LAKE ELSINORE FISHERIES MANAGEMENT
WORK PLAN and QUALITY ASSURANCE PROJECT PLAN

FINAL

Submitted to:
Lake Elsinore & San Jacinto Watersheds Authority
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Riverside, California 92503

Submitted by:
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August 2019

APPROVAL SIGNATURES FOR THE WORK PLAN AND QAPP

Mark Norton, LESJWA TMDL Task Force Lead

Signature 9/9/19 Date

Nicole Dailey, City of Lake Elsinore, Assistant to the City Manager

Signature Date

Heather Boyd, Santa Ana Regional Water Quality Control Board

Signature Date

Chris Stransky, Wood Environment & Infrastructure, Project Manager

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John Rudolph, Wood Environment & Infrastructure, Senior Aquatic Scientist/QA Officer

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Heather Boyd 8/30/2019

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Nicole Dailey, City of Lake Elsinore, Assistant to the City Manager

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Heather Boyd, Santa Ana Regional Water Quality Control Board

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Chris Stransky, Wood Environment & Infrastructure, Project Manager

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John Rudolph, Wood Environment & Infrastructure, Senior Aquatic Scientist/QA Officer

Signature 9/3/19
Date

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ACRONYMS AND ABBREVIATIONS

ºC	degrees Celsius
<	less than
%	percent
µg/kg	micrograms per kilogram
µm	micron
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
CI	confidence interval
cm	centimeter(s)
COC	chain-of-custody
CRM	Certified Reference Material
DDT	dichlorodiphenyltrichloroethane
DI	deionized
DW	Dry Weight
EDD	electronic data deliverable
FL	Fork Length
FMP	Fisheries Management Program
GEI	GEI Consultants, Inc.
ft	feet
g	gram(s)

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ICF	ICF International
ID	Identification
in	inch(es)
kg	kilogram(s)
L	liter(s)
LECL	Lake Elsinore and Canyon Lake
LEMP	Lake Elsinore Management Project
LESJWA	Lake Elsinore and San Jacinto Watershed Authority
m	meter(s)
mm	Millimeter(s)
m/sec	meters per second
m^2	square meters
MB	method blank
MDL	method detection limit
MDL/RLs	method detection limits and reporting limits
M&A	Merkel & Associates
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter(s)
mm	millimeter(s)
MQI	measurement quality indicators
MQO	measurement quality objective
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
PCB	polychlorinated biphenyl
Physis	Physis Environmental
PM	Project Manager
ppt	parts per thousand
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
REC1	Water Contact Recreation
REC2	Non-Contact Recreation
RF	Relative Frequency
RL	Reporting limit
RPD	relative percent difference
RSD	relative Standard Deviation
RWQCB	Regional Water Quality Control Board

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Santa Ana Water Board	Santa Ana Regional Water Board
SDG	sample delivery group
SM	Standard Methods
SOP	standard operating procedure
SOW	Scope of Work
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TBD	to be determined
TL	Total Length
TMDL	total maximum daily load
TOC	total organic carbon
UCR	University of California, Riverside
U.S.	United States
USEPA	United States Environmental Protection Agency
WARM	Warm Freshwater Aquatic Habitat
WILD	Wildlife Habitat
Wood	Wood Environment & Infrastructure Solutions, Inc.
WW	Wet Weight

1.0 INTRODUCTION

1.1 Study Location and Background

Lake Elsinore is a large inland lake that lies at the base of the 780 square mile San Jacinto River watershed. It is located approximately five miles downstream of Canyon Lake, a reservoir established by the construction of the Railroad Canyon Dam in 1928. The Santa Ana Regional Water Quality Control Board (Santa Ana Water Board) has designated the following beneficial uses: Warm Freshwater Aquatic Habitat – (WARM), Water Contact Recreation (REC1), Non-Contact Recreation (REC2), Rare, Threatened or Endangered Species (RARE), Commercial and Sportfishing (COMM), and Wildlife Habitat (WILD).

Lake Elsinore has historically been a terminal lake, with outflows to Temescal Creek occurring rarely and only during prolonged period of extremely high precipitation. The condition of Lake Elsinore under natural circumstances has varied significantly over the last 100 years in response to dry and wet climatic periods affecting the expanse and depth of the lake. Historically, during extremely wet cycles, the surface area of the lake was almost 6,000 acres and would overflow into Temescal Creek. In contrast, during extended drought periods, the lake has become a dry lakebed, most recently between 1954 and 1964. While lake level stabilization is being addressed through recycled water additions to the lake, given the naturally variable climatic conditions and surrounding anthropogenic activities (both current and historic), the quality of the water (especially salinity), the resident biological community (fish, zooplankton, and phytoplankton), and the opportunity for recreation in and on the lake can vary significantly.

Efforts to manage water quality and improve lake level management have been ongoing for many years. An important outcome of these efforts was the implementation of the Lake Elsinore Management Project (LEMP) in the early 1990s. The LEMP resulted in the construction of a levee that separated the main lake from its southeast floodplain (or so-called back basin) to reduce the lake surface area from about 6,000 to 3,000 acres. Anticipated benefits of LEMP included increased average lake depth and significant reduction in evaporative losses, which could improve water quality and recreational opportunities.

In 1994, the Santa Ana Water Board made a finding that the lake's WARM, REC1 and REC2 beneficial uses were impaired due to excessive algae blooms and periodic fish kills. As a result, the lake was listed on the state's list of impaired waters (i.e., 303(d) List). To address the impairment, the Santa Ana Water Board adopted a nutrient Total Maximum Daily Load (TMDL) in 2004[1] that established numeric targets for total nitrogen and total phosphorus (causal targets) and chlorophyll-a, dissolved oxygen and ammonia (response targets).

The nutrient TMDL established waste load and load allocations applicable to dischargers in the Lake Elsinore watershed. To coordinate efforts and share costs for TMDL implementation, these dischargers formed the Lake Elsinore and Canyon Lake (LECL) Task Force in 2005. The LECL Task Force is administered by the Lake Elsinore and San Jacinto Watershed Authority (LESJWA), which was established in 2000 to improve water quality and wildlife habitats in Lake Elsinore, Canyon Lake, and the San Jacinto watershed. Through LESJWA and the LECL Task Force, significant efforts have been directed towards improving water quality in Lake Elsinore to benefit

[1] California Regional Water Quality Control Board. Santa Ana Region. Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate Nutrient Total Maximum Daily Loads (TMDLs) for Lake Elsinore·and Canyon Lake. Resolution No. R8·2004·0037.

recreation and aquatic life, including the lake's fishery. These efforts included but are not limited to the following studies:

- *Fisheries Management Plan (FMP)*[2] – In 2005, LESJWA commissioned EIP Associates to develop a "fisheries enhancement and maintenance program to create a balanced, self-sustaining and valued sport fishery." Because the aquatic environment of the lake was and is highly variable, the FMP uses the term "enhance" rather than restore, with the goal to improve trophic conditions to a more desirable state. The resulting program identified five enhancement objectives in order of priority: (1) carp control; (2) zooplankton community structure enhancement; (3) aquatic and emergent vegetation restoration; (4) fish habitat improvement; and (5) fish community structure improvement. However, it was noted that without carp control and water quality improvements, other objectives may not be attainable.
- *Carp Control Program* – Carp, through their foraging behaviour, cause resuspension of lake bottom sediments, a process called bioturbation. These resuspended sediments can then impact water quality by rendering nutrients bioavailable to planktonic algae. Large, dense populations of carp can have significant impacts on water quality. Computer simulations conducted in 2007 by Dr. Anderson for the LECL TMDL Task Force in support of the In-Lake Sediment Nutrient Reduction Plan for Lake Elsinore estimated that reducing the total number of carp in Lake Elsinore by 75% would lower the average phosphorus concentration from 0.38 mg/L to 0.26 mg/L (a 31% improvement). Even reducing the total number of carp by only 50% was expected to provide a 12% improvement in average phosphorus concentrations[3]. The estimated density (mass) of carp in Lake Elsinore in 2007 at the time of this report was 93 pounds per acre, equivalent to approximately 46 carp per acre. In 2003, prior to the carp removal program, there was an estimated average of 375 carp per acre in Lake Elsinore with a range of 250 to 500 fish/acre. As noted in the 2016 TMDL Progress Report (prepared by Risk Sciences on behalf of the LECL Task Force), the carp removal program implemented from 2002-2008 on Lake Elsinore resulted in the removal of an estimated 1.3 million pounds of carp from the lake (an approximately 88 percent reduction in carp biomass), resulting in beneficial reductions of water column total phosphorus.
- *Sport Fish Stocking Program* – Sport fish have been periodically stocked in Lake Elsinore to support efforts to reduce populations of nuisance carp and threadfin shad. The EIP Associates 2005 report identified shad control as an important need because of this fish species' deleterious impact on zooplankton populations. Shad are zooplanktivores, consuming planktonic cladoceran and copepod species that in turn feed on planktonic algae. This predation by the shad reduces the zooplankton population, particularly the large bodied taxa which are the most efficient algal grazers, thus reducing the ability of the zooplankton to keep algal blooms in check. The LECL Task Force's 2007 "*In-Lake Sediment Nutrient Reduction Plan for Lake Elsinore*,"[4] noted that stocking sport fish had

[2] EIP Associates. 2005. Fisheries Management Plan for Lake Elsinore. August 2005

[3] Dr. Michael Anderson (U.C. - Riverside). Predicted Effects of Restoration Efforts on Water Quality in Lake Elsinore: Model Development and Results. March 12, 2006; see pg. 26.

