UPDATED DRAFT
AQ 2 – HYDROLOGY
TECHNICAL STUDY PLAN

Rush Creek Hydroelectric Project
FERC Project No. 1389

April 2022

UPDATED DRAFT TECHNICAL STUDY PLAN
AQ 2 – Hydrology

POTENTIAL RESOURCE ISSUES

- Modification of Rush Creek hydrology.

PROJECT NEXUS

- Project operations modify the hydrology in Project-affected stream segments[1] and Project reservoirs.

RELEVANT INFORMATION

The following information is available to characterize hydrology in the vicinity of the Rush Creek Project (refer to Southern California Edison Company's [SCE] Pre-Application Document [PAD] Section 4.3 for a summary of water use and hydrology information [SCE 2021]).

- Gaging data from United States Geological Survey (USGS), SCE, and Los Angeles Department of Water and Power (LADWP).

- Section 2.0 Project Location, Facilities, and Operation, and Section 4.3, Water Use and Hydrology of the Rush Creek PAD, presents a summary of Project operations and water use; available stream gage data; and daily historical, existing, and unimpaired hydrology for Project-affected stream segments and Project reservoirs.

- Hydrological analysis methodologies (Chen et al. 2017; England et al. 2018; Flynn et al. 2006; Gotvald et al. 2012; Richter et al. 1996; Veilleux et al. 2014).

POTENTIAL INFORMATION GAPS

- Modeled Proposed Project, historical, and existing hydrology, and refinement (as needed) of the analysis of unimpaired hydrology presented in the PAD Section 4.3 (SCE 2021).

- Hydrologic alteration analyses and high flow/flood-frequency analyses for the different flow regimes in Project-affected stream segments.

- Hydrology of the lower Rush Creek and South Rush Creek channels near State Route 158 (SR-158) related to potential enhancement.

[1] Stream segments as used in this document are typically long sections of stream with a relatively homogeneous flow regime. Segments may be subdivided into smaller reaches for study and/or due to fluvial geomorphology (e.g., stream gradient, channel confinement).

STUDY OBJECTIVES

- Model the Proposed Project, historical, and existing hydrology, and refine (as needed) the analysis of unimpaired hydrology presented in the PAD Section 4.3 (SCE 2021).

- Perform a hydrologic alteration analysis for the unimpaired, existing, and Proposed Project flow regimes in the select Project-affected stream segments.

- Conduct a high flow/flood-frequency analysis for the different flow regimes in the select Project-affected stream segments.

- Develop hydrology data for the lower Rush Creek and South Rush Creek channels near SR-158 to facilitate the evaluation of potential enhancements to address local flooding of residences during high-runoff events.

EXTENT OF STUDY AREA

- The study area for development of the Proposed Project, historical, existing, and unimpaired hydrology includes Project-affected stream segments (Table AQ 2-1 and Map AQ 2-1). The locations for the hydrological alteration analyses and high flow/flood-frequency analyses are also included in Table AQ 2-1 and Map AQ 2-1.

- Studies will not be conducted at locations where access is unsafe (e.g., where there is very steep terrain) or on private property for which SCE has not received specific approval from the landowner to enter the property to perform the study.

STUDY APPROACH

The following describes the study approach for developing Project hydrology; conducting a hydrologic alteration analyses and flood-frequency analyses; developing potential channel enhancement hydrology; and reporting.

HYDROLOGY DEVELOPMENT

- Conduct stakeholder hydrological modeling working group meetings to review and help guide the hydrological modeling approach.

- Use the 2000–2021 period of record (POR) for hydrological modeling based on data availability (historical gage data) (SCE 2021).

- Refine the modeled unimpaired (without the Project[2]) daily average flow hydrology presented in PAD Section 4.3 for the POR based on modeling working group input, as appropriate.

[2] The unimpaired hydrology (2000–2019) presented in the PAD represents synthesized instream flows in Rush Creek without the influence of the Rush Creek Project.

- Develop and use a spreadsheet operations model (or a HEC-ResSim model, if needed)[3], to characterize the Proposed Project (future operations[4]), historical (operations prior to reservoir seismic restrictions[5]), existing (current operations under seismic restrictions[6]) daily average flow hydrology for the POR based on the modeling working group input, as appropriate.

    - Downstream of the Rush Creek Powerhouse, incorporate a sub-daily component into the operations model results (post processor) or into the model to characterize the range of flow fluctuations related to powerhouse operations.

