: ______________________

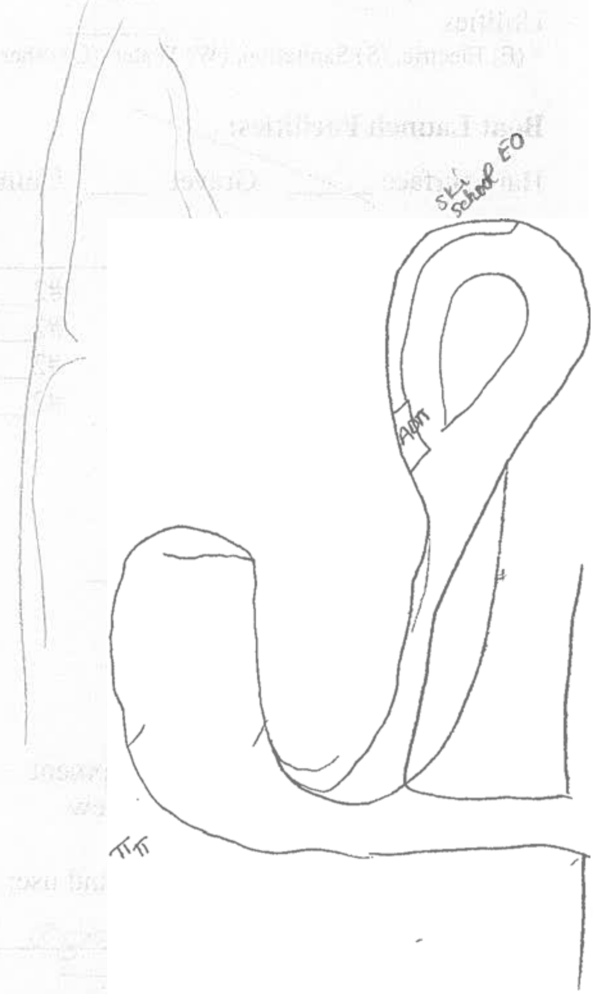
*

U

No Choc pot benches + picnic tables, allow hunting on upper portion of mtn, have to come in on backside - mostly deer no hunting signs posted on lower mtn, school + public programs

FirstLight

Sketch:



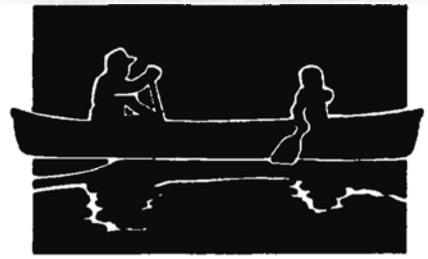
π picnic table
EO = Electrical Outlet

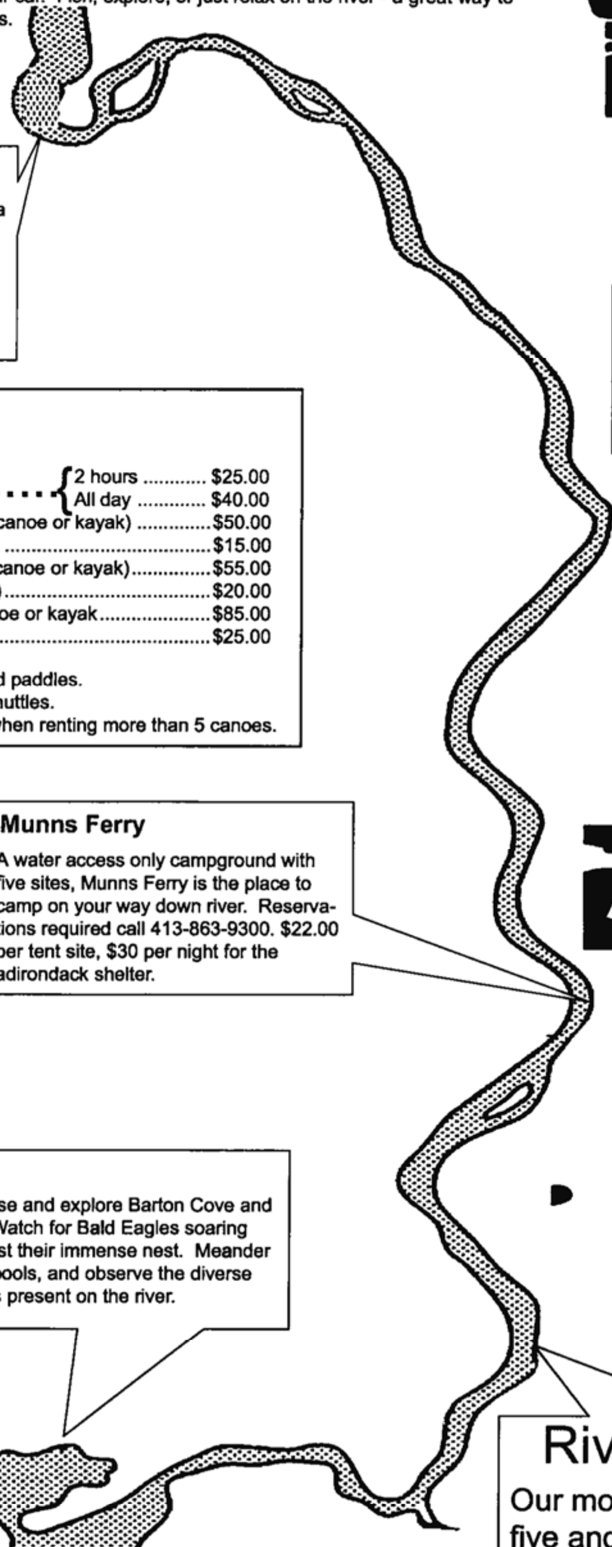
Document Accession #: 20140916-5028   Filed Date: 09/16/2014

DISCOVER THE CONNECTICUT RIVER

Paddling at rton Cove

Designated as an American Heritage River, the Connecticut River has a diverse cultural, geological, and historical background. As a major resource in New England, the Connecticut River provides a large source of recreation opportunities in the area. Experience the river at your own pace by paddling a canoe or kayak from our waterfront base, or by taking a shuttle upriver and paddling back to your car. Fish, explore, or just relax on the river - a great way to spend a few hours, or a few days.





Vernon Dam

This 20 mile trip begins at the Governor Hunt Recreation Area in Vernon, Vermont. A good starting point for canoeists wishing to spend the night at the Munns Ferry Campground. Average paddling time: 10 hours

Pauchaug Brook

Meander past river valley farms on this 14 mile trip. Stop for a stretch at Munns Ferry and continue to Riverview for lunch. A full day of paddling for the average canoeist. Average paddling time: 6 hours

Canoes / Kayaks	2 hours	$25.00
Canoes / Kayaks	All day	$40.00
Riverview Shuttle (includes canoe or kayak)		$50.00
Riverview Shuttle (own boat)		$15.00
Pauchaug Shuttle (includes canoe or kayak)		$55.00
Pauchaug Shuttle (own boat)		$20.00
Vernon Shuttle (includes canoe or kayak		$85.00
Vernon Shuttle (own boat)		$25.00

* All rentals include PFD's and paddles.
* Reservations required for shuttles.
* Group discounts avaliable when renting more than 5 canoes.

Munns Ferry

A water access only campground with five sites, Munns Ferry is the place to camp on your way down river. Reservations required call 413-863-9300. $22.00 per tent site, $30 per night for the adirondack shelter.

Northfield Mountain Recreation and Environmental Center

Quinnetukut II riverboat tickets, river exhibits at the Visitor Center, hiking, mountain biking, orienteering, self guided nature trails, picnic areas on 2,000 wooded acres

Barton Cove

Paddle right from our base and explore Barton Cove and the Connecticut River. Watch for Bald Eagles soaring overhead and paddle past their immense nest. Meander through ancient plunge pools, and observe the diverse plant and animal species present on the river.

Riverview

Our most popular day trip. An easy five and one half mile trip through the scenic French King Gorge. Explore the shoreline features and enjoy a leisurely introduction to day tripping. Average paddling time: 2 -3 hours

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

FirstLight
Site Visit/Inventory Forms

Inspector: AHS, AMW Date: 10-16-11 Time: ______ Photo No: ______

Project: Northfield Site Name/Code: Cabot Camp Weather: cloudy

Owner: FirstLight Telephone: ______

Address: ______

City: ______ State: ______ Zip Code: ______

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal X Launch____ Marina____ Hiking____ Ski Area____

takeout for raft company
franklin bikeway bridge

Access:

X Water access
X Paved access — 2 # of lanes
____ Unpaved access (conventional motor vehicle) — ____ # of lanes
____ Unpaved access (4WD vehicle) — ____ # of lanes
____ ORV access (ATV) — ____ width
____ Foot access — ____ width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? home. outbldgs

Potential/need for expansion/enhancement? ______

Topography: flat

Ground cover: grass

Erosion/Soils: no, silty-loam

Compaction: no

Approximate Shoreline Footage: ______

Bank Fishing (Yes/No): ______

ADA compliant? Obstacles? flat

Rentals? no

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
______	Picnic Tables	________	_______	______________________________
______	Grills	________	_______	______________________________
______	Firepit/ring	________	_______	______________________________
X	Trails (specify use)	________	_______	Length? Franklin bikeway
______	Shelter	________	_______	______________________________
______	Potable Water	________	_______	______________________________
______	Dumping Station	________	_______	______________________________
______	Boat Ramp	________	_______	______________________________
______	Launching Lanes	________	_______	______________________________
______	Playground	________	_______	______________________________
______	Showers	________	_______	______________________________
______	Benches	________	_______	______________________________
______	Interpretive. Displays:	________	_______	______________________________
______	Other: __________	________	_______	______________________________

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking	_________	_________	____________
Camping	_________	_________	____________
Walking/hiking	_________	_________	____________
Swimming	_________	_________	____________
Beach Activities	_________	_________	____________
Launching boats	_________	_________	____________
Fishing	_________	_________	____________
_______________	_________	_________	____________

Parking Lots: For functions		Surface Code	Dimensions
# ADA spaces	≈100×45 _________	_________	_________
# regular spaces	_________	_________	_________
# Vehicle & trailer spaces	_________	_________	_________

# of vehicles in lot _________ Space delineated_________ Curbs_________

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:	________	_______	______	_______
Float: :	________	_______	______	_______

Beach Area Substrate: _________________________ Swim Area Substrate: _________________

Dimensions of beach: ________________ Lifeguards ______ Buoyed swim area ________

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks____________ Total Slips ____________

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: ____________________

Surface code: ____________________

Combined Length of Piers______________

ADA compliant: ____________________

Site Aesthetics:

Viewshed from site: 5

Viewshed from shoreline: 5

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: homes, Kings bridge

Audio perceptions from site: cars on bridge

Audio perceptions from shoreline: " "

Evidence of use at site: VR

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: ____________________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: ____________________

FirstLight

Sketch:

FirstLight

combined with campground

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-15-11 Time: 16:57 Photo No: ____

Project: Turners falls Site Name/Code: Barton Cove nature area Weather: Sunny

Owner: FirstLight Telephone: ____

Address: ____

City: ____ State: ____ Zip Code: ____

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook X Informal____ Launch____ Marina____
Hiking____ Ski Area____

Access:

X Water access
✓ Paved access — 2 # of lanes
____ Unpaved access (conventional motor vehicle) — ____ # of lanes
____ Unpaved access (4WD vehicle) — ____ # of lanes
____ ORV access (ATV) — ____ width
____ Foot access — ____ width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed Seasonal Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? Campground & seasonal host
Potential/need for expansion/enhancement? ____
Topography: relatively flat Ground cover: grass
Erosion/Soils: ____ Compaction: ____
Approximate Shoreline Footage: ____ Bank Fishing (Yes/No): ____
ADA compliant? Obstacles? no, slope Rentals? ____

Sanitation Facilities: (Yes/No) Same as riverview plus 2 showers during summer

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable	1			during fall
Wilderness				

FirstLight 2 outbuildings

Site Facilities:

#	Type	Repairs	Material Code	Other Info
9 · 2+4	Picnic Tables		C/W	
7 · 1+4	Grills		FE	
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
1	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
2	Showers			
1	Benches			
	Interpretive. Displays:			
3 · 3+2 1	Other: trash cans		FE	

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

bike rack FE

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing	~~2~~ 3	2+2	
photos	4		

Parking Lots:		Surface Code	Dimensions
# ADA spaces			
# regular spaces	21	A	
# Vehicle & trailer spaces			

overflow ~5

# of vehicles in lot 5 Space delineated N Curbs Y

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

FirstLight

Campground/Campsite:

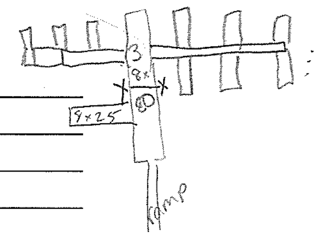
	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites	______	______	______	______
Access (foot, orv, car, boat)	______	______	______	______
# of sites	______	______	______	______
On site parking	______	______	______	______
Water front	______	______	______	______
ADA compliant	______	______	______	______
Utilities	______	______	______	______

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface ______ Gravel ______ Unimproved ______ Carry In ______ Launch/Load prep area: ______

Docks/Piers/Floats Total Docks 1 Total Slips 11



Material code:	#1 Ft	#2 ______	#3 ______	#4 ______	#5 ______
Dimensions:	#1 ______	#2 ______	#3 ______	#4 ______	#5 ______
# of slips:	#1 11	#2 ______	#3 ______	#4 ______	#5 ______
ADA compliant:	#1 N, slope	#2 ______	#3 ______	#4 ______	#5 ______

Fishing Piers:

Number: ______________

Surface code: ______________

Combined Length of Piers ______________

ADA compliant: ______________

Site Aesthetics:

Viewshed from site: 3

Viewshed from shoreline: 5

1 – No noticeable development

2 – Very limited primitive development

3 – Five (5) or less buildings in view

4 – Six (6) to ten (10) buildings in view

5 – Ten (10) or more buildings in view

6 – Highly developed

Nature of abutting development/land use: campground

Audio perceptions from site: cars

Audio perceptions from shoreline: car

Evidence of use at site: G

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: ______________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: dawn to dusk

FirstLight

Sketch:

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AmW Date: 10-16-11 Time: ~~#~~1600 Photo No: 4pics then this

Project: ______ Site Name/Code: BC Campground Weather: ______

Owner: ______ Telephone: ______

Address: ______

City: ______ State: ______ Zip Code: ______

Facility Type:

Campground X Picnic Area ___ Day Use/Overlook ___ Informal ___ Launch X (informal) Marina ___
Hiking ___ Ski Area ___

Access:

X Water access
X Paved access ___ # of lanes
___ Unpaved access (conventional motor vehicle) ___ # of lanes
___ Unpaved access (4WD vehicle) ___ # of lanes
___ ORV access (ATV) ___ width
___ Foot access ___ width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed y Private n Seasonal y Commercial n Fee y Open/Closed C

General Area:

Is the area associated with other facilities or activities? picnic area
Potential/need for expansion/enhancement? add'l potties
Topography: varied Ground cover: ______
Erosion/Soils: some Compaction: yes
Approximate Shoreline Footage: see GIS Bank Fishing (Yes/No): ______
ADA compliant? Obstacles? yes - 1 site + 1 portable Rentals? no

Sanitation Facilities: (Yes/No) multiple

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				seasonal in addition to pit
Wilderness				

FirstLight See map

Site Facilities:

#	Type	Repairs	Material Code	Other Info
______	Picnic Tables	______	______	______
______	Grills	______	______	______
______	Firepit/ring	______	______	______
______	Trails (specify use)	______	______	Length?______
______	Shelter	______	______	______
______	Potable Water	______	______	______
______	Dumping Station	______	______	______
______	Boat Ramp	______	______	______
______	Launching Lanes	______	______	______
______	Playground	______	______	______
______	Showers	______	______	______
______	Benches	______	______	______
______	Interpretive. Displays:	______	______	______
______	Other: ______	______	______	______

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking	______	______	______
Camping	______	______	______
Walking/hiking	______	______	______
Swimming	______	______	______
Beach Activities	______	______	______
Launching boats	______	______	______
Fishing	______	______	______
______	______	______	______

Parking Lots:		Surface Code	Dimensions
# ADA spaces	______	______	______
# regular spaces	______	______	______
# Vehicle & trailer spaces	______	______	______

# of vehicles in lot ______ Space delineated______ Curbs______

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:	______	______	______	______
Float: :	______	______	______	______

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

Group 1 8pt, 1FR, 1 Garbage can, 3 grills
Group 2 4pt, 1FR, 2 " " , 2 grills

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites			2	
Access (foot, orv, car, boat)			car, b	
# of sites	2		29	
On site parking			N	
Water front			21	
ADA compliant			1	
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks_____________ Total Slips _____________

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: __________________

Surface code: __________________

Combined Length of Piers________________

ADA compliant: ______________________

Site Aesthetics:

Viewshed from site: 1

Viewshed from shoreline: 1

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: picnic area

Audio perceptions from site: water, vehicles

Audio perceptions from shoreline: " "

Evidence of use at site: C

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: ______________________

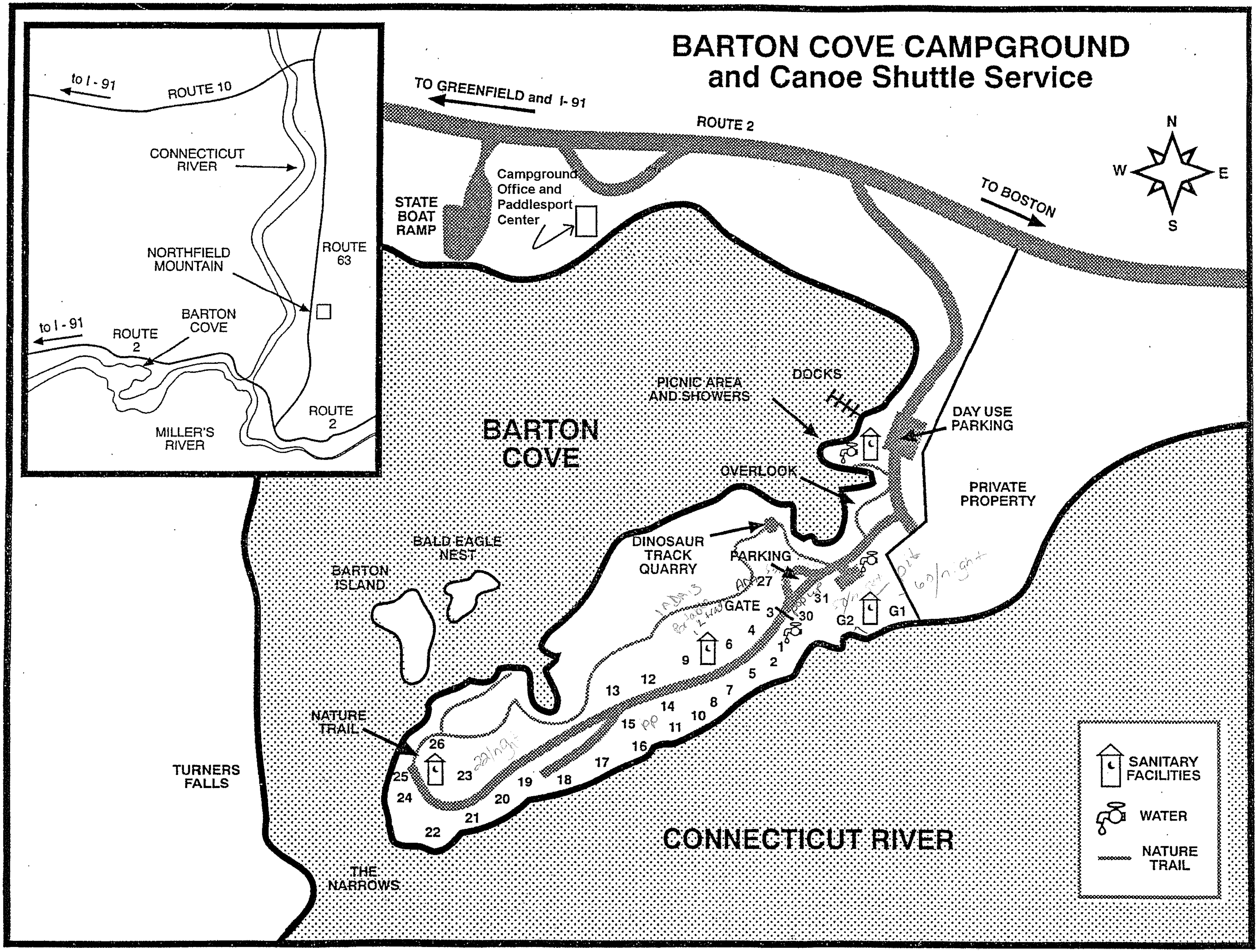
*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: ____

FirstLight

Sketch:

See map


BARTON COVE CAMPGROUND
and Canoe Shuttle Service
to I - 91
ROUTE 10
CONNECTICUT RIVER
NORTHFIELD MOUNTAIN
ROUTE 63
to I - 91
ROUTE 2
BARTON COVE
ROUTE 2
MILLER'S RIVER
TO GREENFIELD and I- 91
ROUTE 2
TO BOSTON
N
W
E
S
STATE BOAT RAMP
Campground Office and Paddlesport Center
BARTON COVE
PICNIC AREA AND SHOWERS
DOCKS
DAY USE PARKING
OVERLOOK
PRIVATE PROPERTY
DINOSAUR TRACK QUARRY
PARKING
GATE
G1
G2
BALD EAGLE NEST
BARTON ISLAND
NATURE TRAIL
TURNERS FALLS
THE NARROWS
CONNECTICUT RIVER
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 30 31
SANITARY FACILITIES
WATER
NATURE TRAIL
22/night
60/night

Barton Cove Campground Rules and Regulations

Please read these rules with everyone in your group. Please abide by these rules. They are designed to enhance your visit to Barton Cove.

- Camper vehicles are allowed in the campground only twice! Once to unload and set up, and once to reload upon departure. At all other times vehicles may be parked in the campground parking lot. Please close and lock the campground gate when you pass.
- Please help keep picnic area and campsites litter free.
- Tents may be placed on designated sites only.
- Fires are allowed in fireplaces only.
- Pets must be kept on a leash and attended at all times. Noisy pets will be asked to leave with their owners.
- Swimming is not allowed from the shores of the picnic area or campground.
- Quiet hours are observed between 10:00 p.m. and 8:00 a.m. Any guests of campers must leave by 9:00 p.m.
- Camping check out time is 11:00 a.m. Earliest check in time is 1:00 p.m.
- Use of electric generators is prohibited.
- Cutting or collecting any living trees, deadwood, or any vegetation is prohibited.
- The use of firearms, fireworks, or explosive devices is prohibited.
- Alcoholic beverages are prohibited.

Infraction of these rules will lead to expulsion.

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-16-11 Time: 1503 Photo No: ____
Project: Northfield Site Name/Code: Barton Cove rental Weather: Cloudy
Owner: FirstLight Telephone: ____
Address: ____
City: ____ State: ____ Zip Code: ____

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal____ Launch X (Kayak) Marina____
Hiking____ Ski Area____

Access:

X	Water access		
X	Paved access	2	# of lanes
	Unpaved access (conventional motor vehicle)		# of lanes
	Unpaved access (4WD vehicle)		# of lanes
	ORV access (ATV)		width
	Foot access		width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed y Private n Seasonal y Commercial n Fee n Open/Closed C

General Area:

Is the area associated with other facilities or activities? campground
Potential/need for expansion/enhancement? addtl pkg?
Topography: gentle slope Ground cover: grass
Erosion/Soils: no, ice damage to bank Compaction: no
Approximate Shoreline Footage: ____ Bank Fishing (Yes/No): No
ADA compliant? Obstacles? yes - no dock Rentals? Canoe/Kayaks 25 for 2 hrs 40 for day ~30 ~30

Sanitation Facilities: (Yes/No) Yes Seasonal

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable	2			
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
10	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
5	Other: trash			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Surface Code	Dimensions
# ADA spaces	no des		
# regular spaces	28		
# Vehicle & trailer spaces	no		

# of vehicles in lot — Space delineated n Curbs y

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites	______	______	______	______
Access (foot, orv, car, boat)	______	______	______	______
# of sites	______	______	______	______
On site parking	______	______	______	______
Water front	______	______	______	______
ADA compliant	______	______	______	______
Utilities	______	______	______	______

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In X Launch/Load prep area: _____

Docks/Piers/Floats Total Docks 0 Total Slips ______

Material code:	#1______	#2______	#3______	#4______	#5______
Dimensions:	#1______	#2______	#3______	#4______	#5______
# of slips:	#1______	#2______	#3______	#4______	#5______
ADA compliant:	#1______	#2______	#3______	#4______	#5______

~~**Fishing Piers:**~~

~~Number: ______~~

~~Surface code: ______~~

Combined Length of Piers ______

ADA compliant: ______

Site Aesthetics:

Viewshed from site: 6 Viewshed from shoreline: 6

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: Campground, FCBC, State launch

Audio perceptions from site: Cars, water

Audio perceptions from shoreline: Cars, water

Evidence of use at site: —

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

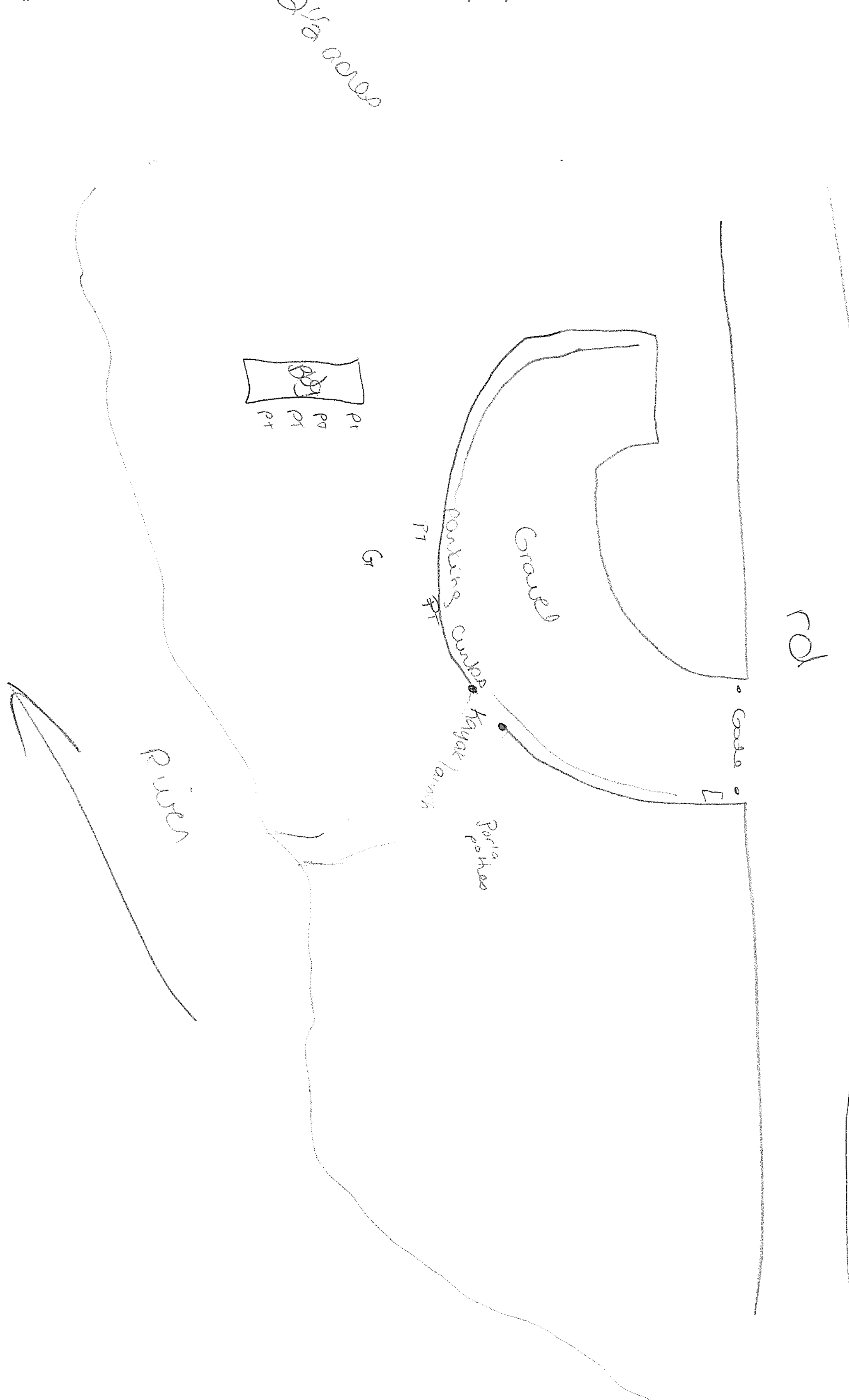
Evidence of Overcrowding: A

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: ______

FirstLight

Sketch:



Barton Cove Campground and Canoe/ Kayak Rentals 2011 Rates
413 863-9300
www.firstlightpower.com/northfield

Barton Cove Campsites: (reservation deposit required)
Camping season is Memorial Day weekend to Labor Day weekend.

