

4.1.1 Aquatic Invasive Species Study

4.1.1.1 Project Nexus

Continued Project O&M and Project-related recreation activities have potential to introduce and propagate AIS. For the purpose of this *AIS Study*, AIS is defined as aquatic, non-native nuisance organisms that invade ecosystems beyond the species' natural, historic range or are native but are considered "nuisance" species because they cause environmental, recreational, or economic harm (e.g. cyanobacteria).

4.1.1.2 Existing Information and Need for Additional Information

Existing, relevant, and reasonably available information regarding AIS within the proposed Project boundary is provided in Section 4.5.1.1 of the Licensees' PAD. As a summary, the Licensees found records of two AIS in the Project reservoir or impoundments, and concluded 15 AIS have potential to occur in the Project reservoir and impoundments. Cyanobacteria (algae) are known to occur in Pyramid Lake, and in December of 2016, after the filing of the Licensees' PAD, adult quagga mussels were located in the Angeles Tunnel between Pyramid Lake and Elderberry Forebay. These mussels were located during a tunnel inspection by the Licensees' staff and were removed at that time. CDFW was notified of the finding. Los Angeles County Department of Parks and Recreation in conjunction with DWR and CDFW instituted boating restrictions on Pyramid Lake. Notifications were also sent to the Metropolitan Water District of Southern California (MWD) and the USFS.

Currently, the Licensees conduct plankton-tow surveys once to twice monthly depending on the time of year, and visual surveys monthly for quagga and zebra mussels in Pyramid Lake. With the recent finding of quagga mussels in the Angeles Tunnel, the Licensees will be expanding their monitoring per established regulations for the management of quagga and zebra mussels, including implementing DWR's *Quagga and Zebra Mussel Rapid Response Plan* for the SWP and developing a containment plan. DWR is currently coordinating with CDFW on the development of a Quagga Mussel Control Plan for Pyramid Lake, Angeles Tunnel and Castaic Lake. The program includes management of vectors, mussel population monitoring, and public education. While DWR is working with CDFW towards approval of a control plan, it is implementing several measures to prevent the spread of mussels. Los Angeles County Department of Parks and Recreation also conducts pre-entry boat inspections at Pyramid Lake for quagga and zebra mussels, as well as, exit inspections where inspectors ensure that live-wells and bilges of watercraft leaving Pyramid Lake are drained of water and verifying that drain plugs are dislodged. The Licensees also conduct monitoring and management on Pyramid Lake for cyanobacteria. No formal surveys for other AIS are conducted in Pyramid Lake, Quail Lake or Elderberry Forebay.

Additional information is needed to determine if AIS are present in the study area for the *AIS Study*. If found, their locations in relation to Project facilities, Project O&M, and Project-related recreation activities will be identified to determine if these locations might

facilitate the propagation of AIS within Pyramid Lake, Quail Lake and Elderberry Forebay.

4.1.1.3 Study Goals and Objectives

The goal of this *AIS Study* is to determine if continued Project O&M and Project-related recreation activities could increase the abundance of AIS or spread them to new areas if they are present within the study area for the *AIS Study*. This may occur if:

- An AIS is located within the study area for the *AIS Study*; and
- A specific Project O&M or recreation activity has a reasonable possibility of spreading AIS.

The objective of this *AIS Study* is to gather sufficient data necessary to fill recognized information gaps about the presence and location of AIS within the proposed Project boundary.

