Bishop Creek Progress Report 2:

APPENDIX H -SEDIMENT & GEOMORPHOLOGY STUDY PROGRESS REPORT

MEMORANDUM

TO: Bishop Creek Relicensing Technical Working Groups (TWG)

FROM: Tyler Kreider

CC: Bishop Creek Relicensing Team

DATE: April 4, 2020

RE: Sediment & Geomorphology Study Progress Report

1.0 INTRODUCTION

This memorandum provides information on the Sediment and Geomorphology (S&G) Study Plan (Study Plan) at the Bishop Creek Hydroelectric Project (Federal Energy Regulatory Commission [FERC] Project No. 1394-080; hereinafter referred to as the "Project"). The Project is located along Bishop Creek southwest of the City of Bishop, Inyo County, California.

Southern California Edison Company (SCE) is the licensee, owner, and operator of the existing hydroelectric facilities subject to the relicensing effort. The project is predominantly located on Bishop Creek but also includes facilities on Birch and McGee Creeks. SCE operates the project under a 30-year license issued by FERC on July 19, 1994. As the current license is due to expire on June 30, 2024, SCE has initiated the formal relicensing process utilizing the Integrated Licensing Process with FERC.

In advance of filing the Notice of Intent (NOI) and Pre-Application Document (PAD), SCE and their relicensing team have worked with stakeholders to identify necessary studies. Efforts began over one year prior to formal initiation of the process with FERC, through a series of TWG meetings that were held in Bishop, California.

Draft study plans were distributed with the PAD and revised after receiving comments pursuant to 18 CFR § 5.9. FERC approved the Revised Study Plan (RSP) with its Study Plan Determination on November 4, 2019. As required by the Integrated Licensing Procedures (ILP) described in 18 Code of Federal Regulations (CFR) section 5.15 (b), this memorandum will support a periodic progress report to stakeholders and will be incorporated by reference in the Initial Study Report (ISR) in November of 2020.

During the TWG Meetings for the Project, stakeholders identified the need to understand the sediment dynamics in Bishop Creek, including understanding what flows mobilize sediment and what Project operations could be modified to mobilize sediments and large woody material (LWM) from forebays above the diversion dams into reaches that have a low sediment supply. This study focuses on the reaches between Plant No. 2 and Plant No. 6, will provide additional information pertaining to riparian and fisheries habitat assessments, and has the potential to reduce maintenance needs of the Project by limiting the accumulation of LWM and sediment in the forebays.

2.0 STUDY GOALS AND OBJECTIVES

This study seeks to develop an understanding of sediment dynamics in Bishop Creek by analyzing relationships between sediment and flow dynamics in Bishop Creek to assist SCE and stakeholders in understanding how Project operations interact with sediment transport in Bishop Creek. To meet this goal, this approved study plan has the following objectives:

- Determine flow conditions in which sediment is mobilized in the stream channel
- Understanding if and how LWM is mobilized
- Evaluate flows that could mobilize sediments and LWM from forebays
- Evaluate how operations (flow release timing, magnitude, and duration) could be modified to provide sediment transport flows
- Understand potential sediment inputs and impacts from higher flows to reaches below Plant 6 from proposed changes in flow/operations

The detailed scope of this study is outlined in the Bishop Creek Hydroelectric Project Sediment & Geomorphology Study Plan, approved by FERC as part of the Study Plan Determination on November 4, 2019.

3.0 ENVIRONMENTAL SETTING/STUDY AREA

Figure 1 presents the proposed study area for the Bishop Creek S&G Study Plan. The study area focused on the seven proposed S&G monitoring sites identified in Figure 1. This includes six S&G monitoring sites (S&G monitoring sites 2 through 6, including a split site at Site 4.1 and Site 4.2) that align with the monitoring sites established by Simons, Li, & Associates (1990), as well as one new monitoring site (S&G monitoring site 7) to characterize channel substrates and dimensions downstream of the junction with Coyote Creek. During the August 2019 site

reconnaissance, the historic pins from Site 2, which was originally included in the Study Plan, could not be located. Through consultation with SCE, Site 2 was abandoned due to lack of historic data for comparison to any new cross sections and adequate characterization of the reach from adjacent Sites 7 and 4.1/4.2. Thus, Site 2 was not evaluated during 2019 and will not be included in future S&G study efforts.