Tent sites	22.00/ night; minimum stay: 2 nights on weekends, 3 nights on holiday weekends. Maximum 6 people, 2 tents/ site. Additional tent charge applies.
Group site 1	60.00/ night (12-15 tents, up to 50 people)
Group site 2	40.00/ night (5-7 tents, up to 25 people)
Wood	5.00/ bundle/ arm load plus tax
Ice	1.50/ 5lb bag plus tax

Munn's Ferry Campsites: *(boat access only; reservation and deposit required)*
Camping season is Memorial Day weekend to Columbus Day weekend.

Tent sites	22.00/ night
Shelter	30.00/ night

A maximum stay of 2 nights, or 3 nights on holiday weekends.

Canoe and Kayak Rentals: Available Memorial Day weekend to Labor Day weekend.
Saturday and Sunday 9:00am – 6:00pm, Monday through Friday 9:00am – 5:00pm.

Includes lifejackets and paddles. Renters less than 18 years old must be accompanied by an adult. Waiver must be signed. Prices are per boat with a 2 hour minimum charge. A $12.00 per hour fee will be charged for late returns. Group discount of 1 free rental for each 5 boats rented.

	<u>0-2 hours</u>	<u>full day</u>	<u>2nd day</u>
<u>Rental fees:</u> (*tax not included*)	$25.00	$40.00	$25.00
<u>Unguided River Trips:</u> with rental of canoe or kayak (*includes paddles and lifejackets; tax not included)*	<u>Riverview</u> (5.5 mi.) $55.00/ boat	<u>Pauchaug</u> (14 mi.) $60.00/ boat	<u>Vernon</u> (20 mi) $90.00/ boat (2 day rental)
For customer owned canoes and kayaks: upriver transport fee	$20.00/ boat	$25.00/ boat	$30.00/ boat

<u>Please note:</u>
A minimum charge will apply to any single customer boat being shuttled as follows:

$30.00/ boat	$40.00/ boat	$50.00/ boat

River trips are available on Saturday & Sunday. Reservations are recommended.
Weekday trips are available only by reservation and a minimum charge will apply.

Reservation Policy
Campsites: **Barton Cove** campsite reservations require a deposit equal to one night stay. A minimum stay of 2 nights on weekends, 3 nights on holiday weekends. **Munn's Ferry** reservations require full payment as deposit. Full payment is required at time of check-in.
Group site reservations on weekends require full payment as deposit.
Unguided River Trips: Reservations require a deposit equal to the shuttle fee of reserved boats for that trip (ex. Deposit of $45.00 required to reserve 3 rental kayaks for Riverview trip).

Deposits may be paid by VISA or MASTERCARD when the reservation is made. Checks must be made payable to Northfield Mountain and received no more than 7 days after the reservation is made. Cash will be accepted after the campground opens on Friday of Memorial Day weekend.

Cancellation and Change Policy:
Campsites:
- For cancellations or changes made more than 7 days prior to your check-in date. a $10.00 processing fee will be charged. The balance will be refunded or applied to the new reservation.
- **No refunds** will be issued for cancellations made **less than 7 days prior** to your check-in date.
- A $10.00 processing fee will be charged for changes made less than 7 days prior to your check-in date.

Group sites:
- **No refunds** will be issued for cancellations of group site reservations made less than **1 month prior** to check-in date.

Unguided River Trips:
- Refunds will be issued for cancellations of reserved river trips when made by the Campground Operators due to unsafe river or weather conditions.
- For cancellations or changes made more than 7 days prior to the start of your reservation your deposit will be refunded or applied to the new reservation.
- No refunds will be issued for cancellations or changes made less than 7 days prior to the start of your reservation.

Campground Rules and Regulations

Please read these rules with everyone in your group. Please abide by these rules, they are designed to enhance your visit to Barton Cove.

- Camper vehicles are allowed in the campground only twice! Once to unload and set up, and once to reload upon departure. At all other times vehicles may be parked in the campground parking lot. Please close and lock the campground gate when you pass. *(Access to Munn's Ferry is by boat only).*
- Please help keep picnic area and campsites litter free.
- Tents may be placed on designated sites only.
- Fires are allowed in fireplaces only. Firewood may be purchased at the camper check in area.
- Cutting or collecting any living trees, standing deadwood, or vegetation is prohibited.
- Help protect local forests from invasive insects, do not transport firewood from home.
- Pets must be kept on a leash and attended at all times. Noisy pets will be asked to leave with their owners.
- Swimming is not allowed from the shores of the picnic area or campground.
- Quiet hours are observed between 10:00pm and 8:00am. Any guests of campers must leave by 9:00pm.
- Camping check out time is 11:00am.
- Use of electric generators is prohibited.
- Alcoholic beverages are prohibited.
- The use of firearms, fireworks or explosive devises is prohibited.

FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-16-11 Time: 11:07 Photo No: ____
Project: Northfield Site Name/Code: ~~Barton Cove~~ State BL Weather: sun/clouds
Owner: DCR Telephone: ____
Address: ____
City: ____ State: ____ Zip Code: ____

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook____ Informal____ Launch X Marina____
Hiking____ Ski Area____

Access:

X Water access
✓ Paved access — 2 # of lanes
____ Unpaved access (conventional motor vehicle) — ____ # of lanes
____ Unpaved access (4WD vehicle) — ____ # of lanes
____ ORV access (ATV) — ____ width
____ Foot access — ____ width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership			X				
Management			X				

Operations:

Staffed N Private N Seasonal y Commercial N Fee N Open/Closed O

General Area:
Is the area associated with other facilities or activities? No
Potential/need for expansion/enhancement? single car parking
Topography: flat Ground cover: Grass
Erosion/Soils: minor shoreline Compaction: No
Approximate Shoreline Footage: ≈300 Bank Fishing (Yes/No): Yes
ADA compliant? Obstacles? yes Rentals? N

Sanitation Facilities: (Yes/No) – maybe portable – owned already

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
1	Boat Ramp			
2	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
	Other:			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing	1		
Leaf peepers	fluctuating		

Parking Lots:		Surface Code	Dimensions
# ADA spaces	1 single 1 trailer	A	15x20
# regular spaces		A	
# Vehicle & trailer spaces	22+22(44)	A	
# of vehicles in lot	8	Space delineated Y	Curbs N

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ____________ Swim Area Substrate: ____________

Dimensions of beach: ____________ Lifeguards ______ Buoyed swim area ________

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface X Gravel ____ Unimproved ____ Carry In ____ Launch/Load prep area: ____

Docks/Piers/Floats Total Docks 1 Total Slips ____ already noted

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: ____

Surface code: ____

Combined Length of Piers ____

ADA compliant: ____

Site Aesthetics:

Viewshed from site: 6

Viewshed from shoreline: 6

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: geese, vehicles homes boat club

Audio perceptions from site: ____

Audio perceptions from shoreline: ____

Evidence of use at site: ____

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

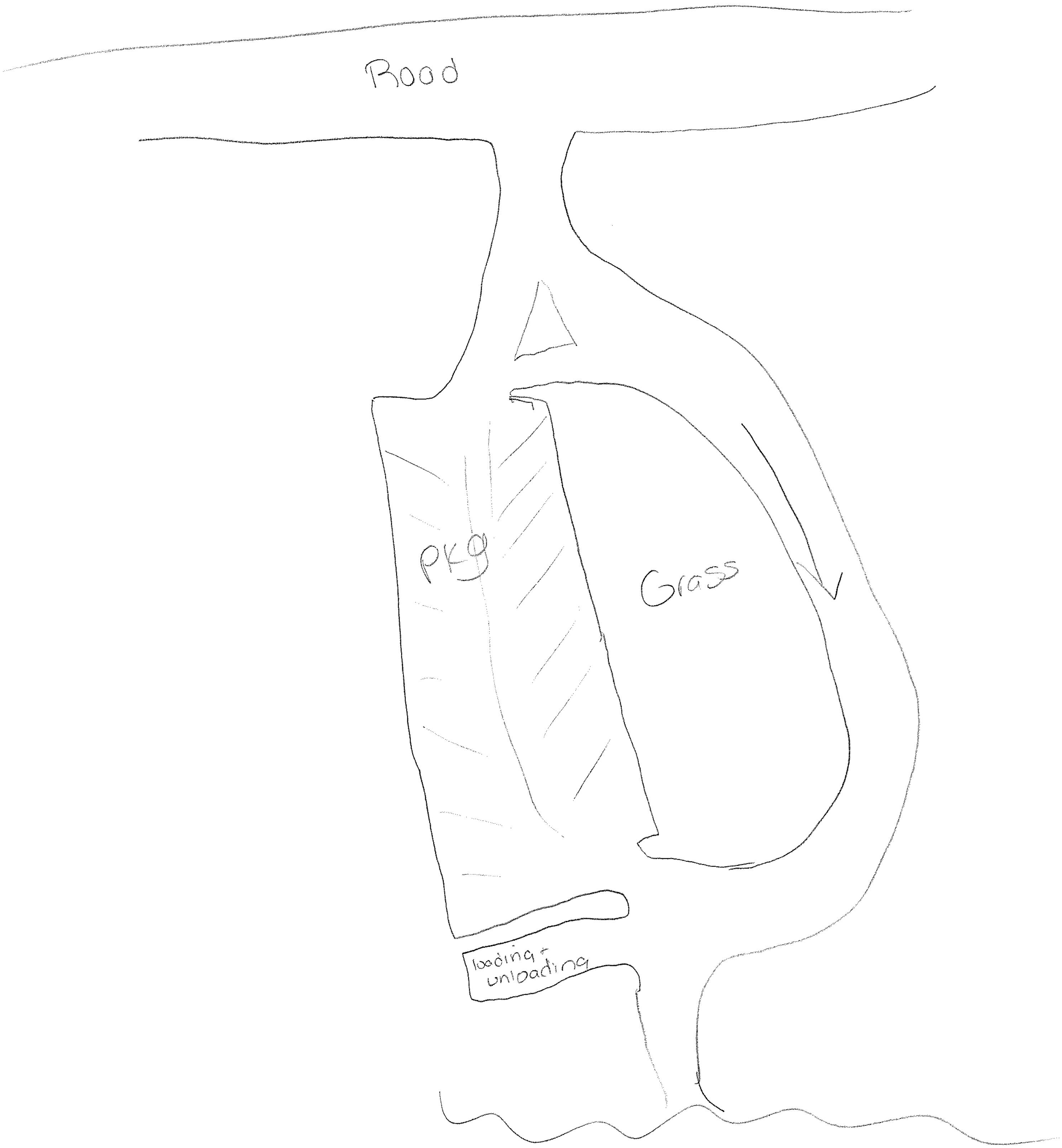
Evidence of Overcrowding: ____

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: No single car pkg. Single car pkg prohibited

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW   Date: 10-16-11   Time: 1649   Photo No: ______

Project: Turners Falls   Site Name/Code: Unity Park   Weather: ______

Owner: ______   Telephone: ______

Address: ______

City: ______   State: ______   Zip Code: ______

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook ^ Informal____ Launch____ Marina____ Hiking____ Ski Area____

Access:

X	Water access		
X	Paved access	2	# of lanes
______	Unpaved access (conventional motor vehicle)	______	# of lanes
______	Unpaved access (4WD vehicle)	______	# of lanes
______	ORV access (ATV)	______	width
______	Foot access	______	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	north of 1st				South of 1st		
Management	X				X		

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? fishway, unity park

Potential/need for expansion/enhancement? parking lot delineation, bathrooms

Topography: flat   Ground cover: grass

Erosion/Soils: no   Compaction: no

Approximate Shoreline Footage: ______   Bank Fishing (Yes/No): ______

ADA compliant? Obstacles? N   Rentals? no

Sanitation Facilities: (Yes/No) ?   mon-fri office hours @ unity park south

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

bike path 10' wide

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
1	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
3+1	Other: bleachers			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

trash cans   bike rack   swing bench

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			
swinging/playground	2	2	

Parking Lots: lot 1 85x90   lot 2 also for fishway

	lot 1	lot 2	Surface Code	Dimensions
# ADA spaces	1	2		
# regular spaces		12+12		
# Vehicle & trailer spaces				
# of vehicles in lot	4	6+4		

Space delineated n   Curbs n

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______   Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

2 ballfields
1 basketball ct.

FirstLight

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks__________ Total Slips __________

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: __________

Surface code: __________

Combined Length of Piers__________

ADA compliant: __________

Site Aesthetics:

Viewshed from site: 6

Viewshed from shoreline: 6

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: ~~[illegible]~~ turners falls dam, businesses home

Audio perceptions from site: cars

Audio perceptions from shoreline: cars

Evidence of use at site: wear on equipment, g

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

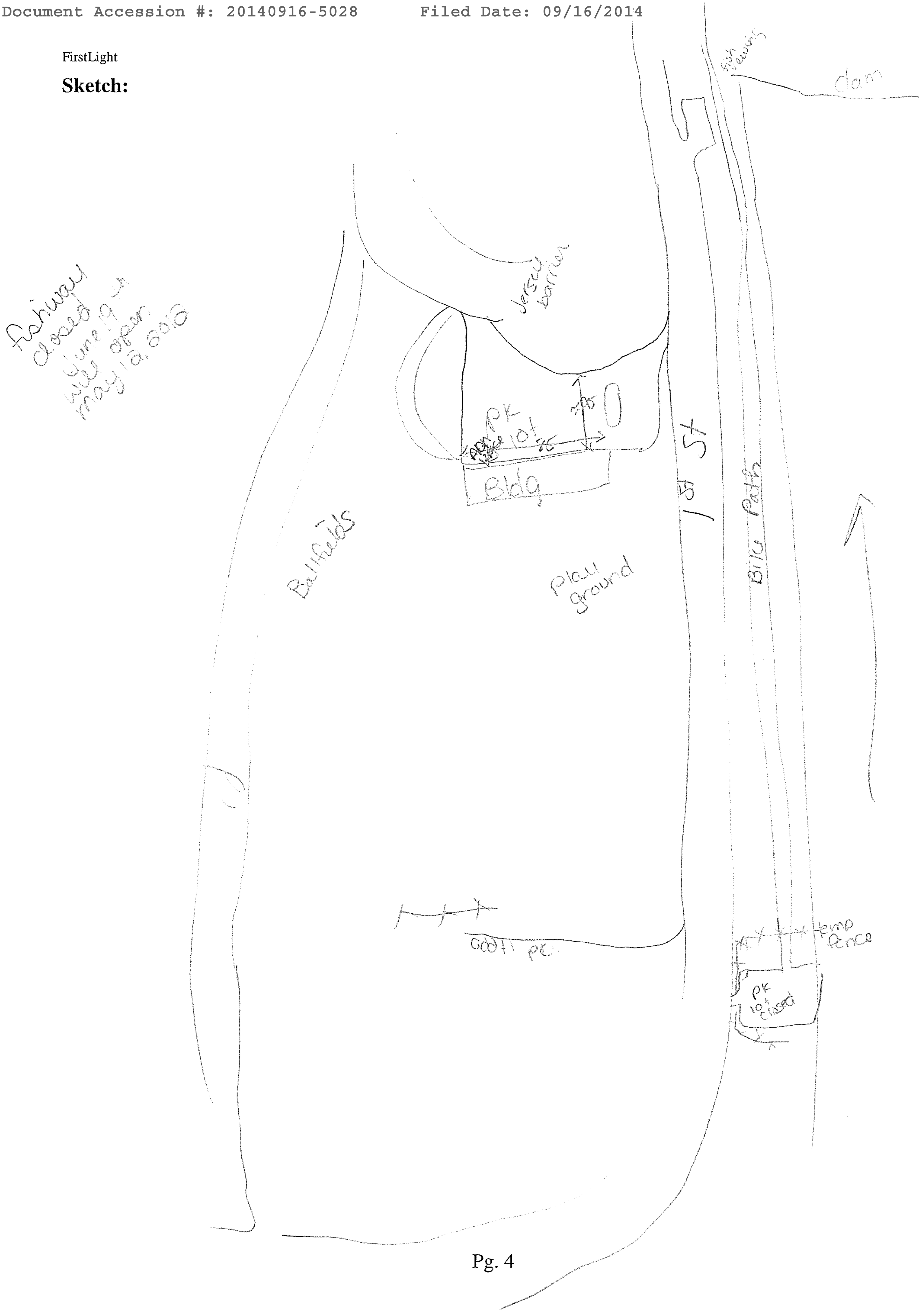
Evidence of Overcrowding: __________

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: undeveloped area currently closed due to potential [illegible] waste collection from Hurricane Irene

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: AMW HAS Date: 10/17/11 Time: 9:01 Photo No: ________
Project: Turners Falls Site Name/Code: Branch Canal Weather: Sunny
Owner: FirstLight Telephone: ________
Address: ________
City: ________ State: _____ Zip Code: ________

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook X Informal____ Launch_____ Marina_____
Hiking______ Ski Area_______

Access:

______	Water access		
X	Paved access	1	# of lanes
______	Unpaved access (conventional motor vehicle)	______	# of lanes
______	Unpaved access (4WD vehicle)	______	# of lanes
______	ORV access (ATV)	______	width
______	Foot access	______	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed n Private n Seasonal n Commercial n Fee n Open/Closed O

General Area:
Is the area associated with other facilities or activities? Power Canal
Potential/need for expansion/enhancement? Signage
Topography: Flat w/ Gentle Slope Ground cover: Paved | Grass
Erosion/Soils: No Compaction: Minor
Approximate Shoreline Footage: (GIS) Bank Fishing (Yes/No): ________
ADA compliant? Obstacles? N Rentals? N

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
4	Benches	N	W	
	Interpretive. Displays:			
	Other:			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Surface Code	Dimensions
# ADA spaces			
# regular spaces			
# Vehicle & trailer spaces			

# of vehicles in lot ______ Space delineated N Curbs N

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

FirstLight

Campground/Campsite: NO

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities: NO

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks_____________ Total Slips _____________ N

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers: N

Number: ___________________

Surface code: ___________________

Combined Length of Piers_______________

ADA compliant: _______________________

Site Aesthetics:

Viewshed from site: 6

Viewshed from shoreline: 6

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: Hydro Station | Power Canal

Audio perceptions from site: Birds Water Traffic

Audio perceptions from shoreline: Birds, Water, Traffic

Evidence of use at site: C, G

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

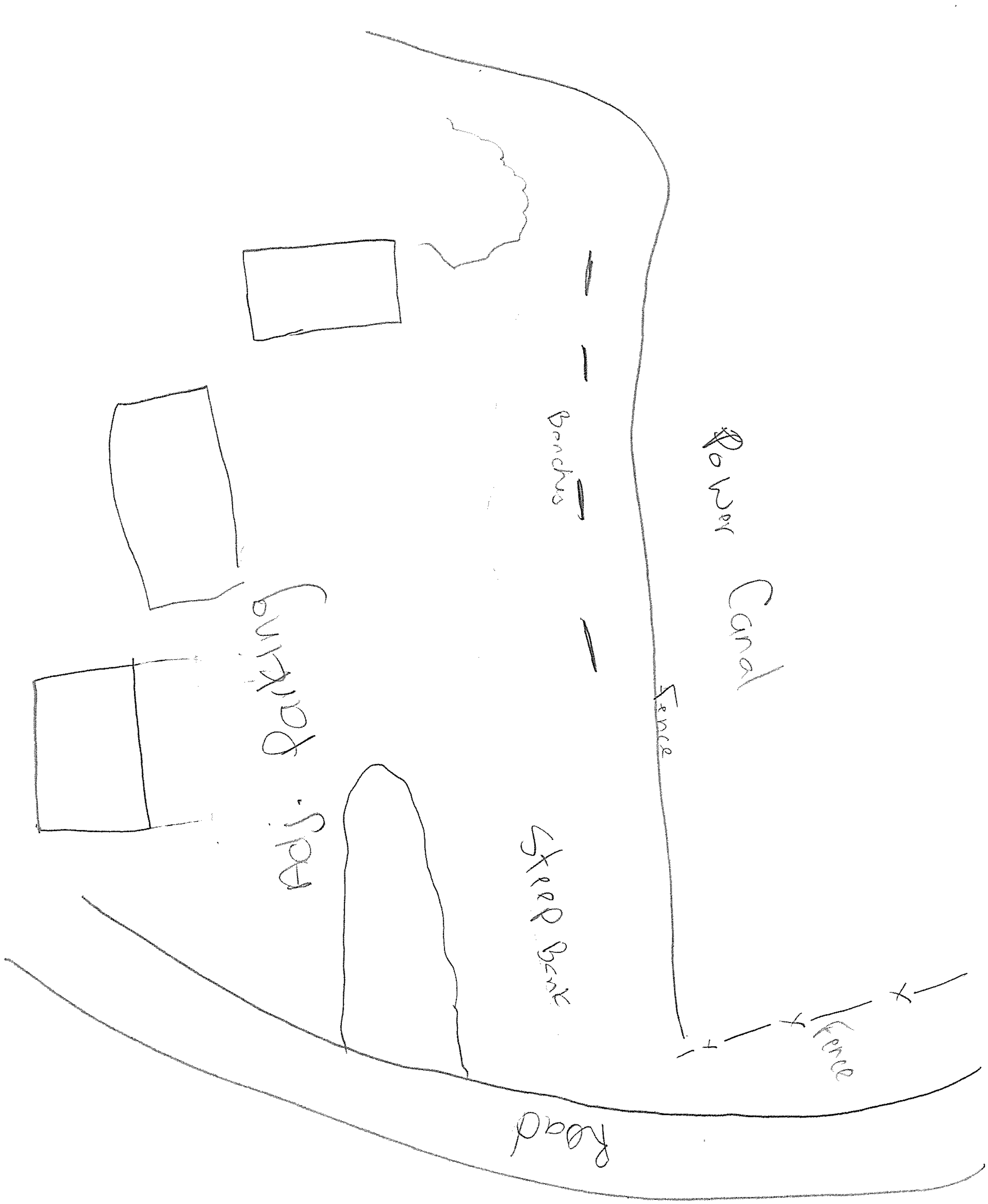
Evidence of Overcrowding: None

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: Adjacent Parking Lot for old Mill

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: HAS, AMW Date: 10-17-11 Time: 8:25 Photo No: ______
Project: Turners Falls Site Name/Code: #1 Station Weather: Sunny
Owner: First Light Telephone: ______
Address: ______
City: ______ State: ______ Zip Code: ______

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook X Informal X Launch____ Marina____
Hiking____ Ski Area____

Trail Fishing

Access:

\	Water access		
X	Paved access	2	# of lanes
	Unpaved access (conventional motor vehicle)		# of lanes
	Unpaved access (4WD vehicle)		# of lanes
	ORV access (ATV)		width
	Foot access		width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? Power Station
Potential/need for expansion/enhancement? None
Topography: Gradual Slope / Steep to water Ground cover: Paved
Erosion/Soils: Minor Compaction: Moderate to heavy
Approximate Shoreline Footage: 350' Bank Fishing (Yes/No): Y
ADA compliant? Obstacles? Formal Y Informal N Rentals? N

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive Displays:			
	Other:			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Surface Code	Dimensions
# ADA spaces	0		
# regular spaces	6	A	63 x 25
# Vehicle & trailer spaces	0		

# of vehicles in lot 0 Space delineated N Curbs N

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

Campground/Campsite: N

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities: N

Hard surface _____ Gravel _____ Unimproved _____ Carry In _____ Launch/Load prep area: _____

Docks/Piers/Floats Total Docks __________ Total Slips __________

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: N

Surface code: __________

Combined Length of Piers __________

ADA compliant: __________

Site Aesthetics:

Viewshed from site: 3

Viewshed from shoreline: 3

1 – No noticeable development

2 – Very limited primitive development

3 – Five (5) or less buildings in view

4 – Six (6) to ten (10) buildings in view

5 – Ten (10) or more buildings in view

6 – Highly developed

Nature of abutting development/land use: Hydro Station

Audio perceptions from site: Water, Power Station

Audio perceptions from shoreline: Water, Power Station

Evidence of use at site: C, E,

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: None

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: __________

FirstLight

Sketch:

FirstLight
Site Visit/Inventory Forms

Inspector: AMW HAS Date: 10/17/11 Time: 9:32 Photo No: ______

Project: Turners Falls Site Name/Code: Cabot Woods Fishing Access Weather: Sunny

Owner: First Light Telephone: ______

Address: ______

City: ______ State: ______ Zip Code: ______

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook X Informal____ Launch____ Marina____ Hiking____ Ski Area____

Closes @ 5pm

Access:

X	Water access		
X	Paved access	2	# of lanes
____	Unpaved access (conventional motor vehicle)	____	# of lanes
____	Unpaved access (4WD vehicle)	____	# of lanes
____	ORV access (ATV)	____	width
____	Foot access	____	width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? Cabot Hydro

Potential/need for expansion/enhancement? Portable toilet

Topography: Flat Gentle Slope to H_2O Ground cover: Paved / Grass

Steep to water & trails

Erosion/Soils: Minor Compaction: NO

Approximate Shoreline Footage: 700 Bank Fishing (Yes/No): Yes

ADA compliant? Obstacles? Y Rentals? N

Sanitation Facilities: (Yes/No) No

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
3	Picnic Tables			
	Grills			
	Firepit/ring			
3	Trails (specify use)			Length? 256 ft 3 Access trails to water
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
3	Other: Trash Can	N	FE	

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Dog Walking/hiking	1		1
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Surface Code	Dimensions
# ADA spaces	3	A	
# regular spaces	98	A	10x18
# Vehicle & trailer spaces			

# of vehicles in lot 10 Space delineated Y Curbs N

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

FirstLight

Campground/Campsite: No

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface ______ Gravel ______ No Unimproved ______ Carry In ______ Launch/Load prep area: ______

Docks/Piers/Floats Total Docks____________ Total Slips____________

Material code:	#1______	#2______	#3______	#4______	#5______
Dimensions:	#1______	#2 No	#3______	#4______	#5______
# of slips:	#1______	#2______	#3______	#4______	#5______
ADA compliant:	#1______	#2______	#3______	#4______	#5______

Fishing Piers:

Number: ________________ Combined Length of Piers________________

Surface code: ________________ No ADA compliant: ________________

Site Aesthetics:

Viewshed from site: 6 Viewshed from shoreline: 6

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: Cabot Fishlab

Audio perceptions from site: Wind, Plane,

Audio perceptions from shoreline: Wind, Plane

Evidence of use at site: Trails, Erosion, Compaction, Garbage

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

Evidence of Overcrowding: None

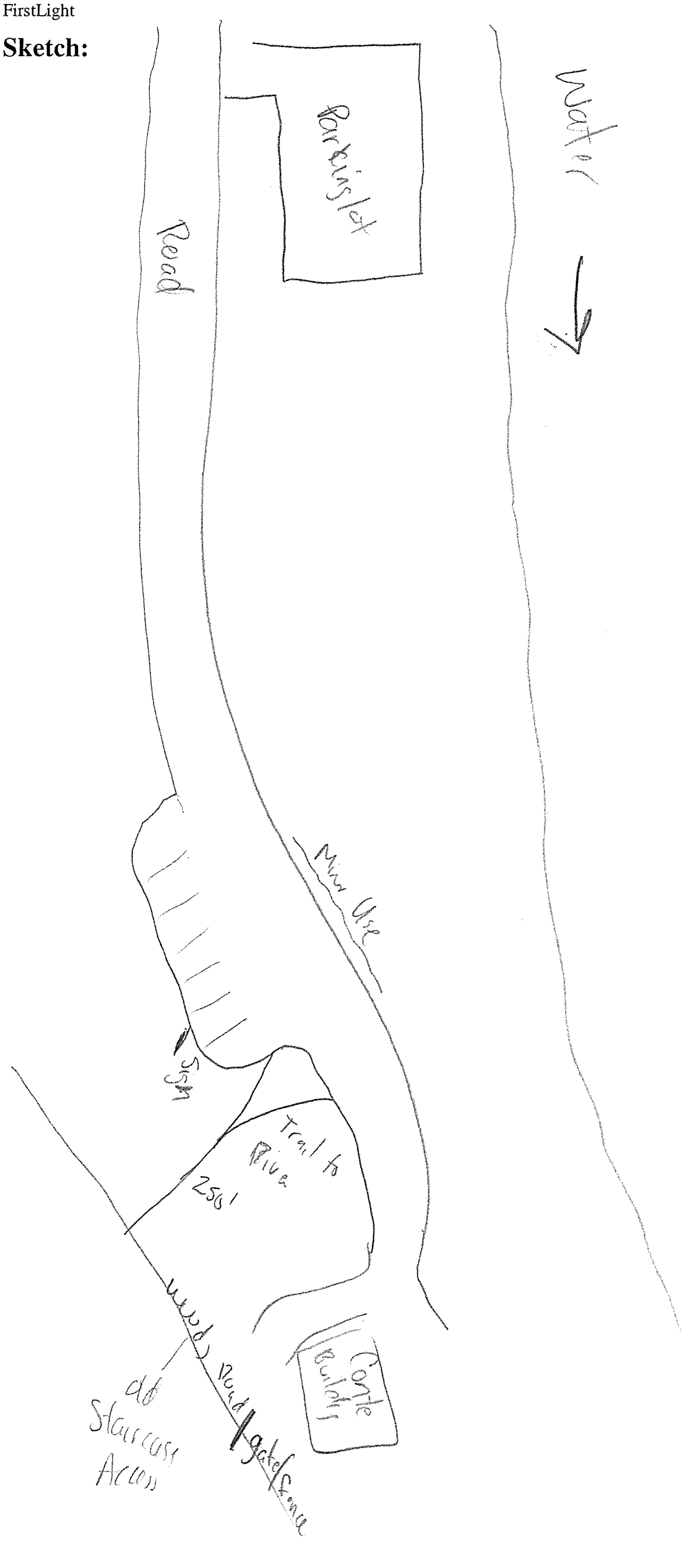
*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: Trail to water intersects woods road halfway between Road and water

Erosion due to recent flooding @ shoreline

FirstLight

Sketch:



FirstLight
Site Visit/Inventory Forms

Inspector: AMW HAS Date: 10/17/11 Time: 10:23 Photo No: ________

Project: Turners Falls Site Name/Code: Poplar St Portage Weather: Sunny

Owner: First Light Telephone: ________

Address: ________

City: ________ State: ____ Zip Code: ________

Facility Type:

Campground____ Picnic Area____ Day Use/Overlook X Informal____ Launch____ Marina____
Hiking____ Ski Area____ Portage Trail

Access:

X Water access
X Paved access — 2 # of lanes
____ Unpaved access (conventional motor vehicle) ____ # of lanes
____ Unpaved access (4WD vehicle) ____ # of lanes
____ ORV access (ATV) ____ width
____ Foot access ____ width

Ownership/Management

	Licensee	Federal	State	County	Local	Private	Other
Ownership	X						
Management	X						

Operations:

Staffed N Private N Seasonal N Commercial N Fee N Open/Closed O

General Area:

Is the area associated with other facilities or activities? N

Potential/need for expansion/enhancement? Stairs Canoe Slide | Portable toilet

Topography: Flat Steep to water Ground cover: Gravel | Grass

Erosion/Soils: Moderate Compaction: Severly compacted

Approximate Shoreline Footage: 100 ft Bank Fishing (Yes/No): Y

ADA compliant? Obstacles? N Rentals? N

Sanitation Facilities: (Yes/No)

Type:	Unisex	# of Units Women	# of Units Men	Notes (ADA, etc)
Flush				
Composting				
Vault				
Pit				
Portable				
Wilderness				

FirstLight

Site Facilities:

#	Type	Repairs	Material Code	Other Info
	Picnic Tables			
	Grills			
	Firepit/ring			
	Trails (specify use)			Length?
	Shelter			
	Potable Water			
	Dumping Station			
	Boat Ramp			
	Launching Lanes			
	Playground			
	Showers			
	Benches			
	Interpretive. Displays:			
1	Other: Trash Can			

Material codes; (A) asphalt, (B) Brick, (C) concrete, (CG) compacted gravel, (CRS) crushed gravel, (FE) metal, (G) grass, (GTF) geo-tech fabric, (NS) native soil, (O) other/specify, (P/F) plastic/fiberglass, (RC) rock crib, (S) sand, (W) wood.