[4] In-Lake Sediment Nutrient Reduction Plan for Lake Elsinore. Submitted by: Lake Elsinore/Canyon Lake TMDL Task Force. October 22, 2007

significantly reduced the populations of both carp and shad, thereby helping to improve water quality in the lake.

- *Fish Community Surveys* – Periodic fish surveys have been conducted in Lake Elsinore by the University California, Riverside (UCR) and the California Department of Fish & Wildlife. Dr. Michael Anderson of UCR conducted hydroacoustic fish surveys in Lake Elsinore in Spring 2008 and 2015[5][6]. In his most recent survey, the lake was found to be dominated by small fish (95.6% are less than 3.5 cm in length - consistent with threadfin shad) with an estimated areal density of 54,100 fish/acre. In contrast, the density of large fish (greater than 20 cm in length) was estimated to be only 12.3 fish/acre.
- Zooplankton and Phytoplankton Surveys – Various studies have evaluated the zooplankton and phytoplankton communities of Lake Elsinore – both critical elements to water quality and a functioning fish community[7][8]. For example, in a May 2004 UCR report, Zooplankton Monitoring at Lake Elsinore[9], prepared on behalf of LESJWA, the authors noted the impact of increased salinity on the zooplankton and the importance of addressing this water quality issue before considering other strategies to manage the biological community. Additional zooplankton and phytoplankton data collected as part of the 2015 fish survey further indicated how increased salinity is influencing zooplankton and phytoplankton community characteristics

The LECL Task Force in collaboration with the Santa Ana Regional Water Quality Control Board have drafted a revised and updated TMDL for LECL to make corrections to the prior TMDL and take into account the findings from the many studies conducted on Lake Elsinore since TMDL adoption in 2004. The supporting technical documentation for the TMDL revision includes fishery management as an important component of a comprehensive implementation program to meet the revised numeric water quality targets for the lake. Within two years of the effective date of the revised TMDL, existing TMDL implementation plans, e.g., the Riverside County MS4 Program's Comprehensive Nutrient Reduction Plan (CNRP)[10] and the agricultural community's Agricultural Nutrient Management Plan[11], will need to be revised to take into account the requirements of the revised TMDL. As part of that revision process, water quality management projects such as fishery management, including carp removal, will be an important part of the TMDL implementation efforts moving forward.

The nutrient TMDL revision is intended to address impairments for toxicity, nutrients, and organic enrichment/low dissolved oxygen. However, the lake is also listed as impaired for polychlorinated biphenyls (PCB) and dichlorodiphenyltrichloroethane (DDT). The impairment listings for these constituents are based on elevated fish tissue concentrations observed during various fish tissue studies, with the most recent data being collected in a State Water Resources Control Board

[5] Technical Memorandum. Hydroacoustic Fisheries Survey for Lake Elsinore: Spring, 2008. Submitted October 26, 2008

[6] Technical Memorandum. Fishery Hydroacoustic Survey and Ecology of Lake Elsinore: Spring, 2015. Submitted February 28, 2016

[7] Veiga-Nascimento, R.A. 2004. Water Quality and Zooplankton Community in a Southern California Lake Receiving Recycled Water Discharge. Master of Science Thesis, University of California, Riverside.

[8] Tobin, M.E. 2011. A Characterization of the Phytoplankton, Zooplankton, and Benthic Invertebrate Communities of Lake Elsinore. Master of Science Thesis, University of California, Riverside.

[9] Veiga-Nascimento, R.A. and Michael A. Anderson. Department of Environmental Science, University of California – Riverside. Zooplankton and Aeration Monitoring at Lake Elsinore. Final 5th Quarterly Zooplankton and Aeration Summary. Tech Memo. May 2004.

[10] CDM Smith. 2013. Comprehensive Nutrient Reduction Plan for Lake Elsinore and Canyon Lake

[11] The Western Riverside County Agriculture Coalition. 2013. Agricultural Nutrient Management Plan (AgNMP) for the San Jacinto Watershed

(SWRCB) 2007 study[12]. PCBs were listed as a 303(d) impairment in 2006 and DDT was added to the list after the 2014/2016 listing process. DDT was listed as an impairment despite an analysis of available fish tissue data dating back to the early 1980s indicating that the concentration of the banned pesticide has declined markedly from the 1980s to 2007. However, no recent fish tissue data are available for DDT or PCBs for Lake Elsinore to quantify how much fish tissue PCB and DDT concentrations have declined in the 12 years since the previous samples were analysed.

1.2 Study Purpose

The purpose of the study is to conduct fish, zooplankton, and phytoplankton surveys to update information on the aquatic communities of Lake Elsinore. The study will also subsample fish for analysis of PCB and DDT concentrations in their tissues. Targeted fish will also be analyzed for nutrient concentrations to quantify the mass of nutrients removed if a carp-removal program is implemented, or if other species are removed during future fish die-offs. Results of these data collection efforts will be used to: (1) develop recommendations to improve the Lake Elsinore fishery and habitat to support efforts to implement the revised nutrient TMDL; (2) determine appropriate fish species for future fish stockings in the lake; (3) determine the need for additional removal of fish nuisance species impacting water quality, and (4) evaluate trends in PCB and DDT concentrations over time.

It is important to note that this fish survey and related tissue sampling will occur during an atypical period for Lake Elsinore. The large Holy Fire wildfire began on August 6, 2018 and reached full containment on September 13, 2018 with total burned area of 23,025 acres (35.9 square miles). Lake Elsinore is within the Holy Fire's burned watershed area, with multiple sub-watersheds draining to the lake. Since containment of the fire, the area received numerous storms of varying intensity, totaling approximately 23 inches of rain from October 4, 2018 through March 22, 2019, with large debris flows entering the lake during several of the larger storm events. Approximately two weeks after an early December 2018 storm dropped approximately 2 inches of rain in the watershed area, a large fish die-off was observed in Lake Elsinore which continued through January 2019. The die-off was attributed to the golden algae, *Prymnesium parvum*, a species not previously observed in high concentrations in the lake. A total of 150 tons of fish were removed from the lake during this event, consisting primarily of common carp and threadfin shad, although numerous channel catfish and largemouth bass along with other species were removed as well. One of the purposes of this fishery community survey is to evaluate what impact, if any, these events had on the fish and plankton populations. Data collected from this survey will be compared to the most recent acoustic survey of fish populations by Dr. Anderson conducted in 2015.

1.3 Project Partners

Wood Environment and Infrastructure Solutions, Inc. (Wood) will be the prime contractor and point of contact for the program. Wood will be supported by an expert team of sub-service firms to support the program including GEI Consultants Inc. (GEI), ICF International (ICF), Merkle & Associates (M&A), Dr. Rosalina Stancheva, and EcoAnalysts, Inc. Wood will coordinate activities between all project sub-service firms.

[12] Davis, J.A., A.R. Melwani, S.N. Bezalel, J.A. Hunt, G. Ichikawa, A. Bonnema, W.A. Heim, D. Crane, S. Swenson, C. Lamerdin, and M. Stephenson. 2009. Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA.

In addition to the sub-service firms listed above, Wood will coordinate with local lake management staff including Mr. William Johnson, Mr. Johnathan Skinner, and Ms. Nicole Dailey. Their extensive in-lake experience will provide invaluable insight into areas of the lake best targeted for collecting specific species of fish, lake observations outside the scope of this study, and for communication of results to the public.

1.4 Work Plan Contents

This Work Plan has been prepared by Wood to summarize the elements of the study. These elements include collection of fish, zooplankton, phytoplankton, and fish tissue samples. Wood will coordinate and oversee analysis of all tissue samples, which will include the associated quality assurance and quality control (QA/QC), reporting, and analysis of these data. Included in this Work Plan is the associated Quality Assurance Project Plan (QAPP) for chemical analysis of tissues in addition to a summary of methods related to collection and analysis of samples. This Work Plan and QAPP will be provided to all the study partners listed in Section 2.2 (Table 2-1).

