Drought – Year 2

CACHE CREEK OFF-CHANNEL AGGREGATE MINING PONDS – 2021 MERCURY MONITORING

FINAL Report

Monitoring and Report by

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TABLE OF CONTENTS

SUMMARY OF THE 2021 MONITORING AND ITS FINDINGS

- This Fall 2021 monitoring was the seventh year of fish mercury testing (Year 7) for four off-channel aggregate mining ponds, adjacent to lower Cache Creek between Capay and Woodland: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1 ponds. The monitoring was initiated in 2015. Three other ponds were added to the monitoring program in 2017: Teichert-Esparto–Mast, Teichert-Woodland–Storz, and Syar–West ponds. For these ponds, 2021 was Year 5 of mercury monitoring. The monitoring is required by Section 10-5.517 of the Yolo County Code, which was revised and updated in December 2019. That Ordinance requires 5 years of annual pre-reclamation mercury monitoring for mining ponds, and then bi-annual monitoring for 10 years following reclamation to permanent water bodies. The fish monitoring includes new sampling each year and assessment of mercury levels in relation to comparable baseline fish data from Cache Creek.

<u>Fish Mercury Monitoring Summary – All Sites, 2015-2021</u>

Pit Sites	2015	2016	2017	2018	2019	2020	2021
Cemex – Phase 1	≤	≤	≤	≤	≤	≤	≤
Cemex – Phase 3	>	>	>	>	>	≤	>
Cemex – Phase 4							INC
Teichert-Esparto – Reiff	INC	>	>	>	>	>	>
Teichert-Esparto – Mast			>	INC	>		
Teichert-Woodland – Storz			INC	≤	≤	≤	≤
Syar – B1	>	>	>	>	>	>	>
Syar – West			>	≤	>	>	>

≤ = at or below ambient INC = inconclusive > = elevated over ambient

- As summarized in the table above, the Cemex–Phase 3, Teichert-Esparto, Syar–B1, and Syar–West pits have had "three or more years out of five elevated over the ambient". The program requires that the County take certain steps following a third year in five of exceedance for a pit:

  – Require an additional <u>five years of fish mercury monitoring and water column profiling</u>. This pattern will continue until a lake is found to be at or under the ambient for a five-year period; the regulations also allow the County to require continued monitoring during mining. Comparison monitoring during this time will also be conducted at control/reference sites.

  – Require <u>Expanded Analysis</u> – including expanded water column profiling of all relevant water quality parameters (multiple times per year rather than a single time per year) and one-time bottom sediments analysis. Expanded analyses, as set out in the Ordinance, began in 2018 and are reported separately – see summary status tables of these activities at the end of this section.

- Once the reports are completed, the County will notify individual operators of results in individual ponds that require Lake Management Plans (LMPs). The information in the fish monitoring, water column profiling, and bottom sediments reports will then be used to identify mercury control methods to reduce fish mercury levels and prepare required LMPs.

- Implementation of the LMP is required within three years of completion of the expanded monitoring. Management controls may differ for different pits based on site conditions; and may differ during mining, while idle, and post-mining. LMPs may be multi-part or phased to reflect this. Fish monitoring and water column profiling will continue, per the regulations, for a minimum of five more years. Required periodic analysis of ambient conditions will also continue.

• For environmental mercury, fish consumption is by far the most significant exposure route for people and wildlife. Fish also provide an accurate measure of relative mercury exposure levels over time, and for comparison between ponds and Cache Creek. For these reasons, the mercury monitoring program for Yolo County aggregate mining ponds focuses on fish.

• A variety of collection techniques were used to obtain samples of the fish found in each of these ponds, including seines, gill nets, baited setlines, dip nets, and angling. Large, angling-sized fish were tested individually for fillet muscle mercury, relevant to human consumption. Small, young, "biosentinel" fish were analyzed whole-body, relevant to wildlife consumption and inter-annual comparisons, in replicate multiple-individual composite samples.

• Samples of both large and small fish of multiple species, as available and as possible under severe drought conditions, were collected from the seven identified ponds (in their current configurations). A total of 142 adult, angling-sized fish (mainly bass) were sampled individually for fillet muscle mercury analysis in this 2021 monitoring. Additionally, a total of 537 small, young, biosentinel fish were split into 87 multi-individual, whole fish composite samples by site, species, and size. These were also analyzed for mercury.

• The new 2021 data are compared with results from 2015-2020, and with the most closely corresponding 'baseline' and historic fish collections conducted previously in Cache Creek (from the stretch of creek within the planning and aggregate-mining area). As in prior years, the ponds sampled in 2021 were found to show distinct, individual mercury signatures that were broadly consistent across the different fish types tested.

• **Cemex – Phase 1 Pond:** Twenty adult Largemouth Bass were sampled, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. The Cemex–Phase 1 Pond remained one of the lowest mercury ponds of the sites being monitored. Concentrations in 2021 were statistically similar to or lower than corresponding baseline Cache Creek samples of same or similar species and sizes. The Phase 1 Pond was therefore not found to be "elevated in three or more years of five" and did not trigger seasonal water column profiling and consideration of mercury management. However, the overall low mercury status of this pond, and the fish mercury trends over the years monitored in relation to operations changes, made it a key comparison for management insights for the elevated ponds. It was chosen as a control/reference site, as required for the "expanded analysis" parts of the monitoring, and has been part of that work since 2018.

- **Cemex – Phase 3 Pond:** The former Phase 3-4 Pond was divided into two separate parts in late 2020, with active mining continuing in the eastern, Phase 4 Pond and the western, Phase 3 sub-basin becoming an isolated, relatively undisturbed pond. Mercury monitoring continued this year in both the Phase 3 and Phase 4 Ponds. In 2021, twenty adult Largemouth Bass were sampled from Phase 3, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Green Sunfish, and juvenile Largemouth Bass. Except for the Mosquitofish samples, all of the 2021 Phase 3 fish were elevated in mercury on average. As the former combined Phase 3-4 Pond was found to be "elevated for three or more years of five" over creek baselines (2015-2019, all 5 years), that triggered the addition of "expanded analysis" and development of a mercury management plan. Expanded analysis work began in the Phase 3-4 Pond in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports. After Phase 3-4 was split into two parts, this work continued in both ponds in 2021.

- **Cemex – Phase 4 Pond:** In 2021, twenty adult Largemouth Bass were sampled from Phase 4 (the active-mining pond), and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Green Sunfish, and juvenile Largemouth Bass. Overall mercury results were 'inconclusive' in 2021, with some samples relatively elevated and others, including the key adult bass, similar to or below baseline comparisons. However, as the former combined Phase 3-4 Pond was found to be "elevated for three or more years of five" over creek baselines (2015-2019, all 5 years), that triggered the addition of "expanded analysis" and, following a period of data gathering, development of a mercury management plan. Expanded analysis work began in the Phase 3-4 Pond in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports. After Phase 3-4 was split into two parts, this work continued in both ponds in 2021. Future status of Phase 4 will depend on cummulative monitoring results.

- **Teichert – Esparto Pond:** The previously separate Reiff and Mast Ponds were combined by Teichert into a single large Esparto Pond in early 2020, by excavating parts of dividing levees. Monitoring continued in the combined pond. With the second year drought conditions of 2021, the Esparto Pond began the sampling season interconnected but dried down into disconnected, shallow basins by summer. Samples of adult Largemouth Bass (20), White Catfish (6), and Common Carp (2) were taken from the central basin. Small, young-of-year fish were sampled from two basins; these included Mosquitofish, juvenile Largemouth Bass, juvenile Green Sunfish, and Red Shiners. Average mercury levels in all sample types showed increases in 2021, particularly in the small, young fish – which are most representative of recent conditions. This site remained highly elevated in mercury in 2021. All of the fish sample types averaged significantly higher mercury than corresponding Cache Creek baseline samples. Similar results from previous years in the Reiff and Mast ponds triggered the collection of additional information ("expanded analysis") to help guide development of a mercury management plan.

Water column profiling and collection of bottom sediment samples began in May 2018 and are the subject of accompanying reports.

- **Teichert-Woodland – Storz Pond:** Drought conditions dried this pond down into two disconnected sub-basins in 2021. A sample of 18 small adult bass (the main size present) and 2 larger bass was taken. Small, young-of-year fish samples included multiple composites of Mosquitofish, juvenile Largemouth Bass, and juvenile Bluegill Sunfish. Mosquitofish were taken from both sub-basins to check for potential localized differences; no difference was found. The adult bass and all of the small fish samples remained in the lower range of mercury levels for this site, which has consistently been the first or second lowest mercury pond in the monitoring program. Relative to Cache Creek comparison data, Storz Pond continued to rank as "not elevated over baseline" in 2021 and is not flagged for expanded analysis or management planning. One-time-per-year routine water profiling was added to the monitoring in 2020, following recent revisions of the mining ordinance. With five years now with low mercury status, this site can shift to a schedule of fish and water testing once each two years rather than annually.

- **Syar – B1 Pond:** Drought conditions affected both Syar Ponds significantly in 2020-2021, dropping water levels to far below normal. In addition to impacts on the ponds, it also made access and some fish collections difficult or not possible. Sixteen adult Largemouth Bass were sampled, one adult Bluegill Sunfish and for the first time here, four Channel Catfish. Young-of-year small fish were sampled with multiple composites of Mosquitofish, juvenile Largemouth Bass, and juvenile Bluegill Sunfish. Fish mercury was up in 2021 over the previous year for most sample types but remained significantly lower than the peak levels found here in 2015-2016. Despite the relatively lower levels in recent years, B1 Pond fish mercury in 2021 remained significantly higher on average than most baseline Cache Creek comparisons, most importantly in the Largemouth Bass. Because of the overall status of the B1 Pond as "elevated over baseline in three or more years of five" (all years since 2015), water column profiling and collection of bottom sediments was started here in 2018, in support of the development of a lake management plan. That work is detailed in accompanying reports.

- **Syar – West Pond:** Drought conditions affected both Syar Ponds significantly in 2020-2021, dropping water levels to far below normal. In addition to impacts on the ponds, it also made access and some fish collections difficult or not possible. Thirteen adult Largemouth Bass were sampled. Young-of-year small fish samples included multiple composites of Mosquitofish, juvenile Bluegill Sunfish, and juvenile Largemouth Bass. Fish mercury was up in 2021 over the previous year for most sample types; most importantly, the adult bass samples averaged higher than the bass from all previous years. Syar-West fish mercury in 2021 was significantly higher on average than most baseline Cache Creek comparisons, as in 2017, 2019, and 2020. Because of the overall status of the West Pond as "elevated over baseline in three or more years of five" as of 2020, expanded analysis and development of a lake management plan is required. Expanded analyses have in fact been conducted here since 2018, as a second control/reference site. This pond is far deeper than the other ponds and is representative of the range of final depths projected at several of the sites. With elevated fish mercury status as of 2020, this work will help in the development of a lake management plan.

Status of Other Components of the Mercury Monitoring Program

<u>Water Column Profiling</u> *(elevated sites and controls)*

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Cemex – Phase 1 (control)</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Cemex – Phase 3</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td><td>✓</td></tr>
<tr><td>Cemex – Phase 4</td><td>✓</td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td></td><td></td><td></td><td></td><td>(1x)</td></tr>
<tr><td>Syar – B1</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Syar – West (control to 2020)</td><td></td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>

<u>Bottom Sediment Collections</u> *(single event, elevated sites and controls)*

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Cemex – Phase 1 (control)</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Cemex – Phase 3-4</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Syar – B1</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Syar – West (deep control)</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
</table>

<u>Reports Completed</u>

<table>
<tr><th>Report</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Fish Mercury Monitoring</td><td>Final</td><td>Final</td><td>Final</td><td>Final</td><td>Final</td><td>Draft</td><td>Draft</td></tr>
<tr><td>Water Column Profiling</td><td></td><td></td><td></td><td>Final</td><td>Final</td><td>Draft</td><td>Draft</td></tr>
<tr><td>Bottom Sediments (1x)</td><td></td><td></td><td></td><td colspan="2">Final</td><td></td><td></td></tr>
</table>

INTRODUCTION

This monitoring was conducted for Yolo County in the summer and fall of 2021, to provide ongoing fish mercury information from a set of aggregate mining ponds located adjacent to lower Cache Creek. The monitoring was triggered by Section 10.5.517 of the Yolo County Surface Mining Reclamation Ordinance (Yolo County Code), which was enacted originally in 1996. Earlier reports (2015-2018) have gone into detail about the County's history with the mercury issue, placing the first years of monitoring into context with the 1996 Ordinance. In December 2019, the County adopted a comprehensive update to the Cache Creek Area Plan (CCAP), which included a full revision of this code section (Yolo County Code 2019), incorporating new findings and issues identified since 1996. Mercury monitoring and reporting since then, including this 2021 report, complies with the updated ordinance requirements. The complete 2019 Ordinance is attached, as Appendix A, at the end of this report. Below, in this introduction, parts that most directly affect this fish mercury monitoring program are excerpted and discussed. Ordinance text is shown in ***bold italics***, with discussion in plain text.

Yolo County, CA Code of Ordinances, Sec. 10-5.517
Dec 2019 Revision – Mercury Bioaccumulation in Fish.

As part of each approved long-term mining plan involving wet pit mining to be reclaimed to a permanent pond, lake, or water feature, the operator shall maintain, monitor, and report to the Director according to the standards given in this section. Requirements and restrictions are distinguished by phase of operation as described below.

(a) MERCURY PROTOCOLS. The Director shall issue and update as needed "Lower Cache Creek Off-Channel Pits Mercury Monitoring Protocols" (Protocols), which shall provide detailed requirements for mercury monitoring activities. The Protocols shall include procedures for monitoring conditions in each pit lake, and for monitoring ambient mercury level in the lower Cache Creek channel within the CCAP planning area, as described below.
Mercury Protocols for these tasks were developed before the monitoring program began in 2015 and were followed through 2019. The protocols were revised, expanded, and updated (Slotton 2021) to support the 2019 revision of the County Code Ordinance.

(b) AMBIENT MERCURY LEVEL. The determination of the ambient or "baseline" fish mercury level shall be undertaken by the County every ten years in years ending in 0. This analysis shall be undertaken by the County for use as a baseline of comparison for fish

mercury testing conducted in individual wet mining pits.
The most recent creek sampling targeted to the aggregate mining zone was conducted in 2011 and 2012 (Slotton and Ayers 2013). Data from other earlier studies that coincidentally fell within the planning area have also been used for comparisons. Another full Cache Creek Baseline set of fish collections will be conducted some time in the next few years, as possible dependent on the presence of sufficient water and fish in the creek in these drought times.

(c) PIT MONITORING.

(1) Mining Phase (including during idle periods as defined in SMARA). The operator shall monitor fish and water column profiles in each pit lake once every year during the period generally between September and November for the first five (5) years after a pit lake is created. Fish monitoring should include sport fish where possible, together with other representative species that have comparison samples from the creek and/or other monitored ponds. Sport fish are defined as predatory, trophic level four fish such as bass, which are likely to be primary angling targets and have the highest relative mercury levels. The requirements of this subsection apply to any pit lake that is permanently wet and navigable by a monitoring vessel.
This monitoring began in 2015, at four aggregate mining ponds: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. Three other ponds were added to the monitoring program in 2017: Teichert-Esparto–Mast, Teichert-Woodland–Storz, and Syar–West ponds. In 2020, Reiff and Mast were combined into a single Teichert–Esparto Pond and the Cemex Phase 3-4 Pond was separated into two distinct ponds (Phase 3 and Phase 4), making seven total ponds monitored at this time. An important focus of the monitoring has been largemouth bass, which are present in most of the ponds.

If, in the initial five (5) years after the pit lake is created, the applicable response threshold identified in subsection (e) is exceeded in any three (3) of five (5) monitoring years, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).
Earlier in the monitoring program, three of the ponds were found to have fish mercury above baseline creek comparison levels in three or more years: Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. Beginning in 2018, "expanded analysis" testing was initiated at these three ponds, and also at Cemex–Phase 1 as a lower mercury control/reference site (see (f)(1)) and at Syar–West as a deep pond control. The Syar–West Pond has since shifted into the elevated category, requiring this work. With the recent splitting of the Cemex–Phase 3-4 pond into two distinct ponds, both have been included during 2021. The expanded analyses have included one-time sediment testing and seasonal, ongoing water column profiling as specified in Section (f). This work has been in the data gathering stage. Findings are intended to now guide the preparation of realistic lake management plans.