Activities occurring:	# of Adults	# of Minors	Total # of users
Picnicking			
Camping			
Walking/hiking			
Swimming			
Beach Activities			
Launching boats			
Fishing			

Parking Lots:		Surface Code	Dimensions
# ADA spaces	0		
# regular spaces	4	CG	50 x 22 50x130
# Vehicle & trailer spaces			

# of vehicles in lot 0 Space delineated N Curbs N

Beach/Swim Area: (Yes/No)

	Number	Dimensions	Material	ADA Compliant
Dock/Pier:				
Float: :				

Beach Area Substrate: ______ Swim Area Substrate: ______

Dimensions of beach: ______ Lifeguards ______ Buoyed swim area ______

Campground/Campsite:

	RV sites	Cabin sites	Tent sites	Wilderness sites
Group Sites				
Access (foot, orv, car, boat)				
# of sites				
On site parking				
Water front				
ADA compliant				
Utilities				

* (E) Electric, (S) Sanitation, (W) Water, (O) other (specify)

Boat Launch Facilities:

Hard surface ______ Gravel ______ Unimproved ______ Carry In ______ Launch/Load prep area: ______

Docks/Piers/Floats Total Docks____________ Total Slips ____________

Material code:	#1	#2	#3	#4	#5
Dimensions:	#1	#2	#3	#4	#5
# of slips:	#1	#2	#3	#4	#5
ADA compliant:	#1	#2	#3	#4	#5

Fishing Piers:

Number: ____________

Surface code: ____________

Combined Length of Piers____________

ADA compliant: ____________

Site Aesthetics:

Viewshed from site: 6

Viewshed from shoreline: 6

1 – No noticeable development
2 – Very limited primitive development
3 – Five (5) or less buildings in view
4 – Six (6) to ten (10) buildings in view
5 – Ten (10) or more buildings in view
6 – Highly developed

Nature of abutting development/land use: Residential

Audio perceptions from site: Vehicle traffic, birds, wind

Audio perceptions from shoreline: Vehicle traffic, bird, wind

Evidence of use at site: G, C,

*(C) Compaction, (E) Erosion, (G) Garbage, (GD) Ground disturbance, (HW) Human waste, (UI) Unauthorized improvements, (V) Vandalism, (VR) Vegetation removal, (O) Other (Specify)

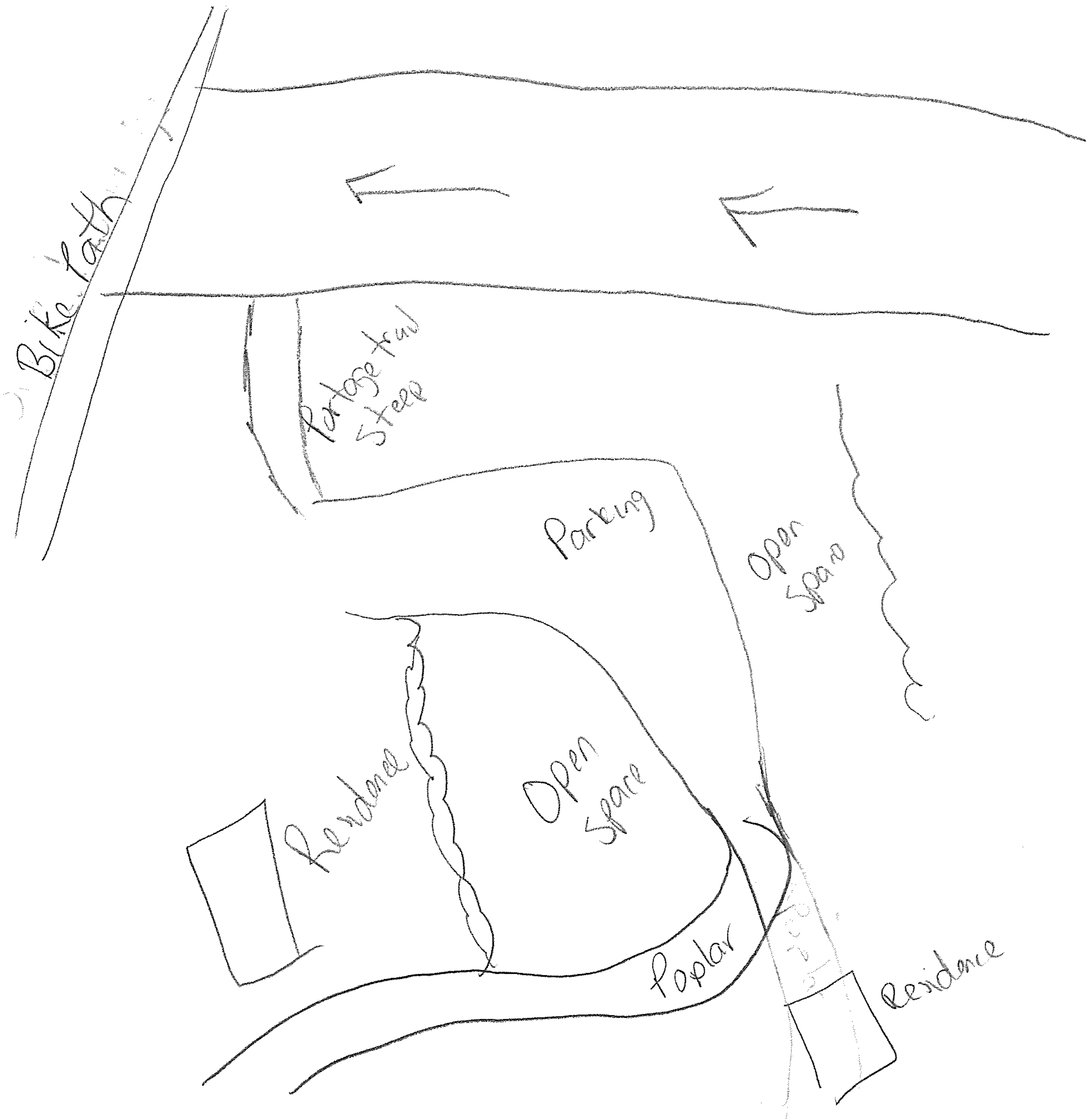
Evidence of Overcrowding: None

*(A) Anecdotal information, (FA) facility/amenity @ capacity, (I) Improper parking, (S) Signage, (SD) site degradation, (U) Unauthorized sites, (W) Waiting lines, (O) Other (Specify)

Notes: ____________

FirstLight

Sketch:



Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.6.3

WHITEWATER BOATING EVALUATION

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

Prepared by:

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The Federal Energy Regulatory Commission (FERC), New England Flow (NE FLOW), Appalachian Mountain Club (AMC), American Whitewater (AWWA), National Park Service (NPS), Vermont River Conservancy (VRC) and Friends of the Connecticut River Paddlers' Trail (FCRP) submitted requests for a controlled flow whitewater boating analysis of the Turners Falls bypass reach. All the requests were similar and requested FirstLight to use accepted whitewater boating evaluation practices to assess the presence, quality, and preferred flow ranges for river based boating resources in the Turners Falls bypass reach. FERC also requested that competing recreational uses and resource needs that may be adversely impacted by any scheduled releases be identified. NE FLOW, AMC, AWWA, NPS, VRC and FCRP also requested that access needs for put-in and take-out along the bypass reach be identified and a flow information and distribution system be assessed. FirstLight proposed to develop and conduct a controlled whitewater boating analysis of the Turners Falls bypass using accepted comparative evaluation practices and consulted with the stakeholders to develop a comparison flow study methodology, determine the number of flows and magnitudes to be evaluated, schedule the timing of the evaluation, and to enlist a group of experienced boaters to participate in the evaluation.

In FERC's September 13, 2013 Study Plan Determination Letter (SPDL), it requested the following "*FirstLight should develop detailed study protocol, logistics, and schedules in consultation with interested stakeholders before it conducts the study. Therefore, within 90 days of the date of the issuance of this determination, we recommend FirstLight submit a detailed study plan for the controlled whitewater boating assessment of the Turners Falls bypassed reach (Task 2 of the revised study plan), including methods to identify and evaluate access to the Turners Falls bypassed reach (Task 3 of the revised study plan). FirstLight should develop the study plan in consultation with the NPS, American Whitewater, Appalachian Mountain Club, Vermont River Conservancy, the Watershed Council, the Friends of the Connecticut River Paddlers' Trail, MADFW, FWS, and NMFS. The plan filed for Commission staff approval should include documentation of consultation, copies of comments and recommendations on the completed study plan after it has been prepared and provided for consultation, and a description of how comments are accommodated by the study plan. FirstLight should allow a minimum of 30 days for agencies and other entities to comment before filing the plan with the Commission. If FirstLight does not adopt a recommendation, the filing should include the reasons, based on site-specific information*".

Based on FERC comments in the September 13, 2013 SPDL, FirstLight revised the study plan to provide detailed study protocol, logistics, and schedule, a method to evaluate bypass access, incorporate revisions to the evaluation forms, and consultation with pertinent stakeholders in development of the revised study plan.

As required by FERC, FirstLight originally had an on-site consultation meeting slated for October 7, 2013, but was cancelled because of the government shutdown. During the week of September 30 through October 4, 2013 the Turners Falls power canal was drained for maintenance and thus water was passed at the Turners Falls Dam. Various whitewater groups paddled the bypass reach during the canal outage, and bypass flow data for this time period was provided to AMC.

FirstLight held a conference call on October 10, 2013 (during the government shutdown) with AWWA, AMC, NE FLOW, and a commercial whitewater rafting company whose operations are based on the Deerfield River. The following issues were discussed: study timing, staging/access locations, composition of the boating team, photograph/videotape documentation locations, safety, shuttles and the need for post whitewater run discussions.

On November 1, 2013 (after the government shutdown), a conference call was held with AWWA, AMC, NE FLOW, National Marine Fisheries Service (NMFS), Massachusetts Division of Fisheries and Wildlife (MADFW), NPS, and Connecticut River Watershed Council (CRWC), to again discuss the 2014 whitewater study methodology. United States Fish and Wildlife Service (USFWS), Massachusetts Department of Conservation and Recreation (MADCR), VRC and FCRP were notified of the conference call but did not participate.

As required by FERC in its SPDL, FirstLight provided a Modified Revised Study Plan (Modified RSP) to CRWC, NMFS, MADFW, USFWS, NE FLOW, MADCR, AWWA, FCRP, AMC, VRC and NPS on November 22, 2013. CRWC, NMFS, NE FLOW, AWWA, and AMC provided comments on the Modified RSP. FirstLight addressed stakeholder comments and filed a Modified RSP along with the consultation record with FERC on January 13, 2014.

On April 25, 2014 FERC approved the Modified RSP with staff recommended modifications.

FirstLight consulted with NE FLOW, AWWA and AMC on March 10 and April 22, 2014 requesting assistance with identifying boaters to participate in the flow study. NE FLOW provided FirstLight updates on boater participants between May 4 and July 16, 2014. FirstLight held a consultation meeting and site visit on July 1, 2014 with AWWA, AMC and NE FLOW to review the Modified RSP and FERC recommendations, and to finalize study plan logistics and details.

1.2 Study Progress Summary

Task 1: Develop Boating Evaluation Protocol, Logistics and Schedule

The boating evaluation protocols, logistics and schedule were finalized based on FERC recommendations to the Modified RSP and discussions from the July 1, 2014 consultation meeting.

Task 2: On-Water Boating Evaluation

Prior to the evaluation, FirstLight inspected the bypass area for rebar and removed it, to the extent possible. The on-water boating evaluation was conducted on July 19, 20, and 21, 2014. Over the course of the three day study, 45 participants with various levels of boating experience ran a combination of the six flows in a variety of watercraft.

Task 3: Identify and Evaluate Access to the Turner Falls Bypass Reach

FirstLight has conducted real estate record research for land ownership along the Turners Falls bypass reach. FirstLight conducted site visits to potential bypass access points, including two specifically identified by NE FLOW in their comments on the Modified RSP, as part of field work associated with other studies in late summer of 2014.

Task 4: Data Review and Analysis

FirstLight has begun the review and analysis of data collected from the July 19, 20, and 21, 2014 boating evaluation.

Task 5: Report Development

Report development will occur during the 4th quarter of 2014 with a final report completed in the 1st quarter of 2015.

1.3 Variances from Study Plan and Schedule

Under Task 1, "Photograph/Videotape Coverage Locations", of the Modified RSP, FirstLight proposed a site near the Turners Falls Road Bridge as a location. Based on discussions with the boater stakeholders at the July 1, 2014 consultation meeting, this site was eliminated and replaced with photo and video coverage from the Gill-Montague Bridge near Turners Falls Dam.

1.4 Remaining Activities

Remaining activities for this study include potential additional field work associated with reviewing potential bypass access sites, completion of boating evaluation data review and analysis, and report writing. The final report will be completed in the 1st quarter of 2015.

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Relicensing Study 3.6.4

ASSESSMENT OF DAY USE AND OVERNIGHT FACILITIES ASSOCIATED WITH NON-MOTORIZED BOATS

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight
GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers   TRC

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The National Park Service (NPS), Appalachian Mountain Club (AMC), Vermont River Conservancy (VRC), Friends of the Connecticut River Paddlers' Trail (FCRP), New England Flow (NE FLOW), American Whitewater (AWWA), and Connecticut River Watershed Council (CRWC) requested a study of project facilities to support multiple-day self-powered boating trips on that section of the Connecticut River extending through the Project boundaries of the Turners Falls and Northfield Mountain Projects. FirstLight developed a study plan to assess: existing overnight and access facilities; the need for additional and future facilities; an alternate walkable canoe portages; spacing of facilities; and the consistency between river use and the season of facility operations. The study plan was approved with modifications by the Federal Energy Regulatory Commission (FERC) on September 13, 2013.

FirstLight attended a FCRP meeting on July 17, 2013 in Hadley MA. Trust for Public Land (TPL), AMC, VRC, Massachusetts Department of Conservation and Recreation (MADCR) and CRWC were also in attendance. At the meeting, TPL exhibited a map of the MA-CT river section showing existing and potential access and recreation sites developed from a 2012 inventory conducted by the FCRP. In a post-meeting discussion, FirstLight asked TPL for their data layers from the 2012 inventory for use when conducting the field component of this study. TPL indicated a willingness to provide the information.

FirstLight made follow up contact with TPL for the data on several occasions by e-mail (8-22-13 and 3-3-14- see Appendix A for correspondence log) and by telephone. FirstLight contacted the FCRP by e-mail on June 20, 2014 regarding access to the data, and received the GIS shapefiles from the 2012 inventory on July 10, 2014.

1.2 Study Progress Summary

Task 1: Literature Review

FirstLight has conducted an internet search regarding information on the Connecticut River Trail and has reviewed the AMC "River Guide/Massachusetts, Connecticut, Rhode Island" 4th Edition (2006), and the "Connecticut River Paddlers' Trail MA-CT Expansion Feasibility Study" prepared by the VRC (February 8, 2013) for information regarding facilities, access and use of the Connecticut River through the Projects' areas.

Task 2: Field Work

Field work was scheduled to commence on July 29, 2014; however, high water conditions due to severe thunderstorms and upstream hydro operations prevented field work from being conducted by boat. Pertinent stakeholders (NPS, AMC, CRWC, VRC, FCRP, MADCR) were notified on August 20, 2014 and August 21, 2014 of when field work would be conducted and were invited to participate. Follow up emails to those interested in participating in the field work were sent on August 22 – 27 confirming arrangements. Field work was completed on August 28-29, 2014. Representatives from AMC, CWRC, and the Northfield Open Space Committee participated in the field work on one or both days. Prior to conducting the field investigation, available municipal property records were reviewed to determine general (FirstLight, private, public) land ownership adjacent to the study area. Field work included boating the shorelines of the study area and ground verifying the location of existing and potential use and access sites, including those identified in the "MA-CT Expansion Feasibility Study", to assess the adequacy of existing sites and the feasibility of developing potential sites. Areas where potential canoe portage trails may be beneficial to paddlers were also investigated.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

The intent of the field work was to assess existing and potential access and facilities associated with non-motorized boating.

Task 3: Report Preparation

A report will be completed in the 1st quarter of 2015.

1.3 Variances from Study Plan and Schedule

There are no variances from the FERC-approved study plan.

1.4 Remaining Activities

Remaining activities for this study include additional consultation with stakeholders to identify additional literature for review and possible locations for future carry-in facilities, field data review and analysis, and report writing.

Appendix A
Consultation Record

Newell, Arthur (Bud) E.

From: Newell, Arthur (Bud) E.
Sent: Monday, March 03, 2014 2:21 PM
To: 'clem.clay@tpl.org'
Subject: RE: CT River Paddlers Trail

Hi Clem,

I'm just following up to our earlier discussions regarding access to TPL's data used to develop the CT River Paddlers Trail map. Though we probably will not be in the field until mid-summer on this study component, we have started preparing for the field season and are developing schedules and getting some of the up front leg work done as hopefully spring and summer will soon be upon us.

Your information would be useful and helpful not only for our field work component, but would also provide a common basis for future discussions regarding the water trail. Would you please let me know if TPL is still willing to provide it's data layers to us. If so, it would be great if we had your information by the end of March.

I certainly appreciate your assistance and cooperation. Please let me know if you have any questions or issues.

Hope all is well.

Bud

A.E. Newell III
Environmental Specialist

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T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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From: Newell, Arthur (Bud) E.
Sent: Monday, August 26, 2013 9:54 AM
To: 'Clem Clay'
Subject: RE: CT River Paddlers Trail

Hi Clem,

There is no big rush on getting the data, so whenever it is convenient for you will work for me. Our GIS person says shapefiles would be great, and as you noted, Noah's points/attributes and the parcel data are probably the most important layers. I have passed your note on MassGIS to our people so we can go in and see what is available there.

You will certainly see the results of our work as it will be included as part of the FERC license application for the projects. The actual data will belong to FirstLight and I will check with them on making the data available to you – I don't expect it will be a problem. At this point, we do not plan on being in the field for this study until sometime next summer, but I will keep you posted. As with developing the study plans, the study results and license application will also be subject to review and comment by interested parties.

I recall from the July meeting that there was some discussion on developing campsites on state lands. Obviously with a bunch of interested parties involved in this, it's important to coordinate efforts. Norm Sims, representing AMC and AW, has been very active in the licensing meetings and discussions and has placed a lot of emphasis on the development of the water trail in Mass. I've worked with Norm on other projects and studies and we have always have a good working relationship, and I expect this will carry over into this project as well.

Thanks again for your assistance.

Bud

From: Clem Clay [mailto:Clem.Clay@tpl.org]
Sent: Friday, August 23, 2013 5:02 PM
To: Newell, Arthur (Bud) E.
Subject: Re: CT River Paddlers Trail

Hi Bud,

Thanks for getting in touch. It was good to meet you in July and I'd be happy to work with you on this. I would also love to see the results of your work, if possible. Probably the two main items of interest are Noah's GPS points with attributes, and the parcel data for the towns. Would you want those as shapefiles? I am not bad with GIS for my own use but do not pretend to be an expert at packaging data for others to use, so please bear with me. Also, next week is a bit crazy, but I should have time on Wednesday to work on it. I think your best bet on conserved lands is to use what MassGIS offers, since they update it regularly and serve it up in various service formats, potentially making it easier to keep your work current. However, I can walk you through the way I interpret some of the attributes of that data; for example, permanently conserved farmland along the river is not a great place to try to set up a campsite or access point because the easement may well prevent making public access permanent.

You should also know that there are continuing discussions about using existing state lands to establish some campsites, and there will be a need to address both funding for site development and stewardship, and the optimal way to manage these sites as part of an overall system. It would seem advisable to coordinate that discussion with the work you and others are doing in hopes that we each contribute to one another's successes rather than generating redundant outcomes.

Let me know any more detail about what format you want data in, and I will try to get to it ASAP. And please let me know whether you will be at liberty to share any of your research and results.

Many thanks,
Clem

Arthur (Bud) E." <anewell@trcsolutions.com> 8/22/2013 9:12 AM >>>
Hi Clem,

We met at the Paddlers Trail meeting in Hadley last month. I am one of the consultants working for FirstLight on the recreation studies for the Turner Falls and Northfield Mountain Projects. After the meeting, you and I had talked about possibility of TRC getting a copy of the data TPL collected and developed for the Ct River Paddlers Trail map you had at the meeting. Our staff conducted an inventory of formal Project recreation facilities, as well as obvious informal recreation access and sites from Vernon Falls Dam to the Poplar St put-in near the rail trail bridge in Montague last year. As part of the re-licensing studies for the Turner Falls Project, we will be conducting a study aimed specifically at assessing day use and overnight facilities associated with non-motorized boating on the section of the river from Vernon Falls Dam to Sunderland Bridge. As currently proposed (pending FERC approval) this study would determine if: an alternate walkable canoe portage trail (Turner Falls) is feasible; the need for and possible locations for future carry-in boat facilities (particularly at Turners Falls Dam, Station #1, Cabot Station, and the

Deerfield River Confluence) and overnight facilities; current facilities are adequately spaced for non-motorized boating day use trips; and, what, if any, improvements are necessary at existing facilities to meet current and near future use particularly at put-in and take-out facilities.

We have reviewed the Vermont River Conservancy report on the trail expansion into Mass and Ct and found it very informative and useful. The data collected during Noah's field efforts as well as your background data (parcel, conserved/state/federal lands, etc.) would be very useful to us to compare with the data we have assembled and to make sure we look at sites (particularly potential sites) identified by Noah when we conduct additional field work next year for this specific study.

I would certainly appreciate getting your data if this is something you are still willing to share. Depending on file size, you can try e-mailing it to me (we sometimes have trouble receiving anything over 10 MB in size) or mail it to me on disk at the address below.

Thanks, let me know if you have any questions.

Bud Newell

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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Clem Clay
Connecticut River Program Director
The Trust for Public Land
26 South Prospect St., #4
Amherst, MA 01002
413-253-6686
413-253-6682 fax
www.tpl.org/ctriver

Newell, Arthur (Bud) E.

From: Noah Pollock <noah.pollock@gmail.com>
Sent: Thursday, July 10, 2014 11:53 AM
To: Newell, Arthur (Bud) E.
Subject: Re: Ct. River Paddlers Trail data
Attachments: CRPT_Campsite_Assessment.xls

Hi Bud,
I was just thinking about that request! Thanks for the follow-up.
See attached shapefiles with potential campsites,existing access points, portage trails, etc. There are some notes in the attribute table.
I've compressed the MA open space layer as well. I do not have the individual parcel data Clem had although I believe it is available online. I've also attached a spreadsheet with some data as well. And here are all of Clem's maps - as pdfs...

Happy to chat about any specifics. I'll be in the area late July as well and could potentially meet up. In particular, I'd be happy to help with the Turner's Falls portage issues, or re-visit some of the most appealing potential campsites identified in the assessment.

Noah

On Thu, Jul 10, 2014 at 9:32 AM, Newell, Arthur (Bud) E. <anewell@trcsolutions.com> wrote:

> Hi Noah,
>
> Just flowing up to our earlier e-mails regarding the shapefiles from your report on the CT River Trail in Massachusetts. I just noticed in my earlier e-mail that I indicated we would be doing the field work next year (I think this was a paste and cut from my initial e-mail to Clem). We are actually looking at getting in the field in late July/early August, so I am hoping I can possibly get the data within the next coupleof weeks, depending on your schedule.
>
> Hope you are enjoying your time in the field with your various projects. It certainly has been good weather for working near and on the water.
>
> I appreciate your help.
>
> Bud

From: Noah Pollock [mailto:noah.pollock@gmail.com]
Sent: Sunday, June 22, 2014 10:29 PM
To: Newell, Arthur (Bud) E.
Subject: Re: Ct. River Paddlers Trail data

Hi Bud,

Thanks for reaching out!

First, unfortunately Clem's position was eliminated at TPL, so that may explain why he hasn't been in touch.

Yes, I'm happy to get you any data you need for your research. For starters, here is a link with pdf maps developed throughout MA. I don't have access to the digital versions of the parcel data, unfortunately, but I do think this data is available on the MA GIS data clearinghouse.

I can get you shapefiles with some of the data points (access points, potential campsites, etc) as well if you'd like. I'll be in the field all week - so it wouldn't be until next Monday, however.

Thanks,

Noah

On Fri, Jun 20, 2014 at 10:37 AM, Newell, Arthur (Bud) E. <anewell@trcsolutions.com> wrote:

> Hi Noah,
>
> Following up to a voicemail I left you a few minutes ago.

We met at the Paddlers Trail meeting in Hadley last July. I am one of the consultants working for FirstLight on the recreation studies for the Turner Falls and Northfield Mountain Projects. At the meeting, I had talked to Clem Clay (TPL) about possibility of TRC getting a copy of the data you and TPL collected and developed for the Ct River Paddlers Trail map you had at the meeting. Clem indicated this would not be a problem, but I have not received it yet after several e-mails and telephone calls. As part of the re-licensing studies for the Turner Falls Project, we will be conducting a study aimed specifically at assessing day use and overnight facilities associated with non-motorized boating on the section of the river from Vernon Falls Dam to Sunderland Bridge. As proposed this study would determine if: an alternate walkable canoe portage trail (Turner Falls) is feasible; the need for and possible locations for future carry-in boat facilities (particularly at Turners Falls Dam, Station #1, Cabot Station, and the Deerfield River Confluence) and overnight facilities; current facilities are adequately spaced for non-motorized boating day use trips; and, what, if any, improvements are necessary at existing facilities to meet current and near future use particularly at put-in and take-out facilities.

We have reviewed the Vermont River Conservancy report on the trail expansion into Mass and Ct and found it very informative and useful. The data collected during your field efforts as well as your background data (parcel, conserved/state/federal lands, etc.) would be very useful to us to compare with the data we have assembled and to make sure we look at sites (particularly potential sites) identified by Noah when we conduct additional field work next year for this specific study.

I am wondering if you may be able to provide the data instead. I will continue to pester Clem as well as we are looking at doing our field work later this summer.