4.1.1.4 Study Methods

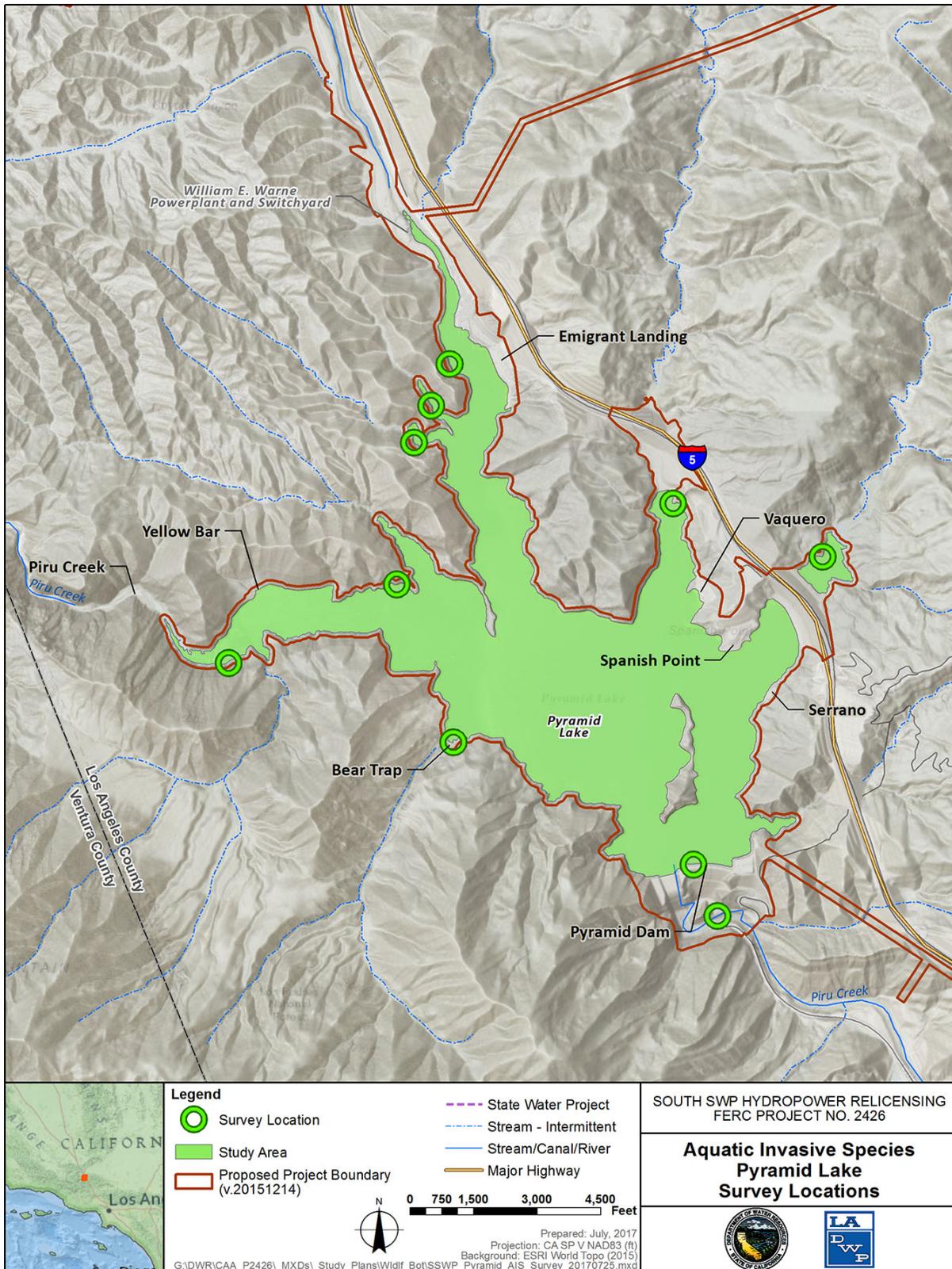
Study Area

The study area for the *AIS Study* consists of Pyramid Lake, Quail Lake and Elderberry Forebay and one site downstream of Pyramid Dam. Specific survey areas for each reservoir are shown on Figures 4.1-1 to 4.1-3.