2.0 PROJECT MANAGEMENT RESPONSIBILITIES

2.1 Project description

The primary elements of this Study are:

- Field mobilization and collection of fish, zooplankton, and phytoplankton for analysis of community structure
- Collection of fish tissue samples for analysis of PCBs, DDTs, and nutrients;
- Internal data QA/QC;
- Preparation of a draft and a final report summarizing the results of sampling, laboratory analyses, and data analysis; and
- Provide recommendations to build upon the success of beneficial management strategies to improve the Lake Elsinore fishery and implementation of the revised TMDL.

2.2 Key Project Personnel

The key project personnel and their roles for this monitoring program are as follows:

a. ***Project Manager/Senior Scientist: Chris Stransky (Wood)*** – Mr. Stransky is the overall project manager and lead senior scientist. He will be responsible for overall project management, study design, coordination with funding partners, and completion of reports and other contract deliverables.

b. ***Senior Aquatic Biologist/Quality Assurance Officer: John Rudolph (Wood) –*** Mr. Rudolph will have primary responsibility for all sample collections, adherence to proper methods, data analysis, generation of technical reports for LESJWA, communication with other agency Program Managers, and coordination of as-needed regulatory support. Mr. Rudolph will have final decision authority for questions or issues regarding sampling of fish and plankton, and analysis of tissue samples. Mr. Rudolph will also provide technical assistance in drafting of the Fisheries Management report.

c. ***Aquatic Biologist/Field Survey Lead: Kevin Stolzenbach (Wood) –*** Mr. Stolzenbach will lead the day-to-day field collection activities and ensure that proper methods are being used. He will be responsible for all equipment operation, sample collection, and coordination with the subcontracted laboratories. He will also be responsible for reporting activities related to the field collection methodologies including QA/QC documentation, field checklists, site-to-site cross-checks on sample containers and labels, and chain-of-custody (COC) forms. He will ensure that the proper field QA/QC documentation is provided for all reports as well. In his Field Lead role, Mr. Stolzenbach will assist Mr. Rudolph with the day-to-day operations of this project. Kevin will also provide technical assistance in drafting of the Fisheries Management report.

d. ***Senior Scientist Consultant: Richard Meyerhoff: (GEI) –*** Mr. Meyerhoff will be responsible for providing senior oversight and review of the reporting effort based on his regulatory insight in relation to the TMDL for Lake Elsinore and Canyon Lake.

e. ***Senior Fisheries Expert: Craig Wolf (GEI) –*** Mr. Wolf will be responsible for preparing the Fisheries Management report based on the results of the field sampling, statistical

analysis and interpretation of fish and plankton community. He will also provide oversight of all GEI staff performing field sampling efforts.

f. ***Senior Fisheries Scientist: Joel Mulder (ICF) –*** Mr. Mulder will support field sampling efforts and in the interpretation of fisheries data during report preparation.

g. ***Senior Fisheries Scientist: Lawrence Honma (Merkel & Associates) –*** Mr. Honma will oversee purse seining field efforts.

h. ***Contract Analytical Laboratory: Mark Baker (Physis Environmental) –*** Mr. Baker will coordinate and oversee sample preparation and chemical analysis of fish tissue samples.

i. ***Contract Zooplankton Taxonomy Laboratory:*** **Gary Lester (EcoAnalysts) -** Mr. Lester will coordinate and oversee zooplankton taxonomy and QA.

j. ***Contract Phytoplankton Taxonomy Laboratory:*** **Rosalina Stancheva (Independent) -** Ms. Stancheva will coordinate and oversee phytoplankton taxonomy and QA.

Key project personnel, roles, and associated contact information are provided in Table 2-1. An organizational chart is provided in Figure 2-1.

Table 2-1.
Project Point of Contacts

Name	Affiliation	Title	Telephone Number, E-mail Address
Chris Stransky	Wood Environment & Infrastructure	Project Manager	(858) 300-4350 (o) (858) 775-5547 (c) chris.stransky@woodplc.com
John Rudolph	Wood Environment & Infrastructure	Senior Aquatic Biologist/Quality Assurance Officer	(858) 514-6465 (o) (858) 243-8158 (c) john.rudolph@woodplc.com
Kevin Stolzenbach	Wood Environment & Infrastructure	Aquatic Biologist/Lead Field Scientist	(858) 300-4342 (o) (847) 650-5552 (c) kevin.stolzenbach@woodplc.com
Richard Meyerhoff	GEI	Senior Scientist Consultant	(303) 264-1013 (o) rmeyerhoff@geiconsultants.com
Craig Wolf	GEI	Senior Fisheries Scientist	(303) 264-1028 (o) CWolf@geiconsultants.com
Lawrence Honma	Merkel & Associates	Senior Fisheries Scientist	(858) 560-5465 (o) LHonma@merkelinc.com
Joel Mulder	ICF	Senior Fisheries Scientist	(213) 312-1799 (o) Joel.Mulder@icf.com
Mark Baker	Physis Environmental	Laboratory Analytical Project Manager	(714) 602-5320 (o) markbaker@physislabs.com
Gary Lester	EcoAnalysts	Laboratory Taxonomy Project Manager - Zooplankton	(208) 882-2588 x21 (o) glester@ecoanalysts.com
Dr. Rosalina Stancheva	Independent	Laboratory Taxonomy Project Manager – Phytoplankton	(858) 231-0506 (o) rosalinastan@gmail.com

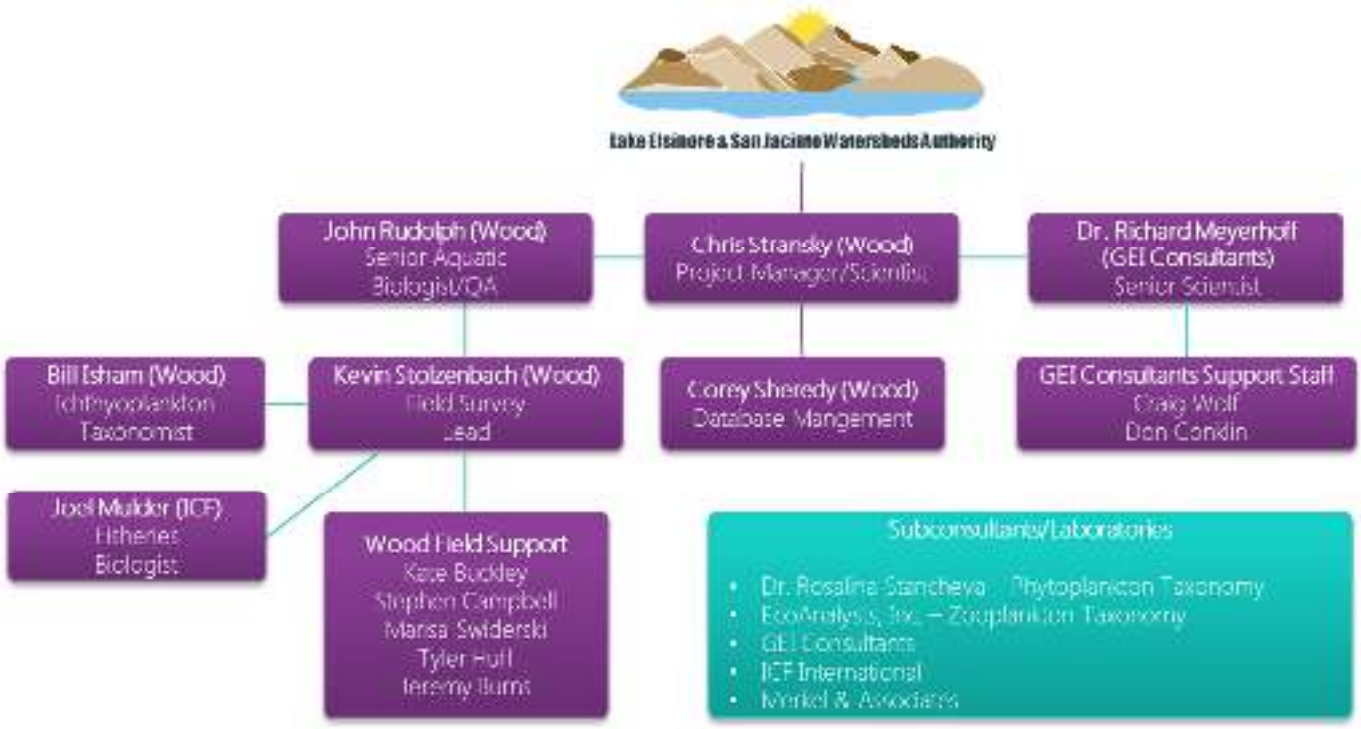

Figure 2-1. Organizational Chart

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3.0 DATA REVIEW AND SAMPLE COLLECTION PROCEDURES

3.1 Brief Historical Data Review

Along with regular fish stockings for recreational purposes, a number of biological surveys and fish reports have been conducted in Lake Elsinore over the years since 1964, the last year in which the lake was dry, including the following: 1984 Lake Elsinore State Recreation Area General Plan[13], 1993 and 2002 California Department of Fish and Wildlife (DFW) surveys[14], 2002-2008 carp removal program[15], 2003 EIP Associates seining survey[16], 2003-2004 zooplankton community survey technical memos[17] and master's thesis by Rebecca Ann Veiga-Nascimento of University of California Riverside (UCR), 2005 EIP Associates FMP, the Spring and Fall 2010 California Department of Fish and Wildlife surveys[1819], characterization of the phytoplankton, zooplankton, and benthic invertebrate communities thesis by Michele Tobin of UCR, the DFW 2014 Aquatic Invasive Species Assessment[20], and finally the acoustic surveys performed by Dr. Michael Anderson of UCR in 2008 and 2015.