For future, post-mining years: monitoring and potential lake management requirements:

(2) Reclamation Phase. No monitoring is required after mining has concluded, during the period that an approved reclamation plan is being implemented, provided reclamation is completed within the time specified by SMARA or the project approval, whichever is sooner.

(3) Post-Reclamation Phase. After reclamation is completed, the operator shall monitor fish and water column profiles in each pit lake at least once every two (2) years during the period of September-November for ten (10) years following reclamation. Monitoring shall commence in the first calendar year following completion of reclamation activities. If fish monitoring results from the post-reclamation period exceed the applicable response threshold described in subsection (e) or, for ponds that have implemented mitigation management, results do not exhibit a general decline in mercury levels, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(4) Other Monitoring Obligation. If monitoring conducted during both the mining and post-reclamation phase did not identify any exceedances of the ambient mercury level for a particular pit lake, and at the sole discretion of the Director no other relevant factors substantially support that continued monitoring is merited, the operator shall have no further obligations.

(e) RESPONSE THRESHOLDS.

(1) Fish Consumption Advisory. If at any time during any phase of monitoring the pit lake's average sport fish tissue mercury concentration exceeds the Sport Fish Water Quality Objective (as of 2019, the level was 0.2 mg/kg), the operator shall post fish consumption advisory signs at access points around the lake and around the lake perimeter. Catch-and-release fishing may still be allowed.
The sites have been posted. Catch and release fishing has been common at the Syar ponds and not at the others.

(2) Mining Phase Results. If, during the mining phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three (3) of five (5) monitoring years, annual monitoring shall continue for an additional five (5) years, and the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).
Fish monitoring has continued at all pit lakes found to be elevated in fish mercury, and at those still in the initial five years of testing. As noted above in (c)(1), expanded analysis is in progress at the identified elevated mercury sites and control/reference ponds, gathering data to help develop lake management plans.

For future, post-mining years: monitoring and potential lake management requirements:

(3) <u>Post-Reclamation Phase Results</u>. If during the first ten (10) years of the post-reclamation phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three (3) of five (5) monitoring years, biennial monitoring shall continue for an additional ten (10) years, and the operator shall undertake expanded analysis pursuant to subsection(f) and preparation of a lake management plan pursuant to subsection (g).

(f) EXPANDED ANALYSIS.

(1) <u>General</u>. If, during the mining or post-reclamation phase, any pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three (3) years, the operator shall undertake expanded analyses. The analysis shall include expanded lake water column profiling (a minimum of five profiles per affected wet pit lake plus one or more nonaffected lakes for control purposes) conducted during the warm season (generally May through October) in an appropriate deep profiling location for each pit lake. The following water quality parameters shall be collected at regular depth intervals, from surface to bottom of each lake, following protocols identified in subsection (a): temperature, dissolved oxygen, conductivity, pH and oxidation-reduction potential (ORP), turbidity or total suspended solids, dissolved organic matter, and algal density by Chlorophyll or Phycocyanin. The initial analysis shall also include one-time collections of fine grained (clay/silt) bottom sediments from a minimum of six well distributed locations for each affected lake, and from one or more non-affected lakes for control purposes, to be analyzed for mercury and organic content.

The current expanded analysis work is guided by these directions. Data gathering on these various, potentially important parameters began in 2018; 2021 data are presented in the companion report on water profiling.

(2) <u>Scope of Analysis</u>. The purpose of the expanded analyses is to identify and assess potential factors linked to elevated methylmercury production and/or bioaccumulation in each pit lake. In addition to the analyses described in subsection (f)(1) above, the analysis should also consider such factors as: electrical conductivity, bathymetry (maximum and average depths, depth-to-surface area ratios, etc.), and trophic status indicators (concentrations, Secchi depth, chlorophyll a, fish assemblages, etc.). Additional types of testing may be indicated and appropriate if initial results are inconclusive.

These suggestions are all being followed in the expanded analysis work.

(3) <u>Use of Results</u>. The results of the expanded analyses undertaken pursuant to this subsection shall be used to inform the preparation of a lake management plan described below under subsection (g).

As noted above, this work has been in the data gathering stage. Findings are intended to now guide the preparation of realistic lake management plans. This, and future management and monitoring activities, are described in these final Ordinance excerpt sections:

(g) LAKE MANAGEMENT ACTIVITIES.

(1) General. If monitoring conducted during the mining or post-reclamation phases triggers the requirement to undertake expanded analysis and prepare and implement a lake management plan, the operator shall implement lake management activities designed by a qualified aquatic scientist or equivalent professional acceptable to the Director, informed by the results of subsection (f). Options for addressing elevated mercury levels may include (A) and/or (B) below at the Director's sole discretion and at the operator's sole expense.

(A) ***Lake Management Plan. Prepare a lake management plan that provides a feasible, adaptive management approach to reducing fish tissue mercury concentrations to at or below the ambient mercury level. Potential mercury control methods could include, for example: addition of oxygen to or physical mixing of anoxic bottom waters; alteration of water chemistry (modify pH or organic carbon concentration); and/or removal or replacement of affected fish populations. The lake management plan may be subject to external peer review at the discretion of the Director. Lake management activities shall be appropriate to the phase of the operation (e.g., during mining or post-reclamation). The Lake Management Plan shall include a recommendation for continued monitoring and reporting. All costs associated with preparation and implementation of the lake management plan shall be solely those of the operator. Upon acceptance by the Director, the operator shall immediately implement the plan. The lake management plan shall generally be implemented within three years of reported results from the expanded analyses resulting from subsection (f). If lake management does not achieve acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator may prepare an alternate management plan with reasonable likelihood of mitigating the conditions.***

(B) Revised Reclamation Plan. As an alternative to (A), or if (A) does not achieve acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator shall prepare and submit revisions to the reclamation plan (including appropriate applications and information for permit amendment) to fill the pit lake with suitable fill material to a level no less than five (5) feet above the average seasonal high groundwater level, and modify the end use to agriculture, habitat, or open space at the discretion of the Director, subject to Article 6 of the Mining Ordinance and/or Article 8 of the Reclamation Ordinance as may be applicable.

(2) IMPLEMENTATION OBLIGATIONS.

(A) If a lake management plan is triggered during the mining or post-reclamation phase and the subsequent lake management activities do not achieve acceptable results and/or demonstrate declining mercury levels, the operator may propose different or additional measures for consideration by the Director and implementation by the operator, or the Director may direct the operator to proceed to modify the reclamation plan as described in subsection (g)(1)(B).

(B) Notwithstanding the results of monitoring and/or lake management activities during the mining phase, the operator shall, during the post-reclamation phase, conduct the required ten years of biennial monitoring.

(C) If monitoring conducted during the post-reclamation phase identifies three monitoring years of mercury concentrations exceeding the ambient mercury level, the operator shall implement expanded analyses as in subsection (f), to help prepare and implement a lake management plan and associated monitoring.

(D) If subsequent monitoring after implementation of lake management activities, during the post-reclamation phase, demonstrates levels of fish tissue mercury at or below the ambient mercury level for any three monitoring years (i.e., the management plan is effective), the operator shall be obligated to continue implementation of the plan and continue monitoring, or provide adequate funding for the County to do both, in perpetuity.

As fish have been found to be the most straightforward, clear measure of methylmercury exposure and bioaccumulation in aquatic systems, this monitoring focuses on fish. All seven of the currently identified ponds (Table A, Figure A) were monitored for fish mercury in 2021. Five of the ponds have been monitored since 2015 and, for them, this was Year 7 of sampling: Cemex–Phase 1, Cemex Phase 3 and Phase 4 (formerly Phase 3-4), Teichert–Esparto (formerly Reiff and Mast), and Syar–B1. Two additional ponds were added to the monitoring in 2017; for these, 2021 was Year 5: Teichert-Woodland–Storz and Syar–West. Both large and small fish samples of multiple species, as available, were collected and analyzed from each of the ponds.

The purpose of this report is to present the new 2021 fish mercury data from the tested aggregate mining ponds and, for each pond, to compare levels to similar baseline samples taken from the planning area of Cache Creek in 2011-2012 and in earlier studies. A key objective is to help the mining operators and Yolo County determine if specific pond sites are falling below, at, or above fish mercury concentrations found in adjacent Cache Creek. This will help guide future reclamation and, if necessary, pond management.

The factors that influence the production of methylmercury and its uptake by fish are complex and can change from one year to the next, often leading to a range of fish mercury levels over time rather than some absolute value. Because of this, the Ordinance states that multiple years of data are needed to make assessments. Therefore, another objective is to compare this year's data (2021) with monitoring results found at the same sites in the previous monitoring years (2015-2020).

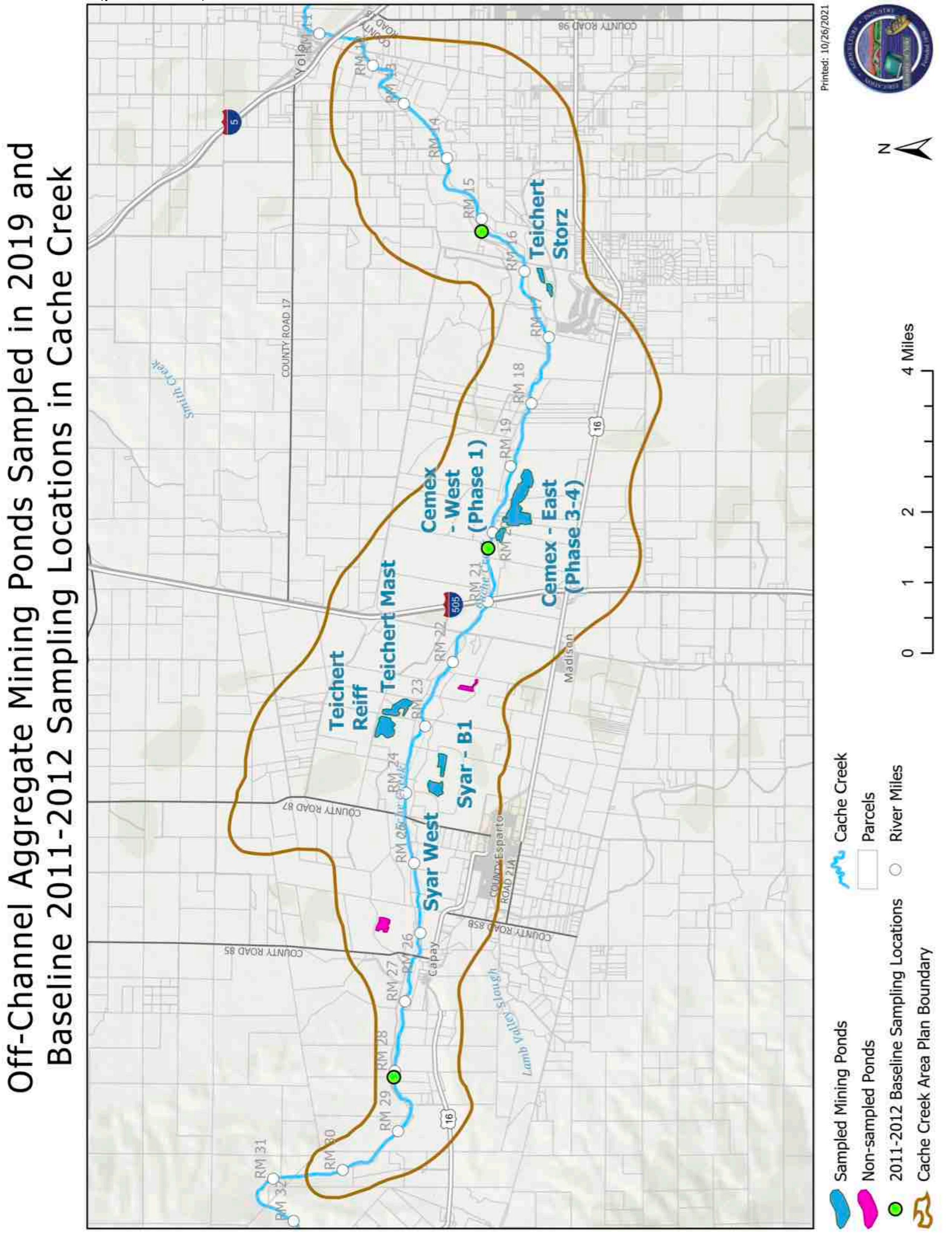
In the sections below we will discuss the methods used, followed by a presentation of the 2021 fish mercury data, by individual pond site. Each data table is accompanied by a matching figure with the same number that graphically shows the information. For each site, we first present the analytical results from each individual large fish sample and each small fish composite sample. Then we show the new data in reduced form (means, error bars, etc.) for each sample type and compare to 2015-2020 same-site findings and the most closely comparable historic creek data. For creek comparisons, we are focusing on historic data specifically from the planning / aggregate-mining section of the creek, roughly between River Mile 28 (below the Capay diversion dam) and River Mile 15 (app. 1 km below County Road 94B). In particular, these include the 2011 Baseline collections from River Mile 15 (RM15), RM20, and RM28, which were conducted specifically to provide comparable samples for the pond monitoring. In the data tables and figures, the 2011 Baseline comparison data are highlighted with bold text and outlines. Additional historic sampling that was coincidentally done within the planning region of Cache Creek includes a project around the Cache Creek Nature Preserve in 2000-2006 (RM15 and RM17 small fish) and a CalFed 1998-2000 UC Davis study of the entire Cache Creek watershed that included some fish collections in the study zone.

After individual reporting sections for each pond, a final data section consolidates summary results for each fish type, from all the sites and baseline creek samples for easy comparison. In the Discussion/Conclusions, the available pond data to-date are placed into the context of the updated Yolo County Ordinance, with next steps and recommendations. Appendix A includes the full text of the new Ordinance. Appendix B shows photos of the Fall 2021 fish mercury monitoring work.

Table A. Wet Pits Subject to Annual Mercury Monitoring
(modified from Yolo County Exhibit C)

Operator	Site	Pit	Year Mining Crossed Water Table (app)	End Reclamation Plan	Year Monitoring Began	Monitoring Year in Fall 2019
Cemex	Madison	**Phase 1**	< 1996	Lake and habitat	2015	Year 7
Cemex	Madison	**Phase 3-4**	≤ 2002	Lake and habitat	(2015-2020)	
		(Phase 3 and Phase 4 were separated in late 2020)				
Cemex	Madison	**Phase 3**		Lake and habitat		(Year 7)
Cemex	Madison	**Phase 4**		Lake and habitat		(Year 7)
Teichert	Esparto	**Reiff**	≤ 2002	Lake and habitat	(2015-2019)	
Teichert	Esparto	**Mast**	2007-2008	Lake and habitat	(2017-2019)	
		(Reiff and Mast were combined into one pond in 2020)				
Teichert	Esparto	**Esparto**				(Year 7)
Teichert	Woodland	**Storz**	2010-2011	Lake and habitat	2017	Year 5
Syar	Madison	**B1**	≤ 2002	Lake and habitat	2015	Year 7
Syar	Madison	**West**	≤ 2002	Lake and habitat	2017	Year 5

Figure A. Map of aggregate mining ponds and Cache Creek baseline monitoring locations *(from 2019)*



METHODS

Field sampling was coordinated with staff of the three mining companies: Teichert, Cemex, and Syar. Access ramps for boat launching were constructed at the Cemex ponds. We used our sampling boat to move around those ponds and collect the fish. This was not possible at the Syar and Teichert sites, which were heavily impacted by the drought, making the shorelines inaccessible to heavy equipment.

The fish samples were taken with a variety of techniques. Adult fish were collected with gill nets in a range of mesh sizes, with baited set lines laid at the bottom of ponds (catfish), by angling (bass) and, as a last resort in ponds with no boat or shore access due to the drought, by spearfishing. Small, young fish samples were collected with a variety of seines and hand nets.