- Identify available climate change data / modeling applicable to the Rush Creek Watershed. If data / modeling exists, incorporate, as appropriate, to characterize future climate change hydrology (unimpaired, Proposed Project) over the term of the new license (e.g., 50 years).

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HYDROLOGIC ALTERATION ANALYSIS

- Analyze and compare Proposed Project, historical, existing, and unimpaired daily average flows using the following data and approaches in select Project-affected stream segments (Table AQ 2-1 and Map AQ 2-1) (e.g., Richter et al. 1996).

    - Monthly flow exceedance plots / tables for the POR.

    - Time-series plots for the POR.

    - January to December (annual) plots / tables showing mean daily and 95%, 90%, 75%, 50% (median), 25%, 10%, and 5% exceedance flows.

    - Tables and summary analysis showing differences in the following:

        - Monthly timing and magnitude of mean and median flow conditions (e.g., high and low flows).

[3] If limitations in representing the daily hydrology using a spreadsheet model are identified by the stakeholder modeling group, a HEC-ResSim model will be used. The goal of the operations model is to accurately and transparently represent operations.

[4] The Proposed Project hydrology is the modeled hydrology based on how the Project will be operated in the future with removal of Waugh Lake and the reservoir portion of Agnew Lake and modified operations (including maximum storage) at Gem Lake.

[5] The historical hydrology (2000–2011) will be used to develop / calibrate the historical hydrology model over the 2000–2021 POR. The historical hydrology represents instream flows and Project operation under the existing license conditions prior to implementation of the seismic restrictions in 2012.

[6] The existing hydrology (2012–2019) will be used to develop / calibrate the existing hydrology model over the 2000–2021 POR. The existing hydrology represents instream flows and Project operation under the existing license conditions and implementation of the seismic restrictions in 2012.

- Magnitude, duration, and timing of annual high flow and low flow conditions (1-day, 3-day, 7-day, monthly, etc.), including the presence of pulse flow events.

- Rate, timing, and frequency of hydrograph changes (e.g., rate and timing of the declining limb of the spring high flow hydrograph).

FLOOD FREQUENCY

- Generate a flood-frequency analysis for the Proposed Project, historical, existing, and unimpaired flows using annual peak daily flow data and peak flow estimates in select Project-affected stream segments.

  - Determine the best method to estimate peak flow from peak daily flow (e.g., Chen et al. 2017) and generate a 2000–2021 annual peak flow data set.

  - Use PeakFQ (Veilleux et al. 2014; Flynn et al. 2006), a software package developed by the USGS, which uses Bulletin 17c (England et al. 2018) procedures for flood-frequency analysis of streamflow records, or equivalent, and estimate flood magnitudes (annual daily average peak) and their corresponding annual exceedance probabilities.

  - Use regional flood-frequency curves (Gotvald et al. 2012) to develop an additional estimate of unimpaired peak flow magnitudes and their corresponding annual exceedance probabilities.

  - Summarize any other peak flow or probable maximum flood (PMF) data available for the study area (e.g., PMF calculations for the SCE dams by Geotechnical Water Resources in 2011), including historical flow data outside of the 2000–2021 analysis period of record. Include this data, as appropriate, in the characterization of high flow events.

POTENTIAL ENHANCEMENT HYDROLOGY

- Generate hydrological data for the lower Rush Creek and South Rush Creek channels near SR-158 to facilitate the evaluation of potential enhancements to address local flooding of residences during high-runoff events including:

  - Determine the Rush Creek/South Rush Creek percent flow split downstream of Horseshoe Falls over a range of flow conditions (e.g., minimum flow releases from Agnew Dam to peak flow events).

    - Use temporary gage data from South Rush Creek (see gage installation below) and data from USGS gage 10287289 (Rush Creek at Flume below Agnew Lake near June Lake, California) to determine the flow split relationship. Also, use any historical data collected to help determine the flow split relationship (e.g., 2017 empirical flow data).

- Determine additional flows entering South Fork Rush Creek and Rush Creek near SR-158.
  - Install and operate[7] temporary gages (October 2022 to September 2024) at the following locations:
    - South Rush Creek upstream of SR-158 (River Mile [RM] 0.2).
    - Unnamed tributary entering South Rush Creek upstream of SR-158 (RM 0.12).
    - Unnamed tributary entering Rush Creek upstream of SR-158 (RM 17.66).
    - Reversed Creek upstream of the confluence with Rush Creek (RM 0.25).
  - Use the empirical data and watershed area to develop a time series of accretion to South Rush Creek, Rush Creek upstream of SR-158, and Reversed Creek to Rush Creek.
- Estimate the peak design flow for each of the channels / culverts at SR-158 (South Rush Creek, Rush Creek, and Powerhouse Tailrace). Potential backwater effects from Silver Lake on the channels and culverts near SR-158 during spring high flows will be developed in the AQ 1 – Instream Flow Technical Study Plan.