Given Lake Elsinore's unique and varied characteristics over time, there is much available data and literature relating to the biological community in Lake Elsinore that will be critical to understanding the dynamic nature of the biological community in this lake. A review has been conducted on historical reports and data regarding the biological communities in Lake Elsinore to better inform the collection efforts. A thorough summary of historical fishery community characteristics, along with prior fish tissue PCB and DDT evaluations, will be provided as part of the final Fishery Management Activities Report.

3.2 Sample Collection

3.2.1 Planktonic Community

Understanding the connectivity of the entire food web is vital to understanding the ecological status of the Lake Elsinore fishery. This begins by looking at bottom up influences of the phytoplankton and zooplankton communities.

Tri-annual plankton samples throughout the lake will be performed to assess phytoplankton and zooplankton community structure and variability, both spatially and temporally (Figure 3-1). These three surveys will be conducted at three stations approximately 4 months apart.

Zooplankton tows will be conducted by performing duplicate vertical tows through the water column at each station using a Wisconsin plankton net with a 120 millimeter (mm) opening and 63 micron (µm) mesh. At each station the duplicate tows will be composited into a 250 milliliter

[13] California. Dept. of Parks and Recreation. 1984. Lake Elsinore State Recreation Area. 78 pgs

[14] State of California Department of Fish and Wildlife. 2002. Lake Elsinore Fish Population Indices for Assessment of Undesirable Fish Removal

[15] Lake Elsinore Fishery Assessment. 2008

[16] Data summary provided to LESJWA October 2008.

[17] April 2003 to November 2004. Zooplankton and Aeration Monitoring at Lake Elsinore. Six quarterly technical memos and one final report provided to LESJWA

[18] State of California. The Resources Agency. Department of Fish and Game: Lake Elsinore General Fish Survey Spring, 2010

[19] State of California. The Resources Agency. Department of Fish and Game: Lake Elsinore General Fish Survey Fall, 2010

[20] State of California Department of Fish and Wildlife. Initial Report Aquatic Invasive Species Assessment of Lake Elsinore, Riverside County, 2014

(mL) high-density polyethylene(HDPE) bottle and preserved with a final concentration of 5% Lugol's iodine by volume (example, for 250mL sample, add 5mL of 2% Lugol's iodine).

Zooplankton samples will be kept cool (between 3-6 degrees Celsius (ºC) in the dark until transferred to EcoAnalysts, Inc. for taxonomic analysis. Samples will be shipped to EcoAnalysts by overnight delivery on blue ice to arrive at the laboratory by 10am. A subsample target count of 200 organisms will be made (or all organisms in the sample if fewer than 200 are present in the sample) including rotifers, with aggregate taxonomic identification made to the lowest practicable level. A digital synoptic photographic reference collection will also be provided for each taxa identified. The data deliverables will include taxa list and enumeration, density/liter per taxon, taxa richness/diversity, and biomass. All zooplankton taxonomic data will be uploaded to the California Environmental Data Exchange Network (CEDEN).

Phytoplankton will be collected from the top 2 meters (m) of the water column at each station using a peristaltic pump and lowering/raising the inlet tube through the water column at a uniform speed. Separate samples for diatoms and soft-bodied phytoplankton will be subsampled from the top 2-m composite at each station and placed into 250-mL HDPE bottles. The samples will be preserved to a final concentration of 10% Lugol's iodine solution (soft-bodied phytoplankton) or 4% buffered formalin (diatoms).

Figure 3-1. Proposed Plankton Tow Stations

Phytoplankton samples will be kept cool (between 3-6ºC) in the dark until transferred to Dr. Rosalina Stancheva for taxonomic analysis (soft-bodied algal and diatoms). Dr. Stancheva will pick up the samples at the Wood office. Each sample will have a total of 300 soft algal units and 600 diatom valves (if present in sufficient abundance) identified to the lowest possible taxon. The data deliverables will include a taxa list, enumeration, and cell density (cells/ml) for both soft-bodied algae and diatom taxa. A digital photographic reference collection of the top 10 most abundant taxa in each sample will also be provided. All phytoplankton taxonomic data will be uploaded to CEDEN.

3.2.2 Fish Community

Fish sampling will be performed during the late summer/early fall window, so that any young-of-the-year fish from spring spawning will be large enough to capture and evaluate species recruitment. An approximate sampling schedule is outlined in Table 3-1.

All fish captured during beach seines, otter trawls and purse seines will be measured using total length or fork length (species dependent) to the nearest millimeter (mm) and weighed to the nearest gram (g) in the manner outlined in Table 3-2. For bony fishes, total length is measured from the anterior tip of the head to the posterior end of the caudal fin. Fork length is measured from the anterior tip of the head to the notch in the caudal fin (or center when the tail is not forked).

For more abundant fish, the first 50 individuals will be measured and weighed, the next 150 will be measured and batch weighed, and the remainder will be batch-weighed to provide an estimate of total abundance and biomass.

Table 3-1. Sampling Schedule

Sampling Method	# of Stations	Schedule of Sampling	Tentative Dates	Comments
Plankton Tows	3	Tri-annual	July, October, February	Vertical Tows
Beach Seine (¼" mesh)	3	Event 1 (Late Summer) Event 2 (3-4 Weeks After Event 1) Event 3 (3-4 Weeks After Event 2)	Event 1 – Week of Sept 2-6 Event 2 – Week of Sept 23-27 Event 3 – Week of Oct 14-18	Tagging During Events 1&2 only
Tag and Recapture (3000 tags)	3	Late Summer/Early Fall	Concurrent with Beach Seine Events	Recapture During Beach Seining Events 2 & 3
Otter Trawl (16 ft headrope)	3	Late Summer/Early Fall	Week of Oct 7-11	After Beach Seine Event 1&2
Purse Seine (230 ft long, 20 ft deep)	3	Late Summer/Early Fall	Week of Oct 7-11	After Beach Seine Event 1&2

Table 3-2. Fish Length and Weight Processing

Fish No.	Length (mm)	Weight (g)	Notes
1-50	Individual fish	Individual fish	--
50-200	Individual fish	Batch Weigh	--
200+	Not Measured	Batch Weigh	Abundance and other biological metrics estimated from ratios obtained from first 200 fish

3.3 Beach Seining and Fish Tagging

Beach seining and a tag-and-recapture study will occur concurrently at three areas over three events (Figure 3-2). Areas selected for beach seining efforts were selected through review of the prior EIP fishery characterization effort in 2004-05 and consultation with Mr. William Johnson of the City of Lake Elsinore. The seine net will be set up to use various lengths by attaching sections to the wings to lengthen the net, ranging from 50 feet (ft) up to 850 ft depending on site characteristics. The nets will be 8-ft high with ¼ inch (in) mesh. The three areas of the lake will be the NW end of the lake (Launch Pointe Beach and West Marina Beach), the NE side of the

lake (Whiskers Fishing Beach and Elm Grove Beach, and the SW region of the lake (Perret Park and South Levee). These stations were selected due to their popularity amongst fishermen and because they allow for easy access to perform the beach seine surveys with small vessels and trucks on the beach. Generalized regions of the lake were selected rather than specific beaches to allow for flexibility in sampling to overcome obstacles such as: 1) poor catch at the primary location 2) restricted access for support vessels or trucks or 3) allowing sufficient time to sample an additional site at the discretion of the Field Lead. Additional areas that could be sampled are the SE channel and SW Levee, which will act as alternates in case any of the other areas are not accessible on the day of sampling or an area is abandoned due to low productivity or other unforeseen condition.

Figure 3-2. Proposed Beach Seine Stations

Event 1 will consist of the community structure survey where fish will be identified, measured, and weighed. All common carp (up to 4,000 individuals) that are caught will be tagged using Floy anchor tags, then released. Bass, catfish, bluegill, and crappie will be tagged using fin clips and released. **Event 2** will occur 3-4 weeks after Event 1 and will consist of the same community structure survey as performed in Event 1 along including recording any recaptured fish, along with a second round of tag and release. **Event 3** will occur 3-4 weeks after Event 2 and will consist of the same community structure survey and recording any recaptured fish (no further tagging will be performed).