Thanks, and feel free to contact me if you have any questions.

Bud Newell

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330

T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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> --
> *Noah Pollock*
>
> *(802) 540-0319*

--
Noah Pollock
(802) 540-0319

Newell, Arthur (Bud) E.

From:	Norman Sims <normansims1@gmail.com>
Sent:	Wednesday, August 20, 2014 3:18 PM
To:	Newell, Arthur (Bud) E.
Subject:	Re: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats
Follow Up Flag:	Follow up
Flag Status:	Completed

Bud,

Thanks for the note. I will be out of town on Aug. 28-29, so I cannot participate.

Norm Sims

On Wed, Aug 20, 2014 at 8:39 AM, Newell, Arthur (Bud) E. <anewell@trcsolutions.com> wrote:

> To Interested Stakeholders,
>
> TRC has scheduled the field study component for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats, for August 28th and 29th, 2014. Pursuant to FERC's Study Plan Determination Letter of September 13, 2013, you are invited to participate in the field study on one or both days. The field evaluation will be done by boat and due to the extent of shoreline to be assessed, we are asking you to commit to spending the full day in the field with us instead of having to coordinate pick-up and drop-off times and locations for individuals over the course of the day. The field days may be long (in excess of 8 hours).
>
> We will depart from the Riverview Picnic Area off Route 63, just north of the Northfield Mountain Visitors Center at 7:00 a.m. on August 28th and plan to boat and assess the entire impoundment on that day. The river segment from Turners Falls Dam to Sunderland Bridge will be evaluated on August 29th by boat (to the extent possible) and vehicle/foot. We will depart from the Sunderland Bridge boat launch area on river left. I will notify you of the start time from Sunderland Bridge late in the day on the 28th.
>
> If you are going to participate on either or both days, please e-mail or call me by August 25th with the dates that you plan to attend. We can only take one person from each organization due to boat capacity. You will be responsible for providing any personal gear, including PFD's, boots/water shoes, etc. as well as food and drinks. A brief safety tailboard will be held prior to departure on each day to review on-water safety, swimming abilities, special needs, PFDs for each person, and communications in the event of an emergency. Dates may be subject to rescheduling based on impoundment and river conditions and flows.

I will keep those that RSVP advised on the field work and schedule as we get closer to the dates.

Please contact me if you have any questions or need additional information.

Thanks.

Bud

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330

T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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Newell, Arthur (Bud) E.

From: Jahnige, Paul (DCR) <paul.jahnige@state.ma.us>
Sent: Thursday, August 21, 2014 2:41 PM
To: Newell, Arthur (Bud) E.
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Follow Up Flag: Follow up
Flag Status: Flagged

Thanks Bud,

Please count on me for the 29th, I'll await details. Paul

Paul Jahnige
Department of Conservation and Recreation
Director, Greenways and Trails Program
136 Damon Road, Northampton, MA 01060
413-586-8706 ext. 20
paul.jahnige@state.ma.us

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Thursday, August 21, 2014 2:39 PM
To: Jahnige, Paul (DCR)
Cc: Howard, John (John.Howard@gdfsuezna.com); Bill Gabriel (william.gabriel@gdfsuezna.com); Mark Wamser (mwamser@gomezandsullivan.com); Verville, Sarah; Bley, Wendy; Seiders, Heather; Mike Hoover (mhoover@gomezandsullivan.com)
Subject: FW: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Hi Paul,

Thanks for contacting me regarding the field work scheduled for next week. While the September 13, 2013 FERC Study Plan Determination Letter for Study 3.6.4 specifically identifies certain stakeholders to include in consultation, you are clearly a pertinent stakeholder and should be included in consultation. If your schedule changes for the 28th, please let me know. In the meantime, there is room in the boat if you decide to join us on the 29th. I will stay in touch with you as we work out the field trip details for the 29th.

Bud

From: Jahnige, Paul (DCR) [mailto:paul.jahnige@state.ma.us]
Sent: Thursday, August 21, 2014 2:02 PM
To: Newell, Arthur (Bud) E.
Cc: 'John.Howard@gdfsuezna.com'; 'Kristen Sykes'
Subject: FW: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Dear Bud,

I have been in the First Light relicensing process, and recreational meetings, and also the CT River Paddlers Trail effort, unfortunately, I do not believe I got your announcement below about next week's assessment days. Please make sure that I am on your list for such efforts.
I am unfortunately, now not available of AUG 28, but would like to try to attend Aug 29.

Thank you.

Paul Jahnige
Department of Conservation and Recreation
Director, Greenways and Trails Program
136 Damon Road, Northampton, MA 01060
413-586-8706 ext. 20
paul.jahnige@state.ma.us

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Wednesday, August 20, 2014 8:39 AM
To: Norman Sims (normansims1@gmail.com); 'adonlon@ctriver.org'; 'noah.pollock@gmail.com'; 'kevin_mendik@nps.gov' (kevin_mendik@nps.gov); ssyz@vermontriverconservancy.org
Cc: Howard, John (John.Howard@gdfsuezna.com); Bill Gabriel (william.gabriel@gdfsuezna.com); Mark Wamser (mwamser@gomezandsullivan.com); Verville, Sarah; Mike Hoover (mhoover@gomezandsullivan.com); Seiders, Heather; 'Lana Khitrik' (lkhitrik@gomezandsullivan.com)
Subject: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

To Interested Stakeholders,

TRC has scheduled the field study component for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats, for August 28th and 29th, 2014. Pursuant to FERC's Study Plan Determination Letter of September 13, 2013, you are invited to participate in the field study on one or both days. The field evaluation will be done by boat and due to the extent of shoreline to be assessed, we are asking you to commit to spending the full day in the field with us instead of having to coordinate pick-up and drop-off times and locations for individuals over the course of the day. The field days may be long (in excess of 8 hours).

We will depart from the Riverview Picnic Area off Route 63, just north of the Northfield Mountain Visitors Center at 7:00 a.m. on August 28th and plan to boat and assess the entire impoundment on that day. The river segment from Turners Falls Dam to Sunderland Bridge will be evaluated on August 29th by boat (to the extent possible) and vehicle/foot. We will depart from the Sunderland Bridge boat launch area on river left. I will notify you of the start time from Sunderland Bridge late in the day on the 28th.

If you are going to participate on either or both days, please e-mail or call me by August 25th with the dates that you plan to attend. We can only take one person from each organization due to boat capacity. You will be responsible for providing any personal gear, including PFD's, boots/water shoes, etc. as well as food and drinks. A brief safety tailboard will be held prior to departure on each day to review on-water safety, swimming abilities, special needs, PFDs for each person, and communications in the event of an emergency. Dates may be subject to rescheduling based on impoundment and river conditions and flows.

I will keep those that RSVP advised on the field work and schedule as we get closer to the dates.

Please contact me if you have any questions or need additional information.

Thanks.

Bud

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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Newell, Arthur (Bud) E.

From:	Newell, Arthur (Bud) E.
Sent:	Monday, August 25, 2014 2:25 PM
To:	'Joanne & Bill McGee'
Subject:	RE: Ct River assessment

Hi Joanne,

Please feel free to join us on the 28th. Sorry for the delay in getting back to you, but I wanted to see if anyone declined wo that we had space for you.

I am attaching the text from e-mail that went to the stakeholders with the details for Thursday. I look forward to meeting you.

"To Interested Stakeholders,

TRC has scheduled the field study component for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats, for August 28th and 29th, 2014. Pursuant to FERC's Study Plan Determination Letter of September 13, 2013, you are invited to participate in the field study on one or both days. The field evaluation will be done by boat and due to the extent of shoreline to be assessed, we are asking you to commit to spending the full day in the field with us instead of having to coordinate pick-up and drop-off times and locations for individuals over the course of the day. The field days may be long (in excess of 8 hours).

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I will keep those that RSVP advised on the field work and schedule as we get closer to the dates.

Please contact me if you have any questions or need additional information.

Thanks.

Bud"

Bud

A.E. Newell III
Environmental Specialist

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T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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From: Joanne & Bill McGee [mailto:jbmcgee2@verizon.net]
Sent: Friday, August 22, 2014 9:15 AM
To: Newell, Arthur (Bud) E.
Subject: Ct River assessment

Bud,

Andrea Donlon sent on your note about the assessment of the Ct River for day use and overnight facilities. I am a member of the Northfield Open Space Committee An action step in our newest Open Space Plan, approved by the state, calls for additional places to access the Ct. River for kayaks and canoes. Paddlers up in this northern section of the Ct. River have been long concerned about the lack of access spots. Our one access spot, Pauchaug Brook, is in deplorable condition and often times unusable.

Is there room for me to join the group on the river Aug 28th? I will be able to bring a kayaker's perspective to assessment.

Joanne McGee
9 Main St.
Northfield MA 01360

413-498-5022
jbmcgee2@verizon.net

Newell, Arthur (Bud) E.

From: Andrea Donlon <adonlon@ctriver.org>
Sent: Tuesday, August 26, 2014 2:27 PM
To: Newell, Arthur (Bud) E.
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Follow Up Flag: Follow up
Flag Status: Completed

OK, great.

The person who can represent CRWC is Mac Everett and his email is rivermac1@verizon.net and phone number is 413-584-0068.
I will make sure he has the information I have on the trip details and will have him email you to confirm that he can come.

I'll check email Thursday evening and will be there at the appointed time on Friday.

Thanks, Andrea

____
Andrea Donlon, River Steward
CONNECTICUT RIVER WATERSHED COUNCIL, INC.
15 Bank Row
Greenfield MA 01301
Phone: (413)772-2020 x. 205
Fax: (413)772-2090
adonlon@ctriver.org
Become a member today! Join at www.ctriver.org.
CRWC is on Facebook—become a fan

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Tuesday, August 26, 2014 2:19 PM
To: Andrea Donlon
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Hi Andrea,

I notified Joanne yesterday that she is welcome to attend and we can certainly accommodate CRWC person as well on Thursday.

I will get e-mails out to those that have responded tomorrow morning just confirming our plans as we know them to be now. I probably will not know a firm time for Friday until sometime Thursday, but will notify everyone as soon as I can.

Bud

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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From: Andrea Donlon [mailto:adonlon@ctriver.org]
Sent: Tuesday, August 26, 2014 2:05 PM
To: Newell, Arthur (Bud) E.
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Bud,

Just checking in about Thursday. I hope Joanne McGee from Northfield can go. If there is also space, I now have someone who can represent CRWC who is available, but I don't want to bump Joanne if there is only one slot (she has more local knowledge, which would be an asset on the trip). Let me know and I'll proceed from there.

Andrea

Andrea Donlon, River Steward
CONNECTICUT RIVER WATERSHED COUNCIL, INC.
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Greenfield MA 01301
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Fax: (413)772-2090
adonlon@ctriver.org
Become a member today! Join at www.ctriver.org.
CRWC is on Facebook—become a fan

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Monday, August 25, 2014 11:39 AM
To: Andrea Donlon
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Hi Andrea,

Thanks for the update. I am not sure how much in and out of the boat we will be doing and what the terrain will be like. This will be my first time on the impoundment so I have only seen what can be driven and reasonably walked into from the road system.

I will follow up with Joanne as she did contact me and I wanted to see what we were going to get as a response from those on the e-mail invitation before agreeing to take others to make sure we had room for people.

I'll see you Friday at Sunderland Bridge as will follow up with a time after I speak with the our boat owner/driver.

Bud

From: Andrea Donlon [mailto:adonlon@ctriver.org]
Sent: Monday, August 25, 2014 9:08 AM
To: Newell, Arthur (Bud) E.
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Bud,

I would like to attend the field day on Friday. I have a conflict on Thursday and fellow staff members at CRWC can't make it. One of our board members may be able to make it but she is curious how much walking and scrambling there will be.

Because I have had a hard time finding someone from CRWC to attend, I did inquire with affiliate groups like Greater Northfield Watershed Association that participated in commenting on studies and/or the FERC scoping session. Joanne McGee is interested, and I hope she will be allowed to attend given that AMC and MADCR cannot attend on Thursday.

Andrea

Andrea Donlon, River Steward
CONNECTICUT RIVER WATERSHED COUNCIL, INC.
15 Bank Row
Greenfield MA 01301
Phone: (413)772-2020 x. 205
Fax: (413)772-2090
adonlon@ctriver.org
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CRWC is on Facebook—become a fan

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Thursday, August 21, 2014 3:33 PM
To: Andrea Donlon
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Thanks, Andrea.

From: Andrea Donlon [mailto:adonlon@ctriver.org]
Sent: Thursday, August 21, 2014 2:50 PM
To: Newell, Arthur (Bud) E.
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Thanks. I will try to let you know tomorrow what days CRWC will be there. Thursday is not ideal, but I'll see what we can do.

Andrea

Andrea Donlon, River Steward
CONNECTICUT RIVER WATERSHED COUNCIL, INC.
15 Bank Row

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Fax: (413)772-2090
adonlon@ctriver.org
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CRWC is on Facebook—become a fan

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Wednesday, August 20, 2014 3:31 PM
To: Andrea Donlon
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Hi Andrea,

I expect that will be Friday as I expect it will take most of Thursday to get around the impoundment.

Bud

From: Andrea Donlon [mailto:adonlon@ctriver.org]
Sent: Wednesday, August 20, 2014 3:29 PM
To: Newell, Arthur (Bud) E.
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Bud,

Do you know which day might involve discussion of portage routes around TF dam?

Andrea

____

Andrea Donlon, River Steward
CONNECTICUT RIVER WATERSHED COUNCIL, INC.
15 Bank Row
Greenfield MA 01301
Phone: (413)772-2020 x. 205
Fax: (413)772-2090
adonlon@ctriver.org
Become a member today! Join at www.ctriver.org.
CRWC is on Facebook—become a fan

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Wednesday, August 20, 2014 8:39 AM
To: Norman Sims (normansims1@gmail.com); 'adonlon@ctriver.org'; 'noah.pollock@gmail.com'; 'kevin_mendik@nps.gov' (kevin_mendik@nps.gov); ssyz@vermontriverconservancy.org
Cc: Howard, John (John.Howard@gdfsuezna.com); Bill Gabriel (william.gabriel@gdfsuezna.com); Mark Wamser (mwamser@gomezandsullivan.com); Verville, Sarah; Mike Hoover (mhoover@gomezandsullivan.com); Seiders, Heather; 'Lana Khitrik' (lkhitrik@gomezandsullivan.com)
Subject: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

To Interested Stakeholders,

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I will keep those that RSVP advised on the field work and schedule as we get closer to the dates.

Please contact me if you have any questions or need additional information.

Thanks.

Bud

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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Newell, Arthur (Bud) E.

From:	Newell, Arthur (Bud) E.
Sent:	Wednesday, August 27, 2014 7:36 AM
To:	'Mac Everett'
Subject:	RE: Thursday river trip

Hi Mac,

Andrea did contact me and will have the details correct. I will be sending a follow up e-mail to the participants later this morning just reminding everyone and will include you on that message as well.

I look forward to meeting you.

Bud

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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From: Mac Everett [mailto:rivermac1@verizon.net]
Sent: Tuesday, August 26, 2014 9:15 PM
To: Newell, Arthur (Bud) E.
Subject: Thursday river trip

Hi Bud,

I understand Andrea Donlon of CRWC has contacted you regarding my participation on the Thursday river trip to assess day use and overnight facilities on the stretch from Vernon to Turner's Falls. I have a lot of canoe camping experience that should be relevant and I look forward to participating. I understand I need to show up at 7 at the Riverview Picnic Area with food, drink, pfd, and appropriate clothing.

I will be out Wednesday until noon or so, but should be home most of the afternoon if you need to contact me.

My home phone is 413-584-0068

Thanks,

Mac Everett

Newell, Arthur (Bud) E.

From:	Newell, Arthur (Bud) E.
Sent:	Wednesday, August 27, 2014 8:35 AM
To:	'adonlon@ctriver.org'; 'paul.jahnige@state.ma.us'; 'Kristen Sykes'; 'Joanne & Bill McGee'; 'Mac Everett'
Cc:	Howard, John (John.Howard@gdfsuezna.com); Bill Gabriel (william.gabriel@gdfsuezna.com); Mark Wamser (mwamser@gomezandsullivan.com); Verville, Sarah; Bley, Wendy; Mike Hoover (mhoover@gomezandsullivan.com); Seiders, Heather; 'Lana Khitrik' (lkhitrik@gomezandsullivan.com)
Subject:	August 28/29 field work - Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

To Interested Stakeholders:

I am following up to my e-mail of the 20th regarding the field work associated with the Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats study plan. Again, here are the details for the field work being conducted on August 28 and 29:

TRC has scheduled the field study component for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats, for August 28th and 29th, 2014. Pursuant to FERC's Study Plan Determination Letter of September 13, 2013, you are invited to participate in the field study on one or both days. The field evaluation will be done by boat and due to the extent of shoreline to be assessed, we are asking you to commit to spending the full day in the field with us instead of having to coordinate pick-up and drop-off times and locations for individuals over the course of the day. The field days may be long (in excess of 8 hours).

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You will be responsible for providing any personal gear, including PFD's, boots/water shoes, etc. as well as food and drinks. A brief safety tailboard will be held prior to departure on each day to review on-water safety, swimming abilities, special needs, PFDs for each person, and communications in the event of an emergency. Dates may be subject to rescheduling based on impoundment and river conditions and flows.

Please contact me if you have any questions or need additional information.

Thanks.

Bud

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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Newell, Arthur (Bud) E.

From: Newell, Arthur (Bud) E.
Sent: Thursday, August 28, 2014 1:57 PM
To: Kristen Sykes; adonlon@ctriver.org; paul.jahnige@state.ma.us
Subject: Re: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

8:00 a.m tomorrow from Sunderland bridge boat access site.

Bud

Sent from my iPhone

On Aug 26, 2014, at 10:52 AM, "Kristen Sykes" <KSykes@outdoors.org> wrote:

Hi Bud-

Okay, great!

Thanks!

Kristen

Kristen Sykes
Director of Conservation Strategies – Appalachian Mountain Club
Director of Operations – Bay Circuit Alliance
617-391-6565 (p)
609-558-2188 (c)
Website | Facebook | Twitter | YouTube
http://baycircuit.org/wordpress/

Your Connection to the Outdoors

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Monday, August 25, 2014 2:28 PM
To: Kristen Sykes; Jahnige, Paul (DCR)
Cc: 'John.Howard@gdfsuezna.com'; Andrea Donlon (adonlon@ctriver.org); Norman Sims (normansims1@gmail.com)
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Hi Kristen,

Norm Sims (AMC) has let me know he will not be available to attend the field trips, so feel free to join us on the 29th. I will provide you and the others with a time to meet at Sunderland Bridge Launch area once I confirm with our boat driver.

Bud

A.E. Newell III
Environmental Specialist

<image001.jpg> 14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

Follow us on LinkedIn or Twitter | www.trcsolutions.com

From: Kristen Sykes [mailto:KSykes@outdoors.org]
Sent: Thursday, August 21, 2014 2:31 PM
To: Jahnige, Paul (DCR); Newell, Arthur (Bud) E.
Cc: 'John.Howard@gdfsuezna.com'; Andrea Donlon (adonlon@ctriver.org); Norman Sims (normansims1@gmail.com)
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Dear Bud-

I too am deeply involved with the CT River Paddlers' Trail effort and would like to attend but can only make August 29th. Also please add me to your email list for future announcements of this nature.

Best,

Kristen

Kristen Sykes
Director of Conservation Strategies – Appalachian Mountain Club
Director of Operations – Bay Circuit Alliance
617-391-6565 (p)
609-558-2188 (c)
Website | Facebook | Twitter | YouTube
http://baycircuit.org/wordpress/

Your Connection to the Outdoors

From: Jahnige, Paul (DCR) [mailto:paul.jahnige@state.ma.us]
Sent: Thursday, August 21, 2014 2:02 PM
To: 'anewell@trcsolutions.com'
Cc: 'John.Howard@gdfsuezna.com'; Kristen Sykes
Subject: FW: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Dear Bud,

I have been in the First Light relicensing process, and recreational meetings, and also the CT River Paddlers Trail effort, unfortunately, I do not believe I got your announcement below about next week's assessment days. Please make sure that I am on your list for such efforts.
I am unfortunately, now not available of AUG 28, but would like to try to attend Aug 29.

Thank you.

Paul Jahnige
Department of Conservation and Recreation
Director, Greenways and Trails Program
136 Damon Road, Northampton, MA 01060
413-586-8706 ext. 20
paul.jahnige@state.ma.us

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Wednesday, August 20, 2014 8:39 AM
To: Norman Sims (normansims1@gmail.com); 'adonlon@ctriver.org'; 'noah.pollock@gmail.com'; 'kevin_mendik@nps.gov' (kevin_mendik@nps.gov); ssyz@vermontriverconservancy.org
Cc: Howard, John (John.Howard@gdfsuezna.com); Bill Gabriel (william.gabriel@gdfsuezna.com); Mark Wamser (mwamser@gomezandsullivan.com); Verville, Sarah; Mike Hoover (mhoover@gomezandsullivan.com); Seiders, Heather; 'Lana Khitrik' (lkhitrik@gomezandsullivan.com)
Subject: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

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I will keep those that RSVP advised on the field work and schedule as we get closer to the dates.

Please contact me if you have any questions or need additional information.

Thanks.

Bud

A.E. Newell III
Environmental Specialist

<image001.jpg> 14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155

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Newell, Arthur (Bud) E.

From: Jahnige, Paul (DCR) <paul.jahnige@state.ma.us>
Sent: Thursday, August 28, 2014 9:46 PM
To: Newell, Arthur (Bud) E.; Kristen Sykes; adonlon@ctriver.org
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Hi Bud,

Thanks, Unfortunately, I now have another commitment that has arisen, and won't be able to join, but I'lll look forward to the report. Paul ____
From: Newell, Arthur (Bud) E. [anewell@trcsolutions.com]
Sent: Thursday, August 28, 2014 1:56 PM
To: Kristen Sykes; adonlon@ctriver.org; Jahnige, Paul (DCR)
Subject: Re: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

8:00 a.m tomorrow from Sunderland bridge boat access site.

Bud

Sent from my iPhone

On Aug 26, 2014, at 10:52 AM, "Kristen Sykes" <KSykes@outdoors.org<mailto:KSykes@outdoors.org>> wrote:

Hi Bud-

Okay, great!

Thanks!

Kristen

Kristen Sykes
Director of Conservation Strategies – Appalachian Mountain Club Director of Operations – Bay Circuit Alliance
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Your Connection to the Outdoors

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Monday, August 25, 2014 2:28 PM
To: Kristen Sykes; Jahnige, Paul (DCR)

Cc: 'John.Howard@gdfsuezna.com<mailto:John.Howard@gdfsuezna.com>'; Andrea Donlon (adonlon@ctriver.org<mailto:adonlon@ctriver.org>); Norman Sims (normansims1@gmail.com<mailto:normansims1@gmail.com>)
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Hi Kristen,

Norm Sims (AMC) has let me know he will not be available to attend the field trips, so feel free to join us on the 29th. I will provide you and the others with a time to meet at Sunderland Bridge Launch area once I confirm with our boat driver.

Bud

A.E. Newell III
Environmental Specialist

<image001.jpg>

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To: Jahnige, Paul (DCR); Newell, Arthur (Bud) E.
Cc: 'John.Howard@gdfsuezna.com<mailto:John.Howard@gdfsuezna.com>'; Andrea Donlon (adonlon@ctriver.org<mailto:adonlon@ctriver.org>); Norman Sims (normansims1@gmail.com<mailto:normansims1@gmail.com>)
Subject: RE: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Dear Bud-

I too am deeply involved with the CT River Paddlers' Trail effort and would like to attend but can only make August 29th. Also please add me to your email list for future announcements of this nature.

Best,

Kristen

Kristen Sykes
Director of Conservation Strategies – Appalachian Mountain Club Director of Operations – Bay Circuit Alliance
617-391-6565 (p)

609-558-2188 (c)
Website<http://www.outdoors.org/> | Facebook<http://www.facebook.com/AppalachianMountainClub> | Twitter<http://twitter.com/appmtnclub> | YouTube<http://www.youtube.com/AppalachianMtnClub>
http://baycircuit.org/wordpress/

Your Connection to the Outdoors

From: Jahnige, Paul (DCR) [mailto:paul.jahnige@state.ma.us]
Sent: Thursday, August 21, 2014 2:02 PM
To: 'anewell@trcsolutions.com<mailto:anewell@trcsolutions.com>'
Cc: 'John.Howard@gdfsuezna.com<mailto:John.Howard@gdfsuezna.com>'; Kristen Sykes
Subject: FW: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

Dear Bud,

I have been in the First Light relicensing process, and recreational meetings, and also the CT River Paddlers Trail effort, unfortunately, I do not believe I got your announcement below about next week's assessment days. Please make sure that I am on your list for such efforts.
I am unfortunately, now not available of AUG 28, but would like to try to attend Aug 29.

Thank you.

Paul Jahnige
Department of Conservation and Recreation Director, Greenways and Trails Program
136 Damon Road, Northampton, MA 01060
413-586-8706 ext. 20
paul.jahnige@state.ma.us<mailto:paul.jahnige@state.ma.us>

From: Newell, Arthur (Bud) E. [mailto:anewell@trcsolutions.com]
Sent: Wednesday, August 20, 2014 8:39 AM
To: Norman Sims (normansims1@gmail.com<mailto:normansims1@gmail.com>); 'adonlon@ctriver.org<mailto:adonlon@ctriver.org>'; 'noah.pollock@gmail.com<mailto:noah.pollock@gmail.com>'; 'kevin_mendik@nps.gov<mailto:kevin_mendik@nps.gov>' (kevin_mendik@nps.gov<mailto:kevin_mendik@nps.gov>); ssyz@vermontriverconservancy.org<mailto:ssyz@vermontriverconservancy.org>
Cc: Howard, John (John.Howard@gdfsuezna.com<mailto:John.Howard@gdfsuezna.com>); Bill Gabriel (william.gabriel@gdfsuezna.com<mailto:william.gabriel@gdfsuezna.com>); Mark Wamser (mwamser@gomezandsullivan.com<mailto:mwamser@gomezandsullivan.com>); Verville, Sarah; Mike Hoover (mhoover@gomezandsullivan.com<mailto:mhoover@gomezandsullivan.com>); Seiders, Heather; 'Lana Khitrik' (lkhitrik@gomezandsullivan.com<mailto:lkhitrik@gomezandsullivan.com>)
Subject: Field work schedule for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats

To Interested Stakeholders,

TRC has scheduled the field study component for Study 3.6.4, Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats, for August 28th and 29th, 2014. Pursuant to FERC's Study Plan Determination Letter of September 13, 2013, you are invited to participate in the field study on one or both days. The field evaluation will be done by boat and due to the extent of shoreline to be assessed, we are asking you to commit to spending the full day in the field with us instead of having to coordinate pick-up and drop-off times and locations for individuals over the course of the day. The field days may be long (in excess of 8 hours).

We will depart from the Riverview Picnic Area off Route 63, just north of the Northfield Mountain Visitors Center at 7:00 a.m. on August 28th and plan to boat and assess the entire impoundment on that day. The river segment from Turners Falls Dam to Sunderland Bridge will be evaluated on August 29th by boat (to the extent possible) and vehicle/foot. We will depart from the Sunderland Bridge boat launch area on river left. I will notify you of the start time from Sunderland Bridge late in the day on the 28th.

If you are going to participate on either or both days, please e-mail or call me by August 25th with the dates that you plan to attend. We can only take one person from each organization due to boat capacity. You will be responsible for providing any personal gear, including PFD's, boots/water shoes, etc. as well as food and drinks. A brief safety tailboard will be held prior to departure on each day to review on-water safety, swimming abilities, special needs, PFDs for each person, and communications in the event of an emergency. Dates may be subject to rescheduling based on impoundment and river conditions and flows.

I will keep those that RSVP advised on the field work and schedule as we get closer to the dates.

Please contact me if you have any questions or need additional information.

Thanks.

Bud

A.E. Newell III
Environmental Specialist

<image001.jpg>

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.248.7155 Follow us on LinkedIn<http://www.linkedin.com/company/7886> or Twitter<http://twitter.com/TRC_Companies> | www.trcsolutions.com<http://www.trcsolutions.com/>

Newell, Arthur (Bud) E.

From:	Joanne & Bill McGee <jbmcgee2@verizon.net>
Sent:	Tuesday, September 02, 2014 1:51 PM
To:	Newell, Arthur (Bud) E.
Subject:	riverbank assessment

Dear Bud,

First of all, thank you for organizing your work so that we could be a part of the assessment. The work was both fascinating and challenging. After inspecting miles of riverbank, I can certainly understand the difficulties in developing additional access for paddlers.

Despite these difficulties, I hope you will be able to develop some solutions for paddlers including a renovation of Pauchaug Boat Ramp to provide an exclusive launching site for paddlers that will prevent vehicles from creating mudholes and hogging the beach. Although the bank is steep, the Bennett Meadow site seems ideal because parking exists and there is no history of power boats at that location. We also would be interested in a solution at the Riverview Picnic Area that allows the launching of canoes or kayaks from the shore without that long walk. I also like that spot with the chairs at the end of the farm road.