REPORTING

- The study methods and results will be documented in an AQ 2 – Hydrology Technical Study Report (TSR). The TSR will include summary tables and maps, as appropriate.
- Upon request, data will be provided to resource agencies and interested stakeholders in an Excel spreadsheet (electronic format).

SCHEDULE

Date	Activity
September–November 2022	Collaborate with stakeholder modeling working group on approach for refining the historical, existing, and unimpaired hydrology (as appropriate); and developing the Proposed Project hydrology Install temporary flow gages
January–April 2023	Develop the Proposed Project hydrology and refine the analysis of the historical, existing, and unimpaired hydrology

[7] During the winter time period the gages will be operated to the extent reasonably possible given the potential for ice and snow cover. The primary operation period will focus on fall, spring, and summer.

Date	Activity
April–June 2023	Complete the hydrologic alteration analysis and flood-frequency analysis
July–December 2023	Summarize data and prepare draft report (incorporating October 2022–September 2023 data)
January 2024	Distribute draft report to stakeholders
February–April 2024	Stakeholders review and provide comments on draft report (90 days)
April–May 2024	Resolve comments and prepare final report
August–September 2024	Uninstall temporary flow gages Distribute draft final report in Draft License Application (incorporating October 2023–September 2024 data)
January 2025	Distribute final report in Final License Application (incorporating comments by stakeholders on the draft final report filed with the Draft License Application)

REFERENCES

Chen, Bo, W.F. Krajewski, F. Liu, W. Fang; and Z Xu. 2017. Estimating instantaneous peak flow from mean daily flow. Hydrology Research 48 (6): 1474–1488.

England, J.F., Jr., T.A. Cohn, B.A. Faber, J.R. Stedinger, W.O. Thomas, Jr., A.G. Veilleux, J.E. Kiang, and R.R. Mason, Jr. 2018. Guidelines for determining flood flow frequency--Bulletin 17C: U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5.

Flynn, K.M., W.H. Kirby, and P.R. Hummel. 2006. User's manual for program PeakFQ, Annual Flood Frequency Analysis Using Bulletin 17B Guidelines: U.S. Geological Survey Techniques and Methods Book 4, Chapter B4, 42 pgs.

Gotvald, A.J., N.A. Barth, A.G. Veilleux, and Charles Parrett. 2012. Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012-5113, 38 p., 1 pl.

Richter, B.D., J.V. Baumgartner, J. Powell, and D.P. Braun. 1996. A method for assessing hydrologic alteration within ecosystems. Conservation Biology 10:1163-1174.

SCE (Southern California Edison Company). 2021. Rush Creek Project (FERC Project No. 1389) Pre-Application Document. December.

Veilleux, A.G., T.A. Cohn, K.M. Flynn, R.R. Mason, Jr., and P.R. Hummel. 2014. Estimating magnitude and frequency of floods using the PeakFQ 7.0 program: U.S. Geological Survey Fact Sheet 2013-3108, 2 p., https://dx.doi.org/10.3133/fs20133108.

TABLES

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Table AQ 2-1. Hydrology Analysis Locations in Project-affected Stream Segments.

Location Name	Location (RM)	Proposed Project, Historical, Existing, Unimpaired Hydrology			Proposed Project Hydrology Potential Enhancement Hydrology Data Collection (2022–2023)
		Daily Average Hydrology (2000–2021 POR)	Hydrological Alteration Analysis (2000–2021 POR)	High Flow / Flood-Frequency Analysis (2000–2021 POR)	
Rush Creek					
Rush Creek at Rush Meadows Dam	RM 22.24	X	X	X	—
Rush Creek at Gem Dam	RM 19.48	X	X	X	—
Rush Creek Below Agnew Dam	RM 18.61	X	X	X	—
Rush Creek above SR-158	RM 17.58	X	X	X	X
Rush Creek Above Silver Lake	RM 17.38	X	X	X	—
Rush Creek Below Silver Lake	RM 13.67	X	X	X	—
South Rush Creek					
South Rush Creek	RM 0.1	X	X	X	X