General Concepts and Procedures

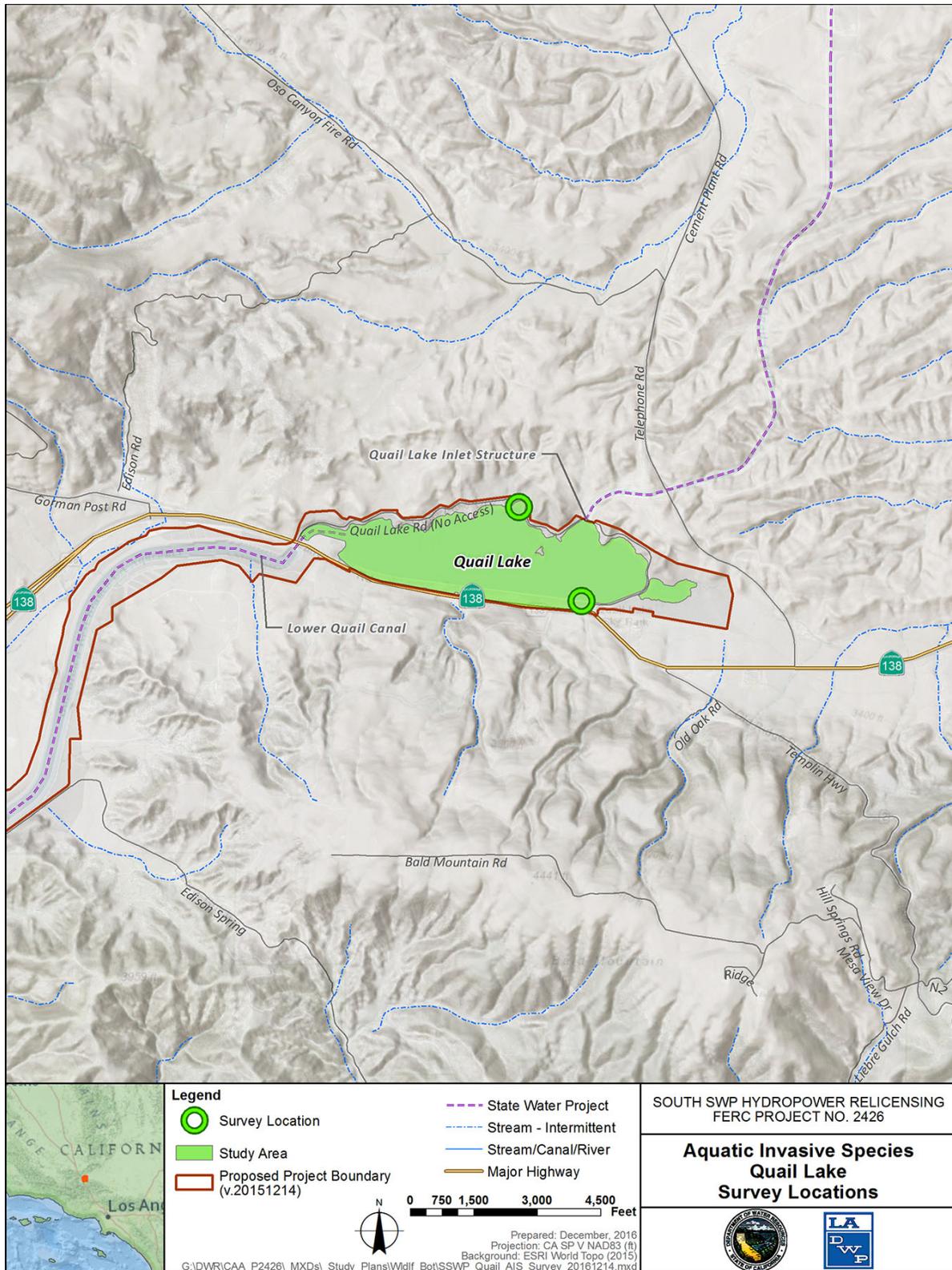
- Personal safety is the most important consideration of each fieldwork team. Fieldwork will only occur in safely accessible areas and under conditions deemed safe by the field crews. Locations within the study area that cannot be accessed in a safe manner (e.g., locations containing dense vegetation or unsafe slopes) and areas inundated when the surveys are performed, will not be surveyed; these areas will be identified in the data summary and an explanation for survey exclusion will be provided.
- The *AIS Study* will begin after FERC issues its Study Plan Determination.
- The *AIS Study* does not include the development of requirements for the new license, which will be addressed outside the *AIS Study*.
- The *AIS Study* focuses on AIS within the proposed Project boundary, but the study area for the *AIS Study* is specific to that resource.
- If required for the performance of the *AIS Study*, the Licensees will make a good faith effort to obtain permission to access private property well in advance of initiating the *AIS Study*. The Licensees will only enter private property if permission has been provided by the landowner.