These S&G monitoring sites are located at the lower end of each reach between powerhouses, which should be in more equilibrium with the stream channel sediment processes relative to any site just downstream of the diversion dam where there would likely be less sediment.

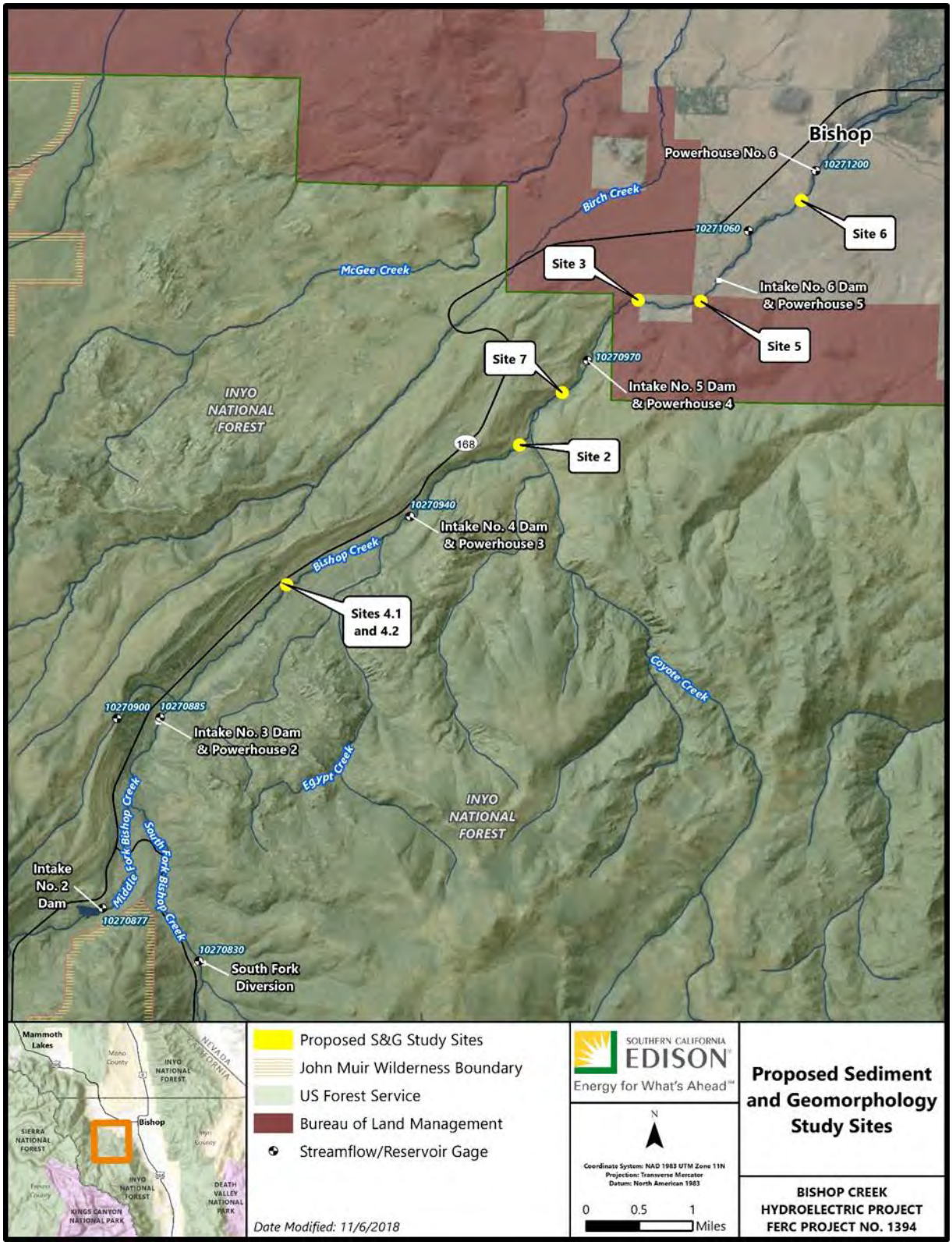

FIGURE 1. PROPOSED SEDIMENT & GEOMORPHOLOGY STUDY SITES

Kleinschmidt

4.0 METHODS

The Bishop Creek S&G study field work followed the approved Study Plan. This study plan included five primary, interconnected tasks: 1) field surveys, 2) an assessment of LWM, 3) an estimate of annual sediment loading, 4) an evaluation of substrate mobility, and 5) an evaluation of flushing flows on sediment mobility and LWM dynamics. Tasks 1 and 2 were completed on July 29-31, 2019 and September 9-13, 2019 by Kleinschmidt staff.

As part of Task 1, the field crew located the spoil piles from prior dredging efforts at Intakes 2, 4, 5, and 6, as well as the LADWP impoundment just downstream of Plant 6. These representative samples will be used to inform discussions about the size of particles moving through Bishop Creek and plan for future field efforts to understand sediment transport in 2020. The following is a summary of the data collected during the 2019 field efforts:

Site-wide Data (Sites 4.1, 4.2, 7, 3, 5, and 6)

1. Pfankuch channel stability rating
2. Channel slope (elevation change divided by stream length)
3. Riffle Substrate D50 and D84
4. LWM assessment
5. D10, D50, D84, and D100 for excavated sediments from previously excavated intake sediment disposal piles (for Intakes 2, 4, 5, and 6, as well as the LADWP impoundment)

Cross-section Specific Data

1. Bankfull cross-section area
2. Channel dimensions (width, depth, area)

5.0 2019 FIELD SURVEY RESULTS

Based on the 2019 field effort, the bankfull flows in Bishop Creek were estimated to range from approximately 20-90 cubic feet per second (cfs), as it was very difficult to find “typical” bankfull indicators. However, it was clear that any flows substantially larger than the approximately 3-25 cfs (as observed during the September 2019 site visit) will preclude wading in the stream channel. Thus, the proposed study Plan Task 4, which included wading in the channel to procure bed sediment samples at bankfull flows, is not feasible. A potential alternative would be to use a