Large fish were field identified, weighed and measured, and sampled for mercury analysis using a non-destructive biopsy technique we developed that allows us to return the fish back to the water in good condition (Slotton et al. 2002). In this technique, numbered sample vials are pre-weighed, empty, to 0.0001 g accuracy. In the field, several scales are removed from each fish on the left side above the lateral line and a small biopsy sample of app. 0.200 g (about the size of a small raisin) is taken of the fillet muscle. The sample is carefully placed into a pre-weighed vial. Vials are closed with sealing screw-tops and stored on ice in a protective vial box. Later, at the laboratory, the vials with sample pieces are again weighed and the exact weight of each sample is determined by subtracting the empty tube weight.

Small young-of-year fish, in contrast, were sacrificed for analyses, analyzed whole. Small fish were field identified, cleaned and sorted by species, bagged in labeled freezer-weight, zip-close bags with air removed, and transported on ice to the laboratory. Fish were then weighed, measured, and assembled into composite groupings of similar-sized fish for each size class. Each composite sample was frozen in doubled freezer-weight bags with water surrounding and air removed, a technique our group has found to maintain natural moisture levels through the freezing process, something that can be a major problem for small fish samples (Slotton et al.

2015). Pre-analytical processing included weighing and measuring the fish in each composite group and drying the sample to constant weight in a laboratory oven at 55 °C. Solids percentage was calculated during this process, through sequential weighings of empty weigh pans, pans with wet sample, and pans with dry sample. Dried samples were later homogenized to fine powders using a laboratory grinder.

Large fish fillet muscle samples were analyzed for mercury directly, on a wet (fresh) weight basis. Small fish composite samples were analyzed whole body, homogenized into dry powders for consistency, as described above. Dry weight results were converted to original wet/fresh weight concentrations using the calculated percentage solids values. Mercury analyses were conducted with a direct mercury analyzer system (Milestone DMA-80 evo), using EPA Method 7473.

Extensive Quality Assurance / Quality Control (QA/QC) samples were included in all analytical runs and tracked with control charts. These included, for each 20 field samples: 3 method blanks, 3 standard reference materials with certified levels of mercury, 2 aqueous calibration samples, a laboratory duplicate, a spiked field sample, a spike duplicate, and 3 continuing calibration samples. For initial machine calibration (stable for over a month), an extensive calibration was performed each month, using at least 15 aqueous calibration solutions, each run in duplicate. Calibration stability was tested each analytical run with the many aqueous and solid reference samples. QA/QC Results for this project were all well within control limits.

2021 FISH MERCURY MONITORING RESULTS

1. CEMEX – PHASE 1 POND

(Google Earth 10/21/20)

1. CEMEX – PHASE 1 POND *(Tables and Figures 1-6)*

Summary

Twenty adult Largemouth Bass were sampled, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. Despite some relative ups and downs over the years, the Cemex–Phase 1 Pond remained one of the lowest in fish mercury of the ponds being monitored. Concentrations in 2021 were statistically similar to or lower than corresponding baseline Cache Creek samples of same or similar species and sizes. The Phase 1 Pond was therefore not found to be "elevated in three or more years of five" and did not trigger seasonal water column profiling and consideration of mercury management. However, the overall low mercury status of this pond, and the interesting changes over the years monitored in relation to operations changes, made it a key comparison for management insights for the elevated ponds. It was chosen as a control/reference site, as required for the "expanded analysis" parts of the monitoring, and has been part of that work since 2018.

Summary 2021 Cemex – Phase 1 Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	≤	≤	Largemouth Bass
		≤	Mosquitofish
		≤	Sunfish
Overall 2021 Findings	≤		

This pond is the older of the 2 current Cemex ponds, dating from the 1990s. It is located just south of Cache Creek and east of Highway 505. The Phase 1 Pond is an oval shaped bowl that is approximately 400 m long and 150 m wide. In 2021, depths ranged narrowly between 5.3 and 5.8 m (17-19 feet). Phase 1 and the other Cemex ponds had their water levels maintained during the drought, presumably by adding water through the season. This pond went through some changes over the years of monitoring. Active mining was underway in 2015. In 2016 there was little or no mining in the pond itself, but it continued to receive the silt and clay slurry effluent of the general plant operations, so the water was very turbid. In 2017, active mining was on hold at both Cemex ponds, so there was less slurry effluent to the Phase 1 Pond. Since 2018, active mining resumed at the Phase 3-4 Pond, continuing since 2020 in the Phase 4 portion, with process slurry effluent discharging to the Phase 1 Pond and generally keeping this shallow pond turbid. This (2021) was Year 7 of monitoring at this site.

We sampled the pond with a range of techniques, and were able to obtain samples of the fish species available. Large, angling-sized fish taken were: 20 Largemouth Bass (*Micropterus salmoides*). Despite fishing effort for other species, they have not been found since 2018. In previous years, we routinely took several Channel Catfish (*Ictalurus punctatus*) and White Catfish (*Ameiurus catus*). We suspect that these may have been fished out of the system (not by us; we always return biopsy-sampled fish back to the ponds in good condition). The small fish present were Mosquitofish (*Gambusia affinis*, 1-2"), juvenile Green Sunfish (1-2"), and juvenile Largemouth Bass (3-4"). Three to four multi-individual composite samples, as available, were analyzed from each of these small fish species, for 11 total composites.

In total, this added up to 20 large fish muscle samples and 11 composite small fish samples, 31 separate fish mercury samples, analyzed from the Cemex–Phase 1 Pond in the Fall 2021 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 1 and, graphically, in Figure 1. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2020 results and the most closely comparable historic creek data (Table 2 and Figure 2). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 3-6.

———

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 1 and 2)

The 2021 bass samples ranged in size between 224 and 302 mm (about 9-12"), with a single much larger fish (393 mm, 15.5"). Adult Bass represent the top predator fish in this region and will typically have the highest mercury levels at any given site. Mercury concentrations generally increased with fish size, as is typical; the large fish had the highest level (0.863 ppm). The 2021 bass samples had fillet muscle mercury ranging from 0.169-0.863 ppm, averaging 0.381 ppm. This was very similar to last year (2020: 0.352 ppm) and statistically similar to all of the previous collections here. As compared to baseline/historic samples from Cache Creek, the 2020 Phase 1 adult Largemouth Bass were not elevated in mercury; they were lower than 6 of 7 similar baseline/historic sample sets from Cache Creek; the difference was statistically significant for three of the comparisons. As noted in previous reports, the Phase 1 bass were among the lower mercury top predator fish samples we have collected in California, across many studies. Although the overall concentrations remained relatively low, the changes seen between 2015 and 2021 provide evidence of some of the factors influencing fish mercury exposure in the aggregate mining ponds. The changes in bass mercury uptake corresponded to changes in mining practices at this site: from active mining plus slurry inputs, to slurry only, to no mining or slurry and, after 2018, back to slurry inputs.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 3 and 4)

Juvenile bass were scarce here in 2021. We collected 9 individual fish. These were divided into four size-class composite samples of 2-3 fish each. These whole-body composites had uniformly low mercury levels of 0.085-0.111 ppm, with a mean of 0.096 ppm. Levels have been consistently low at this pond, across the seven years monitored to this point. Within this range of relatively low juvenile bass mercury concentrations, the 2021 set were in the mid-range of the long-term data. They were statistically lower in 2021 (0.096 ppm) than 2017 (0.146 ppm) and 2019 (0.114 ppm), statistically similar to collections from 2016 (0.094 ppm) and 2020 (0.104

ppm), and statistically higher than samples from 2015 (0.044 ppm) and 2018 (0.068 ppm, single fish). Within each year, variability was very low, allowing statistical differentiations between years and with comparative creek samples. Relative to baseline Cache Creek comparison fish, the 2021 Phase 1 juvenile Largemouth Bass were, on average, not elevated; they were significantly lower in mercury than the River Mile 28 set and significantly above the River Mile 15 set.

Mosquitofish (Tables/Figures 3 and 5)

Mosquitofish were sampled with four ascending size-class sets of 8-10 individuals each. These multiple-fish composites had whole-body mercury ranging from 0.077-0.153 ppm, averaging 0.115 ppm. The seven-year trend of mean levels showed a gradual increase between 2015 and 2017 (0.075-0.135 ppm), a significant decline in 2018 (0.083 ppm), and a gradual increase since then (0.096-0.115 ppm). The 2021 set were significantly higher in mercury than the 2015 and 2018 fish, and statistically similar to the samples from all the other years. As in previous years and at the other sites, this species was more variable within each year than the juvenile bass, showing an increase in mercury with Mosquitofish size. This broadened statistical confidence intervals of the means, leading to more overlap statistically. Relative to the creek baseline comparisons, the 2021 Phase 1 Mosquitofish were not elevated; mean mercury was statistically similar to both River Mile 15 comparisons (0.100-0.103 ppm) and significantly lower than the River Mile 17 sets (0.178 ppm).

Juvenile Green Sunfish (Tables/Figures 3 and 6)

The juvenile Green Sunfish composites had whole-body mercury ranging from 0.077-0.111 ppm, averaging 0.090 ppm, nearly identical to the last two years (0.089 ppm). This species, collected since 2017, was generally consistent with the other two small fish species: highest levels were seen in 2017 (0.118 ppm), lowest in 2018 (0.035 ppm), and a relative increase to an intermediate level in 2019-2021 (0.089-0.090 ppm). These broad changes were statistically significant, though all were relatively low levels. As compared to the creek baseline samples, the 2021 Phase 1 juvenile Green Sunfish were not elevated; levels were statistically similar to two of five comparisons and significantly lower than three.

Table 1. Cemex – Phase 1 Pond: Individual large fish sampled, 2021

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	224	8.8	150	0.3	**0.169**
Largemouth Bass	228	9.0	165	0.4	**0.181**
Largemouth Bass	237	9.3	160	0.4	**0.244**
Largemouth Bass	254	10.0	168	0.4	**0.235**
Largemouth Bass	255	10.0	202	0.4	**0.294**
Largemouth Bass	257	10.1	215	0.5	**0.282**
Largemouth Bass	260	10.2	205	0.5	**0.204**
Largemouth Bass	265	10.4	255	0.6	**0.246**
Largemouth Bass	268	10.6	262	0.6	**0.248**
Largemouth Bass	272	10.7	230	0.5	**0.525**
Largemouth Bass	274	10.8	225	0.5	**0.526**
Largemouth Bass	276	10.9	225	0.5	**0.508**
Largemouth Bass	277	10.9	270	0.6	**0.379**
Largemouth Bass	283	11.1	280	0.6	**0.469**
Largemouth Bass	284	11.2	288	0.6	**0.418**
Largemouth Bass	284	11.2	282	0.6	**0.504**
Largemouth Bass	293	11.5	302	0.7	**0.430**
Largemouth Bass	297	11.7	360	0.8	**0.376**
Largemouth Bass	302	11.9	342	0.8	**0.513**
Largemouth Bass	393	15.5	655	1.4	**0.863**

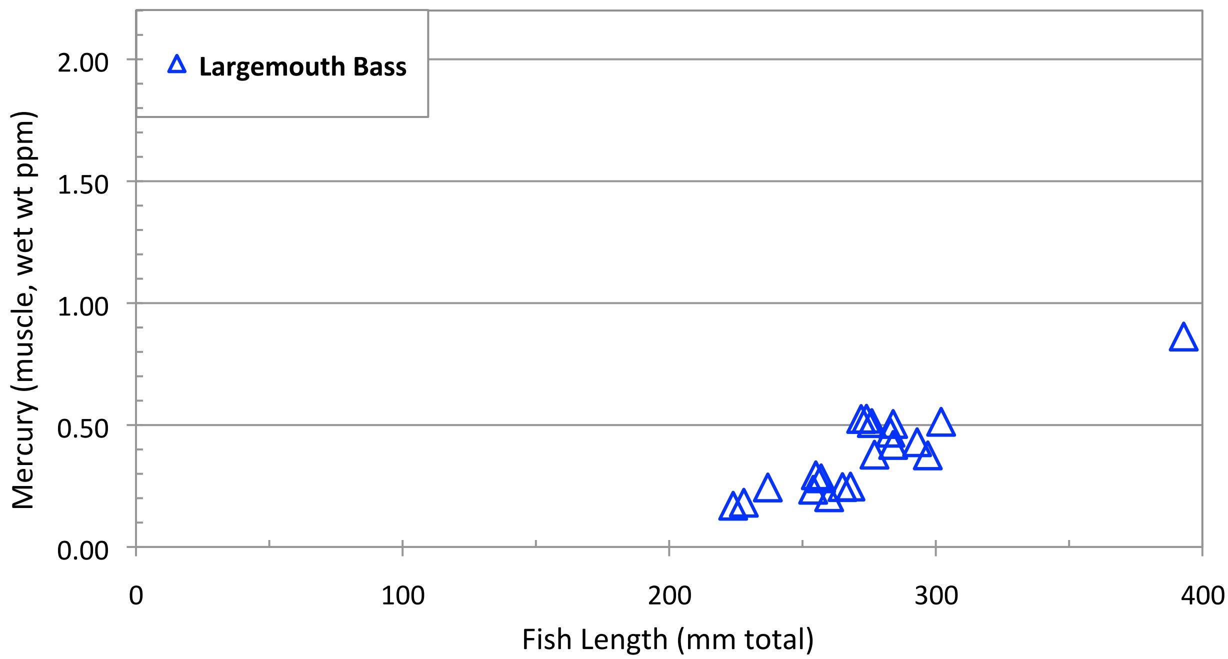


Figure 1. Cemex – Phase 1 Pond: Large fish sampled, 2021
(fillet muscle mercury in individual fish)

Table 2. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Cemex – Phase 1	**2015**	**18**	305	393	**0.278**	± 0.055
Cemex – Phase 1	**2016**	**20**	313	383	**0.350**	± 0.066
Cemex – Phase 1	**2017**	**17**	299	357	**0.393**	± 0.079
Cemex – Phase 1	**2018**	**20**	298	331	**0.481**	± 0.131
Cemex – Phase 1	**2019**	**20**	280	247	**0.404**	± 0.085
Cemex – Phase 1	**2020**	**20**	267	253	**0.352**	± 0.075
Cemex – Phase 1	**2021**	**20**	274	262	**0.381**	± 0.079
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

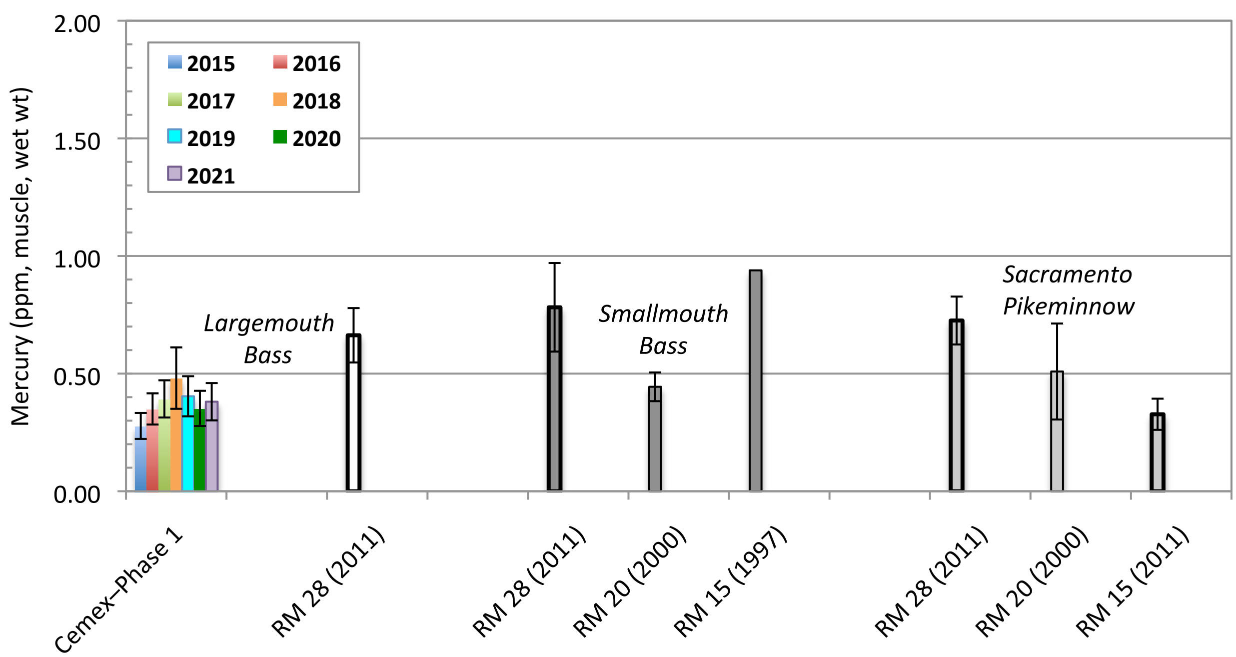


Figure 2. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 3. Cemex – Phase 1 Pond: Small Fish Sampled, 2021
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	(inches)	Av. Fish Weight (g)	(oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	2	71	2.8	4.90	0.17	**0.088**
Largemouth Bass (juv)	3	76	3.0	5.95	0.21	**0.085**
Largemouth Bass (juv)	2	84	3.3	7.68	0.27	**0.111**
Largemouth Bass (juv)	2	85	3.3	8.72	0.31	**0.101**
Green Sunfish (juv)	8	28	1.1	0.23	0.008	**0.077**
Green Sunfish (juv)	9	32	1.2	0.84	0.029	**0.081**
Green Sunfish (juv)	1	40	1.6	5.95	0.210	**0.111**
Mosquitofish	10	27	1.1	0.19	0.007	**0.077**
Mosquitofish	10	32	1.3	0.35	0.012	**0.094**
Mosquitofish	10	37	1.5	0.54	0.019	**0.137**
Mosquitofish	8	41	1.6	0.86	0.031	**0.153**