- The Licensees will acquire all necessary agency permits and approvals prior to beginning fieldwork for the *AIS Study*.
- Field crews may make variances to the *AIS Study* in the field to accommodate actual field conditions and unforeseen problems. Any variances from the *AIS Study* will be noted in the data resulting from the *AIS Study*.
- To prevent the introduction and transmittal of amphibian chytrid fungus and invasive aquatic species (e.g., quagga mussels, zebra mussel, and Asian clams), field crews will be trained on, provided with, and use materials (e.g., Quat) for decontaminating their boots, waders, and other equipment when leaving or traveling between water-based study sites. Field crews will follow DWR's Quagga and Zebra Mussel Rapid Response Plan and CDFW's Aquatic Invasive Species Decontamination Protocol which can be found at the following link: (<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=43333>). All boats used during the study will follow cleaning protocols, including inspections before and after use. All decontamination requirements in place at Project reservoirs including those of DWR's *Quagga and Zebra Mussel Rapid Response Plan* for the SWP will be strictly followed (DWR 2010).



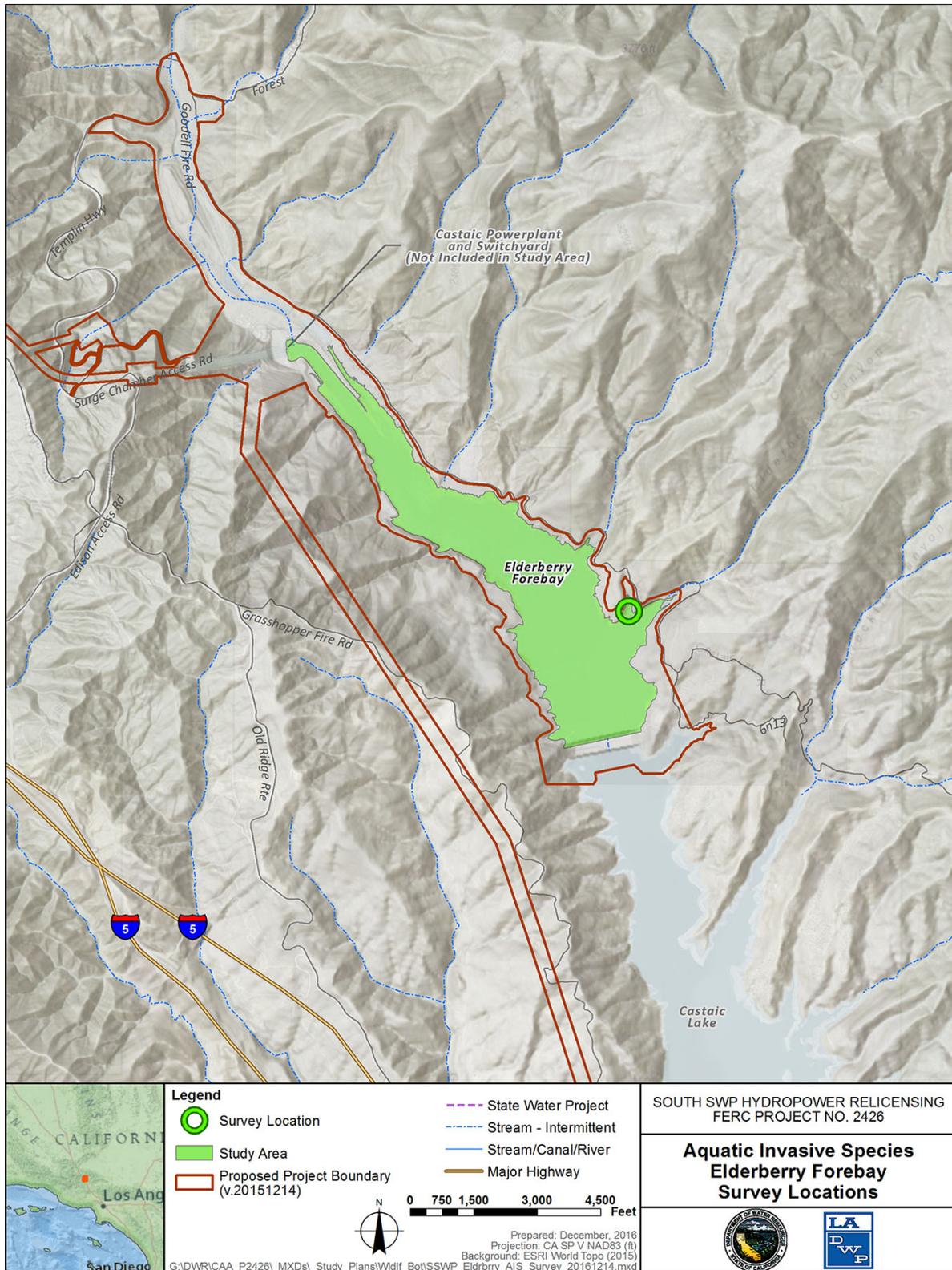
Note: The entire reservoir will be surveyed for invasive plants.