As I mentioned, the Northfield Open Space Committee is interested in shoreline access for walking paths. Now that Department of Conservation and Recreation (DCR) is assuming ownership of the final Schell bridge, we will be working with the agency to develop parks at each end of the bridge and hope to find a way to create a shoreline path from the Boat Ramp to the Schell Bridge and then beyond to Mill Brook where we looked at the erosion control work. That spot is another possible access point for kayaks and canoes. I realize that your mandate does not include shoreline paths. However, we would appreciate any help in working with First Light to include shoreline recreational paths as part of their recreational focus.

Would it be possible to have a copy of your report when it is finished?

Thank you so much for my day on the river. I hope Friday was as interesting and useful as Thursday.

Sincerely,

Joanne McGee
Northfield Open Space Committee
413-498-5022

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Relicensing Study 3.6.5

LAND USE INVENTORY

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers TRC

SEPTEMBER 2014

1.1 Study Summary

The purpose of this study is to review existing land use occurring on Project and adjacent lands, applicable land use controls such as zoning, and data from other relicensing studies to develop land use designations for the Turners Falls and Northfield Mountain Projects lands. Once the existing land uses and land use controls are identified, FirstLight will review available aerial photography and apply an appropriate designation to the Turners Falls Project and Northfield Mountain Project lands. This will aid in future land management decisions for lands within the Turners Falls Project and Northfield Mountain Project boundaries. This study is a desktop exercise, and no consultation has taken place since the issuance of the Federal Energy Regulatory Commission's (FERC) September 13, 2013 Study Plan Determination Letter (SPDL).

1.2 Study Progress Summary

Task 1: Literature and Aerial Photography Review

FirstLight conducted an internet search for local plans, ordinances, statutes, policies and guidelines that may affect use and/or management of Project lands. The following plans were located and reviewed: open space and recreation plans for Northfield, Montague, and Gill; the Gill Community Development Plan; the Hinsdale New Hampshire Master Plan; the Greenfield Master Plan; the Massachusetts Rivers Protection Act; and the Sustainable Franklin County – A Regional Plan for Sustainable Development for Franklin County. FirstLight completed a brief review of available aerial photography to determine areas that may need site visits to verify or determine existing uses. These sites were ground truthed during the last week of July 2014.

Task 2: Development and Application of Land Use Designations

FirstLight has developed draft land use classifications and definitions for this study.

Task 3: Map and Summary Development

This task will begin in 2015 and a report will be completed in the 4th quarter of 2015.

1.3 Variances from Study Plan and Schedule

There are no variances from the FERC approved study plan or schedule.

1.4 Remaining Activities

FirstLight will continue to obtain and review available documents which may affect the use and/or management of Project lands. This information will be used in combination with the results of various relicensing resource studies being conducted as part of the relicensing process. FirstLight will also conduct a search and review of conservation easements within 200 feet of the Projects' boundaries. FirstLight will complete the aerial photography review, development and application of land use designations to Project lands, and maps and report in the 4th quarter of 2015.

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Relicensing Study 3.6.6

ASSESSMENT OF EFFECTS OF PROJECT OPERATION ON RECREATION AND LAND USE

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers   TRC

SEPTEMBER 2014

1.1 Study Summary

This study is to determine whether the operation of the Turners Falls Project and the Northfield Mountain Project has effects on the recreation facilities or land use within the study area, which includes the Project boundary area and downstream of Turners Falls Dam to Sunderland Bridge.

Study results will be based on data from other relicensing studies that are being conducted including the *Recreation Use/User Contact Survey* (Study No. 3.6.1), the *Recreation Facilities Inventory and Assessment* (Study No. 3.6.2), the *Whitewater Boating Evaluation* (Study No. 3.6.3), the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats* (Study No. 3.6.4), and the *Recreation Study at Northfield Mountain, including Assessment of Sufficiency of Trails for Shared Use* (Study No. 3.6.7) to assess the potential impact of continuing operation and maintenance of the Projects' on recreation. Study results will also be based on data from the *Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station* (Study No. 3.2.2), *Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace* (Study 3.3.9), and *Northfield Mountain/Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability* (Study No. 3.1.2).

1.2 Study Progress Summary

Task 1: Data Compilation

The report for the *Recreation Facilities Inventory and Assessment* (Study No. 3.6.2) was completed in 2014. Field work for the *Whitewater Boating Evaluation* (Study No. 3.6.3) and the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats* (Study No. 3.6.4) have been completed and data is currently be reviewed and analyzed. Data collection for the *Recreation Use/User Contact Survey* (Study No. 3.6.1) has been on-going since January 2014. Data for Study No. 3.6.1 is being compiled as it is being collected. Preliminary field investigations associated with the *Recreation Study at Northfield Mountain, including Assessment of Sufficiency of Trails for Shared Use* (Study No. 3.6.7) were completed in February and October 2013 and a more in-depth and detailed assessment is scheduled for October 2014.

Data collection for the *Northfield Mountain/Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability* (Study No. 3.1.2) will be completed by the 4th quarter of 2014. Data compilation is complete for the *Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station* (Study No. 3.2.2) and *Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace* (Study No. 3.3.9), although the hydraulic models for both of these studies are not complete.

Task 2: Data Analysis

This task is contingent upon completion of data compilation efforts for the afore-mentioned studies. Accordingly, this task will be completed in 2015 and 2016.

Task 3: Report Development

Completion of the report is dependent on the data compilation from the afore-mentioned recreation studies, as well as 3.2.2 *Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station;* 3.3.9 *Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace;* and

3.1.2 *Northfield Mountain/Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability*. The reports for Study Nos. 3.2.2, 3.3.9 and 3.1.2 are expected to occur in the 1st quarter of 2015, 2nd quarter of 2015, and 2nd quarter of 2016, respectively. Accordingly, FirstLight anticipates that the report for this study will be completed in the 2nd quarter of 2016.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances from the FERC approved study plan.

1.4 Remaining Activities

Results from the afore-mentioned studies will not be available until 2015-2016. Tasks 1 through 3 will occur as results from these studies are available and the report will be completed in the 2nd quarter of 2016.

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Relicensing Study 3.6.7

RECREATION STUDY AT NORTHFIELD MOUNTAIN, INCLUDING ASSESSMENT OF SUFFICIENCY OF TRAILS FOR SHARED USE

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers   TRC

SEPTEMBER 2014

1.1 Study Summary

This study is designed to determine the number of existing recreation facilities, the number and types of amenities available at each facility and the overall condition of the facilities associated with the Northfield Mountain Project. This study includes a review of the trail system and climbing ledges located within the Northfield Mountain Project boundary.

On September 13, 2013 the Federal Energy Regulatory Commission (FERC) issued its first Study Plan Determination Letter (SPDL) including Study No. 3.6.7. In its SPDL, FERC states relative to Study No. 3.6.7: "*Our review of the study plan indicates that it does not contain a specific methodology to conduct this analysis. Therefore, within 90 days of the date of the issuance of this determination, FirstLight should submit for Commission approval, a proposed methodology for collecting the trail design and condition characteristics listed in the study plan*".

On December 11, 2013, FirstLight submitted a Modified Revised Study Plan (RSP)[1].

On January 10, 2014, FERC approved the Modified RSP without modifications.

FirstLight is gathering information regarding recreation needs at Northfield Mountain, including trail needs for mountain biking, as part of the user contact and mail surveys proposed in *Recreation Use/User Contact Survey* (Study No. 3.6.1).

1.2 Study Progress Summary

Task 1: Review of Existing Information

A review of best trail management practices and trail guidelines from sources such as the International Mountain Bicycling Association (IMBA), United States Forest Service (USFS), and Massachusetts Department of Conservation and Recreation (MADCR) has been completed, as well as a preliminary review of other trail opportunities in the Project area. FirstLight's operation and maintenance guidelines of its trail system have also been reviewed, including GIS shape files for the existing trail system.

Task 2: Field Work

Recreational user data is being collected as part of the *Recreation Use and User Contact Survey* (Study No. 3.6.1) to identify use and recreation users' opinions of the Northfield Mountain recreation facilities and public education programs offered. The recreation use surveys of users at the Visitors' Center commenced in January 2014. A preliminary winter trail inspection was conducted in February 2013 on portions of the Hemlock Hill, Oak Ramble, Rose Ledge, Talus Toe, 10th Mountain, and Lower Jug End trails to assess winter trail conditions. A second preliminary trail inspection was conducted in October 2013 on portions of 10th Mountain, Tooleybush, Ecstasy, Ramble, Hemlock Hill, Porcupine, Hidden Quarry, West Slope, Bobcat, Sidewinder, Hill N Dale, Rose Ledge, Lower Rose Ledge, and Jug End trails to assess general conditions of the various types of trails.

A more detailed trail condition assessment is anticipated to occur in October 2014 during leaf-off conditions.

Task 3: Desktop Analysis

This task will be completed in 2015 after field work has been completed.

[1] The Modified RSP was filed after the 90 days required by FERC due to the government shutdown.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Task 4: Report Development

This report will be developed in conjunction with data analysis. A report will be completed in the 2nd quarter of 2015.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances from the approved study plan.

1.4 Remaining Activities

Recreational user surveys of Northfield Mountain's recreation facilities are on-going and a detailed trail assessment will be conducted in the fall of 2014. This will include a field review of the current trail system, climbing sites, and the existing portion of the New England National Scenic Trail that is within the Project boundary. Trail characteristics, such as grade, cross slope, width, surface material/firmness, width, and drainage, will be assessed for representative sections of trails using standard methodologies adopted from the Universal Trail Assessment Process (UTAP), IMBA guidelines, and/or MADCR guidelines. Representative sections of trails with steep slopes, drainage/erosion issues, and areas subject to regular maintenance will also be assessed. Field staff will conduct on-the-ground measurements to determine trail characteristics and conditions, with particular attention to areas where repair/stabilization measures may be required.

All data will be analyzed and compiled during the 1st quarter of 2015 and a report will be completed in the 2nd quarter of 2015.

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Relicensing Study 3.7.1

PHASE IA, IB, AND PHASE II ARCHAEOLOGICAL SURVEYS

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

Prepared by:

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The goal of Study No. 3.7.1 is to assist the Federal Energy Regulatory Commission (FERC) in meeting its compliance obligation under Section 106 of the National Historic Preservation Act of 1966 (NHPA) by determining whether relicensing the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485) will have any effect on historic properties.

In its September 13, 2013 Study Plan Determination Letter (SPDL), FERC concluded that FirstLight should conduct a full archaeological inventory of the Area of Potential Effect (APE) during the 2014 field season that includes Phase IA, Phase IB and Phase II investigations, and not only the Phase IA study as proposed by FirstLight in its Modified Revised Study Plan (RSP).

In 2014 TRC, on behalf of FirstLight, initiated the Phase IA Archaeological Survey (Reconnaissance Survey) (Study No. 3.7.1) in the towns of Northfield, Erving, Montague, Greenfield, and Gill, Franklin County, Massachusetts, and in Windham County, Vermont, and Cheshire County, New Hampshire. The survey also included field reconnaissance of the Fuller Farm Parcel, which FirstLight is considering removing from the Project boundary as part of its relicensing proposal. The reconnaissance survey was conducted on behalf of FirstLight pursuant to Section 106 of the NHPA, as amended (36 CFR 800), the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (48 Fed. Reg. 190) (1983), and the Massachusetts General Laws, Chapter 9, Sections 26A and 27C (950 CMR 70).

Background research was conducted at the Massachusetts, Vermont, and New Hampshire State Historic Preservation Offices (SHPOs) in February and March, 2014. Local interviews, research, and field survey were conducted in July 2014 under the overall direction of Timothy Sara, M.A. (Principal Investigator). The research team included Edward Moore, M.S., Patrick Walters, B.A, Jessica Mundt, M.A., and Kathrina Aben, M.A.; the research leads all meet the Professional Qualification Standards as part of the larger *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation*.

The reconnaissance survey was conducted in Massachusetts under a State Archaeologist's Permit issued by the Massachusetts Historical Commission (MHC) on June 9, 2014. No permits were required to survey in Vermont and New Hampshire. The reconnaissance survey included research and consultation conducted at State and local institutions to develop appropriate contexts and obtain local information on the project areas. Field survey was conducted to assess areas that may have been favorable for Native American (Precontact) and/or Euro-American (Postcontact) period land use. The information collected is being used to identify areas that are either sensitive or not sensitive for archaeological resources within the Projects' APE and will be utilized to form recommendations regarding future archaeological studies.

1.2 Study Progress Summary

Task 1. Consultation with the Massachusetts, Vermont, and New Hampshire SHPOs and THPOs[1]

In its letter of June, 28, 2013, FirstLight solicited comments from the Massachusetts, Vermont, and New Hampshire SHPOs on the Updated Proposed Cultural Resources Study Plan for a Phase IA Archaeological Survey.

In its July 15, 2013 review letter, the Vermont SHPO indicated the Cultural Resources Study Plan should also include Phase IB site identification survey and Phase II site evaluation components.

[1] See Appendix A for correspondence described herein.

In its July 16, 2013 review letter, the Massachusetts SHPO requested the FERC's determination of the APE, and indicated the need for the consultant to apply for a State Archaeologist's Field Investigation Permit to conduct the archaeological reconnaissance (Phase IA) survey.

In its August 26, 2013 review letter, the Massachusetts SHPO indicated the FERC's determination of the APE was adequate for preliminary identification efforts and requested the consultant submit for review and comment the State Archaeologist's permit application and archaeological research design and methodology, and the proposed scope for the historic properties identification effort, the research design and methodology, and CVs of the qualified professional historic preservation consultants on the research team.

In accordance with the FERC-approved Study Plan, on October 31, 2013, a telephone conference was held among FirstLight, FERC, the Vermont and New Hampshire SHPOs, the Nolumbeka Project, and the Connecticut River Watershed Council (CRWC) to discuss finalization of the APE for the archaeological study.[2] On November 27, 2013, FERC sent a letter confirming that consultation had taken place with respect to the APE and seeking formal concurrence from the Massachusetts, Vermont, and New Hampshire SHPOs on the definition of the APE.

In its December 19, 2013 review letter, the Massachusetts SHPO concurred with the FERC's determination of the Projects' APE. By letter dated January 9, 2013, the Vermont SHPO also concurred with this determination.

In its February 12, 2014 State Archaeologist's Permit application to the Massachusetts SHPO, TRC included a research design for Phase IA, Phase IB, and Phase II archaeological investigations.

In its February 24, 2014 review letter of TRC's State Archaeologist's Permit application, the Massachusetts SHPO indicated that a research design for Phase IA, Phase IB, and Phase II archaeological investigations was not justified at this time in the project review and requested a revised application that addressed only a Phase IA survey (archaeological reconnaissance survey).

In its April 25, 2014 letter, TRC submitted a revised State Archaeologists' Permit Application to the Massachusetts SHPO to conduct a Phase IA survey (archaeological reconnaissance survey).

In its May 7, 2014 review letter, the Massachusetts SHPO requested that TRC submit a Curation Agreement, which was submitted on June, 4, 2014.

In its June 9, 2014 review letter, the Massachusetts SHPO issued a State Archaeologists' Permit to TRC to conduct a Phase IA survey (archaeological reconnaissance survey).

As part of the study, by letters dated March 31, 2014 and April 15, 2014, Tribal Historic Preservation Officers (THPOs) were also contacted to determine their level of interest in the study. This consultation was conducted with the Mashpee Wampanoag Tribe, the Stockbridge-Munsee Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah) of Massachusetts, and the Narragansett Indian Tribe. TRC has also consulted with the Nolumbeka Project as an interested party.

[2] The Massachusetts SHPO and the Narragansett Indian Tribe were also invited to participate in the telephone conference but did not attend.

Task 2. Background Research

The objective of the background research is to identify known archaeological site locations and develop historical contexts that will assist in identifying patterns of land use through the Precontact and Postcontact periods. This will inform the predictability of the location of previously unrecorded archaeological resources potentially in the Projects' APE and the types of sites that might be expected. The study team has reviewed site inventory forms at the SHPOs to identify known archaeological resources within the Projects' APE. As a result, 73 previously recorded archaeological sites were identified: 71 in Massachusetts, two in Vermont, and none in New Hampshire. The study team has also examined previous research and cultural resource management reports relevant to understanding the cultural and historical contexts of the Connecticut River Valley. MHC Reconnaissance Survey Town Reports have also been reviewed for the towns of Erving, Gill, Greenfield, Montague, and Northfield to further refine historical contexts and landscape use in the Projects' APE. This research provides a baseline for predicting the locations and types of archaeological resources in the Projects' APE.

The study team has also consulted with local historical commissions, historical societies, and libraries in the towns of Erving, Gill, Greenfield, Montague, and Northfield in Massachusetts to obtain information on the history and resources of the Projects' APE. The team has also consulted with the Massachusetts Archaeological Society (MAS), Pocumtuck Valley Memorial Association, and the Springfield Museums to make contact with groups or individuals knowledgeable of the archaeological resources of the Connecticut River Valley. For each of these contacts a *Record of Consultation Form* was completed that included information identifying the organization or individual, contact information, the purpose and results of the consultation, resources consulted and general notes. Each completed *Record of Consultation Form* will be included in the full report. Consultation with the repositories is ongoing and should be concluded by the 3rd quarter of 2014.

Based on the results of the research and consultation, the study team is developing both Precontact and Postcontact period contexts. The Precontact context will include settlement and land use patterns of the Middle Connecticut River Valley organized by cultural periods, and an assessment of known and expected archaeological resources. The Postcontact (Historic) context will be organized by township and will include a general discussion of each historical period, assessment of known and expected resources, and a presentation of historical mapping illustrating changes in the Projects' APE over time.

Task 3. Development of a Sensitivity Model

The purpose of the fieldwork was to inspect landforms within the Projects' APE to provide preliminary assessments of sensitivity or non-sensitivity for archaeological resources. Data gathered from the fieldwork will be used in conjunction with the background research to develop a sensitivity model for predicting where archaeological resources might occur and identify areas as either sensitive or not sensitive for archaeological resources within the Projects' APE. The sensitivity model will be used during agency consultation to help determine the need for Phase IB (site identification) field surveys.

To assess the sensitivity of the Projects' APE for Precontact period archaeological resources, the study team is reviewing information on known archaeological resources within a 1-mile buffer of the Projects' APE in order to provide an understanding of the locations and types of archaeological resources in the project vicinities. Past research in the Connecticut River Valley indicates that the locations of archaeological sites dating to the Precontact period can be predicted on the basis of natural and cultural historical models that incorporate a variety of types of information from several disciplines including anthropology, biology, natural history, and geology. Because Native peoples utilizing the Middle Connecticut River Valley were dependent on natural resources, information that seeks to characterize the type and distribution of those natural resources within a given project area is important to an understanding of site location. For these reasons, the study team is examining environmental conditions, both as they exist today and as they are thought to have existed in the past, to develop the sensitivity model.

To provide an understanding of past and current environmental conditions, the study team is reviewing palynological, geological, and soil maps of the region, as well as research related to the glacial and post-glacial development of the Connecticut River Valley. This information is being used to re-construct the geomorphological history of the Projects' APE and serve as a basis for determining if known archaeological resources can be associated with particular environmental settings. Environmental attributes that will be used to identify Precontact period land use patterns include landform type and relative age (if known); distance to a water source and the type of water source; soil type; elevation; slope; and distance from known or suspected resource procurement areas, such as lithic outcrops with desirable stone material or falls for procuring fish. After identifying patterns of landscape use, landforms possessing similar attributes within the Projects' APE will be ranked as <u>sensitive</u> or <u>not sensitive</u> for Precontact period archaeological resources.

In order to determine Postcontact (Historic) period archaeological sensitivity of the Projects' APE, the study team has examined SHPO, historical society, and library records, cartographic and other relevant documentation, as well as landscape and environmental features. Examination of landscape features are also being used as an indicator of the sensitivity for Postcontact period site types. For example, proximity to a fresh water supply and transportation routes (riverine or terrestrial) may augment sensitivity for a variety of site types, such as domestic, agricultural, commercial, industrial, transportation-related, or institutional. Domestic and agriculture-related sites may also be expected on or near fertile, well-drained land. Commercial sites such as taverns and stores would likely be situated near population centers and/or major transportation routes. Institutional sites, such as a schools, churches, libraries or civic buildings, would likely be located in settled areas for accessibility to surrounding communities. Industrial sites and associated buildings or structures - such as warehouses, train depots, and worker housing – may be expected adjacent to rivers or major streams in order to exploit water resources. Also under examination are historic maps, the location of former buildings and structures, transportation-related features, and general areas of occupation or development.

<u>Task 4. Field Reconnaissance</u>

Prior to field investigations, the Projects' APEs were divided into 65 segments defined by topographic and development features as depicted on USGS 7.5-minute topographic maps. Each segment was examined and evaluated by the survey team and accessed by either foot or motorboat. Both shoreline and interior landforms were visually inspected within each survey segment and information on their cultural and environmental settings was recorded on a standardized forms. Recorded attributes included landform characteristics, depositional environment, known archaeological sites, bank vegetation, soil types, and presence or absence of erosion. Completed forms for each survey segment will be included in the full report. Documentation of the segments was also made with digital camera. Where the soil profiles could not be readily observed along the river bank, nine (9) locations were also cored using a hand auger to assess the nature of deposition and subsurface soils on certain landforms.

Although the purpose of fieldwork was to provide preliminary assessments of sensitivity or non-sensitivity for archaeological resources, three previously recorded Precontact period sites were identified in the field based on the observation of surface artifacts, and six previously unrecorded archaeological sites were also identified. These newly identified archaeological sites include a Precontact-period lithic scatter near Ashuela Brook, remnants of historic Munns Ferry near Kidds Island, the remnants of two small summer cottages on upland ridges overlooking the Connecticut River, a historic surface scatter near Cabot Camp, and a partial stacked-stone foundation and spring-related feature near the Route 2 Bridge (French King Bridge).

Task 5. Report Development

Data analysis and preparation of the report documenting the findings of the investigation are ongoing. The Phase 1A report will be completed by the end of 4th quarter of 2014.

1.3 Variances from Study Plan and Schedule

FirstLight has not conducted Phase IB and Phase II archaeological surveys during the 2014 survey season because the Massachusetts SHPO would only grant TRC a State Archaeologists Permit for a Phase IA reconnaissance survey. Any necessary Phase IB site identification or Phase II site evaluation surveys will be conducted in 2015 after state permits for those activities are obtained.

1.4 Remaining Activities

The remaining study activities include a) data analysis and b) completion of the Phase IA Report.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Appendix A
Correspondence Record

FirstLight Power Resources GDF SUEZ

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Internet: john.howard@gdfsuezna.com

John S. Howard
Director- FERC Hydro Compliance

Via Electronic Filing

June 28, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Re: Northfield Mountain Pumped Storage Project, FERC Project No. 2485-063
Turners Falls Hydroelectric Project, FERC Project No. 1889-081
Filing of ***Updated Proposed Study Plan***

Dear Secretary Bose:

On April 15, 2013, pursuant to the regulations of the Federal Energy Regulatory Commission (Commission or FERC), 18 C.F.R. § 5.11, FirstLight Hydro Generating Company (FirstLight), a subsidiary of IPR-GDF SUEZ North America, Inc., Licensee of the Turners Falls Hydroelectric Project (FERC No. 1889) and the Northfield Mountain Pumped Storage Project (FERC No. 2485), filed its Proposed Study Plan (PSP) for the relicensing of the Turners Falls Project and Northfield Mountain Project.

In addition to other components of the PSP, the filing included 36 proposed studies and 11 studies not being proposed. Pursuant to 18 C.F.R. § 5.11, FirstLight was required to hold a study plan meeting or meetings for the purpose of clarifying the PSP and any initial information gathering or study requests, and to resolve any outstanding issues with the respect to the PSP. FirstLight held a Study Plan Meeting on May 14, 2013 in which all of the proposed studies and studies not being proposed were briefly discussed. Thereafter, FirstLight held nine resource-specific study plan meetings to allow for more detailed discussions on each proposed study plan and on studies not being proposed. With respect to study plans, FirstLight and the stakeholders focused on working out details on study methodology. The nine meetings were held on May 14, 15, 21, and 22, and June 4, 5, 11, 12, and 14. In addition, FirstLight met with the Narragansett Tribe on June 6 to discuss proposed studies. All meeting dates and notices as well as PowerPoint materials for these meetings were published on FirstLight's website http://www.northfieldrelicensing.com. FERC attended these meetings in person and/or via teleconferencing as did numerous stakeholders.

FirstLight agreed at these meetings to update the PSP and file a single ***Updated PSP*** with FERC prior to the July 15, 2013[1] deadline for stakeholders to provide comment on the PSP. Given the size of the ***Updated PSP*** and short turnaround period for stakeholder review, modifications from the original PSP are shown in track-change to allow for easier review. A few studies required significant changes and thus are not shown as track-change; they include the following:

- 3.1.1- 2013 Full River Reconnaissance Study
- 3.1.2- Northfield Mountain/Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability
- 3.3.11- Fish Assemblage Assessment
- 3.3.18- Impacts of the Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms

Note that Volume 2 of the original PSP, which included Appendices A-G, has not changed and thus is not being re-filed as part of the ***Updated PSP***. **FirstLight respectfully requests stakeholders to denote in any comment letters what version their comments are based on—the April 15, 2013 PSP filing or the June 28, 2013 *Updated PSP* filing.**

FirstLight is filing the ***Updated PSP*** with the Commission electronically. FirstLight is making the ***Updated PSP*** available for download on its website. To access the ***Updated PSP*** here, navigate to http://www.northfieldrelicensing.com, and click on the "documents" tab on the left side of the screen.

In addition, FirstLight is making available to the public the ***Updated PSP*** at the Northfield Mountain Visitor Center at 99 Millers Falls Road, Northfield, MA 01360 during regular business hours.

If you have any questions regarding this filing, please feel free to contact me.

Sincerely,

John Howard
FERC- Director Hydro Compliance

[1] In Scoping Document 1 and 2, FERC provided a schedule whereby stakeholder comments on the PSP were due on July 14, 2013 which falls on a Sunday. Per FERC regulations, deadlines falling on a weekend or holiday default to the next business day—in this case July 15, 2013.

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VERMONT

State of Vermont
Division for Historic Preservation
One National Life Drive, Floor 6
Montpelier, VT 05620-0501
www.HistoricVermont.org

[phone] 802-828-3211
[division fax] 802-828-3206

Agency of Commerce and Community Development

July 15, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Re: VT SHPO Comments on the June 28, 2013 Updated Proposed Study Plan for the Turners Falls (FERC No. 1889) and Northfield Mountain Pumped Storage (FERC No. 2485) Projects, First Light Power Resources.

Dear Secretary Bose:

Thank you for the opportunity to comment on the above referenced project.

The Vermont Division for Historic Preservation (Division) is providing the Federal Energy Regulatory Commission (FERC) with the following comments pursuant to 36 CFR 800.4, regulations established by the Advisory Council on Historic Preservation to implement Section 106 of the National Historic Preservation Act. Project review consists of assisting FERC in identifying the project's potential impacts to historic buildings, structures, historic districts, historic landscapes and settings, and known or potential archeological resources that are listed in or may be eligible for inclusion in the National Register of Historic Places (National Register).

As currently defined, the Cultural Resources Study Plan (Section 3.7) presented by First Light is limited to a Phase IA Archaeological Survey and a Reconnaissance Level Historic Resources Survey. While these study plan components represent necessary first steps in the cultural resource review process, they are first steps only and will by no means provide all the data necessary to identify and evaluate the full suite of cultural resources present in the Project area.

By definition, the Phase IA study will only provide background information on known archeological resources and a preliminary assessment of the potential location of additional archeological resources within the project area. Similarly, the Reconnaissance Level Historic Resource Survey will identify and compile information on known historic structures but not evaluate the structures to determine their eligibility to the National Register or assess the project's effect on National Register eligible or listed structures.

The Division would also like to clarify that our statements during the June 14, 2013 Study Plan conference call concerning an APE determination of 10 meters (33 feet) from the top of bank along the Project boundary were made in reference to a discussion of Phase IB site identification and Phase II site evaluation study efforts. In general terms, a Phase IA study usually includes a larger zone of review in order to identify the broadest spectrum of cultural resources that may be affected by any project.

The current Phase IA study plan includes provisions for further consultation with the relevant SHPOs, the Narragansett THPO, and any other interested Native American tribes with regard to APE definition, the development of a archeological sensitivity model, and an archeological field reconnaissance methodology. The Division looks forward to this consultation and recommends that a specific consultation schedule be provided in the Revised Study Plan. In addition, the Revised Study Plan should also provide specific reference to the development and implementation of the following Cultural Resource Study Plan components that will be necessary subsequent to the completion of the Phase IA:

- A Phase IB site identification survey within all archeologically sensitive areas and potential site locations within the APE that are actively eroding. This study should include strategies to implement deep testing methods for identification of deeply buried cultural components.

- Phase II site evaluation of any archeological site identified in the Project APE as a result of the Phase IB survey or any known site that is located within a portion of the APE that is actively eroding to determine their boundaries and eligibility for inclusion on the National Register of Historic Places.