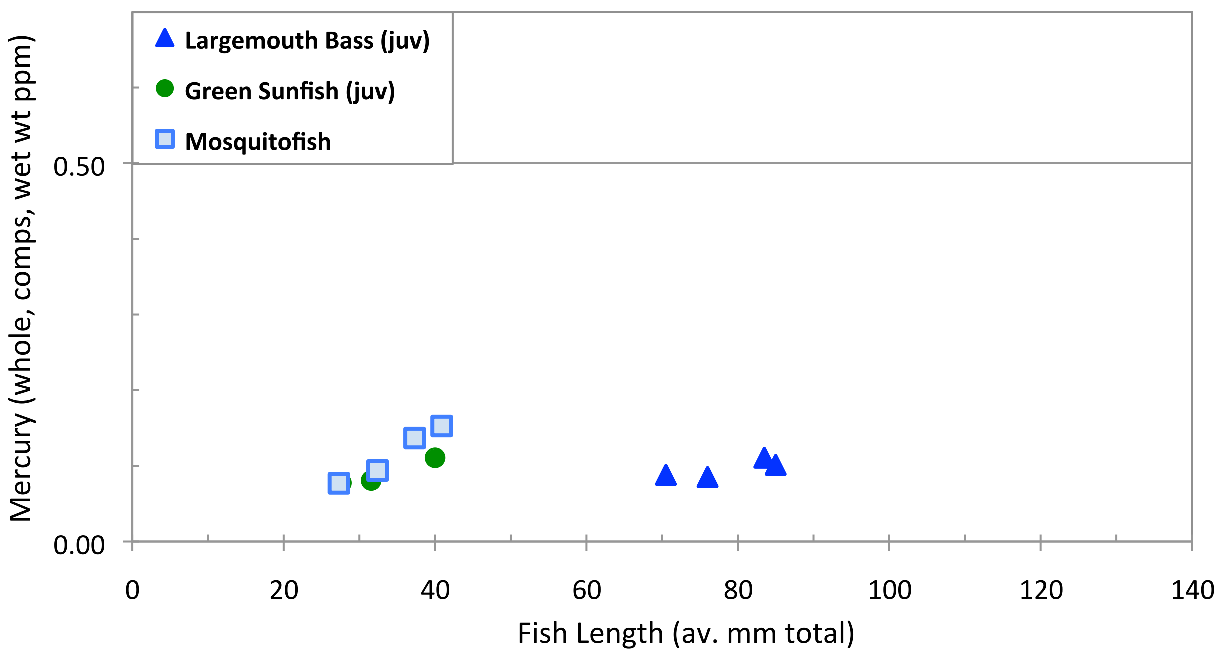


Figure 3. Cemex – Phase 1 Pond: Small, young fish sampled, 2021
(mercury in whole-body, multi-individual composite samples)

Table 4. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Cemex – Phase 1	**2015**	**4**	8	109	17	**0.044**	± 0.004
Cemex – Phase 1	**2016**	**4**	3	102	17	**0.094**	± 0.006
Cemex – Phase 1	**2017**	**4**	2	117	22	**0.146**	± 0.011
Cemex – Phase 1	**2018**	**1**	1	78	6	**0.068**	
Cemex – Phase 1	**2019**	**4**	4-5	106	17	**0.114**	± 0.007
Cemex – Phase 1	**2020**	**5**	2-4	100	13	**0.104**	± 0.008
Cemex – Phase 1	**2021**	**4**	2-3	79	7	**0.096**	± 0.006
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

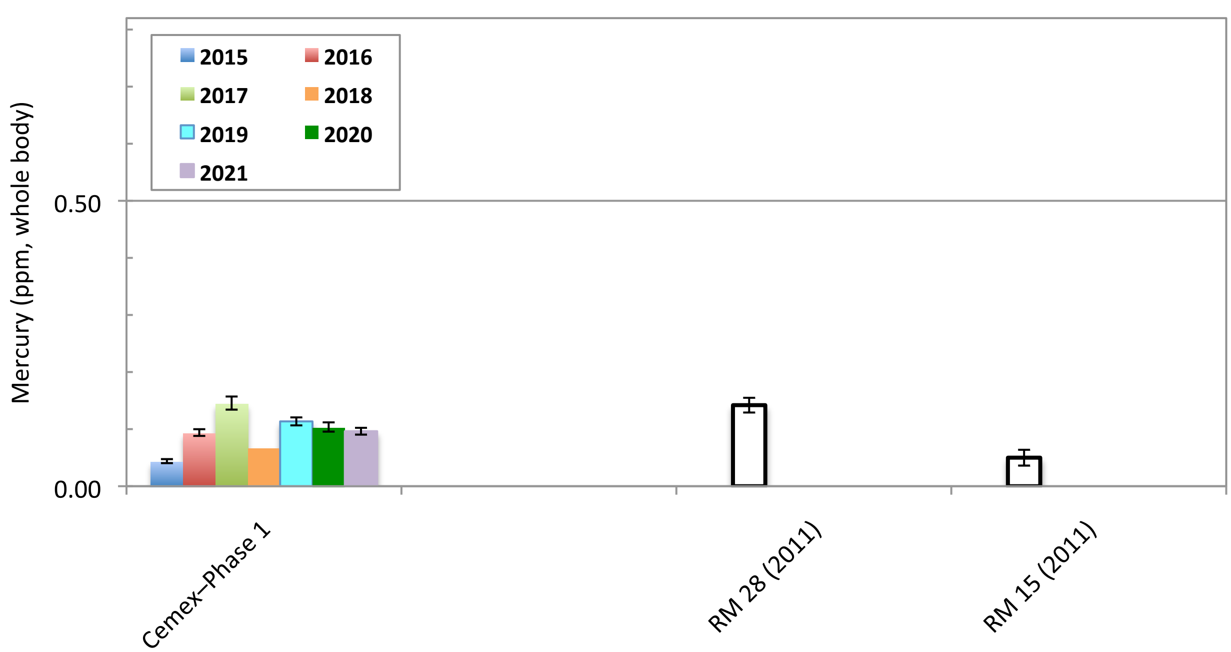


Figure 4. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 5. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Cemex – Phase 1	**2015**	**4**	10	39	0.6	**0.075**	± 0.008
Cemex – Phase 1	**2016**	**4**	10	34	0.4	**0.093**	± 0.019
Cemex – Phase 1	**2017**	**4**	10	33	0.4	**0.135**	± 0.019
Cemex – Phase 1	**2018**	**4**	6-10	34	0.5	**0.083**	± 0.016
Cemex – Phase 1	**2019**	**4**	10	34	0.5	**0.096**	± 0.024
Cemex – Phase 1	**2020**	**4**	12	35	0.5	**0.102**	± 0.021
Cemex – Phase 1	**2021**	**4**	8-10	34	0.5	**0.115**	± 0.018
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

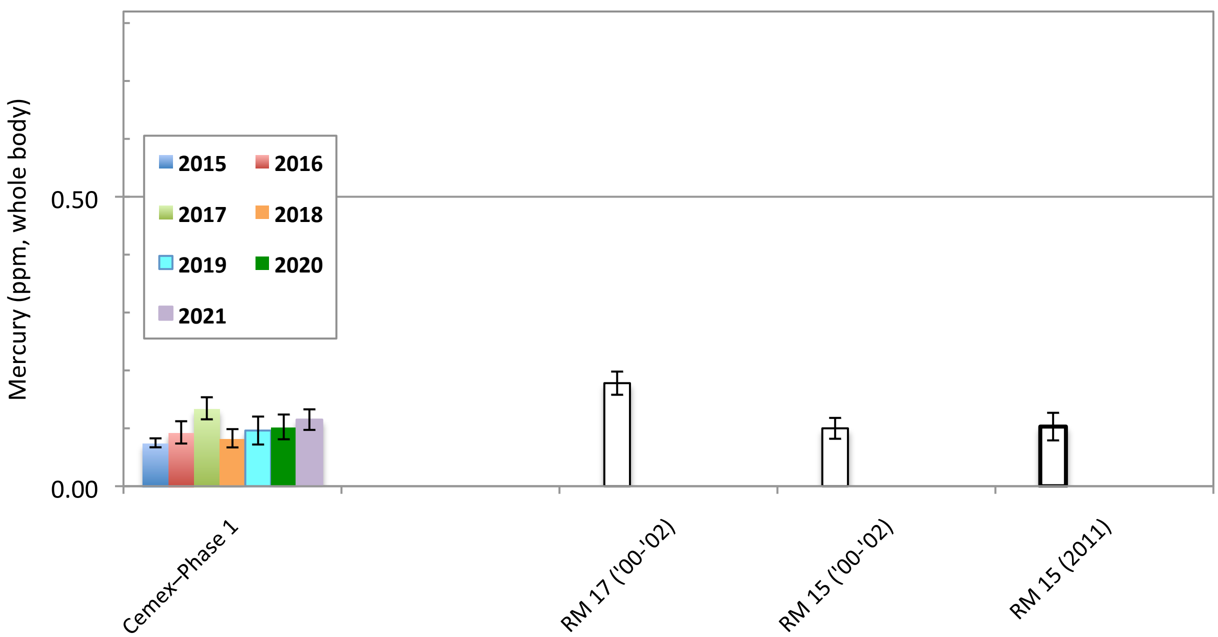


Figure 5. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 6. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	**Year**	**n** (comps)	**n** (inds/ (comp)	**Av Lgth** (mm total)	**Av Wt** (grams)	**Hg** (µg/g = ppm, wet wt)	**Std. Error**
Green Sunfish (juveniles)							
Cemex – Phase 1	**2017**	**4**	8-10	47	1.9	**0.118**	± 0.023
Cemex – Phase 1	**2018**	**4**	2	51	2.1	**0.035**	± 0.009
Cemex – Phase 1	**2019**	**4**	2-10	44	1.7	**0.089**	± 0.011
Cemex – Phase 1	**2020**	**3**	1-3	50	2.7	**0.089**	± 0.009
Cemex – Phase 1	**2021**	**3**	1-9	33	2.3	**0.090**	± 0.011
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

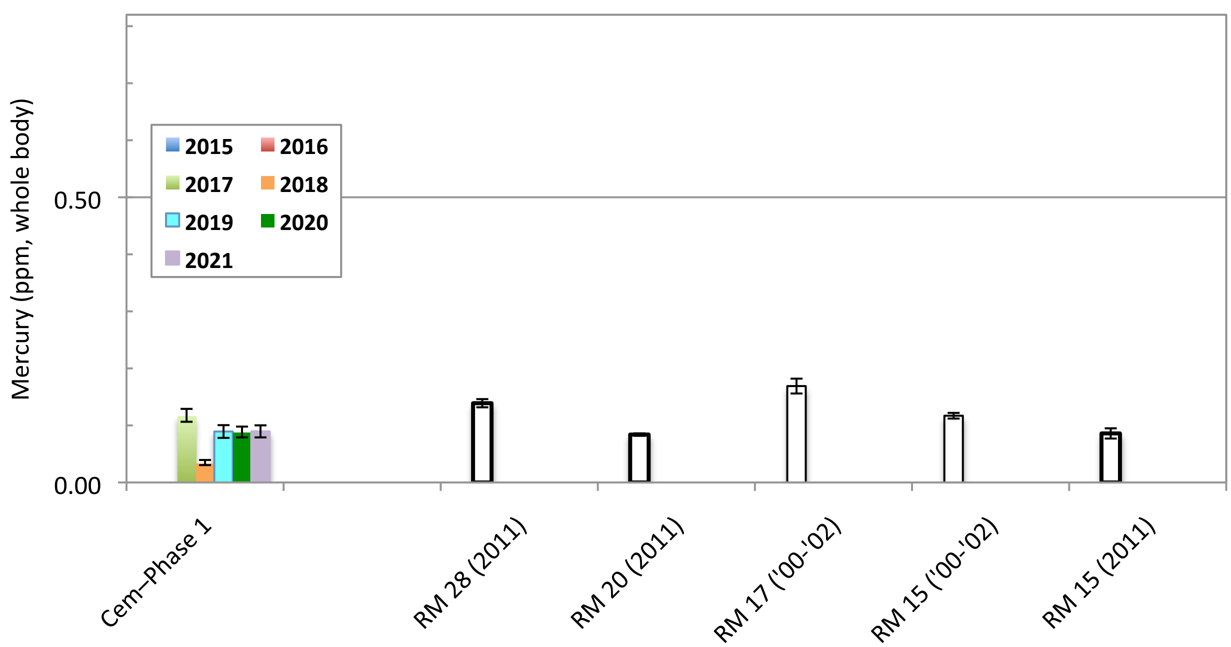


Figure 6. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

2. CEMEX – PHASE 3 POND

(Google Earth 10/21/2020)

2. CEMEX – PHASE 3 POND *(Tables and Figures 7-12)*

Summary

The former Phase 3-4 Pond was divided into two separate parts in late 2020, with active mining continuing in the eastern, Phase 4 Pond and the western, Phase 3 sub-basin becoming an isolated, relatively undisturbed pond. Mercury monitoring continued this year in both the Phase 3 and Phase 4 Ponds. In 2021, twenty adult Largemouth Bass were sampled from Phase 3, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Green Sunfish, and juvenile Largemouth Bass. Except for the Mosquitofish samples, all of the 2021 Phase 3 fish were elevated in mercury on average. As the former combined Phase 3-4 Pond was found to be "elevated for three or more years of five" over creek baselines (2015-2019, all 5 years), that triggered the addition of "expanded analysis" and, following a period of data gathering, development of a mercury management plan. Expanded analysis work began in the Phase 3-4 Pond in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports. After Phase 3-4 was split into two parts, this work continued in both ponds in 2021.

Summary 2021 Cemex – Phase 3 Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	>	>	Largemouth Bass
		≤	Mosquitofish
		>	Sunfish
Overall 2021 Findings	>		

The former Phase 3-4 Pond was divided into two separate parts in late 2020, with active mining continuing in the eastern, Phase 4 Pond and the western, Phase 3 sub-basin becoming an isolated, relatively undisturbed pond. Mercury monitoring continued this year in both the Phase 3 and Phase 4 Ponds. Like the other Cemex ponds, Phase 3 is located just south of Cache Creek and east of Highway 505. It lies between the Phase 1 Pond to the west and the newly separated Phase 4 Pond to the east. The Phase 3 Pond is a rectangular water body that is approximately 700 m long (0.7 km) and 450 m wide. Maximum depth ranged narrowly in 2021, despite drought conditions (8.7-10.1 m, 29-33 feet). This pond was left dormant in 2021, with regard to mining and other earth moving. Riparian and aquatic vegetation rapidly colonized, creating new habitat. Continuing from testing in the previously combined Phase 3-4 Pond, this (2021) was Year 7 of monitoring.