As utilized in the 2005 EIP Associates FMP, the Peterson method will again be utilized to calculate a population estimate based on recapture of tagged fish. This method uses the basic assumption that tags are either distributed randomly into the population or the recovery effort is random. This ensures that the calculated recoveries of tagged fish are representative of the true proportion of tagged fish in the population. The other assumptions of this method are that there is no difference in mortality between tagged and untagged fish, and tagged and untagged fish are equally likely to be captured by the sampling gear.

The population (N) is estimated using the following formula:

$$N = M(U+R)/R$$

where M is the total number of fish tagged, U is the number of untagged fish in recovery sample, and R is the number of tagged fish in the recovery sample.

The three sampling events will allow for three independent population estimates using 1) tagged fish from Event 1 and recoveries from Event 2; 2) tagged fish from Event 2 and recoveries from Event 3; and 3) tagged fish from Events 1+2 and recoveries from Event 3.

The data collected will be used to calculate various metrics related to fish abundance and health such as length-weight curves, size class frequency, and condition factors.

3.4 Otter Trawling

Otter trawling will occur within three weeks of the final beach seine event (**Event 3**) to maximize the possibility of tagged fish recapture. Sampling will use an otter trawl (16-ft headrope, 1-in mesh in the body and ½-in mesh in the cod-end) towed on the bottom for a total of five minutes at three locations (Figure 3-3). Trawling will be conducted at a speed-over-ground of 1.0 meter per second (m/sec) (1.5 to 2.0 knots).

Prior to trawl deployment, the sampling vessel will travel the projected trawl path using a side-scan sonar to ensure that the net will not become entangled by debris on the bottom or any aeration system equipment.

The length of each trawl will vary depending on the site configuration, but a goal will be to target a maximum 5-minute trawl to stay within an approximate 500-m radius of each target sampling location. At the end of each trawl, the net will be retrieved and brought onboard the vessel. The cod-end will be opened, and the catch deposited into pre-cleaned plastic tubs for identification and sorting prior to processing. Fish captured during otter trawling will be processed according to methods outlined in Table 3-2.

Figure 3-3. Proposed Otter Trawl Stations

3.5 Purse Seining

Purse seining will occur within three weeks of the final beach seine event (**Event 3**) to maximize the possibility of tagged fish recapture. This will be performed using a small purse seine (230 ft length, 20 ft depth, ½-in mesh) deployed from a small vessel at three stations (Figure 3-4). At the end of each set, the net will be retrieved and brought onboard the vessel. The cod-end will be opened, and the catch deposited into pre-cleaned plastic tubs for identification and sorting prior to processing. Fish captured during purse seining will be processed according to methods outlined in Table 3-2

Figure 3-4. Proposed Purse Seine Stations

3.6 Fish Tissue Collection and Analysis

Collection of fish for tissue analysis of PCBs, DDTs, and nutrients will occur during the fish community surveys. Four species have been targeted for PCB and DDT tissue analysis to represent the primary resident fish sought by fishermen for consumption, including carp, largemouth bass, crappie, and channel catfish. Additionally, nutrients (total nitrogen (TN) and total phosphorous (TP)) will be analyzed in the tissues of these species as well as threadfin shad for potential use in quantifying nutrient sources removed from the lake if a carp-removal program is implemented, or if other species are removed as a result of future fish die-offs. If insufficient individuals of the target species are collected, alternate species would be considered for analysis including bluegill or red ear sunfish.

The goal during the fishery survey would be to collect fifteen individuals of each species that could then be combined into three composites, consisting of five individuals each (a minimum of three individual fish per composite)[21]. Fish collected in the field will be measured to the nearest mm

[21] California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Branch. 2005. General protocol for sport fish sampling and analysis.

and weighed to the nearest gram on precleaned measuring boards. Measuring boards will be cleaned between processing of subsequent fish.

An attempt will be made to collect carp and largemouth bass of similar length to those in the previous 2007-2008 State of California Surface Ambient Water Monitoring Program (SWAMP) fish tissue collection effort used for 303(d) listing purposes[22]. The smallest fish length collected for any composite will not be any smaller than 75% of the largest fish length. When composites are created, equal tissue weights will be taken from the 3 to 5 individual fish within each composite. Tissue for composites will be taken from the filet of each fish above the lateral line and from the belly to include areas of higher lipid content. Individual fish or composites of five individuals per species (if small such as threadfin shad) will be placed in pre-cleaned aluminum foil, and then double-bagged in a Ziplock bag with the inner bag labelled. Photographs of each fish will be taken with a waterproof tag identifying the sample. All samples will be double bagged, sealed, and labeled on the outside of the bag with the same information as the inside tag using permanent black marker.

The fish will be stored on wet ice until they can be transferred to a freezer at the end of the collection day. Fish will be stored at -20°C until they can be transferred to the laboratory for dissection and homogenization.

Skin-off filets of muscle tissue will be prepared by the analytical laboratory for PCB and DDT analysis to be consistent with analytical methods used for the prior 303(d) listing process (Davis et al., 2009). Tissue analyses for nutrients will use whole fish. Prior to analysis, the entire batch of composite tissue from each site for each species will be thoroughly homogenized by the analytical laboratory using a food-grade processor. All tissue samples will be prepared in a laboratory clean-room environment using noncontaminating techniques.[23]

Analysis will include percent lipids, percent solids, nutrients (TN and TP), DDT (and degradants), PCB congeners and PCB Aroclors (see Appendix A for a full list of analytes). Fish sampling and processing methods, and analytical methods will be consistent with the latest published guidance by SWAMP. A sub-sample of processed fish tissue composite for each species will be kept frozen at the Wood laboratory for 1-year in the event that subsequent confirmation analyses are required.

3.7 Sample Labeling

The field crew will be responsible for clearly labeling all sample containers. The following information will be required on each sample label:

a. Project name
b. Station ID
c. Analysis requested
d. Sampling date and time
e. Sampler's initials

[22] The Cruise Report for the June 2007-March 2008 Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs reported that the 10 carp collected were between 460-518mm total length, and the 22 largemouth bass collected were between 195-395mm total length.

[23] U.S. EPA. (2000). Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume I: Fish Sampling and Analysis. Third Edition. Office of Science and Technology. Office of Water. U.S. Environmental Protection Agency. Washington, D.C

3.7.1 Sample Handling and Custody

Holding times for each tissue analyte are listed in Table 3-3. The field coordinator will be responsible for ensuring that each field sampling team adheres to proper custody and documentation procedures. A master sample logbook of field data sheets shall be maintained for all samples collected during each sampling event. A chain-of-custody form must be completed after sample collection, archive storage, and prior to sample release.

Prior to the transfer of samples, analytical sample labels will be cross-checked with the associated COC. The field crew will check for proper sample identifications, number of samples at each station, and sample information (i.e., dates and times). The accuracy of any special sample notes/observations recorded during sampling will also be re-verified at this time. The project-specific field checklist shall be completed immediately following each sample location and shall also be cross-checked for completion at the end of each day prior to transfer of any samples. Archived samples will be retained for one year from collection.

If a hold-time violation has occurred, the PM and client will be notified. Affected data will be flagged appropriately in the final results submitted to CEDEN.

Table 3-3. Sample Handling and Holding Times

Parameter	Container	Preservation	Holding Time
Zooplankton	250ml HDPE	5% Lugol's Iodine	6 months
Phytoplankton Soft-bodied Algae	250ml HDPE	10% Lugol's Iodine	1-year
Phytoplankton Diatoms	250ml HDPE	4% Buffered Formalin	2-years
Organochlorine Pesticides	Wrapped in foil, zip top bag	Cool to ≤6°C within 24 hours, then freeze to ≤-20°C	1 year; samples must be extracted within 14 days of thawing and analyzed within 40 days of extraction
Polychlorinated Biphenyls	Wrapped in foil, zip top bag	Cool to ≤6°C within 24 hours, then freeze to ≤-20°C	
Total Nitrogen	Wrapped in foil, zip top bag	Cool to ≤6°C within 24 hours, then freeze to ≤-20°C	
Total Phosphorus	Wrapped in foil, zip top bag	Cool to ≤6°C within 24 hours, then freeze to ≤-20°C	

3.8 Field Data Collection

The Field Lead will collect data using paper field data sheets to maintain a complete record of field activities, including the following station and sample information:

Station Occupation Information

- Station ID
- Date
- Time of day
- Occupation latitude and longitude
- Collection type (plankton net, beach seine, purse seine, otter trawl)
- Weather conditions
- Target water depth
- Other comments regarding the station occupation (water color, clarity, algae presence)

Trawl/Seine Event Sample Information

- Station ID
- Date
- Type of trawl/seine
- Trawl time (duration)
- Net over position (latitude, longitude, over time)
- Trawl on deck position (latitude, longitude/ deck time)
- Trawl failure code (if applicable)

3.9 Chain of Custody Procedures

The Lead Field Scientist will be responsible for proper completion of all COC documentation for all samples collected during this program. COC forms will be completed and verified for accuracy at the end of each sampling day. COC forms will be signed prior to initial transfer, and at any additional point of transfer of samples following departure from the field.