- A phased plan to complete Phase II site evaluation of any remaining currently recorded archeological sites in the Project APE to determine their boundaries and eligibility for inclusion on the National Register of Historic Places.

- Identification of Traditional Cultural Properties.

- Historic Structures Assessment and Evaluation Report

The above studies will provide the basis for the development of a project specific Historic Properties Management as well inform on the development of Mitigation Plans and Programmatic Agreements to address any adverse effects to historic properties. Completion of these actions will ensure that this Projects relicensing fully considers potential impacts to historic properties in compliance with the National Historic Preservation Act.

Sincerely:
VERMONT DIVISION FOR HISTORIC PRESERVATION

~~Noelle~~ MacKay
Acting State Historic Preservation Officer

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

July 16, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First St NE Room 1A
Washington, DC 20426

Attn: Frank Winchell, Hydro Power

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. **FERC No. 1889-081 and No. 2485-063.**

Dear Ms. Bose:

Staff of the Massachusetts Historical Commission (MHC), office of the Massachusetts State Historic Preservation Officer have reviewed the updated Proposed Study Plan dated June 28, 2013, received by the MHC on July 3, 2013, for the project referenced above.

Section 3.7 of the updated plan incorporates the MHC's April 24 and June 21, 2013 comments, including a refinement of the project area of potential effect for historic and archaeological resources, shown in figures 3.7.1-1 through 3.7.1-5. Figure 3.7.1-6 includes information on the Fuller Farm property in the vicinity of the Northfield Mountain portion of the project area. The Fuller Farm is included in the MHC's Inventory of Historic and Archaeological Assets of the Commonwealth as the Fredrick Morgan, Sr. House/ Morgan-Fuller Residence (MHC # NFL.178). The MHC has previously provided comments to Firstlight in 2011 regarding this property (see enclosed).

The MHC looks forward to reviewing the scope of the proposed identification and evaluation efforts proposed as part of the updated Proposed Study Plan, including the State Archaeologist's permit application and archaeological research design and methodology, and the proposed scope for the historic properties identification effort, the research design and methodology, and CVs of the qualified professional historic preservation consultants on the research team.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800). Please contact Jonathan K. Patton at this office if you have any questions at this time.

Sincerely,

DSHPO

for: Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

Encl: MHC to FirstLight 12/20/2011

xc w/ encl: see attached

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

xc w/ encl: John Howard, Director FERC Hydro Compliance, Firstlight Power Resources GDF Suez
Charles Momney, Firstlight GDF Suez
Lana Khitrik, Gomez and Sullivan Engineers, P.C.
Mickey Marcus, New England Environmental, Inc.
Representative Stephen Kulik, Attn: Paul Dunphy
Karen Kirk Adams, USACOE-NED, Regulatory
Kate Atwood, USACOE-NED
Marc Paiva, USACO-NED
Cheryl White, Stockbridge-Munsee Tribal Historic Preservation Officer
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Ramona Peters, Mashpee Wampanoag Tribe
John Eddins, ACHP
Giovanna Peebles, VT SHPO
Elizabeth Muzzey, NH SHPO
Bill Lellis, Acting Chief, Conte Anadromous Fish Laboratory
John Wilson, USFW
Local Historical Commissions: Towns of Northfield, Gill, Greenfield, Montague, and Erving

20130903-0004 FERC PDF (Unofficial) 09/03/2013
Document Accession #: 20140916-5028 Filed Date: 09/16/2014

ORIGINAL

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

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2013 SEP -3 A 9:34
FEDERAL ENERGY REGULATORY COMMISSION

August 26, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First St NE Room 1A
Washington, DC 20426

Attn: Frank Winchell, Hydro Power

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. **FERC No. 1889-081 and No. 2485-063.**

Dear Ms. Bose:

Staff of the Massachusetts Historical Commission (MHC), office of the Massachusetts State Historic Preservation Officer have reviewed the revised Proposed Study Plan dated August 14, 2013, received by the MHC on August 19, 2013, for the project referenced above.

Section 3.7 of the revised plan incorporates information included in the MHC's April 24 and June 21, 2013 comments. The results of the 2013 Full River Reconnaissance survey (Study No. 3.1.1; pp. 3-402 and 3-403) and an archaeological sensitivity assessment for the Fuller Farm property within the Northfield Mountain portion of the project area will be incorporated into the proposed archaeological reconnaissance technical report.

Scopes for the proposed identification and evaluation efforts proposed as part of the revised Proposed Study Plan, including the State Archaeologist's permit application and archaeological research design and methodology, and the proposed scope for the historic properties identification effort, the research design and methodology, and CVs of the qualified professional historic preservation consultants on the research team, should be submitted to the MHC for review and comment as they are developed.

The project area of potential effect for archaeological and historic resources is shown in figures 3.7.1-1 through 3.7.1-6 and 3.7.2-1 through 3.7.2-5. The project area of potential effect shown in these figures is adequate for preliminary identification efforts, although as project planning is refined, the MHC looks forward to reviewing additional information, including scaled existing and proposed conditions project plans, for any proposed new construction, demolition, rehabilitation or other activities, at the existing facilities, if any, that may cause effects to significant historic and archaeological resources. The MHC notes that Firstlight proposes to conduct a teleconference in October 2013 to discuss further refinements to the project area of potential effect. The MHC looks forward to further consultation with FERC on FERC's determination of the area of potential effect (36 CFR 800.4(a)(1)).

The paper copy of the document received by the MHC includes only Appendices A and B. Copies of MHC comments on previous submittals for the project are not included in these appendices, although they may be included in Appendix H, Stakeholder Comments on Updated PSP. Appendix H was not included in the submittal to the MHC. To assist in future review of the project and consultation with FERC, the MHC would appreciate the incorporation of a separate cultural resources comments matrix into future project filings. The cultural resources comments matrix should include a list and summaries of all comment letters received to date from State Historic Preservation offices (MA, NH, VT), Tribal Historic Preservation Offices, local historical commissions and interested groups/individuals for potential project effects to cultural resources.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800). Please contact Jonathan K. Patton at this office if you have any questions at this time.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: John Howard, Director FERC Hydro Compliance, Firstlight Power Resources GDF Suez
Charles Momney, Firstlight GDF Suez
Lana Khitrik, Gomez and Sullivan Engineers, P.C.
Mickey Marcus, New England Environmental, Inc.
Representative Stephen Kulik, Attn: Paul Dunphy
Karen Kirk Adams, USACOE-NED, Regulatory
Kate Atwood, USACOE-NED
Marc Paiva, USACO-NED
Cheryl White, Stockbridge-Munsee Tribal Historic Preservation Officer
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Ramona Peters, Mashpee Wampanoag Tribe
Doug Harris, NITHPO
John Eddins, ACHP
Giovanna Peebles, VT SHPO
Elizabeth Muzzey, NH SHPO
Victor Mastone, MBUAR
Bill Lellis, Acting Chief, Conte Anadromous Fish Laboratory
John Wilson, USFW
Local Historical Commissions: Towns of Northfield, Gill, Greenfield, Montague, and Erving

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VT DIVISION FOR HISTORIC PRESERVATION

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426
November 27, 2013

OFFICE OF ENERGY PROJECTS

Project No. 2485-063--Massachusetts
Project No. 1889-081--Massachusetts
FirstLight Hydro Generating Company

Reference: Concurrence on the Area of Potential Effects for the Turner Falls and Northfield Mountain Projects.

To the parties addressed:

We consulted with the Massachusetts, Vermont, New Hampshire State Historic Preservation Officers (SHPOs), along with the Narragansett Indian Tribe, Nolumbeka Project, FirstLight, and others with regard to the areas of potential effects (APEs) involving the relicensings for the Turner Falls Hydroelectric Project and the Northfield Mountain Pumped Storage Project (projects). Based on those consultations, we determine that the APEs should include all lands within the current project boundaries of the two projects, in addition to any other lands outside the project boundaries where historic properties could be affected by project-related adverse effects.

The projects' APEs include lands within Franklin County, Massachusetts, Windham County, Vermont, and Cheshire County, New Hampshire. On lands adjacent to the project boundaries, the APEs would also include an additional 10 meters (33 feet) of lands inland from the top of banks of the Connecticut River and associated tributaries. The enclosed maps demarcate the general geographic and topographic coverage of the APEs for these projects. (See enclosure maps).

At this time, we seek formal concurrence from the Massachusetts, Vermont, and New Hampshire SHPO on our defined APEs for the Turner Falls and Northfield Mountain projects.

CONCUR
Vermont Division for Historic Preservation
Laura Trieschmann 1/9/14
State Historic Preservation Office Date

If you have any questions, please contact Dr. Frank Winchell at 202-502-6104.

Sincerely,

Timothy J. Welch, Chief
West Branch
Division of Hydropower Licensing

Addressees:

Brona Simon, SHPO
Executive Director and State Archeologist
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, MA 02125

Laura Trieschmann, SHPO
State of Vermont
Division for Historic Preservation
One National Life Drive, Floor 6
Montpelier, VT 05620-0501

Elizabeth Muzzey, SHPO
Director
New Hampshire Division of Historical Resources
State of Department of Cultural Resources
19 Pillsbury Street
Concord, NH 03301-3570

Enclosures: APE maps

cc: Mailing List
Public Files

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

ORIGINAL

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

December 19, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First St NE Room 1A
Washington, DC 20426

Attn: Frank Winchell, Hydro Power

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. **FERC No. 1889-081 and No. 2485-063.**

Dear Ms. Bose:

Staff of the Massachusetts Historical Commission (MHC), office of the Massachusetts State Historic Preservation Officer have reviewed your determination of the area of potential effect, received by the MHC on December 12, 2013, for the project referenced above.

The MHC concurs with FERC's determination of the project area of potential effect, to include all lands within the current project boundaries as shown on attached figures 3.7.2.1-4, including within 10 meters of the top of the Connecticut River and tributaries, and any other lands outside the project boundaries where potential effects to historic properties may occur.

As project planning is refined, the MHC looks forward to reviewing additional information, including scaled existing and proposed conditions project plans, for any proposed new construction, demolition, rehabilitation or other activities, at the existing facilities, if any, that may cause effects to significant historic and archaeological resources.

The MHC looks forward to reviewing scopes for the proposed identification and evaluation efforts proposed as part of the revised Proposed Study Plan, including the State Archaeologist's permit application and archaeological research design and methodology, and the proposed scope for the historic properties identification effort, the research design and methodology, and CVs of the qualified professional historic preservation consultants on the research team.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800). Please contact Jonathan K. Patton at this office if you have any questions at this time.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: see attached

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REGULATORY COMMISSION

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

xc: John Howard, Director FERC Hydro Compliance, Firstlight Power Resources GDF Suez
Charles Momney, Firstlight GDF Suez
Lana Khitrik, Gomez and Sullivan Engineers, P.C.
Mickey Marcus, New England Environmental, Inc.
Representative Stephen Kulik, Attn: Paul Dunphy
Karen Kirk Adams, USACOE-NED, Regulatory
Kate Atwood, USACOE-NED
Marc Paiva, USACO-NED
Cheryl White, Stockbridge-Munsee Tribal Historic Preservation Officer
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Ramona Peters, Mashpee Wampanoag Tribe
Doug Harris, NITHPO
John Eddins, ACHP
Giovanna Peebles, VT SHPO
Elizabeth Muzzey, NH SHPO
Victor Mastone, MBUAR
Bill Lellis, Acting Chief, Conte Anadromous Fish Laboratory
John Wilson, USFW
Local Historical Commissions: Towns of Northfield, Gill, Greenfield, Montague, and Erving

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

TRC

4425 Forbes Boulevard
Lanham, Maryland 20706

Main 301-306-6981
Fax 301-306-6986

February 12, 2014

Ms. Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, MA 02125

RE: ***State Archaeologist's Permit Application for Turners Falls Hydroelectric (FERC No. 1889) and Northfield Mountain Pumped Storage (FERC No. 2485) Project in Franklin County, Massachusetts***

Dear Ms. Simon,

As requested in prior correspondence between the Massachusetts Historical Commission (MHC) and the Federal Energy Regulatory Commission (FERC), TRC Environmental Corporation (TRC) is pleased to submit the enclosed State Archaeologist's Permit Application and supporting Research Design and Professional Qualifications for the Firstlight Hydro Generating Company (FirstLight) Turners Falls and Northfield Mountain Hydroelectric Relicensing Project.

The proposed Research Team includes key individuals with prior relevant experience in the ancient archaeology of the glaciated Northeast and Connecticut River Valley region, as well as in historical archaeology. As Principal Investigator and Project Manager for the archaeological studies, I will serve as key liason between your agency, FirstLight, and FERC for the duration of the permit. Key members of the Research Team include Edward Moore, M.S., who received his graduate training in glacial landscape archaeology from the Institute for Quaternary Studies, University of Maine, Orono, Jessica Mundt, M.A., whose graduate research focused on historical archaeology, and Richard Will, Ph.D., RPA, who has extensive experience in the archaeology of the Northeast. Dr. Will will provide overall QA/QC oversight of project research, findings, and resource management recommendations.

Firstlight has entered into a Memorandum of Understanding (MOU) with the Springfield Science Museum, which has agreed to serve as the curation facility for all artifact collections, catalogs, and field records generated from this study. The enclosed application provides detailed information on proposed research methodologies, expected results, qualifications of the Research Team, and the fully executed curation MOU between FirstLight and the Museum.

As part of the background research in advance of intensive field surveys, TRC plans to conduct field reconnaissance of the project area in late March, or as ground conditions permit, and visit local repositories, including the Pocumtuck Valley Memorial Association in Deerfield, and the Springfield Science Museum to view their collections. TRC will also be consulting with the Narragansett Tribe over the course of these studies.

Please do not hesitate to contact me at (301) 276-8040, or tsara@trcsolutions.com should you have any questions or comments during your review of this application.

Sincerely yours,

Timothy R. Sara, RPA
Program Manager, Archaeology

cc: John Howard, FirstLight
Mark Wamser, GSE
Frank Winchell, FERC
Sarah Verville, TRC
Richard Will, TRC

TRC File: 184005.2014.0649

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

February 24, 2014

Timothy R. Sara
Principal Investigator
TRC Environmental Corporation
4425 Forbes Boulevard
Lanham, MD 20706

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. FERC No. 1889-081 and No. 2485-063.

Dear Mr. Sara:

Staff of the Massachusetts Historical Commission (MHC), the office of the State Historic Preservation Officer and the State Archaeologist, have reviewed the State Archaeologist's permit application for reconnaissance, intensive, and site examination archaeological surveys, received February 14, 2014, for the project referenced above.

On December 19, 2013, the MHC and FERC agreed that the project area should be subjected to an archaeological reconnaissance.

The permit application does not propose an adequate methodology for the reconnaissance. Please submit a revised research design and methodology that addresses the following comments.

Scope

The multiple-scoped proposal for reconnaissance, intensive, and site examination archaeological surveys, is not justified at this time in the project review. An adequate research design and methodology for a reconnaissance is not presented in your application. It is premature to request a State Archaeologist's permit for an intensive (locational) survey or site examination. Research designs for an intensive (locational) survey and site examination cannot be developed until the detailed results of the reconnaissance investigation are available for consideration. The specific information required for an adequate research design and methodology to conduct an intensive (locational) survey or archaeological site examination, if warranted, including specific descriptions of the artifact deposits and features and research questions proposed to evaluate the site-specific data, do not exist at this time. Please revise the proposed scope to be for a reconnaissance survey, which is the scope that is proposed in your cover letter dated February 12, 2014. The results of the reconnaissance survey will then allow you to develop an adequate methodology for intensive (locational) archaeological survey, if recommended by FERC and MHC, in specific archaeologically sensitive areas that are proposed for project activities that could adversely affect significant archaeological resources in those specific locations.

Research Design & Methodology

A. Description of the Survey Area in Relation to the Proposed Project

The area of potential effect and the specific proposed project-related impacts that have the potential to adversely affect National Register-eligible historic properties are not described. Please include the specific information in the revised research design and methodology to justify the proposed investigation.

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

Regarding research proposed to be conducted at local and regional repositories, please further describe the range and quantity of information available that is proposed to be reviewed. What is the level of effort, schedule, and expected results of that aspect of the background research? How will the information obtained be applied to the investigation?

B. Consultation
During background research, please propose to consult with local historical commissions, local historical societies, and knowledgeable groups and individuals, including the Massachusetts Commission on Indian Affairs and the Massachusetts Archaeological Society, in addition to those suggested on page 2. In addition to the Narragansett Tribal Historic Preservation Officer, the Tribal Historic Preservation Officers of the Wampanoag Tribe of Gay Head (Aquinnah), Mashpee Wampanoag Tribe, and Stockbridge Munsee Tribe, have at times expressed their wishes to be consulted in advance of proposed archaeological investigations in the Connecticut Valley region of Massachusetts. The MHC advises that you contact these other tribes to determine their interest.

C. Predictive Modeling, Expected Resources, Field Methods, & Expected Results
The proposal tripartite sensitivity model is undefined and arbitrary. It is not clear what relation the tripartite model has for understanding ancient and historical period site selection and land use choices, if there is any real and purposeful difference in the three categories, or how the three categories would assist to locate and identify resources. Instead, explicit criteria for determining areas that are "sensitive" or "not sensitive" need to be developed and evaluated based on existing, reliable data, and that considers issues of accuracy, precision, representativeness, and scale. A reliable binary model will demonstrate areas that are and are not expected to have any material evidence of ancient and historical period land use with both integrity and potential significance. The previous and existing environmental settings and the cultural geography of the project area need to be determined and related to known and expected patterns of ancient and historical period land use and settlement patterns. Please review and apply previous, relevant research findings for the Connecticut River Valley to develop and evaluate a suitable predicative site location model. Suitable predictive models for that region are described in archaeological reports on file at the MHC. Please review and consider results of previous relevant research, and the present the information in the revised research design and methodology.

Based on the background research that provides expectations of site locations in relationship to environmental settings and cultural geographic features (e.g., proximity of a historical period road to predict the location of an historical period occupation), please describe an adequate field methodology that includes shoreline inspection from a boat and a walkover survey of adjacent parcels in order to locate and record archaeologically sensitive areas and any evidence of archaeological sites on the surface or in eroding riverbanks in the survey area. If artifacts visible on the surface are proposed to be collected, then a suitable laboratory and curation research design and methodology needs to be described. Please describe how the results of the visual reconnaissance inspections will be presented in narrative and graphic formats. The MHC expects that scaled archaeological base maps will clearly indicate areas interpreted to be "archaeologically sensitive" and narrative description will clearly explain existing conditions; why the area is considered sensitive according to the predictive model; expected archaeological resources specifying expected site periods, types, sizes, and contents derived from known or comparative data; project-related impacts that could adversely affect the resources; and, specific recommendations for locating and identifying the resources by field testing in those locations. The MHC recommends that you review the report entitled "Holyoke Project Cultural Resource Reconnaissance Survey, Franklin, Hampshire and Hampden Counties, Massachusetts", prepared by Adams et al., 1997 (MHC # 25-2374), on file at the MHC, as an example of a complete reconnaissance report for a similar project along the Connecticut River.

The research design and methodology does not include procedures in the event that human skeletal remains are identified during the proposed investigation. If human skeletal remains are identified on non-federal, non-tribal property, the Massachusetts Unmarked Burial Law procedures are followed (Massachusetts General Laws c. 7, s. 38A, c. 38, s.6, c.9, ss. 26A & 27C and c. 114, s. 17, all as amended). No State Archaeologist's permittee is authorized to excavate human skeletal remains without obtaining a Special Permit (950 CMR 70.20). Please review the state law and regulations and propose a consistent procedure as a contingency in the event that human skeletal remains are encountered during the investigation.

The research design and methodology does not include a list of references cited in the text. Please always include a complete list of sources cited.

D. Artifact Analysis
South's etic artifact "pattern" categories developed in 1970s-era "historic sites archeology" do provided useful information in relationship to actual social behavioral contexts that occurred in a place, at and over time. The arbitrary categories have been applied without regard to depositional contexts or site formation processes, and so they prevent understandings of particular cultural activities and meanings in specific temporal and geographic contexts. Because the categories were developed without regard to specific cultural, historical, and geographic contexts, they are reductive and ahistorical. Please become familiar with current approaches to artifact identification and analysis as practiced by contemporary historical archaeologists. Please describe an adequate methodology for description, analysis, and interpretation of historical period artifacts that considers current, relevant, research programs in modern historical archaeology.

TRC facilities in Maryland and Maine are proposed to be used for artifact processing. TRC's proposal to remove artifacts from Massachusetts to their facilities in Maryland and/or Maine is not acceptable. The proposal to remove artifacts and samples from Massachusetts, to split the specimens among different states, and for an indefinite period, poses dangers of loss and mixing of provenience data, samples and specimens, and insurmountable difficulties for my office to obtain the specimens, samples and records should that be required. Please locate a suitable artifact processing laboratory facility in Massachusetts that the MHC can evaluate for adequacy.

E. Reporting
TRC proposes to submit a management summary memorandum summarizing the results of the reconnaissance archaeological survey. Please propose to instead submit a complete, bound draft report to the MHC for MHC's review and comment for the investigation. The final products to be submitted to MHC are two (2) copies of the final report that addresses MHC's comments on the draft reports; a CD-ROM containing a word processing file with the report author(s), date, title, page count, and an archaeological abstract prepared in accordance with the State Archaeologist's report abstracting guidelines; and, new or updated MHC inventory forms, attached to which are USGS locus maps with the archaeological site clearly bounded, and smaller scale site maps showing the boundaries of the site in relation to archaeological testing.

F. Curation
The permit application Appendix B should specify that the location of the proposed curatorial institution (item #4) is the Springfield Science Museum, which is a part of the Springfield Museums organization. The Memorandum of Understanding (MOU) for proposed curation of artifacts and records at the Springfield Science Museum does not provide assurances that the complete archaeological collection and records will be accessioned. The MOU poses significant uncertainties whether the curation would occur at all: the accession would only occur if clear title was established, and the Museum Committee approved the accession. The MOU does not provide that the Springfield Science Museum will permanently curate the complete archaeological collection consistent with M.G.L. c. 9, s. 26A(1) and 27C; 950 CMR 70.13(1)(d), (3),(4), and (5); and 36 CFR 79. Please find enclosed a sample State Archaeologist's Custody Permit with terms and conditions required to curate archaeological collections in Massachusetts. In addition to the conditions summarized on the sample custody permit, additional terms consistent with 36 CFR 79 would need to be expressed in the curatorial agreement. Please either renegotiate a suitable curation agreement with the

Springfield Science Museum, or locate another institution that is capable and willing to commit to curate the complete collection according to the state and federal requirements. Please provide me a copy of the draft agreement for my review and approval.

Please describe the archival methods and materials proposed to be used for packaging records and artifacts. Please describe the proposed methods for curation of digital data at the curatorial facility that provides reasonable expectation of preserving the integrity and readability of the digital data. Please propose to provide the MHC a copy of the transmittal documentation.

Professional Qualifications

Regarding the professional qualification of your research team, please note that under the State Archaeologist's permit regulations, members of the research team must have considerable experience in the northeast (see 950 CMR 70.10). Please indicate which members of your team will conduct and supervise the field and laboratory components of your scope of work.

Applicable Laws & Regulations

The archaeological investigation is proposed in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (48 Fed. Reg. 190)(1983)), and Massachusetts General Laws, Chapter 9, Sections 26A and 27C (950 CMR 70). The proposed archaeological investigation is not being undertaken in compliance with the Massachusetts Environmental Policy Act nor with 950 CMR 71, 72 or 73, as indicated on pages 1, 3, 5, and 7. Inapplicable regulations should not be cited. Please review the pertinent laws and regulations that apply to your proposed investigations, and please revise the research design and methodology to reference correctly only the pertinent laws and regulations that are applicable to the proposed investigation.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), the Secretary of the Interior's *Standards and Guidelines for Archeology & Historic Preservation* (48 Fed. Reg. 190 (1983)), and M.G.L. c. 9, ss. 26-27C (950 CMR 70). If you have questions or require additional information, please contact Jonathan K. Patton at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

Enclosure: SA Sample Custody Permit

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

CUSTODY PERMIT

Pursuant to M.G.L. Ch. 9, s. 27C and 950 CMR 70, the State Archaeologist may make arrangements for the disposition or display of artifacts, objects and specimens and their accompanying field and laboratory records ("the collection") recovered under a State Archaeologist's permit in appropriate institutions located within the Commonwealth. Pursuant to this authority, the State Archaeologist hereby grants custody of the collections recovered from:

Permit No. Town Site/Project Name

To the following insitution:

Institution ______________________
Address ______________________

Custodian ______________________
Telephone ______________________

SAMPLE

Provided that the following conditions are met:

1) The collection shall be maintained in accordance with professional archaeological curation standards.

2) During accessioning, analysis, storage, and display of the collection, steps shall be taken to insure that correlations between specimens and the field, laboratory and storage records are maintained, so that records of the provenience and contextual relationships of the specimens are not confused or obscured.

3) The collection shall be maintained in a safe and secure storage area with clean and dry conditions which can protect against reasonably foreseeable dangers to the collection. The collection area shall be inspected on a regular schedule by institution staff.

4) The State Archaeologist shall be notified immediately of any change in the location or condition of the collection.

220 Morrissey Boulevard, Boston, Massachusetts 02125 · (617) 727-8470

FirstLight Power Resources
GDF SUEZ

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

March 31, 2014

Doug Harris
Narragansett Indian Tribal Historic Preservation Office
Narragansett Indian Tribe
Narragansett Indian Longhouse
4425-A South County Trail
Charlestown, RI 02813

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485) – Initiation of Phase IA Archaeological Survey

Dear Doug:

FirstLight Hydro Generating Company (FirstLight) will be conducting archaeological investigations in connection with the Federal Energy Regulatory Commission's (the Commission's) relicensing of FirstLight's Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Projects on the Connecticut River in Franklin County, Massachusetts, Cheshire County, New Hampshire, and Windham County, Vermont (Appendix 1). The archaeological studies will assist the Commission in meeting its obligation under section 106 of the National Historic Preservation Act (NHPA), as amended, to consider the effect of relicensing the Projects on historic properties. The archaeological studies will identify known archaeological resources listed in, or eligible for listing in, the National Register of Historic Places (NRHP), and identify and assess any potential effects to these resources from continued operation and maintenance of the Projects.

Initially, the archaeological studies will consist of a Phase IA reconnaissance survey, which is designed to identify known archaeological sites and areas that are sensitive for the presence of archaeological sites within each Project's Area of Potential Effect (APE). The APE for each Project is depicted on maps in Appendix 1. We have recently begun the research component of the Phase IA reconnaissance survey by conducting document searches at the State Historic Preservation Offices in Vermont, Massachusetts, and New Hampshire. We will be continuing document research for the next several months as well as initiating a walkover and boat survey of the APE when ground and water conditions permit. The Phase IA field survey will not include any subsurface testing or artifact collection. We are writing to ascertain whether, and in what capacity, the Narragansett Indian Tribe would like to participate in the Phase IA reconnaissance survey.

In addition, in accordance with your request, we sent you and the Nolumbeka Project a letter dated January 31, 2014 in which we requested a meeting with you in order to discuss initiation of the Traditional Cultural Properties study and to introduce you to our proposed ethnographer for the Traditional Cultural Properties study. We look forward to hearing from you to discuss initiation of the Traditional Cultural Properties study with suggested dates and times when we could meet.

Sincerely,

John Howard

cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

March 31, 2014

Joe Graveline
Nolumbeka Project
88 Columbus Avenue
Greenfield, MA 01301

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485) – Initiation of Phase IA Archaeological Survey

Dear Joe:

FirstLight Hydro Generating Company (FirstLight) will be conducting archaeological investigations in connection with the Federal Energy Regulatory Commission's (the Commission's) relicensing of FirstLight's Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Projects on the Connecticut River in Franklin County, Massachusetts, Cheshire County, New Hampshire, and Windham County, Vermont (Appendix 1). The archaeological studies will assist the Commission in meeting its obligation under section 106 of the National Historic Preservation Act (NHPA), as amended, to consider the effect of relicensing the Projects on historic properties. The archaeological studies will identify known archaeological resources listed in, or eligible for listing in, the National Register of Historic Places (NRHP), and identify and assess any potential effects to these resources from continued operation and maintenance of the Projects.

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In addition, as requested by Doug Harris of the Narragansett Indian Tribe (Tribe) , we sent you and the Tribe a letter dated January 31, 2014 in which we requested a meeting with you in order to discuss initiation of the Traditional Cultural Properties study and to introduce you to our proposed ethnographer for the Traditional Cultural Properties study. We look forward to hearing from you to discuss initiation of the Traditional Cultural Properties study with suggested dates and times when we could meet.