We sampled the pond during day and twilight conditions with a range of techniques, and collected useful samples of most of the fish species present. These included individual fillet muscle samples of 20 Largemouth Bass (*Micropterus salmoides*) across the range of sizes present. The small fish available were juvenile Green Sunfish (*Lepomis cyanellus*, 1-2"), and Mosquitofish (*Gambusia affinis*, 1-2"), each sampled with 3-4 composites, for 10 total composites.

In total, 20 large fish muscle samples and 10 small fish composite samples, 30 separate mercury samples, were analyzed from the Cemex–Phase 3 Pond in the Fall 2021 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 7 and, graphically, in Figure 7. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2020 results and the most closely comparable historic creek data (Table 8 and Figure 8). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 9-12.

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Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 7 and 8)

The 2021 bass samples ranged fairly narrowly in size between 330 and 387 mm (about 13-15"); this pond contains a healthy population of mainly larger bass than in the other ponds. The 2021 samples had fillet muscle mercury ranging from 0.539-1.280 ppm, averaging 0.971 ppm. This was up significantly from 2020 (0.656 ppm) in the combined Phase 3-4 Pond and was higher than all but the highest average found there (2017: 1.093 ppm), which it was statistically similar to. In relation to comparable baseline Cache Creek samples, the 2021 Phase 3 bass were elevated in mercury; the average level was higher than all 7 historical comparisons. The difference was statistically significant for 5 of 7. The 2021 Phase 3 bass average (0.971 ppm) was also significantly higher than the corresponding data from the recently separated, actively mined Phase 4 (0.782 ppm). The bass mercury results from both ponds are shown together in Figure 7(b). Part of the reason for the difference in average mercury levels is that the fish available for collection in the Phase 3 Pond were larger/older on average, all 330-387 mm and 445-740 g in size. In Phase 4, the bass averaged smaller/younger, with about half the fish in a similar size range as in Phase 3 (332-358 mm, 365-550 g), but the rest of the fish in the smaller range of 275-330 mm and 265-430 g. The Phase 3 part of the former Phase 3-4 combined pond was left relatively undisturbed over the last few years, with active mining shifting to the Phase 4 section. Aquatic and riparian vegetation established there, creating steadily improving fish habitat. The catch results indicate that this prime habitat may have been taken over by dominant, largest bass, with many of the smaller bass excluded into the less desirable, active mining habitat of Phase 4. When the size versus mercury data from both ponds are plotted together in Figure 7(b), they blend evenly into each other.

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Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 9 and 10)

As in last few years, juvenile bass were very scarce. There is tremendous predation pressure on them here from the thriving adult bass population. Three individuals were taken though, as compared to just 0-1 in each of the previous three years, allowing some statistical comparison. The three 106-115 mm (4-5") fish had whole body mercury of 0.275-0.329 ppm, averaging 0.302 ppm, in the historic upper range for this site. This was higher than last year's single individual (0.144 ppm) and statistically higher than the 2017 samples (0.249 ppm). It was lower than the 2015, 2016, and 2019 samples – statistically lower than the 2016 set (0.372 ppm). Relative to creek baseline comparisons, the 2021 Phase 3 juvenile Largemouth Bass were elevated in mercury; except for the single fish sample of last year (0.144 ppm), all of the juvenile bass data from this site have been far above the baseline creek samples (0.050-0.142 ppm). The 2021 Phase 3 samples were consistent with that trend.

Juvenile Green Sunfish (Tables/Figures 9 and 11)

Like the juvenile bass, young sunfish were scarce, but we were able to collect 12 individuals, which were split into 3 size-class composites of 2-5 fish each. The samples had whole-body mercury ranging from 0.118-0.214 ppm and averaging 0.159 ppm. This was up significantly from the combined Phase 3-4 Pond in 2020 (0.117 ppm), to a level about mid-range for these samples there since 2017. It remained significantly lower than concentrations in the first monitoring years of 2015-2016 (0.233-0.275 ppm). Compared to baseline juvenile Green Sunfish mercury from Cache Creek, Phase 3 Pond fish in 2021 were elevated on average; they were statistically higher than three creek comparisons and statistically similar to two.

Mosquitofish (Tables/Figures 9 and 12)

We were able to collect strong composite samples of Mosquitofish in 2021, as in all previous years in the combined Phase 3-4 Pond. Four size-class composites of 10 fish each were analyzed. The 2021 samples had whole-body mercury ranging from 0.105-0.201 ppm, averaging 0.137 ppm. This was up from the previous year in the combined pond (2020: 0.112 ppm), though the increase was not statistically significant. Levels remained lower than in all other monitoring years before 2020 (0.157-0.286 ppm), significantly lower than three of the five. Relative to the baseline Cache Creek comparison samples, the 2021 Phase 3 Mosquitofish were, on average, not elevated; statistically lower in mercury than one of three comparisons, similar to one, and higher than one.

Table 7. Cemex – Phase 3 Pond: Individual large fish sampled, 2021

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	330	13.0	480	1.1	**1.006**
Largemouth Bass	337	13.3	445	1.0	**0.938**
Largemouth Bass	339	13.3	510	1.1	**0.973**
Largemouth Bass	340	13.4	505	1.1	**1.168**
Largemouth Bass	344	13.5	510	1.1	**0.559**
Largemouth Bass	345	13.6	545	1.2	**0.588**
Largemouth Bass	350	13.8	510	1.1	**0.880**
Largemouth Bass	360	14.2	620	1.4	**0.539**
Largemouth Bass	360	14.2	625	1.4	**0.996**
Largemouth Bass	362	14.3	555	1.2	**1.016**
Largemouth Bass	363	14.3	555	1.2	**1.049**
Largemouth Bass	364	14.3	605	1.3	**1.099**
Largemouth Bass	366	14.4	470	1.0	**1.280**
Largemouth Bass	366	14.4	595	1.3	**1.073**
Largemouth Bass	367	14.4	610	1.3	**1.010**
Largemouth Bass	370	14.6	650	1.4	**1.089**
Largemouth Bass	371	14.6	635	1.4	**1.133**
Largemouth Bass	372	14.6	640	1.4	**1.026**
Largemouth Bass	375	14.8	740	1.6	**0.950**
Largemouth Bass	387	15.2	695	1.5	**1.055**

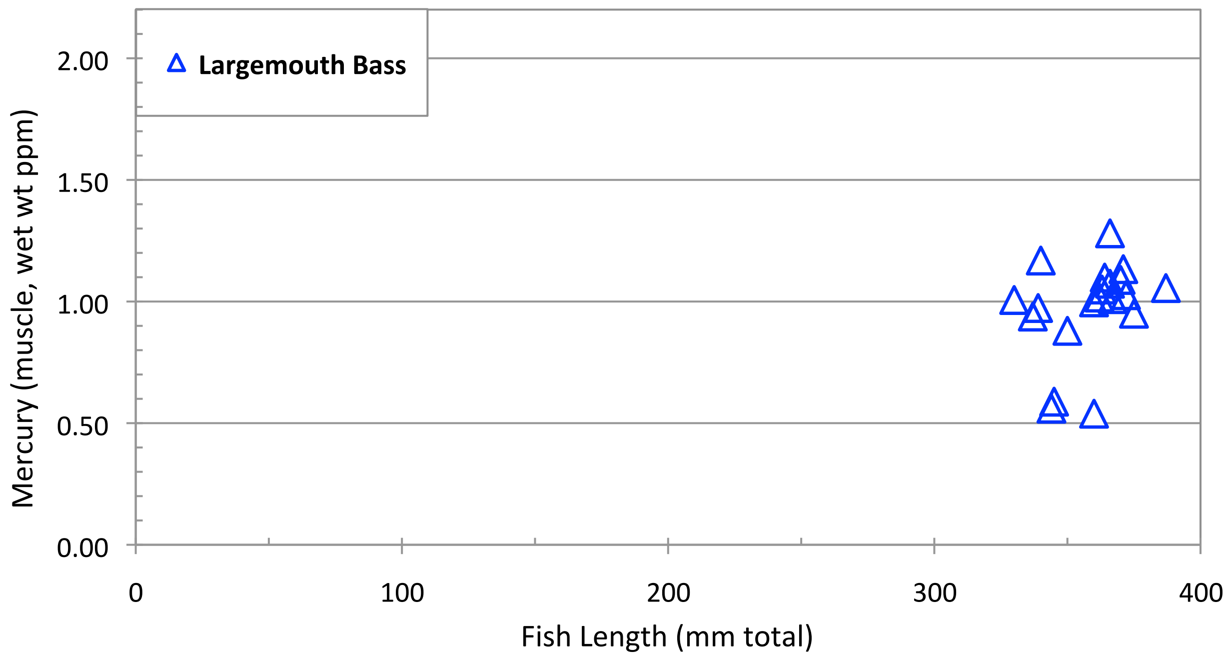

Figure 7. Cemex – Phase 3 Pond: Large fish sampled, 2021
(fillet muscle mercury in individual fish)

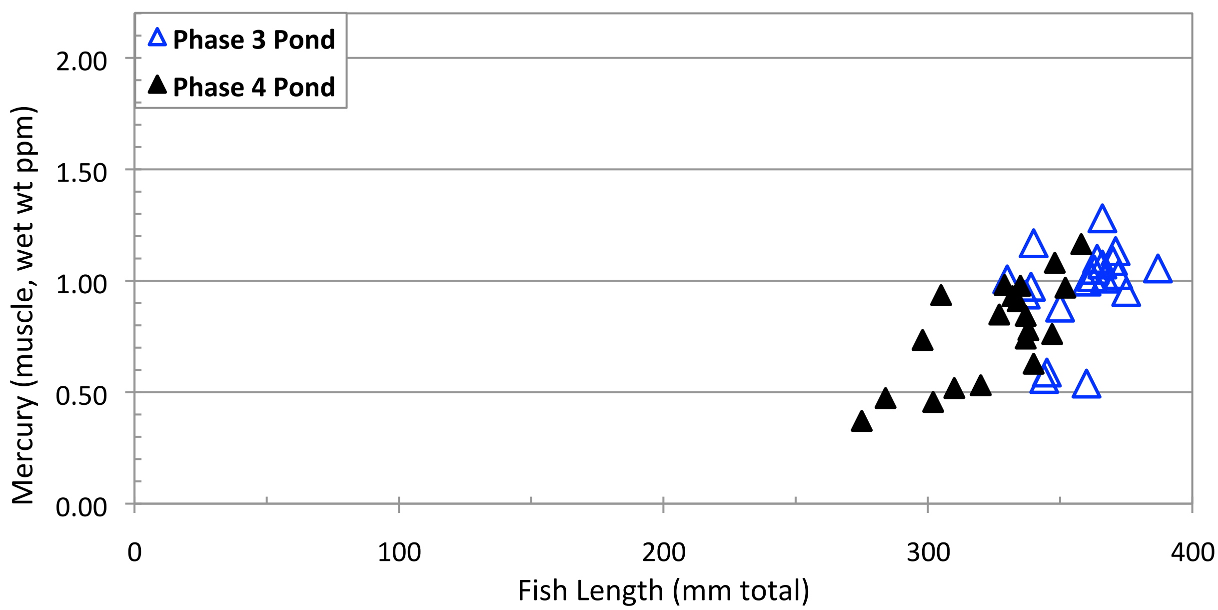

Figure 7(b). Cemex – Phase 3 AND Phase 4 Bass comparison, 2021
(fillet muscle mercury in individual fish)

Table 8. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Cemex – Phase 3-4	**2015**	**20**	344	526	**0.840**	± 0.113
Cemex – Phase 3-4	**2016**	**20**	344	557	**0.858**	± 0.139
Cemex – Phase 3-4	**2017**	**20**	334	479	**1.093**	± 0.172
Cemex – Phase 3-4	**2018**	**20**	331	463	**0.918**	± 0.119
Cemex – Phase 3-4	**2019**	**20**	312	402	**0.819**	± 0.195
Cemex – Phase 3-4	**2020**	**20**	310	399	**0.656**	± 0.094
Cemex – Phase 3	**2021**	**20**	358	575	**0.971**	± 0.092
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

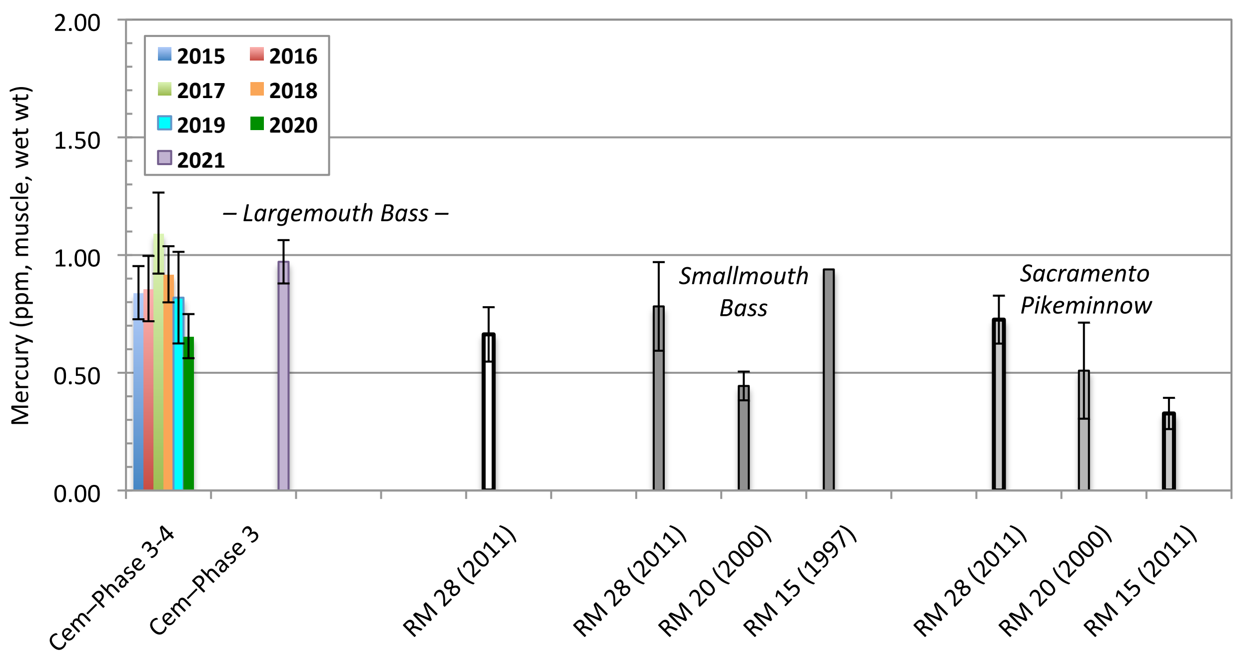

Figure 8. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 9. Cemex – Phase 3 Pond: Small Fish Sampled, 2021
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	Av. Fish Length (inches)	Av. Fish Weight (g)	Av. Fish Weight (oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	1	106	4.2	10.9	0.38	**0.329**
Largemouth Bass (juv)	1	108	4.3	10.8	0.38	**0.275**
Largemouth Bass (juv)	1	115	4.5	14.1	0.50	**0.301**
Green Sunfish (juv)	5	29	1.1	0.45	0.016	**0.118**
Green Sunfish (juv)	5	33	1.3	0.79	0.028	**0.146**
Green Sunfish (juv)	2	38	1.5	0.49	0.017	**0.214**
Mosquitofish	10	28	1.1	0.21	0.007	**0.105**
Mosquitofish	10	33	1.3	0.32	0.011	**0.111**
Mosquitofish	10	37	1.5	0.53	0.019	**0.130**
Mosquitofish	10	42	1.7	0.77	0.027	**0.201**