truck-mounted crane on a bridge over the creek to obtain these samples. However, the ideal bridge would be situated over Bishop Creek, would provide access to a riffle, and be located well downstream of the impoundments in an area that is representative of the reach. Such a bridge does not exist in the Project Area, and therefore, it is unlikely that the Study Plan will be implemented as approved for this task. This means that the annual sediment budget cannot be developed for this site without some major assumptions that cannot be validated to confirm the accuracy of any work done using these assumptions. For reasons described below, the inability to sample bedload may not prevent the TWG and SCE from having an informed discussion about project impacts. Data collected in 2019 helps increase SCE's understanding of the sediment dynamics, and an alternative approach for gaining supplemental data is described below.

The desire to collect bed sediment samples at high flows was based on a desire to estimate an annual sediment transport budget and evaluate the particle sizes that are mobilized during higher flows (bankfull flow). While empirically confirming this condition may not be feasible using conventional bedload sampling techniques, it is possible to draw some inferences about this condition based on the 2019 data collected. Based on the wading and field work that was completed in 2019, it appears that Bishop Creek is relatively stable, even after a summer of near-bankfull flows in 2019, as there was not substantial recent erosion observed in the vicinity of the S&G sites. The D50 of substrate observed in the riffles of Bishop Creek was generally cobbles and boulders (150-600 mm, Figure 2). This supports the theory that this channel has reached equilibrium with the flow regime that is present and there is only minor flushing of sediment through the system as small sections of bank collapse, or surface runoff carries sediment into the channel from outside the primary Bishop Creek channel (such as Coyote Creek).