Each COC form will contain the following information:

- Project name
- Sampling organization
- Point of contact
- Sample IDs
- Collection date and time
- Sample matrix (water, organisms, tissue, etc.)
- Requested analyses
- Sampler's name and signature

The form will serve as a sample analysis request form. Samples will be delivered by field staff or sent via courier to the laboratories along with the COC form specifying the sample identification and analyses to be conducted (by referencing a list of specific analyses or the statement of work for the laboratory). One copy will accompany the samples at all times, while a photo record will be taken of the signed COC as a record.

4.0 TISSUE SAMPLE ANALYSIS

Chemical analysis of fish tissues will be conducted by Physis Environmental Laboratories Inc. located in Anaheim, CA. All analyses will follow U.S. Environmental Protection Agency (EPA) or Standard Methods (SM). After generating of fish composites in the laboratory, lab homogenates will be frozen until analysis is performed. Table 4-1 provides the chemical analyses and methods and associated method detection and reporting limits for tissue samples. Target reporting limits for PCBs and DDTs are at or below levels used in the 2017 SWAMP Bioaccumulation Oversight Group's (BOG) QAPP for the Long-term Monitoring of Bass Lakes and Reservoirs in California. For a full list of analytes see Appendix A.

Table 4-1.
Chemical Analyses of Tissue Samples

Analyte	Extraction Method	Analysis Method	Tissue Target MDL [a]	Tissue Target RL [a]	Units
Solids	NA	SM 2540B	0.1	0.1	%
Lipids	NA	Gravimetric	0.01	0.5	%
Total Nitrogen	EPA Method 9060	EPA 9060	0.01	0.01	mg/g DW
Total Phosphorus	EPA Method 3051a	EPA 6020	0.016	0.05	ug/g DW
DDT and degradants	EPA Method 3540C Soxhlet Extraction	EPA 8270D	Varied [b]	0.5	ng/g WW
PCB Congeners		EPA 8270D	Varied [b]	0.5	ng/g WW
PCB Aroclors 1248, 1254, 1260		EPA 8270D	Varied [b]	20	ng/g WW

Notes:
RL – Reporting Limits
MDL – Method Detection Limit
DW – Dry Weight
WW – Wet Weight
SM - Standard Methods
NA – not applicable
[a] MDL and RL limits provided by Physis Environmental.
[b] A full list of individual analytes and MDLs are included in Appendix A.

5.0 DATA ANALYSIS

Fishery and analytical data will undergo a thorough QA/QC review by Mr. John Rudolph and will be reported using general descriptive statistics to evaluate the health and viability of the Lake Elsinore fish population, as well as compare community characteristics to prior studies. Zooplankton and phytoplankton populations will be additionally examined for temporal patterns across the seasons sampled.

Fish tissue analytical concentrations will be compared to the latest Fish Contaminant Goals (FCG) used by the State of California (SWRCB, 2017[24] and OEHHA, 2008[25]). The State of California fish tissue analytical concentration thresholds were calculated using a modified version of the Office of Environmental Health Hazard Assessment (OEHHA) FCG equation by increasing OEHHA's cooking reduction factor from 0.7 to 1.0. The cooking reduction factor is a numeric value used in OEHHA's equation that represents the approximate amount of a contaminant that is removed from tissue by cooking. A cooking reduction factor of 1.0 implies that the fish will not be prepared in any way as to decrease the amount of contaminant in fish tissue.

[24] SWRCB. 2017. 2014 and 2016 California Integrated Report Clean Water Act Sections 303(d) and 305(b) Staff Report.

[25] OEHHA. 2008. Development of fish contaminant goals and advisory tissue levels for common contaminants in California sport fish: chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene. Pesticide and Environmental Toxicology Branch, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency.

6.0 QUALITY ASSURANCE PROJECT PLAN

6.1 Field Activities

All field activities will be conducted as described in this Work Plan. Should the Lead Field Scientist need to deviate from methods described in this Work Plan (i.e., for safety or sampling logistic reasons), the Lead Field Scientist will contact the Wood Project Manager, who will in turn notify LESJWA.

6.1.1 Vessel Positioning

The vessel position for trawling and purse seining will be recorded prior to fish collection using a handheld GPS. The size and configuration of the areas trawled may vary depending on the site configuration, potential obstructions such as underwater structures, and debris. A pre-trawl survey will be conducted at each location to assess the substrate type and any potential physical obstructions prior to determining final trawl tracks that will best represent each site.

6.1.2 Sample Collection Preparation

Prior to conducting field sampling, field technicians will be responsible for preparing sampling kits that include field logs, COC forms, sample labels, decontamination equipment, and tools. The proper preparation of all sample kits will be verified by the PM prior to field mobilization. Equipment will be inspected for damage prior to use and when returned from use. Wood's Project Manager will be responsible for implementing the field maintenance program. Wood's field lead will be responsible for training all staff on proper collection techniques and procedures related to this program.

6.1.3 Trawl Collection

Field crews will generally target a 5-minute trawl duration with trawls not to exceed 10 minutes; however, priority will be given to remaining in the area of the chosen station location and may not adhere to a set duration time. Coordinates will be noted for beginning and ending of trawl tracks.

6.1.4 Fish Community Data

The quality of fish identification, enumeration, and length measurements will be ensured through pre-survey training and in-survey audits. During the survey, the Lead Field Scientist will make sure that the scales are calibrated at the start of each day, that the appropriate identification aids and processing equipment are available, and that processing follows the protocol described in the approved Work Plan. In addition, the Lead Field Scientist will re-weigh and re-measure two species (10 individuals each) each day of sampling. Any disagreements noted between the initial weights and measurements will be discussed with the field staff and a re-training will take place, if necessary. A representative photo voucher of each species collected will be obtained for QA verification by the Lead Field Scientist.

6.2 Laboratory Analytical Measurement Quality Objectives

Quantitative and qualitative measurement quality objectives (MQOs) have been established for this project to define required data quality for tissue analytical chemistry data.

The Measurement Quality Indicators (MQI) and Measurement Quality Objectives (MQO) that will be used for this study are existing limits that have been used by the SWAMP BOG study historically. The sampling design and analytical methods for this project were selected based on their ability to achieve project MQOs. The working definitions for the project MQIs are established below.

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations. Accuracy will be expressed as percent recovery.

Precision is defined as the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision will be expressed as relative percent difference or percent difference.

Comparability is a measure of the confidence with which one data set can be compared to another. This is a qualitative assessment that has been addressed primarily in sampling design through use of comparable analytical procedures.

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population. This is a qualitative assessment and has been addressed primarily in the sampling design, through the selection of sampling sites, and procedures that reflect the project goals and environment being sampled. It will be ensured during the field and laboratory phase through proper sampling and sample handling procedures.

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Sensitivity has been addressed primarily through the selection of appropriate analytical methods, equipment, and instrumentation. It will be monitored through the achievement of the established method detection limits, instrument calibration, and procedural blanks.

Completeness is a measure of the proportion of the expected, valid data collected during a measurement process. The MQO for completeness is 90% for each measurement process. Completeness will be expressed as a percent of total expected valid samples to be collected.

Method Detection Limits (MDLs) are the minimum concentrations of a substance detected at signal to noise ratio of > 3. The MDLs reported in Table 4-1 were calculated based on the instrument detection limits and conservative estimates of extract and injection volumes (for PEDs).

Reporting Limits (RLs) reported in Table 4-1 are the minimum concentrations of an analyte that can be reliably identified, measured, and reported with complete confidence that the analyte concentration is greater than zero. The sample-specific RL will be inserted into the value field for non-detected chemical parameters with the data qualifier “ND.”

The analytical MQIs and MQOs established for this project are available in Tables 6-1 and 6-2, respectively.