Notes:
POR = Period of Record
RM = River Mile

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MAPS

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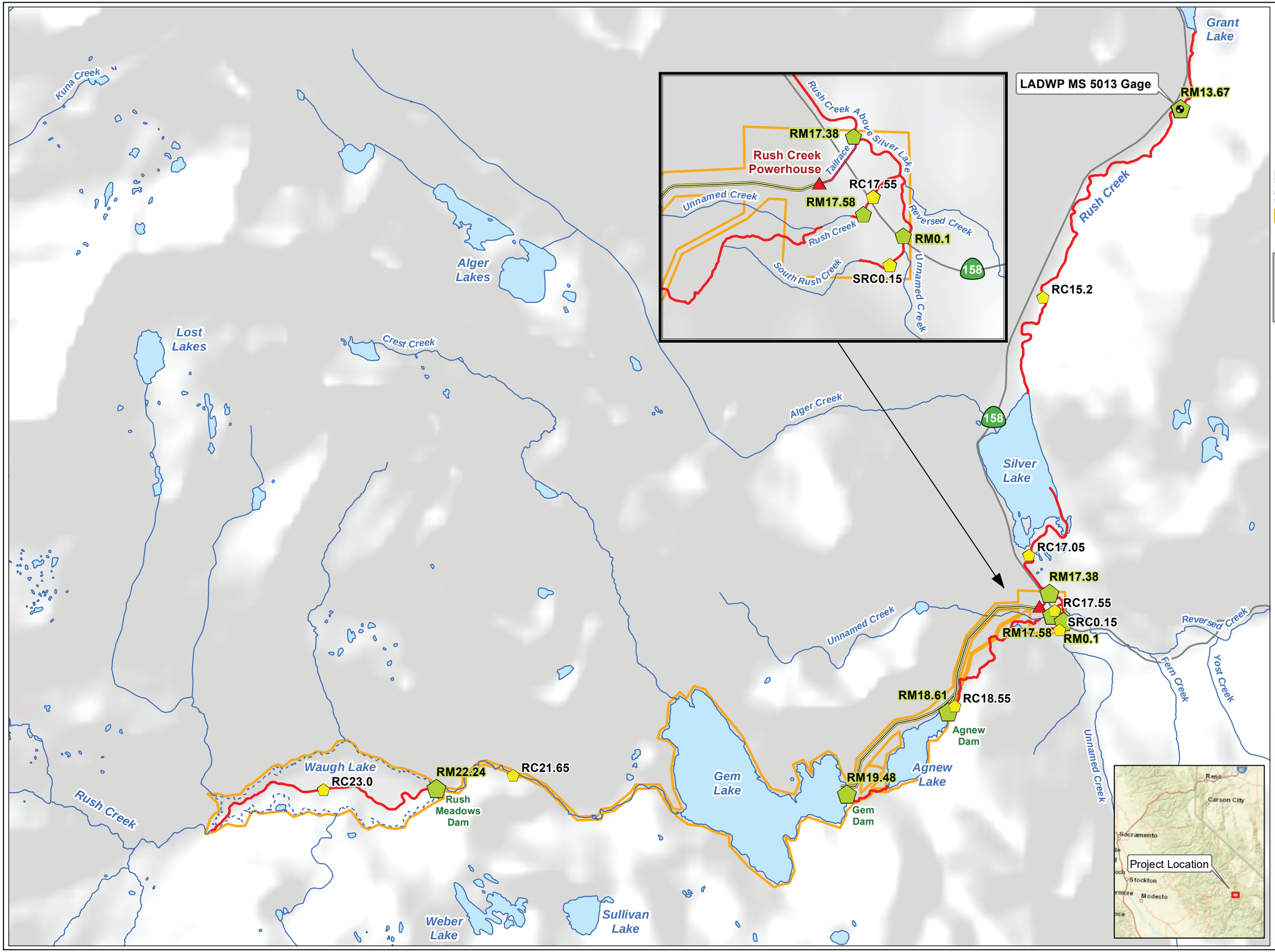

SCE Facilities
- Dam
- Powerhouse
- Flowline / Penstock
- Tailrace

Other Features
- Highway
- River/Stream
- Lake/Reservoir
- Dry Lake/Reservoir
- FERC Boundary

Study Sites and Reaches
- Hydrology Analysis Site
- Geomorphology/Riparian Site
- Instream Flow Modeling Reaches

SOUTHERN CALIFORNIA EDISON
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Rush Creek Project (FERC 1389)

Map AQ 2-1

Analysis and Survey Locations

0 0.25 0.5 Miles

Projection: UTM Zone 11
Datum: NAD 83

Date: 11/3/2021

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