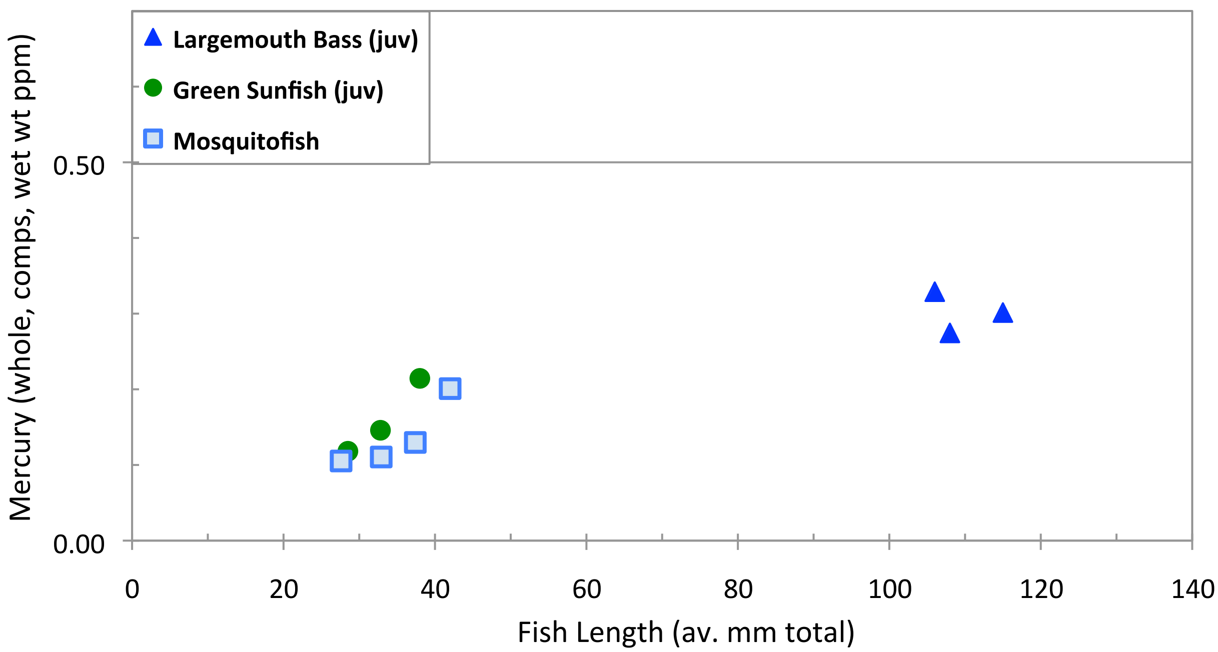

Figure 9. Cemex – Phase 3 Pond: Small, young fish sampled, 2021
(mercury in whole-body, multi-individual composite samples)

Table 10. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Cemex – Phase 3-4	**2015**	**4**	7	108	16	**0.334**	± 0.052
Cemex – Phase 3-4	**2016**	**4**	2	114	18	**0.372**	± 0.053
Cemex – Phase 3-4	**2017**	**4**	2-3	108	16	**0.249**	± 0.033
Cemex – Phase 3-4	**2018**	*(no samples)*					
Cemex – Phase 3-4	**2019**	**1**	1	125	23	**0.336**	
Cemex – Phase 3-4	**2020**	**1**	1	124	23	**0.144**	
Cemex – Phase 3	**2021**	**3**	1	110	12	**0.302**	± 0.016
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

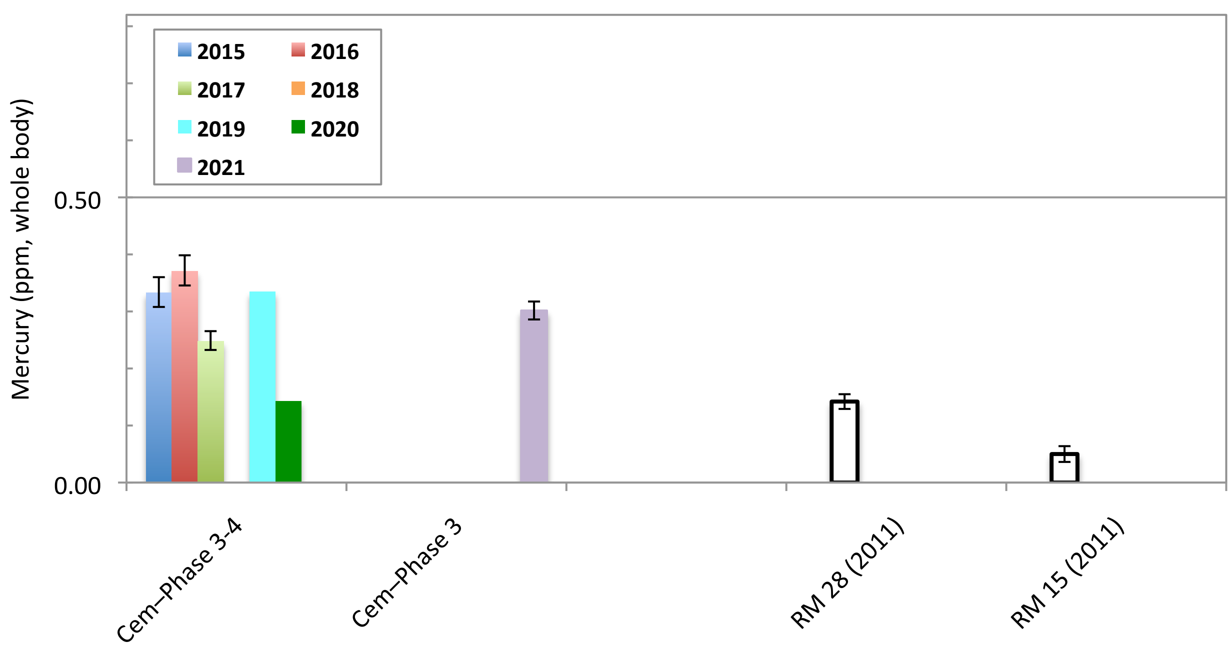

Figure 10. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 11. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Cemex – Phase 3-4	**2015**	**4**	10	47	1.8	**0.275**	± 0.022
Cemex – Phase 3-4	**2016**	**4**	4-5	49	2.0	**0.233**	± 0.026
Cemex – Phase 3-4	**2017**	**4**	2-6	36	0.7	**0.150**	± 0.051
Cemex – Phase 3-4	**2018**	**4**	1	34	0.5	0.112	± 0.020
Cemex – Phase 3-4	**2019**	**4**	10	43	1.6	**0.185**	± 0.016
Cemex – Phase 3-4	**2020**	**4**	1-12	38	0.9	**0.117**	± 0.024
Cemex – Phase 3	**2021**	**3**	2-5	33	0.6	**0.159**	± 0.029
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

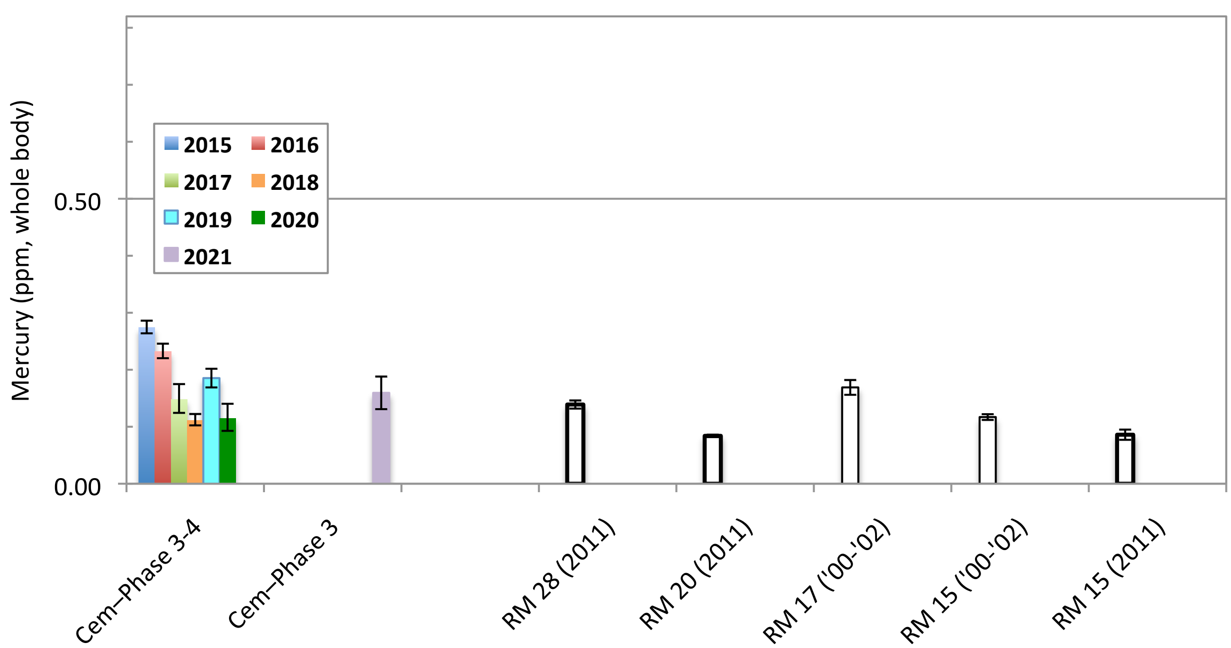

Figure 11. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 12. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Cemex – Phase 3-4	**2015**	**4**	10	37	0.6	**0.228**	± 0.029
Cemex – Phase 3-4	**2016**	**4**	10	37	0.6	**0.157**	± 0.019
Cemex – Phase 3-4	**2017**	**4**	6-10	34	0.5	**0.286**	± 0.035
Cemex – Phase 3-4	**2018**	**4**	3-10	34	0.5	**0.203**	± 0.021
Cemex – Phase 3-4	**2019**	**4**	10	35	0.6	**0.183**	± 0.029
Cemex – Phase 3-4	**2020**	**4**	3-12	33	0.4	**0.112**	± 0.018
Cemex – Phase 3	**2021**	**4**	10	35	0.5	**0.137**	± 0.022
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

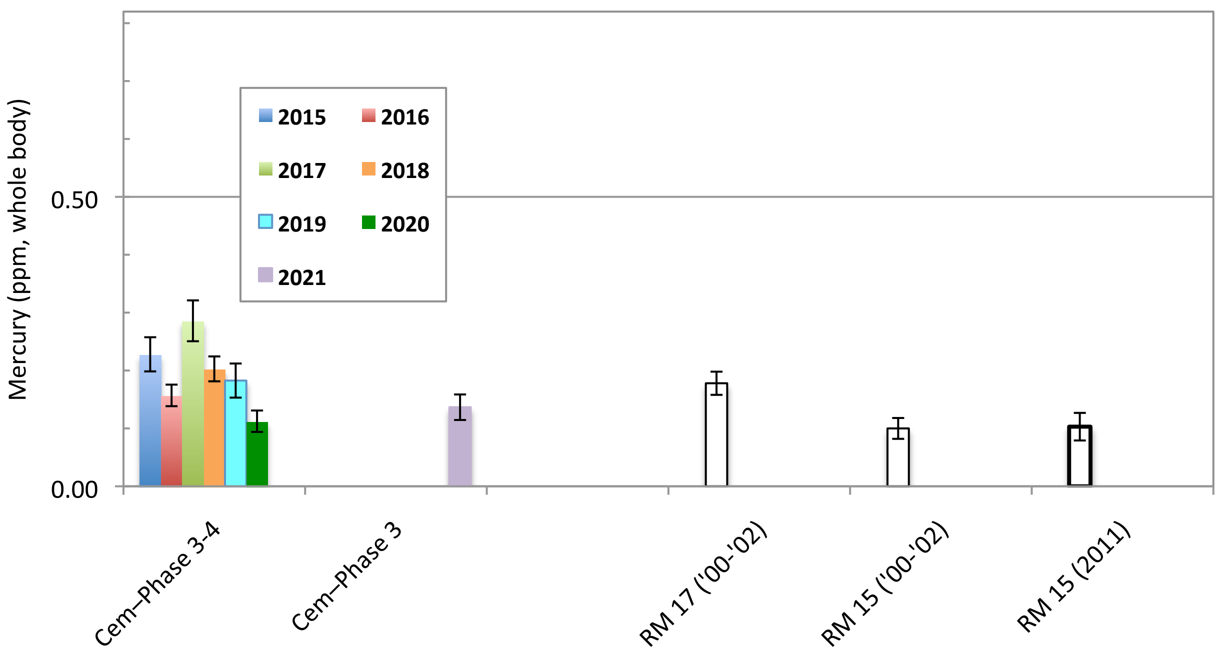

Figure 12. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

3. CEMEX – PHASE 4 POND

(Google Earth 10/21/2020)

3. CEMEX – PHASE 4 POND *(Tables and Figures 13-18)*

Summary

The former Phase 3-4 Pond was divided into two separate parts in late 2020, with active mining continuing in the eastern, Phase 4 Pond and the western, Phase 3 Pond left dormant. Mercury monitoring continued this year in both the Phase 3 and Phase 4 Ponds. In 2021, twenty adult Largemouth Bass were sampled from Phase 4, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Green Sunfish, and juvenile Largemouth Bass. Overall mercury results were 'inconclusive' in 2021, with some samples relatively elevated and others, including the key adult bass, similar to or below baseline comparisons. However, as the former combined Phase 3-4 Pond was found to be "elevated for three or more years of five" over creek baselines (2015-2019, all 5 years), that triggered the addition of "expanded analysis" and, following a period of data gathering, development of a mercury management plan. Expanded analysis work began in the Phase 3-4 Pond in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports. After Phase 3-4 was split into two parts, this work continued in both ponds in 2021. Future status of Phase 4 will depend on cumulative monitoring results.

Summary 2021 Cemex – Phase 4 Results, in relation to baseline comparisons

≤ = at or below ambient   INC = inconclusive   > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	INC	>	Largemouth Bass
		≤	Mosquitofish
		>	Sunfish
Overall 2021 Findings	INC		

The former Phase 3-4 Pond was divided into two separate parts in late 2020, with active mining continuing in the eastern, Phase 4 Pond and the western, Phase 3 sub-basin becoming an isolated, relatively undisturbed pond. Mercury monitoring continued this year in both the Phase 3 and

Phase 4 Ponds. Like the other Cemex ponds, Phase 4 is located just south of Cache Creek and east of Highway 505. It lies east of the newly separated Phase 3 Pond, which is east of the Phase 1 Pond. The Phase 4 Pond is app. 850 m long (0.85 km) and 450 m wide. Maximum depth ranged narrowly in 2021 (8.2-9.4 m, 27-31 feet), despite drought conditions. This pond was mined actively throughout 2021. Continuing from testing in the previously combined Phase 3-4 Pond, this (2021) was Year 7 of monitoring.

We sampled the pond during day and twilight conditions with a range of techniques, and collected useful samples of most of the fish species present. These included individual fillet muscle samples of 20 Largemouth Bass (*Micropterus salmoides*) across the range of sizes present. The small fish available were juvenile Largemouth Bass (3-5"), juvenile Green Sunfish (*Lepomis cyanellus*, 1-2"), and Mosquitofish (*Gambusia affinis*, 1-2"), each sampled with 4 composites, for 12 total composite samples.

In total, 20 large fish muscle samples and 12 small fish composite samples, 32 separate mercury samples, were analyzed from the Cemex–Phase 4 Pond in the Fall 2021 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 13 and, graphically, in Figure 13. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2020 results and the most closely comparable historic creek data (Table 14 and Figure 148). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 15-18.