Finally, the sediment found in the dredge piles from past dredging at Intakes 2, 4, 5, 6 ,and the LADWP intake show that while there are some large particles that are deposited in the impoundments, the majority of the material is sand (all D50 values <6mm, most less than 2 mm; Figure 3). This is also apparent in the photos of the dredge soil sites (Figures 4-8).

The transport of sand-grained material through the system aligns generally with the findings of the Sada and Hawkins (1997) study that looked at the pulse of sediment that was released when the low level outlet was opened at Intakes 3 and 4. That study found that the intake sediment (fines, sand, gravel, but predominantly sand) was generally deposited within 2,500 meters of the intake and equally distributed across pools and riffles. After a flushing flow of 200 cfs for 24

hours was applied, most of the intake sediment in the pools was removed by the flushing flow. In all but 3 of 30 pools surveyed, there was no impact (substantial change) to substrate composition due to the sediment release.

Therefore, given the high flows in 2019, the lack of sand-sized particles observed in the field effort, minimal evidence of bank erosion, minimal drastic changes in the filling of the impoundments (qualitative based on observed sediment), and the Sada and Hawkins (1997) study that found rapid transport of sand-sized particles through the system, it is reasonable to conclude the following:

1. there is relatively little bank erosion to generate new sediment along Bishop Creek and the annual sediment loading is relatively low in the Project reaches;

2. the frequency of higher flows has resulted in a channel that is well armored and able to sustain high flows without substantial bank or bed erosion;

3. the riffles in the S&G study reaches are generally cobble (riffle D_{50} substrate of 150-600 mm; Figures 9 and 10); and

4. any intake sediments (assuming primarily sand and fine gravel, based on surveys of previously dredged sediment) released into Bishop Creek would likely end up in the next intake downstream due to the order of magnitude difference in riffle D_{50} substrate (150-600 mm) and dredged sediment D_{50} (<6mm).

6.0 RECOMMENDATIONS

The information gained during the 2019 field effort informed several of the questions raised by the TWG related to sediment, but there is one area where additional clarity could be provided to resolve these questions. This is in relation to the sizes of particles that are transported during higher (e.g. near bankfull) flows. To reflect the findings of the 2019 field efforts and address this outstanding question, SCE is proposing to modify and add to the approach for S&G Study Plan Task 1 (field studies), Task 3 (estimation of annual sediment loading from bed sediment samples), Task 4 (substrate mobility evaluation), and Task 5 (evaluation of flushing flows) as follows:

1. Task 1 (Field Studies) and Task 3 (Annual Sediment Loading Estimation): Omit the bed sediment sampling field effort and annual sediment loading estimate due to safety concerns and higher than anticipated bankfull conditions identified in this memo that prohibit this data collection.

2. Task 4 (Substrate Mobility Evaluation): Add a tracer rock study to supplement the previously proposed bed substrate mobility calculations utilizing data available from 2019 field efforts. This new tracer rock study objectives will be: 1) confirm the observations of coarse substrate in riffles that indicate that most smaller (<60 mm) substrates are mobilized through the Project, and 2) better understand substrate mobility during a period of normal summer flows and a period of higher spring flows in Bishop Creek. This tracer rock study would occur at previously surveyed riffles at Site 4 (most upstream, steep site) and Site 6 (most downstream, lower gradient) over a period of high flows (near bankfull) and lower flows. This study involves tagging (water-based paint and PIT tag) rocks of desired size classes (8-360 mm, capturing most of the surveyed riffle D_{50} rock sizes) and placing them in target riffles and then re-visiting them after high flows to determine if they were mobilized. The schedule will depend on anticipated flows in Bishop Creek, but is anticipated to start in early summer 2020 with the placement of tracer rocks and then a recovery of the tracers in the fall of 2020 (after summer low flows), and again in the spring of 2021 (after higher spring flows). During each tracer recovery, SCE will determine if the placed tracers remain in place or have been mobilized downstream by visually looking for the painted tracer rocks and utilizing a PIT tag reader. The largest size class of rocks for which the majority of the rocks are not recovered will be assumed to have been mobilized by the highest flow during the observation period. This size class will be compared to calculations of substrate mobility based on channel slope, discharge and velocity to provide better resolution on particle mobility during high flow events.