Figure 4.1-1. Map of Focused Survey Locations for Aquatic Invasive Species on Pyramid Lake



Note: The entire reservoir will be surveyed for invasive plants.

Figure 4.1-2. Map of Focused Survey Locations for Aquatic Invasive Species on Quail Lake



Note: The entire reservoir will be surveyed for invasive plants.

Figure 4.1-3. Map of Focused Survey Locations for Aquatic Invasive Species on Elderberry Forebay

Methods

The *AIS Study* will consist of three steps: (1) gather data and prepare for field effort; (2) conduct surveys; and (3) prepare final report. These steps are described below.

Step 1 – Gather Data and Prepare for Field Effort. The Licensees will prepare field maps for the *AIS Study*, depicting aerial imagery and Project features. Field preparation will include review of the *AIS Study Plan*, development of data sheets and determination of the survey period. This effort will include coordination with staff at Pyramid Lake, Quail Lake and Elderberry Forebay, including the Los Angeles County Department of Parks and Recreation, Los Angeles County Sheriff, and the Pyramid Lake concessionaire, Rocky Mountain Recreation Company.

Step 2 – Conduct Surveys. The Licensees will conduct specific surveys for aquatic invasive snails and clams (Asian clam, European ear snail, and New Zealand mudsnail), red-eared sliders, aquatic invasive plant species (sago pondweed, Eurasian watermilfoil, coontail, water primrose, water hyacinth, hydrilla, and parrot's feather milfoil) and by incidental siting, American bullfrog and red swamp crayfish. The Licensees currently conduct monitoring for zebra and quagga mussels at Pyramid Lake, so they are not proposed for inclusion in the field surveys. Staff from the Environmental Assessment Branch of DWR's Division of Operations and Maintenance monitor and sample for cyanobacteria, so cyanobacteria monitoring is not proposed for additional monitoring in this Study. However, if any AIS that are not specifically targeted during this *AIS Study* are observed, they will be recorded as incidental sightings.