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Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 13 and 14)

The Phase 4 Pond adult Largemouth Bass samples had fillet muscle mercury ranging from 0.371-1.164 ppm, averaging 0.782 ppm. This was up (not significantly) from 2020 (0.656 ppm) in the formerly combined Phase 3-4 Pond, but remained lower than all previous years there (2015-2019: 0.819-1.093 ppm); the difference was statistically significant for the highest comparison (2018: 1.093 ppm). The Phase 4 average bass mercury (0.782 ppm) was significantly lower than the average in the recently separated Phase 3 (0.971 ppm). As discussed above in the section on the

Phase 3 bass, this was at least partly due to the generally smaller/younger fish sizes in the Phase 4 Pond relative to the Phase 3 fish; the largest, most dominant bass appear to have excluded many of the smaller bass from the preferred habitat of Phase 3 and into the less desirable active mining Phase 4 section. With full separation of the two Phases, this left smaller/younger average sizes in Phase 4 in the short term. As shown in the Phase 3 section and again here in Figure 13(b), when the bass size versus mercury data from both ponds are plotted together, they blend fairly evenly into each other. In relation to comparable baseline Cache Creek samples, the 2021 Phase 4 bass were in the borderline, 'inconclusive' range for mercury; the average level was similar to the higher baseline samples; statistically similar to 5 of 7 historical comparisons and significantly higher than 2 of 7.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 15 and 16)

We were able to collect a more extensive set of juvenile bass (12 total) from the recently separated Phase 4 Pond in 2021 than in Phase 3 (3 fish) or from the combined Phase 3-4 Pond throughout 2018-2020 (0-1 fish/yr). The 12 fish were divided into four size-class composite samples of 2-4 fish each, with the sets spanning the 77-120 mm (3-5") size range. The four composites ranged in mercury from 0.135-0.205 ppm, averaging 0.160 ppm. This was significantly lower than in the 2021 Phase 3 Pond (0.302 ppm) and the historic record from the combined Phase 3-4 Pond throughout 2015-2019. In comparison with the Cache Creek baseline samples, though, the 2021 Phase 4 juvenile Largemouth Bass were, on average, still elevated; the elevation was significant for one of the comparisons and statistically overlapping the other.

Juvenile Green Sunfish (Tables/Figures 15 and 17)

Twenty-three individuals were taken, which were split into 4 size-class composites of 3-10 fish each. The samples had whole-body mercury ranging from 0.109-0.203 ppm and averaging 0.160 ppm. This was up significantly from the combined Phase 3-4 Pond in 2020 (0.117 ppm), to a level about mid-range for these samples there since 2017. It remained significantly lower than concentrations in the first monitoring years of 2015-2016 (0.233-0.275 ppm). In contrast with the juvenile bass in the newly separated ponds, the juvenile Green Sunfish samples remained nearly identical in both sides in 2021. Compared to baseline samples from Cache Creek, Phase 4 Pond juvenile sunfish in 2021 were elevated on average; they were significantly higher in mercury than three creek comparisons and statistically similar to two.

Mosquitofish (Tables/Figures 15 and 18)

Four size-class composites of 6-10 fish each were analyzed. The 2021 samples had whole-body mercury ranging from 0.086-0.157 ppm, averaging 0.122 ppm. This was up somewhat from the previous year in the combined pond (2020: 0.112 ppm); the increase was not statistically significant. Levels were statistically lower than in all other monitoring years before 2020 (0.157-0.286 ppm). They were also lower than in comparable samples from the 2021 Phase 3 Pond (0.137 ppm), though not significantly. Relative to the baseline Cache Creek comparison samples, the 2021 Phase 4 Mosquitofish were not elevated; they were statistically lower in mercury than the River Mile 17 sample sets (0.178 ppm) and statistically overlapping (similar to) the two sets from River Mile 15 (0.100-0.103 ppm).

Table 13. Cemex – Phase 4 Pond: Individual large fish sampled, 2021

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	275	10.8	265	0.6	**0.371**
Largemouth Bass	284	11.2	265	0.6	**0.474**
Largemouth Bass	298	11.7	350	0.8	**0.734**
Largemouth Bass	302	11.9	380	0.8	**0.456**
Largemouth Bass	305	12.0	305	0.7	**0.936**
Largemouth Bass	310	12.2	385	0.8	**0.519**
Largemouth Bass	320	12.6	390	0.9	**0.531**
Largemouth Bass	327	12.9	430	0.9	**0.849**
Largemouth Bass	329	13.0	415	0.9	**0.981**
Largemouth Bass	332	13.1	365	0.8	**0.931**
Largemouth Bass	334	13.1	455	1.0	**0.908**
Largemouth Bass	335	13.2	455	1.0	**0.978**
Largemouth Bass	337	13.3	525	1.2	**0.741**
Largemouth Bass	337	13.3	450	1.0	**0.843**
Largemouth Bass	338	13.3	415	0.9	**0.778**
Largemouth Bass	340	13.4	470	1.0	**0.628**
Largemouth Bass	347	13.7	465	1.0	**0.761**
Largemouth Bass	348	13.7	550	1.2	**1.081**
Largemouth Bass	352	13.9	505	1.1	**0.969**
Largemouth Bass	358	14.1	515	1.1	**1.164**

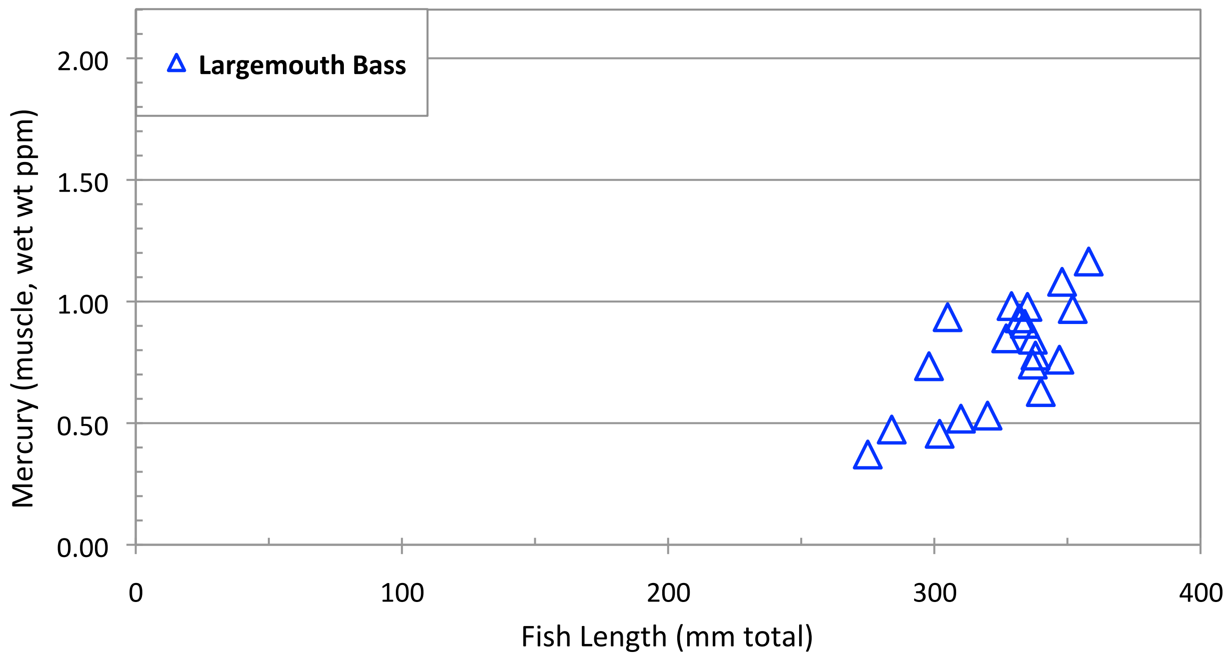

Figure 13. Cemex – Phase 4 Pond: Large fish sampled, 2021
(fillet muscle mercury in individual fish)

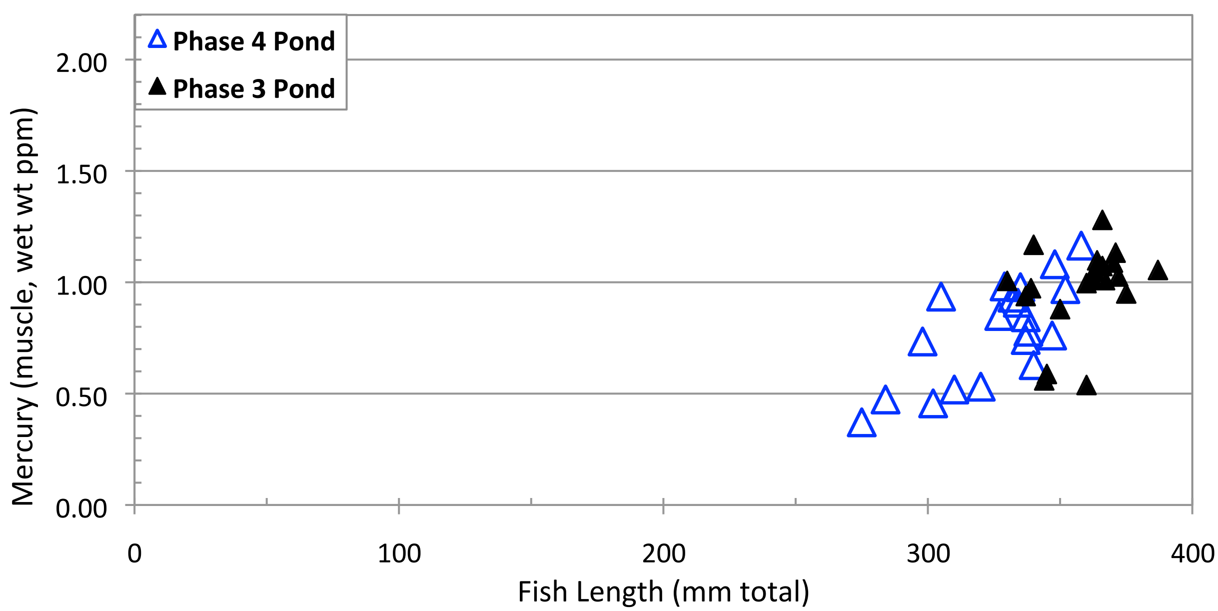

Figure 13(b). Cemex – Phase 4 AND Phase 3 Bass comparison, 2021
(fillet muscle mercury in individual fish)

Table 14. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Cemex – Phase 3-4	**2015**	**20**	344	526	**0.840**	± 0.113
Cemex – Phase 3-4	**2016**	**20**	344	557	**0.858**	± 0.139
Cemex – Phase 3-4	**2017**	**20**	334	479	**1.093**	± 0.172
Cemex – Phase 3-4	**2018**	**20**	331	463	**0.918**	± 0.119
Cemex – Phase 3-4	**2019**	**20**	312	402	**0.819**	± 0.195
Cemex – Phase 3-4	**2020**	**20**	310	399	**0.656**	± 0.094
Cemex – Phase 4	**2021**	**20**	325	418	**0.782**	± 0.105
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

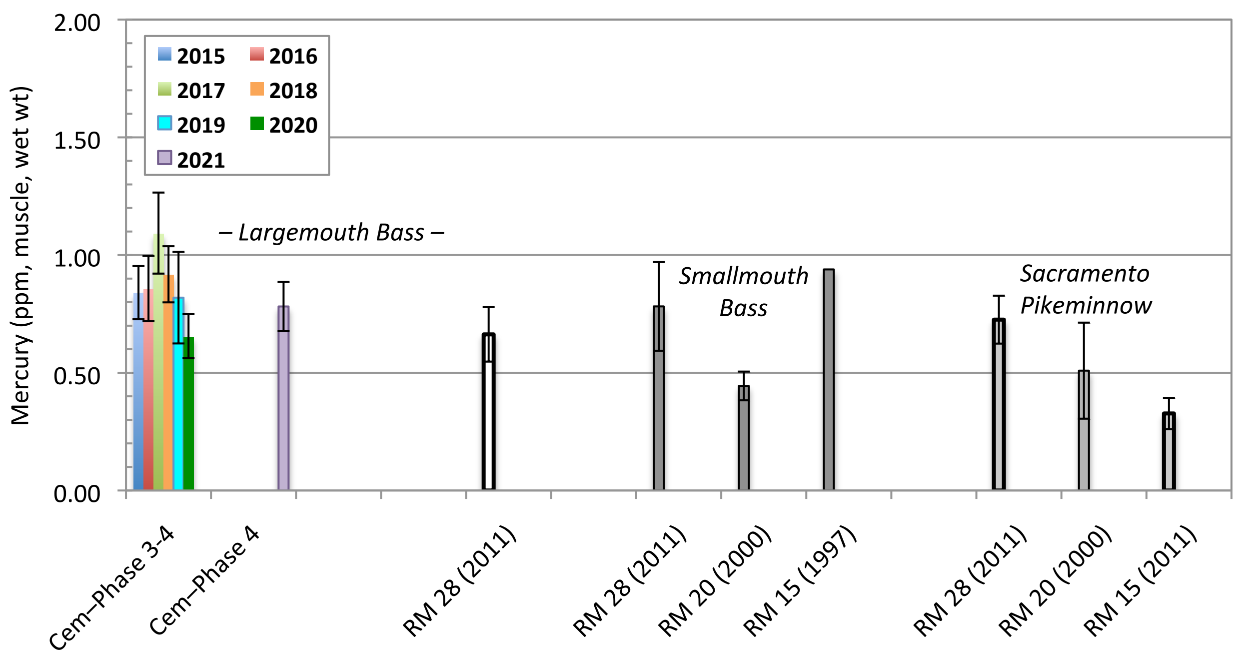

Figure 14. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 15. Cemex – Phase 4 Pond: Small Fish Sampled, 2021
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	(inches)	Av. Fish Weight (g)	(oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	4	77	3.0	6.00	0.21	**0.150**
Largemouth Bass (juv)	4	85	3.4	7.63	0.27	**0.152**
Largemouth Bass (juv)	2	95	3.7	10.8	0.38	**0.135**
Largemouth Bass (juv)	2	120	4.7	21.6	0.76	**0.205**
Green Sunfish (juv)	10	34	1.3	0.22	0.008	**0.152**
Green Sunfish (juv)	6	41	1.6	0.49	0.017	**0.109**
Green Sunfish (juv)	4	48	1.9	0.48	0.017	**0.203**
Green Sunfish (juv)	3	54	2.1	0.93	0.033	**0.176**
Mosquitofish	10	28	1.1	0.20	0.007	**0.086**
Mosquitofish	10	32	1.3	0.37	0.013	**0.116**
Mosquitofish	9	37	1.5	0.53	0.019	**0.130**
Mosquitofish	6	42	1.6	0.79	0.028	**0.157**

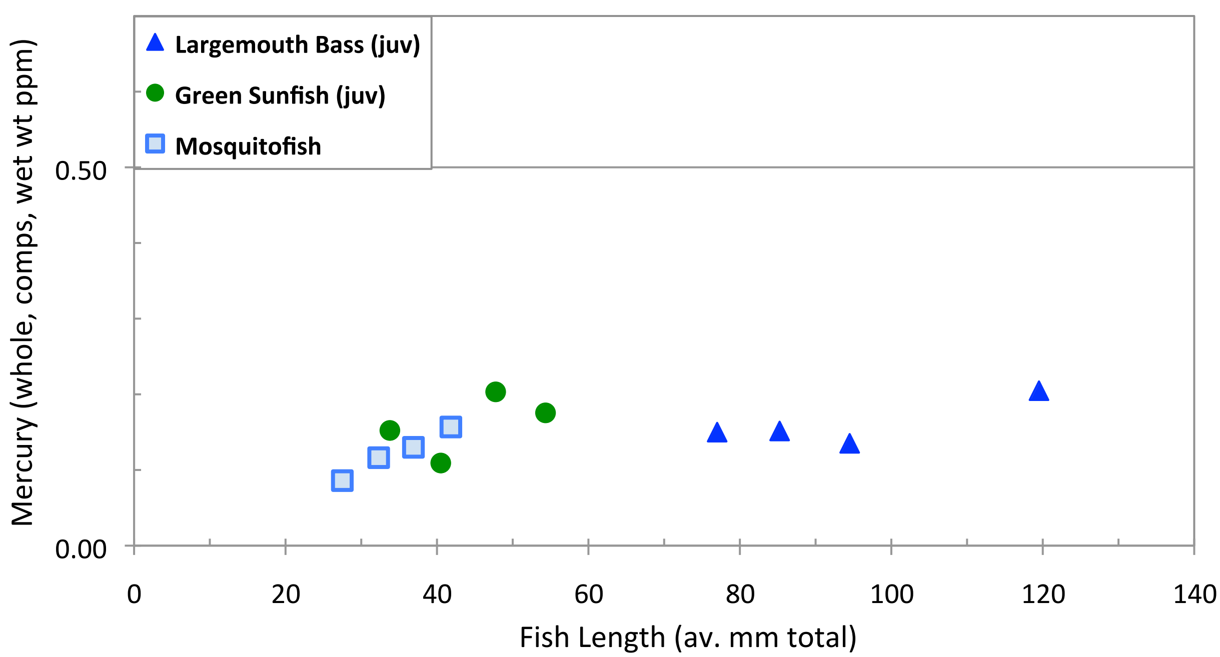

Figure 15. Cemex – Phase 4 Pond: Small, young fish sampled, 2021
(mercury in whole-body, multi-individual composite samples)