Sincerely,

John Howard

cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

FirstLight Power Resources
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Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

April 15, 2014

Doug Harris
Narragansett Indian Tribal Historic Preservation Office
Narragansett Indian Tribe
Narragansett Indian Longhouse
4425-A South County Trail
Charlestown, RI 02813

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485)

Dear Doug:

By letter dated March 31, FirstLight notified you of the initiation of Phase IA archaeological surveys being conducted in connection with the Federal Energy Regulatory Commission (the Commission's) relicensing of FirstLight's Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Projects on the Connecticut River in Franklin County, Massachusetts, Cheshire County, New Hampshire, and Windham County, Vermont. We attached maps depicting each Project's proposed Area of Potential Effect (APE), which had been included as figures in Study No. 3.7.1 of FirstLight's Revised Study Plan, dated August 14, 2013. We are sending this letter to provide maps depicting the final APE for each Project. See Figure Nos. 3.7.2-1 through 3.7.2-6.

If you would like to discuss the Phase IA archaeological survey or the Traditional Cultural Properties study, please do not hesitate to contact me.

Sincerely,

John Howard

Cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

Encl.

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
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Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

April 15, 2014

Joe Graveline
Nolumbeka Project
88 Columbus Avenue
Greenfield, MA 01301

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485)

Dear Joe :

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If you would like to discuss the Phase IA archaeological survey or the Traditional Cultural Properties study, please do not hesitate to contact me.

Sincerely,

John Howard

Cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

TRC

4425 Forbes Boulevard
Lanham, Maryland 20706

Main 301-306-6981
Fax 301-306-6986

April 25, 2014

Ms. Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, MA 02125

RE: ***Revised State Archaeologist's Permit Application for Turners Falls Hydroelectric (FERC No. 1889) and Northfield Mountain Pumped Storage (FERC No. 2485) Projects in Franklin County, Massachusetts***

Dear Ms. Simon,

Thank you for your comment letter of February 24, 2014 regarding TRC Environmental Corporation's (TRC) State Archaeologist's permit application for the Firstlight Hydro Generating Company (FirstLight) Turners Falls and Northfield Mountain Hydroelectric Relicensing Projects. As per your comments, TRC is pleased to submit this revised permit application, supporting research design, and professional qualifications for a Reconnaissance Survey of the Relicensing Projects.

As demonstrated in our prior submittal, the proposed Research Team is composed of key individuals with considerable experience in the archaeology of the Northeast. Key elements of the revised research design for this permit include:

- Detailed discussion of proposed field and archival research and expected results;
- Application of previous Connecticut River Valley research to the proposed study methods;
- Identification of societies, repositories, commissions, and tribes to be consulted during research;
- Corrections to applicable state regulations for the proposed study.

Pease note that the proposed field methodology is for a *non-collection survey*. As such, in accordance with your February 24, 2014 comment letter, this revised permit application does not present in its research design a methodology for artifact analysis or address artifact curation issues. These issues will be addressed in future permit application(s), as needed.

Please do not hesitate to contact me at (301) 276-8040, or tsara@trcsolutions.com should you have any questions or comments during your review of this application.

Sincerely yours,

Timothy R. Sara, RPA
Program Manager, Archaeology

cc: John Howard, FirstLight
Mark Wamser, GSE
Sarah Verville, TRC
Richard Will, TRC

TRC File: 184005.2014.0649

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

May 7, 2014

Timothy R. Sara
Principal Investigator
TRC Environmental Corporation
4425 Forbes Boulevard
Lanham, MD 20706

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. FERC No. 1889-081 and No. 2485-063.

Dear Mr. Sara:

Staff of the Massachusetts Historical Commission (MHC), the office of the State Historic Preservation Officer and the State Archaeologist, have reviewed the revised State Archaeologist's permit application for reconnaissance archaeological survey, received April 28, 2014, for the project referenced above.

Additional information is required regarding the revised research design and methodology. Please submit the following additional information:

The revised permit application indicates that the reconnaissance survey will not include collection of artifacts or samples. However, the proposed investigation will generate field notes and research records. A curatorial facility for the reconnaissance survey research records must be specified in the complete permit application (see 950 CMR 70.13(5)). Please submit a revised Appendix B that specifies the location of the proposed curatorial institution (item #4). If the Springfield Science Museum, which is a part of the Springfield Museums organization, is the proposed curatorial facility for the resulting documentation, then a draft curation agreement with the Springfield Science Museum, consistent with State Archaeologist's Custody Permit terms and conditions and 36 CFR 79, should be submitted for my review and approval.

Please describe the archival methods and materials proposed to be used for packaging research records. Please describe the proposed methods for curation of digital data at the curatorial facility that will preserve the integrity and readability of the digital data. Please propose to provide the MHC a copy of the transmittal documentation.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), the Secretary of the Interior's *Standards and Guidelines for Archeology & Historic Preservation* (48 Fed. Reg. 190 (1983)), and M.G.L. c. 9, ss. 26-27C (950 CMR 70). If you have questions or require additional information, please contact Jonathan K. Patton at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

June 9, 2014

Timothy R. Sara
Principal Investigator
TRC Environmental Corporation
4425 Forbes Boulevard
Lanham, MD 20706

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. **MHC # RC.1099**. FERC No. 1889-081 and No. 2485-063.

Dear Mr. Sara:

Staff of the Massachusetts Historical Commission (MHC), the office of the State Historic Preservation Officer and the State Archaeologist, have reviewed the revised State Archaeologist's permit application, including a draft curation agreement with the Springfield Science Museum, for reconnaissance archaeological survey, received June 5, 2014, for the project referenced above.

The draft curation agreement with the Springfield Science Museum is consistent with State Archaeologist's Custody Permit terms and conditions and 36 CFR 79. Please submit the finalized curation agreement for my signature.

Please find enclosed the State Archaeologist's permit for the investigation and I look forward to reviewing the results.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), the Secretary of the Interior's *Standards and Guidelines for Archeology & Historic Preservation* (48 Fed. Reg. 190 (1983)), and M.G.L. c. 9, ss. 26-27C (950 CMR 70). If you have questions or require additional information, please contact Jonathan K. Patton at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

Encl: SA permit

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

PERMIT TO CONDUCT ARCHAEOLOGICAL FIELD INVESTIGATION

Permit Number 3468   Date of Issue June 9, 2014
Expiration Date June 9, 2015

TRC is hereby authorized to conduct an archaeological field investigation pursuant to Section 27C of Chapter 9 of General Laws and according to the regulations outlined in 950 CMR 70.00.

Turners Falls Hydroelectric & Northfield Mountain Pumped Storage Projects, Northfield, Montague, Gill, Erving, & Greenfield

Project Location

Brona Simon

Brona Simon, State Archaeologist
Massachusetts Historical Commission

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.7.2

RECONNAISSANCE-LEVEL HISTORIC STRUCTURES SURVEY

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers   TRC

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

Between November 2013 and March 2014, TRC, on behalf of FirstLight, conducted background research and fieldwork as part of the historic architectural survey and National Register of Historic Places (NRHP) evaluation of all buildings, structures, objects, sites, and districts 50 years or older within the Projects' Area of Potential Effects (APE). The survey's objective is to provide information about previous NRHP evaluations of historic architectural resources within the Project boundaries, as well as recommendations regarding the NRHP eligibility of surveyed resources that have not been evaluated previously. The 2013-2014 historic architectural survey consisted of background research on previously identified architectural resources in the APE; preparation of a historic context of the APE from the colonial period to the present; a survey of all architectural resources 50 years or older within the APE; and evaluation of their NRHP eligibility, either as an individual resource or as a contributing resource in an NRHP-listed or -eligible historic district. Between March and August 2014, TRC has entered the collected information onto the respective state's architectural inventory forms and formulated justifications for NRHP eligibility for the surveyed resources. A report of survey findings is in progress at this time.

The historic architectural survey and evaluation has been carried out by qualified architectural historians and industrial historians who meet the Secretary of the Interior's Professional Qualification Standards (36 C.F.R. § 61). In addition, the survey has followed all applicable federal and state guidelines, including those contained in National Register Bulletin 24, Guidelines for Local Surveys: A Basis for Preservation Planning (National Park Service 1978, rev. 1985); the Massachusetts Historical Commission's (MHC) Historic Properties Survey Manual (1995); and the New Hampshire Division of Historical Resources (NHDHR) Area and Individual Form Manuals (2013). The Vermont Division of Historic Preservation (VDHP) and NHDHR do not currently have state-specific survey guidelines.

Consultation Record (Appendix A)

On November 27, 2013, FERC defined the APE for the Projects in accordance with Section 106 of the National Historic Preservation Act (NHPA) and in consultation with the three State Historic Preservation Offices (SHPOs) for the states included within the Project boundaries: MHC, NHDHR, and VDHP, along with the Narragansett Indian Tribe, and the Nolumbeka Project. Consultation with each SHPO has been both by letter and in person, as follows:

June 21, 2013: MHC commented on submitted Project Notification Form (PNF)

July 15, 2013: VDHP comment letter on revised proposed study plan.

August 26, 2013: MHC comment letters on revised proposed study plan.

November 18, 2013: TRC Architectural Historians Geoffrey Henry and Ellen Rankin met with MHC reviewer Jonathan Patton to discuss the APE for historic structures, survey methodology, and reporting standards.

November 20, 2013: Mr. Henry and Ms. Rankin met with VDHP architectural historian Jamie Duggan and archeologist Scott Dillon to discuss the APE for historic structures, survey methodology, and reporting standards.

November 21, 2013: Mr. Henry and Ms. Rankin met with Edna Feighner and Nadine Peterson from NHDHR to discuss the APE for historic structures, survey methodology, and reporting standards. On December 5, 2013, FirstLight sent a letter to NHDHR enclosing a memorandum of the November 21, 2013 meeting.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

By letters dated December 19, 2013 and January 9, 2014 respectively, the MA and VT SHPOs issued written concurrence with the FERC-defined APE.

1.2 Study Progress Summary

Task 1: Review of Existing Information

Research has been conducted to date at the separate MHC, VDHP, and NHDHR archives. TRC searched for, and made copies of, survey forms for all previously surveyed resources, National Register nomination forms and determinations of eligibility. Research on local history as well as site-specific research has been conducted at public libraries in Greenfield, Turners Falls, Erving, Northfield (MA), Vernon and Brattleboro (VT), and Hinsdale (NH), at the Montague, Gill, and Northfield (MA) Town Offices, and the Great Falls Discovery Center in Turners Falls.

The initial phase of the survey included a background review of the 31 previously identified resources within the APE. The Turners Falls Historic District, consisting of historic industrial, residential, and commercial buildings in Turners Falls, was listed in the NRHP in 1983 and contains 13 contributing resources located within the Projects' APE. Six historic resources in the APE—Cabot Power Station and Dam; Eleventh Street Bridge; East Mineral Road Bridge; Gill-Montague Bridge; French King Bridge; and Schell Memorial Bridge—previously have been determined eligible for the NRHP by the MHC. Three previously surveyed resources—Central Vermont Railroad Bridge over the Connecticut River (MA); Boston & Maine Railroad-Fort Hill Branch Bridge over Ashuelot River (NH); and Boston & Maine Railroad-Fort Hill Branch Bridge Piers over the Connecticut River (NH)—have been determined not eligible for NRHP listing. Eight previously surveyed resources have not been evaluated for NRHP eligibility.

TRC also has conducted background research on the history and development of the Projects' APE and its surroundings for the preparation of an historic context spanning the colonial period to the present. Published histories and previous architectural and historical studies of individual towns and villages in Franklin County, MA, Windham County, VT, and Cheshire County, NH were consulted, as were historic maps and atlases of the three counties. FirstLight archivists have scanned historic photographs and building and engineering records of FirstLight-owned facilities including the Turners Falls Dam, Power Canal, Gatehouse, and Cabot Station. FirstLight staff and other individuals knowledgeable about local history and the history of the area's hydroelectric facilities have been interviewed. The historic context has identified the themes of recreation, transportation (including canals and railroads), and hydroelectric power as important themes in the history and development of the Projects' APE.

Pending review of the final report on survey findings by the respective SHPOs and FERC (with possible requests for further information), it is not anticipated that additional research and file review will be necessary.

Task 2: Fieldwork

In November 2013, TRC conducted a windshield survey to confirm the results of the background research and determine the presence of additional historic architectural resources within the project area. In March 2014, TRC conducted a comprehensive field survey consisting of a systematic walkover of the lands within the Projects' APE. The survey team of architectural historians visited each of the previously identified resources and documented through field notes and descriptions any other resource that appeared to be 50 years or older. Information about the current appearance, including the setting, physical condition, and character-defining architectural features of the resources and any secondary buildings were recorded on the appropriate state architectural inventory forms. High-resolution digital photographs of multiple views were taken of each resource including general context views that show the resource in relation to one another and their surroundings. TRC mapped the locations of the previously and newly surveyed resources on the relevant United States Geological Survey (USGS) quadrangle maps.

Pending review of the final report on survey findings by the respective SHPOs and FERC (with possible requests for further information and/or photographs), it is not anticipated that additional fieldwork will be necessary.

Task 3: Desktop Analysis

Upon completion of the field investigations, TRC analyzed all collected data and prepared an historic context that identifies the significant themes, events, and/or people that had an impact on the historical development of the area and its built resources. TRC determined the areas, period(s), and level(s) of significance for each surveyed resource and applied the NRHP criteria for evaluation.

Information collected during the research and fieldwork tasks has been entered into the applicable state architectural inventory form. For each state, the inventory form is the primary means for documenting a historic resource. Massachusetts uses the MHC standard inventory forms (Forms A through H) developed for eight categories of historic resources. Vermont has a standard inventory form for historic structures. Both of these states use these forms as well as an accompanying survey report to evaluate projects. In New Hampshire, there are two forms used for Section 106 Projects, primarily the Project Area Form, and this is used to record and evaluate historical resources, rather than an accompanying report.

Pending review of the final report on survey findings by the respective SHPOs and FERC (with possible requests for further information), it is not anticipated that additional data entry will be necessary.

Task 4: Report Development

A report on the findings of the 2013-2014 architectural survey is in progress at this time. The report will include resources in all three states and will consist of the following sections: Project Description and Location; Definition of the APE; Survey Methodology; Historic Context; and NRHP Status and Evaluation of Previously and Newly Surveyed Resources. The final report will be transmitted to the MHC and VDHR for review and concurrence with NRHP evaluations. The NHDHR will only review the Project Area Form and will provide comments on recommendations (if any) for further survey work in New Hampshire. It is anticipated that the final report (and in the case of New Hampshire, the Project Area Form) will be submitted to FERC and the respective SHPOs in the 4th quarter of 2014.

1.3 Variances from Study Plan and Schedule

There were no variations from the FERC-approved study plan.

1.4 Remaining Activities

Remaining activities include preparation of final report, submittal of state survey forms to SHPOs for review and submittal of final report and survey forms to SHPOs and FERC for determinations of NRHP eligibility.

Appendix A
SHPO Correspondence and Comments

20130701-0015 FERC PDF (Unofficial) 07/01/2013
Document Accession #: 20140916-5028 Filed Date: 09/16/2014

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FEDERAL ENERGY REGULATORY COMMISSION

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

June 21, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First St NE Room 1A
Washington, DC 20426

Attn: Frank Winchell, Hydro Power

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. **FERC No. 1889-081 and No. 2485-063.**

Dear Ms. Bose:

Staff of the Massachusetts Historical Commission (MHC), office of the Massachusetts State Historic Preservation Officer have reviewed the Project Notification Form (PNF), received by the MHC on June 3, 2013, and the MHC's files, for the project referenced above.

The MHC, as the office of the Massachusetts State Historic Preservation Officer, is reviewing and commenting on the project pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), to assist and advise the Federal Energy Regulatory Commission (FERC) in fulfilling its responsibilities.

The USGS maps provided in the PNF outline a proposed project area of potential effect. As project planning is refined, the MHC looks forward to reviewing additional information, including scaled existing and proposed conditions project plans, for any proposed new construction, demolition, rehabilitation or other activities, at the existing facilities, if any, that may cause effects to significant historic and archaeological resources. Please provide the MHC with the FERC's determination of the area of potential effect (36 CFR 800.4(a)(1)).

The PNF indicates that Firstlight has retained the TRC Companies as its cultural resources consultant. Project information should be provided to TRC to assist in its evaluation efforts for proposed impacts to significant historic and archaeological resources during the proposed cultural resource survey. TRC will apply for a State Archaeologist's Field Investigation Permit (950 CMR 70) to conduct the previously requested archaeological reconnaissance survey. The archaeological survey Research Team should include individuals with previous relevant experience in ancient and historical period archaeology of the glaciated Northeast and in the Connecticut River Valley region of New England (see 950 CMR 70.10). The MHC's review and comment on the proposed research design and methodology will assist FERC in developing the scope of the identification efforts (36 CFR 800.4(a)).

The MHC looks forward to reviewing the scope of the proposed identification and evaluation efforts proposed as part of the Firstlight Study Plans, including the State Archaeologist's permit application and archaeological research design and methodology, and the proposed scope for the historic properties identification effort, the research design and methodology, and CVs of the qualified professional historic preservation consultants on the research team. The archaeological research design and methodology should include a description of TRC's facilities, equipment, staffing, and other resources necessary to undertake archaeological research, fieldwork, laboratory processing, analysis, and reporting to carry projects to completion in accordance with the Standards for Field Investigation (950 CMR 70.13). An adequate curatorial facility for the archaeological materials and records of the investigation should be located prior to submitting the permit application, with preference for curation within Massachusetts for the Massachusetts survey area.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800). Please contact Jonathan K. Patton at this office if you have any questions at this time.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: John Howard, Director FERC Hydro Compliance, Firstlight Power Resources GDF Suez
Charles Momney, Firstlight GDF Suez
Lana Khitrik, Gomez and Sullivan Engineers, P.C.
Mickey Marcus, New England Environmental, Inc.
Representative Stephen Kulik, Attn: Paul Dunphy
Karen Kirk Adams, USACOE-NED, Regulatory
Kate Atwood, USACOE-NED
Marc Paiva, USACO-NED
Cheryl White, Stockbridge-Munsee Tribal Historic Preservation Officer
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Ramona Peters, Mashpee Wampanoag Tribe
John Eddins, ACHP
Giovanna Peebles, VT SHPO
Elizabeth Muzzey, NH SHPO
Bill Lellis, Acting Chief, Conte Anadromous Fish Laboratory
John Wilson, USFW
Local Historical Commissions: Towns of Northfield, Gill, Greenfield, Montague, and Erving

20130716-5071 FERC PDF (Unofficial) 7/15/2013 9:16:18 PM
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VERMONT

State of Vermont
Division for Historic Preservation
One National Life Drive, Floor 6
Montpelier, VT 05620-0501
www.HistoricVermont.org

[phone] 802-828-3211
[division fax] 802-828-3206

Agency of Commerce and Community Development

July 15, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Re: VT SHPO Comments on the June 28, 2013 Updated Proposed Study Plan for the Turners Falls (FERC No. 1889) and Northfield Mountain Pumped Storage (FERC No. 2485) Projects, First Light Power Resources.

Dear Secretary Bose:

Thank you for the opportunity to comment on the above referenced project.

The Vermont Division for Historic Preservation (Division) is providing the Federal Energy Regulatory Commission (FERC) with the following comments pursuant to 36 CFR 800.4, regulations established by the Advisory Council on Historic Preservation to implement Section 106 of the National Historic Preservation Act. Project review consists of assisting FERC in identifying the project's potential impacts to historic buildings, structures, historic districts, historic landscapes and settings, and known or potential archeological resources that are listed in or may be eligible for inclusion in the National Register of Historic Places (National Register).

As currently defined, the Cultural Resources Study Plan (Section 3.7) presented by First Light is limited to a Phase IA Archaeological Survey and a Reconnaissance Level Historic Resources Survey. While these study plan components represent necessary first steps in the cultural resource review process, they are first steps only and will by no means provide all the data necessary to identify and evaluate the full suite of cultural resources present in the Project area.

By definition, the Phase IA study will only provide background information on known archeological resources and a preliminary assessment of the potential location of additional archeological resources within the project area. Similarly, the Reconnaissance Level Historic Resource Survey will identify and compile information on known historic structures but not evaluate the structures to determine their eligibility to the National Register or assess the project's effect on National Register eligible or listed structures.

The Division would also like to clarify that our statements during the June 14, 2013 Study Plan conference call concerning an APE determination of 10 meters (33 feet) from the top of bank along the Project boundary were made in reference to a discussion of Phase IB site identification and Phase II site evaluation study efforts. In general terms, a Phase IA study usually includes a larger zone of review in order to identify the broadest spectrum of cultural resources that may be affected by any project.

The current Phase IA study plan includes provisions for further consultation with the relevant SHPOs, the Narrangansett THPO, and any other interested Native American tribes with regard to APE definition, the development of a archeological sensitivity model, and an archeological field reconnaissance methodology. The Division looks forward to this consultation and recommends that a specific consultation schedule be provided in the Revised Study Plan. In addition, the Revised Study Plan should also provide specific reference to the development and implementation of the following Cultural Resource Study Plan components that will be necessary subsequent to the completion of the Phase IA:

- A Phase IB site identification survey within all archeologically sensitive areas and potential site locations within the APE that are actively eroding. This study should include strategies to implement deep testing methods for identification of deeply buried cultural components.

- Phase II site evaluation of any archeological site identified in the Project APE as a result of the Phase IB survey or any known site that is located within a portion of the APE that is actively eroding to determine their boundaries and eligibility for inclusion on the National Register of Historic Places.

- A phased plan to complete Phase II site evaluation of any remaining currently recorded archeological sites in the Project APE to determine their boundaries and eligibility for inclusion on the National Register of Historic Places.

- Identification of Traditional Cultural Properties.

- Historic Structures Assessment and Evaluation Report

The above studies will provide the basis for the development of a project specific Historic Properties Management as well inform on the development of Mitigation Plans and Programmatic Agreements to address any adverse effects to historic properties. Completion of these actions will ensure that this Projects relicensing fully considers potential impacts to historic properties in compliance with the National Historic Preservation Act.

Sincerely:
VERMONT DIVISION FOR HISTORIC PRESERVATION

~~Noelle~~ MacKay
Acting State Historic Preservation Officer

Document Accession #: 20140916-5028 Filed Date: 09/16/2014

ORIGINAL

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

FILED
OFFICE OF THE SECRETARY
2013 SEP -3 A 9: 34
FEDERAL ENERGY REGULATORY COMMISSION

August 26, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First St NE Room 1A
Washington, DC 20426

Attn: Frank Winchell, Hydro Power

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. **FERC No. 1889-081 and No. 2485-063.**

Dear Ms. Bose:

Staff of the Massachusetts Historical Commission (MHC), office of the Massachusetts State Historic Preservation Officer have reviewed the revised Proposed Study Plan dated August 14, 2013, received by the MHC on August 19, 2013, for the project referenced above.

Section 3.7 of the revised plan incorporates information included in the MHC's April 24 and June 21, 2013 comments. The results of the 2013 Full River Reconnaissance survey (Study No. 3.1.1; pp. 3-402 and 3-403) and an archaeological sensitivity assessment for the Fuller Farm property within the Northfield Mountain portion of the project area will be incorporated into the proposed archaeological reconnaissance technical report.

Scopes for the proposed identification and evaluation efforts proposed as part of the revised Proposed Study Plan, including the State Archaeologist's permit application and archaeological research design and methodology, and the proposed scope for the historic properties identification effort, the research design and methodology, and CVs of the qualified professional historic preservation consultants on the research team, should be submitted to the MHC for review and comment as they are developed.

The project area of potential effect for archaeological and historic resources is shown in figures 3.7.1-1 through 3.7.1-6 and 3.7.2-1 through 3.7.2-5. The project area of potential effect shown in these figures is adequate for preliminary identification efforts, although as project planning is refined, the MHC looks forward to reviewing additional information, including scaled existing and proposed conditions project plans, for any proposed new construction, demolition, rehabilitation or other activities, at the existing facilities, if any, that may cause effects to significant historic and archaeological resources. The MHC notes that Firstlight proposes to conduct a teleconference in October 2013 to discuss further refinements to the project area of potential effect. The MHC looks forward to further consultation with FERC on FERC's determination of the area of potential effect (36 CFR 800.4(a)(1)).

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

The paper copy of the document received by the MHC includes only Appendices A and B. Copies of MHC comments on previous submittals for the project are not included in these appendices, although they may be included in Appendix H, Stakeholder Comments on Updated PSP. Appendix H was not included in the submittal to the MHC. To assist in future review of the project and consultation with FERC, the MHC would appreciate the incorporation of a separate cultural resources comments matrix into future project filings. The cultural resources comments matrix should include a list and summaries of all comment letters received to date from State Historic Preservation offices (MA, NH, VT), Tribal Historic Preservation Offices, local historical commissions and interested groups/individuals for potential project effects to cultural resources.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800). Please contact Jonathan K. Patton at this office if you have any questions at this time.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: John Howard, Director FERC Hydro Compliance, Firstlight Power Resources GDF Suez
Charles Momney, Firstlight GDF Suez
Lana Khitrik, Gomez and Sullivan Engineers, P.C.
Mickey Marcus, New England Environmental, Inc.
Representative Stephen Kulik, Attn: Paul Dunphy
Karen Kirk Adams, USACOE-NED, Regulatory
Kate Atwood, USACOE-NED
Marc Paiva, USACO-NED
Cheryl White, Stockbridge-Munsee Tribal Historic Preservation Officer
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Ramona Peters, Mashpee Wampanoag Tribe
Doug Harris, NITHPO
John Eddins, ACHP
Giovanna Peebles, VT SHPO
Elizabeth Muzzey, NH SHPO
Victor Mastone, MBUAR
Bill Lellis, Acting Chief, Conte Anadromous Fish Laboratory
John Wilson, USFW
Local Historical Commissions: Towns of Northfield, Gill, Greenfield, Montague, and Erving

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

August 26, 2013

Lana Khitrik
Gomez and Sullivan Engineers, P.C.
1961 Wehrle Drive
Williamsville, NY 14221-5776

RE: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric Project And Northfield Mountain Pumped Storage Project, Franklin County, MA. MHC # RC.1099. **FERC No. 1889-081 and No. 2485-063.**

Dear Ms. Khitrik:

Staff of the Massachusetts Historical Commission (MHC), office of the Massachusetts State Historic Preservation Officer, have reviewed the revised Proposed Study Plan dated August 14, 2013, received by the MHC on August 19, 2013, for the project referenced above.

Three paper copies of the updated study plan, including only Appendices A and B, were received by the MHC. The MHC requires only one paper copy of complete project documents for review and comment.

For future project submittals, please submit one (1) paper copy of project documents, including all appendices, to this office. The submittal cover letter should reference MHC # RC.1099.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800). Please contact Jonathan K. Patton at this office if you have any questions at this time.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: Kimberly D. Bose, Federal Energy Regulatory Commission, Attn: Frank Winchell, Hydro Power
John Howard, Director FERC Hydro Compliance, Firstlight Power Resources GDF Suez
Charles Momney, Firstlight GDF Suez
Mickey Marcus, New England Environmental, Inc

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

FirstLight Power Resources
GDF SUEZ

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

December 5, 2013

Nadine Peterson
New Hampshire Division of Historical Resources
State Historic Preservation Office
19 Pillsbury Street
Concord, NH 03301-3570

VIA CERTIFIED MAIL

Re: FirstLight Hydro Generating Company, Turners Falls Hydroelectric Project (FERC Project No. 1889) and Northfield Mountain Pumped Storage Project (FERC Project No. 2485)

Dear Ms. Peterson:

On November 21, 2013, Geoffrey Henry and Ellen Rankin from TRC met with you and Edna Feighner to discuss the Area of Potential Effect (APE) for surveying historic structures, survey methodology, and reporting format in connection with the proposed relicensing of FirstLight Hydro Generation Company's (FirstLight) Turners Falls Hydroelectric Project and Northfield Mountain Pumped Storage Project. Your office asked that TRC submit a memorandum of the meeting for your review and concurrence. Accordingly, TRC has prepared the attached memorandum of the discussions of the meeting for your review and concurrence. FirstLight would appreciate obtaining your concurrence or suggested changes to the memorandum by January 6, 2014 by responding to Geoffrey Henry of TRC ghenry@trcsolutions.com.

One of the topics discussed was the status of a letter from the Federal Energy Regulatory Commission (FERC) requesting your concurrence with the proposed APE for historic structures. We note that FERC issued its letter requesting concurrence on November 27, 2013. I have attached a copy for your convenience in the event you haven't received it.

If you have any questions regarding the meeting memorandum, please contact me at the above address or Geoffrey Henry at ghenry@trcsolutions.com.

Please feel free to contact me if you have any questions.