Table 6-1.
Measurement Quality Indicators for Laboratory Measurements in Tissue

Accuracy	Precision	Recovery	Completeness	Sensitivity
CRM, PT within 70-130% of the certified 95% CI stated by provider of material. If not certified then within 50-150% of reference value.	Duplicate RPD <25%; n/a if concentration of either sample <RL Matrix Spike Duplicate RPD <25%	Matrix spike 50% - 150% or control limits based on 3x the standard deviation of laboratory's actual method recoveries	90%	See Table 4.1

Notes:
CRM – Certified Reference Material
RPD – Relative Percent Difference
CI – Confidence Interval
RL – Reporting Limit

Table 6-2.
Measurement Quality Objectives for Laboratory Measurements in Tissue

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Tuning	Per analytical method	Per analytical method
Calibration Standard	Initial method setup or when the calibration verification fails	• Correlation coefficient (r2> 0.990) for linear and non-linear curves • If RSD<15% average RF may be used to quantitate; otherwise use equation of the curve. • First- or second-order curves only (not forced through the origin) • Minimum of 5 points per curve (one of them at or below RL)
Continuing Calibration Verification	Per 12 hours	• Expected response or expected concentration ±20% • RF for SPCCs = initial calibration
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analytes
Reference Material	Per 20 samples or per analytical batch (preferably blind)	70-130% recovery if certified, otherwise 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD); RPD <25%
Laboratory Duplicate	Per 20 samples or per batch, whichever is more frequent	RPD <25%; n/a if concentration of either sample <RL
Surrogate	Included in all samples and all QC samples	Based on historical laboratory control limits (50-150% or better)
Internal Standard	Included in all samples and all QC samples (as available)	Per laboratory procedure

Notes:
RSD - Relative Standard Deviation
RF – Relative Frequency

6.2.1 Procedures to Assess all Identified QA Objectives

Quality assurance procedures have been incorporated into routine laboratory operations and the project design to assess the achievement of the QA objectives. These include verification that measurement equipment and instruments will be maintained and calibrated, and that background contamination will be minimized.

6.2.2 QC Checks and/or Procedures

The project design incorporates QC procedures and checks in both the field and laboratory in order to assess data quality. The study design and QC samples are intended to assess the major components of total study error, thereby facilitating the final evaluation of whether environmental data are of sufficient quality to support project related conclusions. The QC sample requirements are designed to provide measurement error information that can be used to initiate corrective actions with the goal of limiting the total measurement error.

Analytical Laboratory

Laboratory samples are processed and analyzed in analytical batches or sample delivery groups (SDGs). A suite of QC samples that monitor the accuracy and precision of the methods are incorporated for each batch. For this project, these QC samples may include method blanks, matrix spikes (MS), matrix spike duplicates (MSD), and field/laboratory duplicates. The QC samples incorporated into an analytical batch are method specific and are defined in Table 6-2. In addition to these QC samples, surrogate standards are spiked into each sample analyzed for organic compounds. Table 6-2 defines the preparation procedures for laboratory QC samples.

6.3 Tissue Chemical Analysis

Analytical QA/QC will be maintained during the analytical portion of this study by using laboratory replicates, method blanks (MBs), blank spikes, and matrix spike and matrix spike duplicates (MS/MSDs). These QA/QC methods for tissues are consistent with that required and performed for the samples collected for this program.

- **Laboratory Replicate/Split** – A sample is split by the laboratory into two portions and each portion is analyzed. Once analyzed, the results are evaluated by calculating the relative percent difference (RPD) between the two sets of results. This calculation measures the reproducibility (precision) of the sample analysis. Typically, replicate results will fall within an accepted RPD range, depending upon the analysis.
- **Method Blanks –** A method blank is an analysis of a known clean sample matrix that has been subjected to the same complete analytical procedure as the field sample to determine whether potential contamination has been introduced during processing. Blank analysis results are evaluated by checking against the RL for that analyte. Blank results should be less than the RL for each analyte.
- **Blank Spikes** – A blank spike entails adding a known amount of the chemical(s) of interest to a known clean sample matrix. The clean sample matrix is spiked with a known concentration of the analytes of interest. The recovery of the spike is a measure of the accuracy of the analysis. The spike recoveries are compared against accepted and known method-dependent acceptance limits. Results outside these limits are subject to corrective action.
- **Matrix Spike and Matrix Spike Duplicates** – MS/MSDs entail adding a known amount of the chemical(s) of interest to one of the actual samples being analyzed. One sample is split into three separate portions. One portion is analyzed to determine the concentration of the analyte in question in an unspiked state; the other two portions are spiked with a known concentration of the analytes of interest. The recovery of the spike, after accounting for the concentration of the analyte in the original sample, measures the accuracy of the analysis. An additional precision measure is made by calculating the RPD of the duplicate spike recoveries. Both the RPD values and spike recoveries are compared against accepted and known method-dependent acceptance limits. Results outside these limits are subject to corrective action.

6.4 Data Analysis and Reporting QA/QC

QA/QC extends throughout an entire program beyond the initial data collection. Following initial receipt of the data an independent review of all raw data and laboratory reports will be performed by John Rudolph as the Project QA Officer. Within two weeks of receipt, the Wood Leads will screen preliminary data deliverables for the following major items:

- A 100-percent check between electronic data provided by field team and the laboratory, and the hard copy reports
- Conformity check between the COC forms and laboratory reports
- A check for field data and laboratory data report completeness
- A check for typographical errors on the laboratory reports

- A check for suspect values, flagged data, and review of laboratory and field QA data

Raw valid data will then be entered into a Wood internal project-specific database. A 100% QA check of this data entry against the laboratory reports and associated raw data will be performed before proceeding with subsequent analysis. Subsequent steps will include the creation of spreadsheets for statistical analysis and graphing, and summary tables for the report. Each of these steps requires a 100% QA check as well to ensure proper transcription, reporting units, analysis parameters and methods, and use of significant figures. Any data and associated conclusions included in the report itself will also undergo a 100% QA check against the raw data and summary tables.

Data Validation Procedures

Evaluation of laboratory performance against prescriptive requirements is assessed through the acceptability of QC sample results that are independent of sample matrix (e.g. method blanks). An assessment of the subjective requirements involves identification of potential matrix effects and includes an evaluation of the analytical results and the results of analytical duplicates and matrix spike samples.

The items listed below are considered and evaluated in a routine verification of laboratory-generated data.

- Laboratory reports and COC form documentation (to check for errors and omissions)
- Laboratory case narratives (to check for anomalies and exceedances of QA/QC requirements)
- Laboratory reports (to check for correct reporting limits and units)
- Extraction and analysis holding times
- Method blank (to note any detected analytes and their respective concentrations)
- Surrogate compounds, their spiking levels, the reported concentrations, and the percent recoveries
- MS/MSD samples, their spiking levels, reported concentrations, percent recoveries, and relative percent differences between the MS and the MSD
- Laboratory control samples, their spiking levels, determined concentrations, and percent recoveries (if applicable).
- Laboratory duplicate samples, field duplicate samples, and relative percent differencesCorrective Action Procedures

An effective Quality System requires prompt and thorough correction of non-conformance conditions that can affect data quality both in the field and in the laboratory. Rapid and effective corrective action minimizes the possibility of questionable data or documentation. Corrective action procedures for this project depend on the severity of the non-conformance condition. In cases in which immediate and complete corrective action is implemented by project personnel, the corrective action will be recorded in the appropriate log book. Non-conformance conditions which could have an impact on project data quality must be communicated to the Project Director or Laboratory Analysis Lead by the QA Officer or Lead Field Scientist within 24 hours. These

types of issues require a formal corrective action and root cause analysis. The problem resolution will follow the steps listed below.

- Determine when and how the problem developed.
- Assign responsibility for problem investigation and documentation.
- Determine corrective actions to eliminate the problem.
- Define a schedule for completion of the corrective action.
- Assign responsibility for implementing the corrective action.
- Document and verify that the corrective action has eliminated the problem.

At a minimum, corrective action and/or notification of the QA officer will be implemented within two working days if QC requirements are not met. Corrective actions, including a data review or re-analysis will be implemented where possible. If these actions are not feasible or appropriate, then appropriate qualifiers will be added to the data.

The QA Officer is responsible for verifying that corrective action is implemented according to internal laboratory policies and this QAPP. Verification may be accomplished through review of analytical data, observed improvements in procedures, and modifications to SOPs.

Data Management

All raw data, derived data, and results obtained though analyses will be maintained electronically. Copies of the final report, including laboratory results and field records, will be retained for a minimum of five years after project completion.

The laboratories will provide data as PDF files of laboratory reports and in a CEDEN compatible electronic database format. The Project Director and QA Officer will review all laboratory reports and electronic data deliverables (EDDs) for accuracy and completeness.

Original hard copies of the data are filed in a secure cabinet until requested by the PM and/or inclusion into the Final Report. Electronic copies are stored and backed up by each analyst and respective laboratory internal project manager.

6.5 Data Usability

Should insufficient valid data be available to appropriately draw conclusions for the primary study questions, follow-up actions, including the possibility of recollecting data, will be evaluated and agreed upon by the project stakeholder work group. The ability to draw valid comparisons will be addressed by evaluating statistical power to detect differences among desired metrics. A change in statistical power of more than 20 percent related to invalid data for any specific metric may be considered sufficient to warrant consideration of corrective actions to fulfill the data gaps.