Surveys for aquatic invasive snails and clams will be performed at nine locations on Pyramid Lake, and at one site just downstream of Pyramid Lake (see Figure 4.1-1). To the extent practical, survey sites will coincide with sites currently sampled for AIS by DWR. Two locations on Quail Lake will also be selected per Figure 4.1-2. Elderberry Forebay will also be surveyed for invasive snails and clams, with one transect selected along the shoreline (see Figure 4.1-3).

Specific survey sites will be located in areas where AIS are more likely to be introduced or in areas with potential habitat for AIS snails and/or clams. In general, areas with silt, sand, or gravel substrate and a relatively low gradient will be targeted for the focused survey, which will be conducted from a boat.

At each focused site, surveyors will establish a 320-foot transect along (parallel to) the shoreline, covering what is accessible from the boat (a total of approximately 3 feet, spread above and below the waterline). The Licensees will collect general site information, including the geographical extent of the site (using a map-grade GPS unit), the date and time of the survey, field crew member's present, and general characterization of the weather. Representative photographs of each site will be taken.

The Licensees will record the dominant and sub-dominant substrate, the average water depth, and the maximum water depth encountered during the survey. Basic water quality parameters will be collected including water temperature, dissolved oxygen

(DO), pH, conductivity, and turbidity using a hand-held probe (e.g., HydroLab or YSI) and measure water clarity using a Secchi disc. For purposes of characterizing the aquatic plant species composition along each transect, all aquatic vegetation will be identified to the species level within the littoral zone using a presence/absence protocol. The littoral zone is the near shore area where sunlight penetrates to the sediment and allows aquatic plants (macrophytes) to grow.

At each focused survey location, the presence or absence of Asian clams, European ear snail, New Zealand mudsnail, and channeled apple snail will be evaluated using two methods: visual surveys and a sediment sieve.

First, a visual inspection of the shoreline aquatic vegetation and immediate shallow water will occur at each survey site to determine the presence of snails, clams, or other mollusks. Depending on gradient, water level and clarity, staff will also visually inspect an area of the shoreline up to 33 feet from the wetted edge.

Additionally, up to 10 unique sediment samples will be collected and sieved within each focused site. Five samples will be collected along the shoreline (approximately 66 feet apart), and five more will be collected approximately 33 feet offshore, perpendicular from the corresponding onshore sample, which will be used as reference points for each offshore sample (Grohs and Klumb 2010). The samples collected along the shoreline, under the water, will involve shoveling substrate directly into a five-gallon bucket with a stainless steel wire cloth affixed to the bottom (Figure 4.1-4). Each sample will consist of enough sediment to fill the bucket to a predetermined volume (approximately two to three shovel loads). The substrate sample will be rinsed to remove the fine sediment, and staff will note the presence or absence of snails and clams of interest in each subsample. Other bivalves and mollusks will be identified to the extent possible.

Samples taken offshore will be collected using an Ekman dredge or similar device (Figure 4.1-5) and will follow the same process described above.



Figure 4.1-4. Example Sieve and Bucket System



Figure 4.1-5. Example Ekman Dredge

The Licensees will also conduct surveys for the red-eared slider. Basking and visual encounter surveys will be conducted in the nine focused locations in Pyramid Lake, one

site downstream of Pyramid Lake, the two sites on Quail Lake and the one site on Elderberry Forebay identified for the aquatic invasive snail and clam surveys. The Licensees will survey suitable habitat within focused locations. Surveys will be performed with binoculars and a tripod-mounted spotting scope. Additionally, surveys will be conducted for a period of up to one hour per survey site and will occur at dawn. The following data will be recorded: date, time, observer, GPS location, weather description, presence or absence of slow-moving water, basking substrate type, percent submergent and emergent vegetation, estimated water depth, and description of nearby upland habitat. Additional reptile or amphibian species seen during these surveys will be recorded as incidental sightings.