Sincerely,

John Howard
Director FERC Hydro Compliance

cc: Edna Feighner

Enclosure

MEETING MEMO

MEETING WITH NEW HAMPSHIRE SHPO TO DISCUSS FIRSTLIGHT TURNERS FALLS/NORTHFIELD MOUNTAIN PROJECTS

ATTENDEES: Edna Feighner and Nadine Peterson, New Hampshire SHPO and Geoffrey Henry and Ellen Rankin, TRC Environmental

PLACE/DATE/TIME: New Hampshire SHPO, Concord, NH, November 21, 2013, 1:00 PM

---

1. Meeting was requested by TRC to discuss the FirstLight Turners Falls/Northfield Mountain APE for historic structures, survey methodology, and reporting format.
2. NH SHPO stated that they are awaiting the letter from FERC to confirm the APEs for the Projects.
3. TRC presented summary of windshield survey conducted 11/20/2013 within NH portion of the Project boundaries:
   a. Bridge piers, abutments, roadbed, and trestles of abandoned Boston & Maine Railroad line over the Connecticut River and through Town of Hinsdale.
   b. Bridge carrying Route 63 over Ashuelot River at Hinsdale.
   c. Gaging station just east of Route 63 bridge (south bank) at Hinsdale.
   d. Concrete culvert just west of Route 63 bridge (north bank) at Hinsdale.
4. TRC stated that FERC may request one report for all three (MA, VT and NH) SHPOs with one historic context but separate chapters for the NRHP evaluations for each state, with survey forms for each state attached as appendices. NHSHPO stated that they do not accept conventional survey reports as required by other SHPOs. Instead, they request all information be submitted on the NH SHPO "Project Area Form" found at http://www.nh.gov/nhdhr/programs/survey.htm. The Project Area Form is intended to minimize unnecessary survey work not consistent with the Project purpose and anticipated effects.
5. The Project Area Form should include a description of the project, geographic context, discussion of the 50+ year old resources in the APE, and an historic context relevant both to the survey area and the architectural resources identified. The historic context should utilize existing historic contexts (Ms. Peterson identified an existing NH railroad context), as well as Area Forms already completed for Hinsdale. The Project Area Form should conclude with recommendations on the need for further, more intensive survey to determine NRHP eligibility. The Project Area Form is submitted to NH SHPO for review by their DOE committee which meets twice-monthly.
6. Ms. Peterson stated that the anticipated project effects may determine TRC's recommendations for further survey efforts. For a re-licensing where there are no other anticipated actions (demolitions, construction, etc.), the Project Area Form may recommend no further survey work is warranted at this time. Ms. Peterson cautioned that the report should not use terms "effect" or "no effect" in accordance with Section 106 but rather "impacts" or "no anticipated consequences," as discussions of effects before NRHP determinations have been made are premature.

7. If normal project operations and variance in river flow may affect the B&M bridge piers/abutments in the CT River , then a recommendation should be made for intensive survey work for this resource. A Project Area Form for the Fort Hill Division of the B&M near Hinsdale was submitted to NH SHPO in 1994. Ms. Peterson stated that a new Project Area Form should be submitted updating the results of the 1994 survey.
8. Ms. Peterson stated that the Project Area Form is a planning document that may serve as the basis for NRHP decisions should there be future construction/demolition activities within the Project area that have the potential to affect historic resources.
9. NH SHPO requested TRC prepare a meeting memo and submit to them for review and concurrence for their project files.

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.7.3

TRADITIONAL CULTURAL PROPERTIES STUDY

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers   TRC

SEPTEMBER 2014

1.1 Study Summary and Consultation Record to Date

The objective of this study is to document any known Traditional Cultural Properties (TCPs) listed in, or eligible for, listing in the National Register of Historic Places (NRHP) within the Projects' Area of Potential Effect (APE) and to document and assess any potential effects to such properties from the continuing operation and maintenance of the Projects. As contemplated by National Register Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties (Parker & King 1990), TCPs are already known to the community as they are important in maintaining the continuing cultural continuity of the living community. Thus, the purpose of the TCP study is to record existing properties that possess a shared recognition and use by members of the living community for potential listing to the NRHP. A major component of the TCP study includes collection of information, through a series of interviews, from the Narragansett Indian Tribe (NIT) and other interested cultural /stakeholders such as the Nolumbeka Project, on properties that are rooted in the tribe's history and are important in maintaining the continuing cultural identity of the tribal community. The FERC-approved study plan provides that FirstLight shall consult with the NIT on the selection of the ethnographer, who will collect information from the NIT.

On January 20, 2014, FirstLight contacted the Tribal Historic Preservation Officer (THPO) for the NIT by telephone to request a meeting with the NIT and the Nolumbeka Project. All letters from FirstLight to the NIT and Nolumbeka Project were sent certified mail, return receipt requested. The NIT requested that FirstLight make its request for a meeting in writing. Accordingly, on January 31, 2014, FirstLight submitted a written request (see Appendix A) to the NIT and the Nolumbeka Project requesting a meeting. On March 31, 2014, FirstLight sent a letter (Appendix A) to the NIT and the Nolumbeka Project to ascertain whether, and in what capacity, the NIT and the Nolumbeka Project would like to participate in the Phase IA archeological reconnaissance survey. FirstLight also noted that it looked forward to hearing from the NIT and the Nolumbeka Project with suggested dates and times for a meeting to introduce FirstLight's proposed ethnographer for the TCP.

On April 15, 2014, FirstLight sent a letter (Appendix A) to the NIT and the Nolumbeka Project in which FirstLight enclosed figures representing the final APE for the Projects. FirstLight requested the NIT and the Nolumbeka Project to contact FirstLight if either entity wanted to discuss the Phase IA archaeological survey or the TCP study.

In response to correspondence from FERC and the Nolumbeka Project's letter (Appendix A) to FirstLight dated April 15, 2014, on April 24, 2014, FirstLight sent a letter (Appendix A) to the NIT and the Nolumbeka Project (hard copy and by e-mail) indicating its willingness to discuss compensating Tribal members for their time and expenses in participating in the TCP study.

On July 14, 2014, FirstLight's proposed ethnographer contacted the NIT by telephone to introduce himself to the NIT Deputy THPO. The ethnographer and the THPO had two telephone conversations on that day. The NIT Deputy THPO reiterated its earlier requests that FirstLight provide funding for the NIT to conduct its own archaeological study and for funds to build a database. The telephone conversations concluded with the NIT Deputy THPO agreeing to meet with FirstLight and the Nolumbeka Project at FirstLight's office (per the request of the Deputy THPO). On August 11, 2014, FirstLight's ethnographer reached the NIT Deputy THPO by telephone to discuss possible dates for a meeting. The NIT Deputy THPO stated that he was speaking with someone else and would call the ethnographer back. To date, the NIT has not called back.

1.2 Study Progress Summary

Task 1: Meeting with the Massachusetts, Vermont, and New Hampshire SHPOs, the Narragansett THPO, and the Nolumbeka Project

The objective of this task was to consult with the Massachusetts, Vermont, and New Hampshire SHPOs, the NIT THPO, and the Nolumbeka Project with respect to development of the precise APE for the Projects. In accordance with the FERC-approved Study Plan, on October 31, 2013, a telephone conference was held among FirstLight, FERC, the Vermont and New Hampshire SHPOs, the Nolumbeka Project, and the Connecticut River Watershed Council (CWRC) to discuss finalization of the APE for the archaeological study.[1] On November 27, 2013, FERC sent a letter confirming that consultation had taken place with respect to the APE and seeking formal concurrence from the Massachusetts, Vermont, and New Hampshire SHPOs on the definition of the APE. The Massachusetts SHPO concurred with the definition of the APE by letter dated December 19, 2013. The Vermont SHPO concurred by letter dated January 9, 2014.

Task 2: Tribal Consultation and Documentation of TCPs

As set forth above, FirstLight has contacted the NIT on several occasions to introduce its ethnographer to the NIT and to discuss documentation of TCPs in accordance with the FERC-approved Study Plan. Documentation of TCPs has not occurred because the NIT has yet to respond to several requests for a meeting. Although FirstLight has offered to reimburse Tribal members for their labor and expenses incurred in participating in the TCP, the NIT's perspective is that FirstLight should provide funding to the Tribe so that the NIT can conduct its own parallel studies.

Task 3: Background Research

Background research was conducted at the three state SHPO offices and on the internet. There are no reported TCPs in the Projects' APE. There is one NIT TCP in the Project vicinity. Known as the Turners Falls Sacred Ceremonial Hill Site, which is located at the municipal airport in Turners Falls, Franklin County, Massachusetts, the site was listed in the NRHP in December 2008. The majority of information on additional TCPs, if any, would be gathered through interviews with NIT elders.

Task 4: Field Visit

This task involves a field visit among Tribal representatives, other stakeholders such as the Nolumbeka Project, and FirstLight to the potential TCPs within the Projects' APE. Because FirstLight has been unsuccessful in meeting with the NIT to document potential TCPs, no field visit has occurred.

Task 5: Report Development

FirstLight anticipates filing a final report documenting any further progress in implementing the FERC-approved Study Plan by the 1st quarter of 2015.

1.3 Variances from Study Plan and Schedule

The schedule for the FERC-approved Study Plan has not been met because it has not been possible to document TCPs with the NIT.

FirstLight anticipates filing a final report by the 1st quarter of 2015.

[1] The Massachusetts SHPO and the Narragansett Indian Tribe were also invited to participate in the telephone conference but did not attend.

1.4 Remaining Activities

Tasks 2 (Tribal Consultation and Documentation of TCPs) and 4 (Field Visit) will be conducted if the NIT participates in the FERC-approved TCP study. To date, NIT has not responded to FirstLight's requests to meet and commence TCP documentation.

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Appendix A
Correspondence Record

20140203-5080 FERC PDF (Unofficial) 2/3/2014 9:51:09 AM
Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

January 31, 2014

Doug Harris
Narragansett Indian Tribal Historic Preservation Office
Narragansett Indian Tribe
Narragansett Indian Longhouse
4425-A South County Trail
Charlestown, RI 02813

Joe Graveline
Nolumbeka Project
88 Columbus Avenue
Greenfield, MA 01301

Re: FirstLight's Traditional Cultural Properties Study Plan
Northfield Mountain Pumped Storage Project, FERC Project No. 2485
Turners Falls Hydroelectric Project, FERC Project No. 1889

Dear Doug and Joe,

I am following up on a telephone conference call I had with Doug on January 20, 2014 regarding FirstLight's initiation of the Traditional Cultural Properties Study Plan. As part of the Federal Energy Regulatory Commission's (FERC) relicensing process for the Northfield Mountain and Turners Falls Projects, this Plan was approved by the FERC in its Study Plan Determination Letter (SPDL) dated September 12, 2013. Both the Traditional Cultural Resources Study Plan and FERC's SPDL are available on our relicensing website at http://www.northfieldrelicensing.com. As further background, I have attached a copy of our August 14, 2013 letter to the Narragansett Indian Tribal Historic Preservation Office, in which we first discussed our proposal to conduct a Traditional Cultural Properties study.

As a first step in moving forward with the Traditional Cultural Properties study, we would like to consult with you regarding the selection of the ethnographer. We have selected Dr. Richard T. Will, who is an anthropologist with a specialization in archaeology, Native American consultation, and oral history. Dr. Will has worked with members of the Penobscot Indian Nation, Passamaquoddy Tribe, and several Indian Nations in western New York. For example in 2005, Dr. Will was the principal investigator for, and author of, *Voices of the People: Perspectives on Project Effects by the Tuscarora*. This oral history was conducted in connection with the FERC relicensing of New York Power Authority's Niagara Power Project. For background information on Dr. Will, I have attached his resume to this letter.

The purpose of this letter is to request a meeting to introduce you to Dr. Will. We would like to suggest an initial meeting sometime during the week of March 3, 2014. Can you suggest some dates and times during that week for an initial meeting? If the week of March 3 is inconvenient, we would appreciate it if you could suggest some alternative dates and times. We look forward to hearing from you. Thank you.

Sincerely,

John Howard

cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

Attachments:

- August 14, 2013 letter to the Narragansett Indian Tribal Historic Preservation Office
- Richard T Will Resume

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

March 31, 2014

Doug Harris
Narragansett Indian Tribal Historic Preservation Office
Narragansett Indian Tribe
Narragansett Indian Longhouse
4425-A South County Trail
Charlestown, RI 02813

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485) – Initiation of Phase IA Archaeological Survey

Dear Doug:

FirstLight Hydro Generating Company (FirstLight) will be conducting archaeological investigations in connection with the Federal Energy Regulatory Commission's (the Commission's) relicensing of FirstLight's Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Projects on the Connecticut River in Franklin County, Massachusetts, Cheshire County, New Hampshire, and Windham County, Vermont (Appendix 1). The archaeological studies will assist the Commission in meeting its obligation under section 106 of the National Historic Preservation Act (NHPA), as amended, to consider the effect of relicensing the Projects on historic properties. The archaeological studies will identify known archaeological resources listed in, or eligible for listing in, the National Register of Historic Places (NRHP), and identify and assess any potential effects to these resources from continued operation and maintenance of the Projects.

Initially, the archaeological studies will consist of a Phase IA reconnaissance survey, which is designed to identify known archaeological sites and areas that are sensitive for the presence of archaeological sites within each Project's Area of Potential Effect (APE). The APE for each Project is depicted on maps in Appendix 1. We have recently begun the research component of the Phase IA reconnaissance survey by conducting document searches at the State Historic Preservation Offices in Vermont, Massachusetts, and New Hampshire. We will be continuing document research for the next several months as well as initiating a walkover and boat survey of the APE when ground and water conditions permit. The Phase IA field survey will not include any subsurface testing or artifact collection. We are writing to ascertain whether, and in what capacity, the Narragansett Indian Tribe would like to participate in the Phase IA reconnaissance survey.

In addition, in accordance with your request, we sent you and the Nolumbeka Project a letter dated January 31, 2014 in which we requested a meeting with you in order to discuss initiation of the Traditional Cultural Properties study and to introduce you to our proposed ethnographer for the Traditional Cultural Properties study. We look forward to hearing from you to discuss initiation of the Traditional Cultural Properties study with suggested dates and times when we could meet.

Sincerely,

John Howard

cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

FirstLight Power Resources
GDF SUEZ

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

March 31, 2014

Joe Graveline
Nolumbeka Project
88 Columbus Avenue
Greenfield, MA 01301

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485) – Initiation of Phase IA Archaeological Survey

Dear Joe:

FirstLight Hydro Generating Company (FirstLight) will be conducting archaeological investigations in connection with the Federal Energy Regulatory Commission's (the Commission's) relicensing of FirstLight's Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Projects on the Connecticut River in Franklin County, Massachusetts, Cheshire County, New Hampshire, and Windham County, Vermont (Appendix 1). The archaeological studies will assist the Commission in meeting its obligation under section 106 of the National Historic Preservation Act (NHPA), as amended, to consider the effect of relicensing the Projects on historic properties. The archaeological studies will identify known archaeological resources listed in, or eligible for listing in, the National Register of Historic Places (NRHP), and identify and assess any potential effects to these resources from continued operation and maintenance of the Projects.

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In addition, as requested by Doug Harris of the Narragansett Indian Tribe (Tribe) , we sent you and the Tribe a letter dated January 31, 2014 in which we requested a meeting with you in order to discuss initiation of the Traditional Cultural Properties study and to introduce you to our proposed ethnographer for the Traditional Cultural Properties study. We look forward to hearing from you to discuss initiation of the Traditional Cultural Properties study with suggested dates and times when we could meet.

Sincerely,

John Howard

cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

April 15, 2014

Doug Harris
Narragansett Indian Tribal Historic Preservation Office
Narragansett Indian Tribe
Narragansett Indian Longhouse
4425-A South County Trail
Charlestown, RI 02813

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485)

Dear Doug:

By letter dated March 31, FirstLight notified you of the initiation of Phase IA archaeological surveys being conducted in connection with the Federal Energy Regulatory Commission (the Commission's) relicensing of FirstLight's Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Projects on the Connecticut River in Franklin County, Massachusetts, Cheshire County, New Hampshire, and Windham County, Vermont. We attached maps depicting each Project's proposed Area of Potential Effect (APE), which had been included as figures in Study No. 3.7.1 of FirstLight's Revised Study Plan, dated August 14, 2013. We are sending this letter to provide maps depicting the final APE for each Project. See Figure Nos. 3.7.2-1 through 3.7.2-6.

If you would like to discuss the Phase IA archaeological survey or the Traditional Cultural Properties study, please do not hesitate to contact me.

Sincerely,

John Howard

Cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

Encl.

FirstLight Power Resources
GDF SUEZ

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Email: john.howard@gdfsuezna.com

John S. Howard
Director FERC Hydro Compliance
Chief Dam Safety Engineer

Via Certified Mail

April 15, 2014

Joe Graveline
Nolumbeka Project
88 Columbus Avenue
Greenfield, MA 01301

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889 and 2485)

Dear Joe :

By letter dated March 31, FirstLight notified you of the initiation of Phase IA archaeological surveys being conducted in connection with the Federal Energy Regulatory Commission (the Commission's) relicensing of FirstLight's Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Projects on the Connecticut River in Franklin County, Massachusetts, Cheshire County, New Hampshire, and Windham County, Vermont. We attached maps depicting each Project's proposed Area of Potential Effect (APE), which had been included as figures in Study No. 3.7.1 of FirstLight's Revised Study Plan, dated August 14, 2013. We are sending this letter to provide maps depicting the final APE for each Project. See Figure Nos. 3.7.2-1 through 3.7.2-6.

If you would like to discuss the Phase IA archaeological survey or the Traditional Cultural Properties study, please do not hesitate to contact me.

Sincerely,

John Howard

Cc: Kimberly Bose, Secretary, FERC (filed electronically)
Massachusetts Historical Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada

20140428-0022 FERC PDF (Unofficial) 04/28/2014
Document Accession #: 20140916-5028 Filed Date: 09/16/2014

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COMMISSION

2014 APR 28 A 10:06

FEDERAL ENERGY
REGULATORY COMMISSION

The Nolumbeka Project Inc.
88 Columbus Avenue
Greenfield, MA 01301
Ph: (413) 657-6020
Fax: (413) 498-4318
Email: oldgraywolf@verizon.net

April 15, 2014
John Howard
Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360

Re: Federal Energy Regulatory Commission Relicensing of the Turners Falls Hydroelectric and Northfield Mountain Pumped Storage Project, (FERC Nos. 1889-081 and 2485-063) – Initiation of Phase 1A Archaeological Survey

Dear John:

We are responding to your letter dated March 31, 2014 concerning the Phase 1A reconnaissance Survey and your additional request to meet with you to discuss the initiation of the Traditional Cultural Properties study and to meet your proposed ethnographer.

The Nolumbeka Project would like to participate in the Phase 1A reconnaissance survey including, but not limited to, the walk over and boat assessment of the APE. In addition we would also request to review, in a timely manner, the documents produced by the related archaeological research from the Historic Preservation Offices in Vermont, Massachusetts, and New Hampshire as well as the archaeological reports amassed by the project proponents in their files. We are seeking to add a parallel set of eyes with our indigenous cultural perspective to the process as we have requested repeatedly through our written correspondences with FERC, FirstLight and TransCanada.

The Nolumbeka Project has a number of concerns regarding what appears to be FirstLight's choice to assign non-tribal entities to determine what providing "Adequate" coverage of Tribal cultural resources will look like. Also, we see the lack of funding to support a balanced tribal collaboration with the utilities in this licensing process as falling short of the spirit and intent of the 106 Federal processes.

In addition to setting up a time to meet with FirstLight to discuss the initiation of the Traditional Cultural Properties study and meet with your ethnographer, we feel there also needs to be a meeting to find a solution to the lack of funding to support our research and lack of access to the documents the tribes and the Nolumbeka Project need for a balanced and complete review of the research data. This research data will be used to set the standards for the next fifty years on indigenous cultural preservation on the river and the surrounding affected areas of potential impact.

The dates, timing and content of the requested meetings needs to be clearly agreed to by Doug Harris before we can enter into these conversations with FERC and FirstLight. We look forward to working with you to see this process through to a successful completion.

Sincerely,

Joe Graveline

Joe Graveline
President the Nolumbeka Project

cc: Kimberly Bose, Secretary, FERC
Massachusetts Historic Commission
New Hampshire Division of Historical Resources
Vermont Division for Historic Preservation
John Ragonese, TransCanada
Doug Harris NITHPO

20140424-5054 FERC PDF (Unofficial) 4/24/2014 10:14:26 AM
Document Accession #: 20140916-5028 Filed Date: 09/16/2014

FirstLight Power Resources
GDF SUEZ

Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Internet: john.howard@gdfsuezna.com

John S. Howard
Director- FERC Hydro Compliance
Chief Dam Safety Engineer

VIA CERTIFIED MAIL

April 24, 2014

Doug Harris
Narragansett Indian Tribal Historic Preservation Office
Narragansett Indian Tribe
Narragansett Indian Longhouse
4425-A South County Trail
Charlestown, RI 02813

Re: Traditional Cultural Properties Study
Northfield Mountain Pumped Storage Project, FERC Project No. 2485
Turners Falls Hydroelectric Project, FERC Project No. 1889

Dear Doug:

I am writing to follow up on my previous correspondence regarding FirstLight Hydro Generating Company's (FirstLight) Traditional Cultural Properties (TCP) Study, to be conducted as part of the Federal Energy Regulatory Commission's (FERC) relicensing process for FirstLight's Northfield Mountain Pumped Storage Project and Turners Falls Hydroelectric Project. In my August 14, 2013 letter, I indicated that in light of FirstLight's agreement to conduct the TCP Study in close consultation with the Narragansett Indian Tribe (Tribe), FirstLight felt that the extent of direct funding of tribal initiatives you proposed was unnecessary for purposes of the relicensing process. Subsequently, as a first step in moving forward with the TCP Study, I invited you, by letter dated January 31, 2014, to consult with FirstLight regarding the selection of the ethnographer for the TCP Study.

Although we have not yet heard from you, I understand, based on correspondence from FERC Staff and Joe Graveline's April 15, 2014 letter addressed to my attention, that funding concerns may be hampering the Tribe's ability to participate in the TCP Study. FERC Staff's April 11, 2014 letter indicates that while FERC cannot direct license applicants to fund or pay for tribal participation in the relicensing process, in some proceedings applicants have provided funding or assistance to tribes to carry out specific aspects of TCP investigations. FirstLight agrees with FERC Staff that the Tribe's participation in the TCP Study would be extremely beneficial. To that end, FirstLight is willing to discuss compensating tribal members for their time and expenses associated with participating in the TCP Study.

We therefore reiterate our request for a meeting to introduce you to our proposed enthographer and discuss compensation issues. We can also discuss the Tribe's interest in participating in FirstLight's ongoing Phase IA archaeological reconnaissance survey.

We look forward to hearing from you.

Sincerely,

John Howard
FERC- Director Hydro Compliance

cc: Kimberly D. Bose, Secretary, FERC (filed electronically)
Joe Graveline, President, Nolumbeka Project Inc. (via certified mail)

Document Accession #: 20140916-5028   Filed Date: 09/16/2014

Relicensing Study 3.8.1

EVALUATE THE IMPACT OF CURRENT AND POTENTIAL FUTURE MODES OF OPERATION ON FLOW, WATER ELEVATION AND HYDROPOWER GENERATION

Initial Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight™ GDF SUEZ

Prepared by:

Gomez and Sullivan Engineers

SEPTEMBER 2014

1.1 Study Summary

Study No. 3.8.1 *Evaluate the Impacts of Current and Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation* includes the development of an operations model of the Connecticut River from TransCanada's Wilder Dam to the Holyoke Gas and Electric's Holyoke Dam. The purpose for developing the operations model is to evaluate the impacts of alternative modes of operation on water elevations, flows and hydropower generation.

There has been no consultation with stakeholders required for this study since issuance of the Federal Energy Regulatory Commission's (FERC) Study Plan Determination Letter (SPDL).

1.2 Study Progress Summary

Task 1. Modify Model

FirstLight has modified the HEC-ResSim simulation model provided by the United States Corps of Engineers (USACOE) via The Nature Conservancy (TNC) to reflect the following:

- Converted the daily time step model to an hourly time step model. Currently the model's period of record extends from 1960-2003; however, the United States Geological Survey (USGS) via TNC has updated the hydrologic data to include the period 2004 to 2012. FirstLight has incorporated the inflows from tributaries between TransCanada's Wilder Dam down to Holyoke Dam. However, the inflow to Wilder Dam must be provided to FirstLight from the USACOE as it needs to run its HEC-ResSim model of the entire system and provide FirstLight with the regulated Wilder inflow data (FirstLight's model does not extend upstream beyond Wilder Dam).

- The model provided to FirstLight by the USACOE was also modified to better simulate
    - the Northfield Mountain Project pumping and generating cycles;
    - water level fluctuations observed in the Turners Falls Impoundment and Upper Reservoir; and
    - the timing and magnitude of fish ladder flows, attraction flows and bypass flows

Task 2. Calibration

The modified HEC-ResSim model was calibrated to annual generation at the FirstLight projects and three TransCanada projects (Wilder, Bellows Falls and Vernon) for the year 2000. This was a year in which no changes to the turbine electrical or hydraulic capacities occurred at the FirstLight and TransCanada Projects. Note that once the 2004-2012 hydrologic data is added to the HEC-ResSim model, the model may be verified with the most up-to-date station electrical and hydraulic capacities. Overall the annual energy calibration was within 10% of observed annual generation at the facilities.

The model was also calibrated to mean daily flows at two USGS gages on the Connecticut River including the North Walpole, NH gage (Gage No. 01154500) located above Bellows Falls Dam and the Montague, MA gage (Gage No. 01170500) located below Cabot Station and the Deerfield River.

Task 3. Establish Baseline Model

The calibrated model was subsequently updated to reflect today's equipment and operating conditions- this model is referred to as the baseline model. The baseline model serves as the point of comparison to alternative operating scenarios (termed "production runs"). All production runs will subsequently be compared to the baseline model results relative to water elevations, flows and generation.

Task 4. Production Runs

FirstLight has used the model internally to evaluate the impact on generation, impoundment elevations and flows from various modes of operation. For example, the model was used to simulate conditions under the Temporary Amendment FirstLight is seeking relative to using more of the Northfield Mountain Project Upper Reservoir. FirstLight will use the model in the future to simulate alternative operating conditions.

Task 5. Use of Model Output for other Uses

The HEC-ResSim model will be used to inform other studies such as the instream flow study. The instream flow study will develop habitat versus flow relationships for various species and life stages of fish. The habitat versus flow relationship can be married with the operations modeling hourly discharge data – such as below Cabot Station—to develop habitat versus time graphs.

Task 6. Report

A final report will be completed in the 1st quarter of 2017, after all field studies are completed so that various alternative operating scenarios can be evaluated.

1.3 Variances from Study Plan and Schedule

To date, there have been no variances from the study plan.

1.4 Remaining Activities

- Update hydrologic period of record to include 2004-2012.
- Obtain from the USACOE the inflow to Wilder from their operations model for the period 2004-2012.
- Validate the model calibration based on the 2004-2012 hydrology.
- Simulate various production runs.
- Complete a final report.

Document Content(s)

Transmittal Letter of ISR.PDF...1
2014 Initial Study Report 3_1_1Reduced.PDF................................3
2014 Initial Study Report Summary 3_1_2.PDF 669
2014 Initial Study Report Summary 3_1_3.PDF 905
2014 Initial Study Report Summary 3_2_1.PDF 908
2014 Initial Study Report Summary 3_2_2.PDF............................1055
2014 Initial Study Report Summary 3_3_1.PDF............................1062
2014 Initial Study Report Summary 3_3_2.PDF............................1140
2014 Initial Study Report Summary 3_3_3.PDF............................1151
2014 Initial Study Report Summary 3_3_4.PDF............................1159
2014 Initial Study Report Summary 3_3_5.PDF............................1162
2014 Initial Study Report Summary 3_3_6.PDF............................1179
2014 Initial Study Report Summary 3_3_7.PDF............................1211
2014 Initial Study Report Summary 3_3_8.PDF............................1214
2014 Initial Study Report Summary 3_3_9.PDF............................1227
2014 Initial Study Report Summary 3_3_10.PDF...........................1238
2014 Initial Study Report Summary 3_3_11.PDF...........................1241
2014 Initial Study Report Summary 3_3_12.PDF...........................1281
2014 Initial Study Report Summary 3_3_13.PDF...........................1474
2014 Initial Study Report Summary 3_3_14.PDF...........................1476
2014 Initial Study Report Summary 3_3_15.PDF...........................1479
2014 Initial Study Report Summary 3_3_16.PDF...........................1482
2014 Initial Study Report Summary 3_3_17.PDF...........................1485
2014 Initial Study Report Summary 3_3_18.PDF...........................1487
2014 Initial Study Report Summary 3_3_19.PDF...........................1507
2014 Initial Study Report Summary 3_4_1.PDF............................1509
2014 Initial Study Report Summary 3_4_2.PDF............................1512
2014 Initial Study Report Summary 3_5_1.PDF............................1516
2014 Initial Study Report Summary 3_6_1.PDF............................1522
2014 Initial Study Report Summary 3_6_2.PDF............................1526
2014 Initial Study Report Summary 3_6_3.PDF............................1679
2014 Initial Study Report Summary 3_6_4.PDF............................1683
2014 Initial Study Report Summary 3_6_5.PDF............................1718
2014 Initial Study Report Summary 3_6_6.PDF............................1720
2014 Initial Study Report Summary 3_6_7.PDF............................1723
2014 Initial Study Report Summary 3_7_1.PDF............................1726
2014 Initial Study Report Summary 3_7_2.PDF............................1763
2014 Initial Study Report Summary 3_7_3a.PDF...........................1778
2014 Initial Study Report Summary 3_8_1.PDF............................1795