All data reported for this project will be subject to a 100% check for errors in transcription, calculation and computer input by the laboratory internal project manager. Additionally, the laboratory internal project manager will review sample logs and data forms to ensure that requirements for sample preservation, sample integrity, data quality assessments and equipment calibration have been met. At the discretion of the lab director, data that do not meet these requirements will either not be reported or will be reported with qualifiers which serve as an explanation of any necessary considerations.

Data generated by project activities will be reviewed against the MQIs and MQOs in Tables 6-1 and 6-2. Data that do not meet with these standards will be flagged accordingly. Rejected data will not be included in data analyses, while data flagged as qualified will be evaluated for inclusion on a case-by-case basis in conjunction with the associated QA data and program objectives.

PCB and DDT tissue concentrations will be summed for comparison with State of California threshold values. It is possible that some of the constituents that comprise each summation may be flagged as rejected through the validation process. When this occurs, the censored results will not be included in the summation used for comparison. However, the difference between summations with and without rejected values will be compared to each other. If the rejected values comprise more than 30% of the total sum for a sample, and the concentration prior to censoring was above the threshold level in Table 3, then the sample will be designated for reanalysis. Samples with censoring of more than 30% but with uncensored sums below the threshold level will not be designated for reanalysis.

QA narratives will be produced and incorporated into the final Fisheries Management Report. This narrative will summarize the data set from a QA standpoint.

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7.0 REPORTING

Table 7-1 outlines the reporting schedule for this Study. Data and reporting deliverables will be composed of the following:

- EDDs in Microsoft Excel
- QA/QC Information, including all field and laboratory raw data sheets, spike and recovery information, and internal QC audits; all data will be checked according to project requirements
- Draft and Final Project Reports that include the following components:
    - Executive summary
    - Introduction and background information
    - Materials and methods utilized
    - Summarized results of fisheries sampling and tissue chemistry.
    - A data QA/QC review and any limitations identified
    - Recommendations for beneficial management strategies, and potential changes to the existing management plan to improve the Lake Elsinore fishery, including:
        - Recommended in-lake habitat improvements
        - Recommended list of fish for future stocking based on in-lake water quality and habitat conditions
        - Recommendations regarding carp removal efforts
    - List of references
- All analytical tissue chemistry and field collected data will be formatted according to the latest CEDEN template requirements and uploaded to CEDEN.

All final reports will be submitted to LESJWA electronically (in PDF and Word format).

Table 7-1.
Management Reports

Activity	Date [a]		Project Deliverable	Deliverable Due Date
	Anticipated Initiation	Anticipated Completion		
Draft Work Plan	5/15/2019	7/7/2019	Draft Work Plan	7/7/2019
Final Work Plan	5/15/2019	8/21/2019[b]	Final Work Plan	8/21/2019
Historical Data Review and Compilation	4/15/2019	5/31/2019	Historical Data Review Summary	NA
Zooplankton & Phytoplankton Sampling	7/1/19	2/30/2020	NA	NA
Beach Seining and Fish Tagging	8/1/2019	10/31/2019	NA	NA
Otter Trawling	8/1/2019	10/31/2019	NA	NA
Purse Seining	8/1/2019	10/31/2019	NA	NA
Fish Tissue Sampling and Analysis	8/1/2019	12/31/2019	NA	NA
Report Preparation	10/31/2019	6/30/2020	Future Fishery Management Activities Report	TBD
Optional Nuisance Fish Removal	NA	NA	TBD upon consultation with LESJWA	NA

Notes:
[a] Dates are subject to change
[b] Assumes one round of comments and two-week turn around on Draft Work Plan.
NA - Not applicable
TBD – To be determined

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Appendix A

Individual Tissue Analytical Constituents Measured

Appendix Table A-1. Lake Elsinore Fisheries Management Tissue Analyte List				
Constituent	**Method**	**Units**	**STANDARD MDL**	**STANDARD RL**
Percent Solids	SM 2540 B	%	0.1	0.1
Percent Lipids	Gravimetric	%	0.01	0.5
Total Phosphorus	EPA 6020	µg/dry g	0.016	0.05
Total Nitrogen	EPA 9060	mg/dry g	0.01	0.01
Organochlorine Pesticides (DDTs)	EPA 8270D	ng/wet g		
2,4'-DDD	EPA 8270D	ng/wet g	0.267	0.5
2,4'-DDE	EPA 8270D	ng/wet g	0.2	0.5
2,4'-DDT	EPA 8270D	ng/wet g	0.194	0.5
4,4'-DDD	EPA 8270D	ng/wet g	0.198	0.5
4,4'-DDE	EPA 8270D	ng/wet g	0.193	0.5
4,4'-DDMU	EPA 8270D	ng/wet g	0.223	0.5
4,4'-DDT	EPA 8270D	ng/wet g	0.128	0.5
Aroclors	EPA 8270D	ng/wet g		
Aroclor 1248	EPA 8270D	ng/wet g	10	20
Aroclor 1254	EPA 8270D	ng/wet g	10	20
Aroclor 1260	EPA 8270D	ng/wet g	10	20
PCB Congeners	EPA 8270D	ng/wet g		
PCB008	EPA 8270D	ng/wet g	0.017	0.5
PCB018	EPA 8270D	ng/wet g	0.029	0.5
PCB027	EPA 8270D	ng/wet g	0.25	0.5
PCB028	EPA 8270D	ng/wet g	0.023	0.5
PCB029	EPA 8270D	ng/wet g	0.25	0.5
PCB031	EPA 8270D	ng/wet g	0.25	0.5
PCB033	EPA 8270D	ng/wet g	0.25	0.5
PCB044	EPA 8270D	ng/wet g	0.028	0.5
PCB049	EPA 8270D	ng/wet g	0.036	0.5
PCB052	EPA 8270D	ng/wet g	0.012	0.5
PCB056(060)	EPA 8270D	ng/wet g	0.25	0.5
PCB064	EPA 8270D	ng/wet g	0.1	0.5
PCB066	EPA 8270D	ng/wet g	0.027	0.5
PCB070	EPA 8270D	ng/wet g	0.023	0.5
PCB074	EPA 8270D	ng/wet g	0.021	0.5
PCB077	EPA 8270D	ng/wet g	0.018	0.5
PCB087	EPA 8270D	ng/wet g	0.081	0.5
PCB095	EPA 8270D	ng/wet g	0.25	0.5
PCB097	EPA 8270D	ng/wet g	0.25	0.5
PCB099	EPA 8270D	ng/wet g	0.028	0.5
PCB101	EPA 8270D	ng/wet g	0.027	0.5
PCB105	EPA 8270D	ng/wet g	0.047	0.5
PCB110	EPA 8270D	ng/wet g	0.074	0.5

Appendix Table A-1. Lake Elsinore Fisheries Management Tissue Analyte List				
Constituent	**Method**	**Units**	**STANDARD MDL**	**STANDARD RL**
PCB114	EPA 8270D	ng/wet g	0.072	0.5
PCB118	EPA 8270D	ng/wet g	0.069	0.5
PCB126	EPA 8270D	ng/wet g	0.086	0.5
PCB128	EPA 8270D	ng/wet g	0.081	0.5
PCB137	EPA 8270D	ng/wet g	0.25	0.5
PCB138	EPA 8270D	ng/wet g	0.057	0.5
PCB141	EPA 8270D	ng/wet g	0.25	0.5
PCB146	EPA 8270D	ng/wet g	0.1	0.5
PCB149	EPA 8270D	ng/wet g	0.092	0.5
PCB151	EPA 8270D	ng/wet g	0.073	0.5
PCB153	EPA 8270D	ng/wet g	0.065	0.5
PCB156	EPA 8270D	ng/wet g	0.089	0.5
PCB157	EPA 8270D	ng/wet g	0.103	0.5
PCB158	EPA 8270D	ng/wet g	0.074	0.5
PCB169	EPA 8270D	ng/wet g	0.116	0.5
PCB170	EPA 8270D	ng/wet g	0.118	0.5
PCB174	EPA 8270D	ng/wet g	0.25	0.5
PCB177	EPA 8270D	ng/wet g	0.085	0.5
PCB180	EPA 8270D	ng/wet g	0.154	0.5
PCB183	EPA 8270D	ng/wet g	0.056	0.5
PCB187	EPA 8270D	ng/wet g	0.168	0.5
PCB189	EPA 8270D	ng/wet g	0.109	0.5
PCB194	EPA 8270D	ng/wet g	0.164	0.5
PCB195	EPA 8270D	ng/wet g	0.093	0.5
PCB198	EPA 8270D	ng/wet g	0.093	0.5
PCB199(200)	EPA 8270D	ng/wet g	0.25	0.5
PCB201	EPA 8270D	ng/wet g	0.104	0.5
PCB203	EPA 8270D	ng/wet g	0.25	0.5
PCB206	EPA 8270D	ng/wet g	0.155	0.5
PCB209	EPA 8270D	ng/wet g	0.25	0.5