To document the presence of aquatic invasive plants (including alligatorweed, water hyacinth, hydrilla, water primrose, parrotfeather, etc.) in the open water (as compared to the shoreline surveys described above), the Licensees will conduct one survey of the portions of Pyramid Lake open to motorized boats, following pre-established survey transects spaced approximately 96 feet apart. The water surface will be surveyed for aquatic plants. In addition to the boat operator, there will be two surveyors, one on either side of the boat, each scanning a 48-foot-wide area. A weed rake will be used along the transect and checked periodically to retrieve aquatic weeds that are not visible from the surface.

All aquatic plant species documented during the open water surveys will be identified to species level, if possible. If necessary for identification, plants will be collected and keyed using the Jepson Manual (Baldwin et. al. 2012).

If an AIS plant species is identified, the following information will be collected:

- Digital photos to document the occurrence
- GPS delineated point or polygon
- Estimated phenology and descriptions of reproductive state
- Potential Project-related activities in the vicinity of the specimen
- Estimated size of occurrence (i.e. number of individuals)

AIS plant surveys will be conducted in the late summer or early fall.

American bullfrog and red swamp crayfish will be noted if incidentally observed during the Study.

Quality Assurance and Quality Control

Field data will be collected in a manner that promotes high quality results, and will be subject to appropriate QA/QC procedures including rechecking field data sheets, spot-checking data, and reviewing electronic data, including GIS products, for completeness.

Analysis

Following the surveys, the Licensees will prepare GIS maps depicting AIS occurrences, Project facilities, Project-related recreation activities and other data collected during surveys. Water quality will be reviewed, where applicable and as relevant to the potential introduction or establishment of AIS in the study area for the *AIS Study*.

Reporting

The Licensees will compile *AIS Study* results for incorporation, to the extent they have been completed, into the ISR, USR, DLA, and FLA. A map showing the locations of AIS found in the reservoir will be included in the summary.

Specific AIS will be reported to relevant agencies within three days of being located as follows:

- CDFW, if quagga or zebra mussels, New Zealand mudsnail, or channel apple snail are located
- California State Parks, Division of Boating and Waterways, if water hyacinth is observed
- California Department of Food and Agriculture (CDFA), if hydrilla is observed

4.1.1.5 Consistency of Methodology with Generally Accepted Scientific Practices

The *AIS Study* methodology is consistent with recently performed surveys for AIS, including 2014 and 2016 surveys for Asian clams in New York and New Bullards Bar Reservoir in California respectively; 2010 surveys for New Zealand mudsnails in Washington; and 2012 surveys for aquatic invasive plants, snails and bivalves in the Umpqua National Forest in Oregon.

4.1.1.6 Schedule

The *AIS Study* will begin after FERC issues its Study Plan Determination. The Licensees anticipate the schedule below will be followed to complete the *AIS Study*.

Fieldwork Preparation	June 2018 – July 2018
Fieldwork	August 2018
Data QA/QC	October 2018
Data Analysis and Reporting	October 2018 – December 2018

4.1.1.7 Level of Effort and Cost

Based on the work effort described above, the Licensees estimate the current cost to complete this *AIS Study* will range between \$140,000 and \$181,000.

4.1.1.8 References

- Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, editors. 2012. The Jepson Manual: Vascular Plants of California, second edition. University of California Press, Berkeley.
- Grohs, K. and R. Klumb. 2010. Asian clam sampling on five South Dakota Reservations. USFWS. Accessed October 17, 2016. Last updated October 7, 2010. Available online: <<https://www.fws.gov/mountain-prairie/fisheries/gpFWCODocs/GrohsandKlumbSDReservationsAsianClamReport2010.pdf>>. USFWS. Pierre, South Dakota.
- DWR. 2010. The Quagga and Zebra Mussel Rapid Response Plan for the State Water Project. 93 pp. CONFIDENTIAL/PRIVILEGED – Not for Public Distribution.