3. Task 5 (Flushing Flow Evaluation): This task will essentially remain unchanged. SCE will rely on previous studies at the site, field data collected during 2019, and the tracer rock study (proposed Task 4) to consider the impacts of utilizing flushing flows to mobilize sediment and large woody material in Bishop Creek, including a qualitative assessment of potential impacts to macroinvertebrates.

The objectives, methods, results and discussion of findings will still be summarized in a final Sediment & Geomorphology Study Report, as approved in the current Study Plan (Task 6). The exact scope of these proposed modifications to the Study Plan will be further developed with input from the Aquatic Technical Working Group for this Project, but the proposed modifications to the study plan are anticipated to provide resolution to the TWG's questions regarding sediment mobility through the Project.

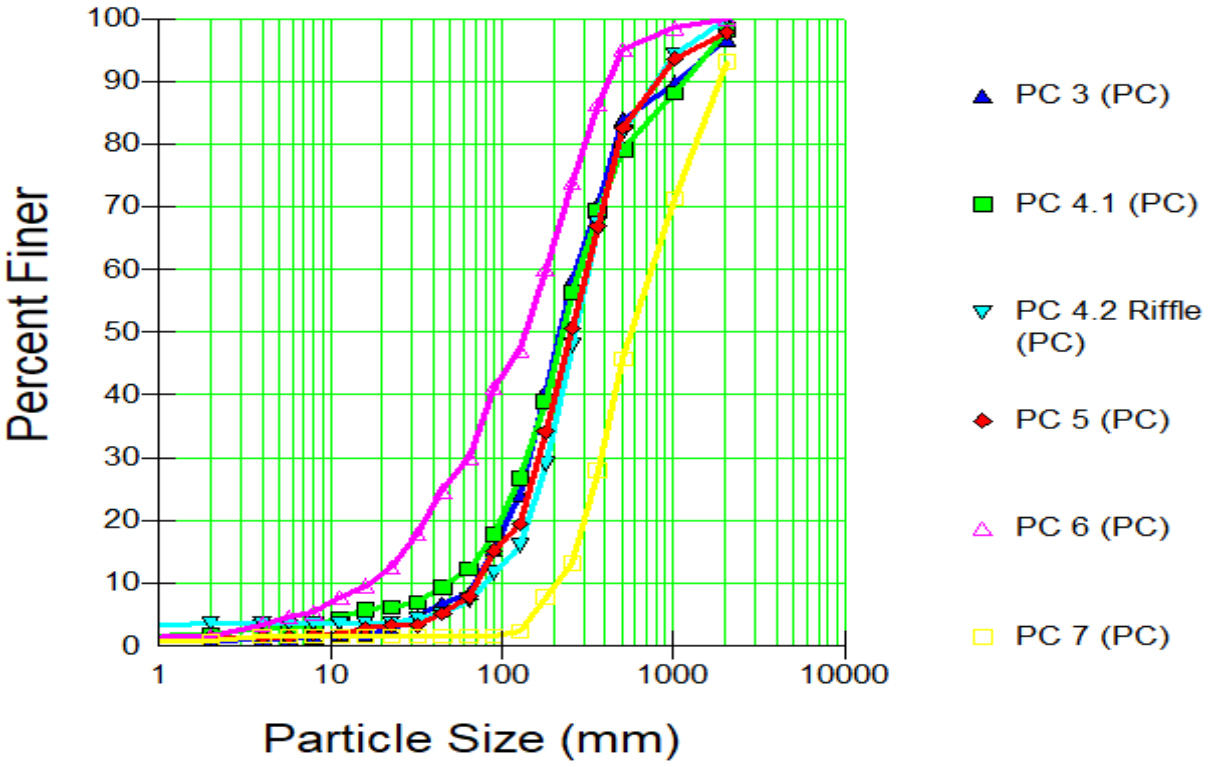

FIGURE 2. RIFFLE SUBSTRATE PARTICLE SIZES. (NUMBER IN LEGEND IS THE SITE NUMBER)

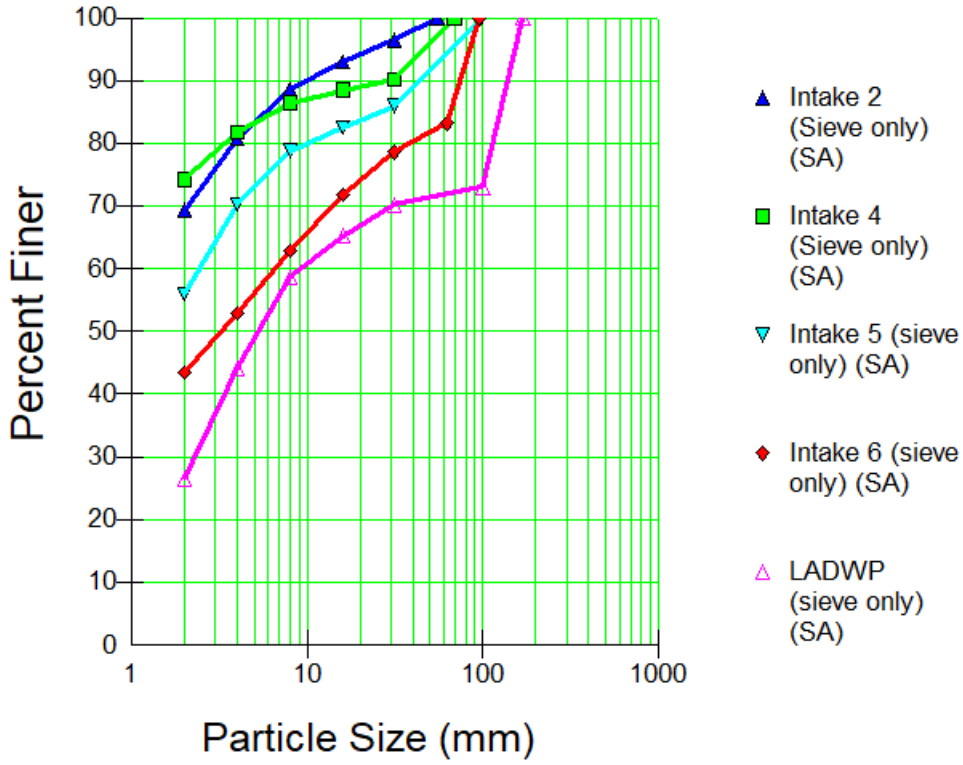

FIGURE 3. DREDGED SEDIMENT PARTICLE SIZES FOR BISHOP CREEK

FIGURE 4. INTAKE 2 DREDGED SEDIMENT PILE IN FOREGROUND.

FIGURE 5.INTAKE 4 DREDGED SEDIMENT PILE IN FOREGROUND.

FIGURE 6. INTAKE 5 DREDGED SEDIMENT PILE IN FOREGROUND.

FIGURE 7. INTAKE 6 DREDGED SEDIMENT PILE ON ROADWAY IN CENTER OF PHOTO.

FIGURE 8. LADWP INTAKE (JUST BELOW PLANT 6 IN BACKGROUND) DREDGED SEDIMENT PILE.

FIGURE 9. EXAMPLE SUBSTRATE AT SITE 4, TRANSECT 5, SHOWING DIVERSITY OF PARTICLE SIZES

FIGURE 10. EXAMPLE SUBSTRATE AT SITE 6, TRANSECT 5, SHOWING DIVERSITY OF PARTICLE SIZES (LARGEST SQUARE IN FRAME IS 128 MM FOR REFERENCE)

REFERENCES

Sada, D.W. and Hawkins, H.G. 1997. Effects of Intake Pond Sediment Releases on Bishop Creek Turbidity and Pool Quality; Inyo County, California. Unpubl. Tech. rept. prepared for Southern California Edison, Rosemead, CA. Dated March 20, 1997.