Table 16. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Cemex – Phase 3-4	**2015**	**4**	7	108	16	**0.334**	± 0.052
Cemex – Phase 3-4	**2016**	**4**	2	114	18	**0.372**	± 0.053
Cemex – Phase 3-4	**2017**	**4**	2-3	108	16	**0.249**	± 0.033
Cemex – Phase 3-4	**2018**	*(no samples)*					
Cemex – Phase 3-4	**2019**	**1**	1	125	23	**0.336**	
Cemex – Phase 3-4	**2020**	**1**	1	124	23	**0.144**	
Cemex – Phase 4	**2021**	**4**	2-4	94	12	**0.160**	± 0.015
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

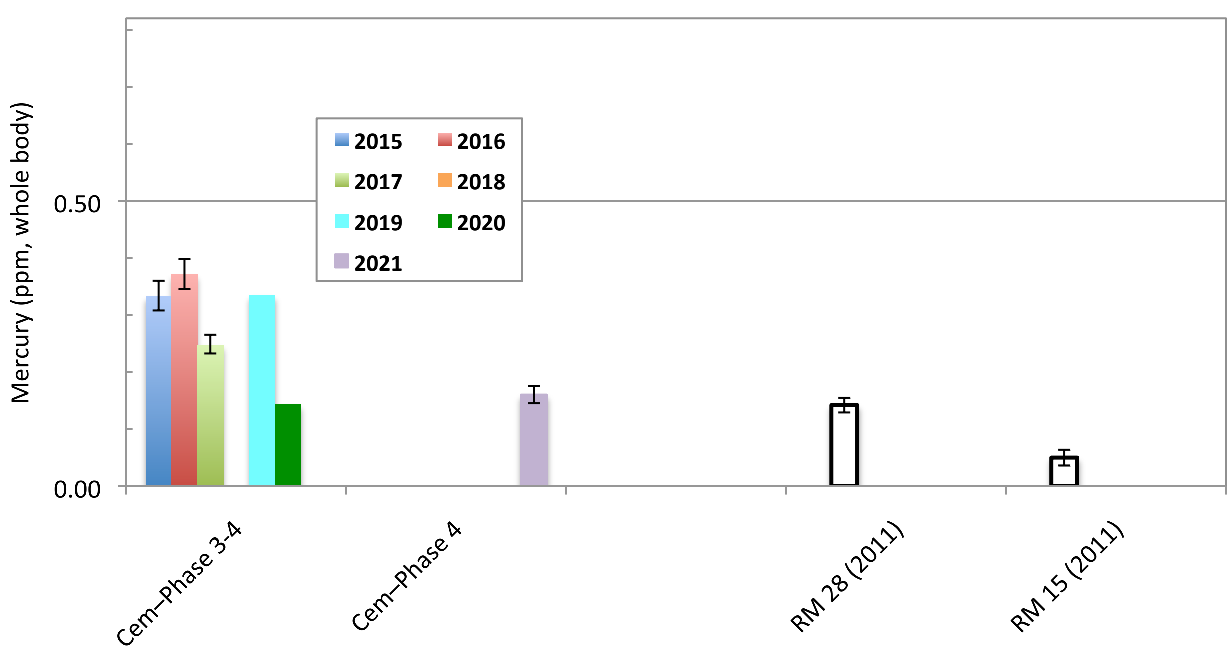

Figure 16. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 17. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	**Year**	**n** (comps)	**n** (inds/ (comp)	**Av Lgth** (mm total)	**Av Wt** (grams)	**Hg** (µg/g = ppm, wet wt)	**Std. Error**
Green Sunfish (juveniles)							
Cemex – Phase 3-4	**2015**	**4**	10	47	1.8	**0.275**	± 0.022
Cemex – Phase 3-4	**2016**	**4**	4-5	49	2.0	**0.233**	± 0.026
Cemex – Phase 3-4	**2017**	**4**	2-6	36	0.7	**0.150**	± 0.051
Cemex – Phase 3-4	**2018**	**4**	1	34	0.5	0.112	± 0.020
Cemex – Phase 3-4	**2019**	**4**	10	43	1.6	**0.185**	± 0.016
Cemex – Phase 3-4	**2020**	**4**	1-12	38	0.9	**0.117**	± 0.024
Cemex – Phase 4	**2021**	**4**	3-10	44	0.5	**0.160**	± 0.020
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

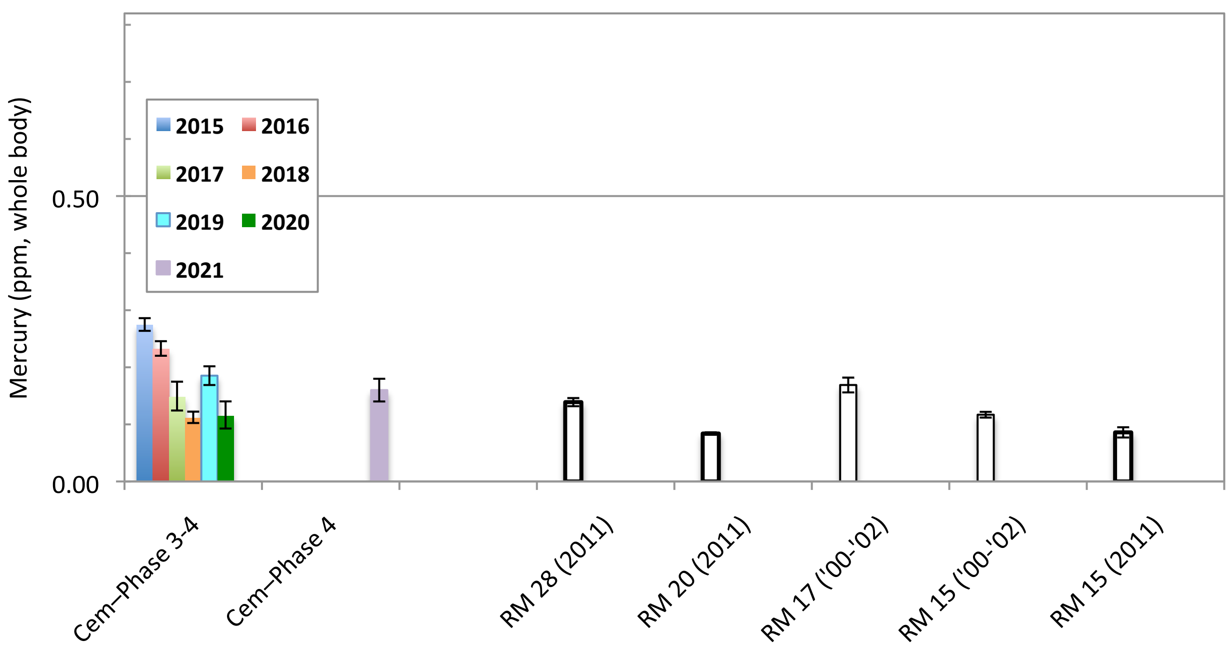

Figure 17. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 18. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Cemex – Phase 3-4	**2015**	**4**	10	37	0.6	**0.228**	± 0.029
Cemex – Phase 3-4	**2016**	**4**	10	37	0.6	**0.157**	± 0.019
Cemex – Phase 3-4	**2017**	**4**	6-10	34	0.5	**0.286**	± 0.035
Cemex – Phase 3-4	**2018**	**4**	3-10	34	0.5	**0.203**	± 0.021
Cemex – Phase 3-4	**2019**	**4**	10	35	0.6	**0.183**	± 0.029
Cemex – Phase 3-4	**2020**	**4**	3-12	33	0.4	**0.112**	± 0.018
Cemex – Phase 4	**2021**	**4**	6-10	35	0.5	**0.122**	± 0.015
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

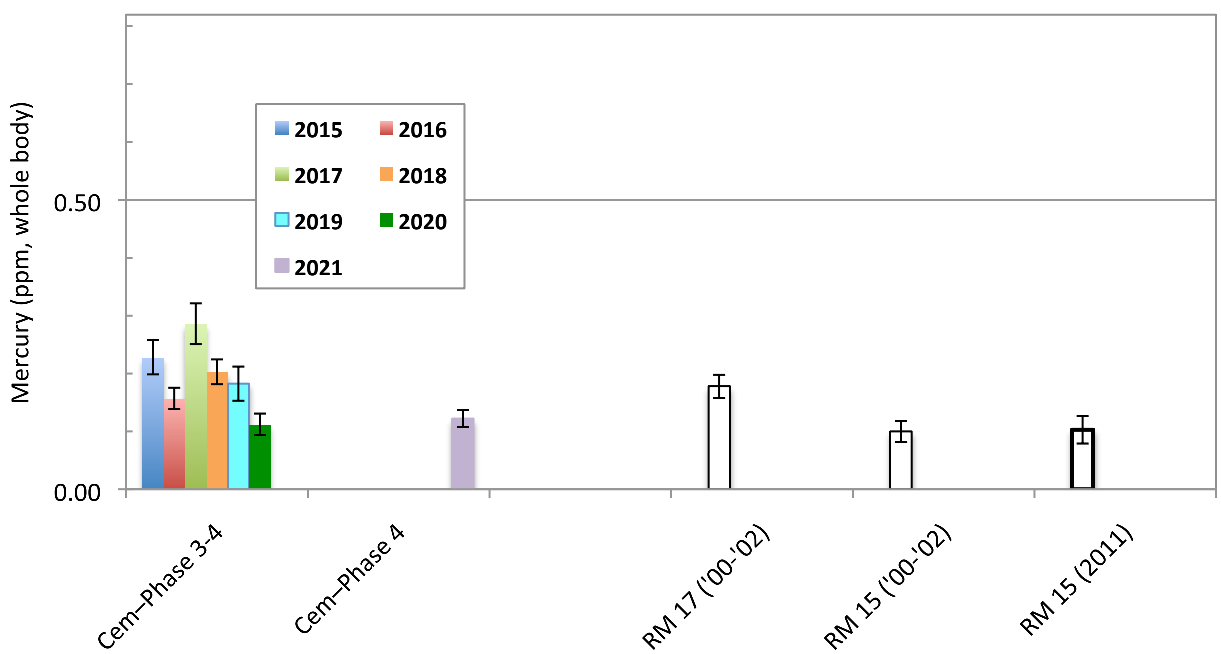

Figure 18. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

4. TEICHERT – ESPARTO POND

(Google Earth 10/21/2020)

4. TEICHERT – ESPARTO POND *(Tables and Figures 19-27)*

Summary

The previously separate Reiff and Mast Ponds were combined by Teichert into a single large Esparto Pond in early 2020, by excavating parts of dividing levees. Monitoring continued in the combined pond. With the second year drought conditions of 2021, the Esparto Pond began the sampling season interconnected but dried down into disconnected, shallow basins by summer. Samples of adult Largemouth Bass (20), White Catfish (6), and Common Carp (2) were taken from the central basin. Small, young-of-year fish were sampled from two basins; these included Mosquitofish, juvenile Largemouth Bass, juvenile Green Sunfish, and Red Shiners. Average mercury levels in all sample types showed increases in 2021, particularly in the small, young fish – which are most representative of recent conditions. This site remained highly elevated in mercury in 2021. All of the fish sample types averaged significantly higher mercury than corresponding Cache Creek baseline samples. Similar results from previous years in the Reiff and Mast ponds triggered the collection of additional information ("expanded analysis") to help guide development of a mercury management plan. Water column profiling and collection of bottom sediment samples began in May 2018 and are the subject of accompanying reports.

Summary 2021 Teichert–Esparto Results, in relation to baseline comparisons

≤ = at or below ambient   INC = inconclusive   > = elevated over ambient

Large/Adult Fish			Young-of-Year Fish
Largemouth Bass	>	>	Largemouth Bass
White Catfish	>	>	Mosquitofish
Carp	>	>	Sunfish
		>	Red Shiner
Overall 2021 Findings	>		

The site is located at Teichert's Esparto Facility, just north of Cache Creek and west of Highway 505, between 505 and County Road 87. Mining began here in or before 2002. Active mining has been sporadic over the years, but aggregate processing was mostly continuous; slurry returns have typically kept the pond water very turbid/opaque. The combined Esparto Pond is approximately 1100 m long (1.1 km) and 300-500 m wide; drought reduced it into three smaller sub-basins within that footprint. Maximum depths dropped from 10.4 m (34 ft) in October 2020 to 9.4 m (31 ft) in May 2021 to 4.3 m (14 ft) in October 2021. Continuing from previous testing in Reiff and Mast Ponds, this (2021) was Year 7 of monitoring.

We sampled the pond(s) as possible, using a range of gear over multiple days. The fish collected included, for large, angling-sized fish, samples of 20 Largemouth Bass (*Micropterus salmoides*), 6 White Catfish (*Ameiurus catus*), and 2 Common Carp (*Cyprinus carpio*). Small fish samples included juvenile Largemouth Bass (3-5"), juvenile Bluegill Sunfish (*Lepomis macrochirus*, 1-2"), Red Shiners (*Cyprinella lutrensis*), and Mosquitofish (*Gambusia affinis*, 1-2"). We collected 3-4 multi-individual composite samples from each of these 4 species from the Reiff basin (13 total). Small fish were also used to address the re-separation of the basins in the drought, with potentially different conditions in the separate ponds. In the former Mast Northwest basin, we were able to obtain closely comparable (to the Reiff basin samples) sets of Mosquitofish and Red Shiners, with 3 multi-individual composite samples each.

In total, this added up to 28 large fish muscle samples and 19 young, small fish composites, or 47 separate mercury samples analyzed from the drought-separated basins of the Esparto Pond in the Fall 2021 monitoring. The fish metrics and analytical results from each individual large fish muscle sample can be seen in Table 19 and, graphically, in Figure 19. Then, for each large fish species taken, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2020 results and the most closely comparable historic creek data (Tables and Figures 20-22). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 23-27.

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 19 and 20)

We took a sample of 20 bass in 2021, as they became prevalent here and drought conditions hampered our ability to collect the other species. The bass present in 2021 were smaller on average than last year, ranging in size mostly from 210-328 mm (8-13") and 85-345 g (0.2-0.8 lbs), with two larger fish both 463 mm (14.3") and 470-520 g (1.0-1.1 lbs). Mercury concentrations increased with size, as is normal, with highest levels in the larger fish. The average mercury, across the full size range, was 1.648 ppm. Despite the smaller average size/age of the 2021 bass, mercury was up from 2020 (1.238 ppm) and was statistically similar to the peak levels seen in 2017-2018 (1.679-1.997 ppm). This site again had the highest bass mercury level among the currently monitored ponds. As compared to baseline data from Cache Creek, the Esparto Pond 2021 adult Largemouth Bass remained elevated; significantly above all comparisons.

The relative increase in bass mercury from last year (2020) was apparent across all fish sizes. In Figure 19(b), bass from 2021 are compared to the set from 2020. The 2021 fish were higher in mercury at every comparable size class. Additionally, the normal increase in mercury with size followed a steeper trend line in 2021. As we discussed in previous reports, we think that a shift in food web structure may have played a role, particularly the prevalence or absence of the small prey species Red Shiner. Bass first began showing up in collections here in 2017. At the time, Red Shiners were the dominant small fish. For whatever reason, these shiners were extremely high in mercury for such small/young fish, averaging up to 0.695 ppm. The initial peak bass mercury years of 2017-2018 coincided with the presence of shiners. As the bass numbers and sizes increased, the Red Shiners decreased drastically in abundance. The growing bass apparently targeted the high-mercury Red Shiners as their choice food, reducing them to very low numbers and reaching very high mercury levels themselves in the process. This apparently left only lower-mercury foods for the bass. With the rebounding population of Red Shiners this year, again with very high mercury levels for small fish (see next section), bass mercury is apparently shooting up to levels similar to the last time Red Shiners were prevalent here. Time will tell how this settles, but this may be a prime example of how changes to food web structure can change mercury transfer to top predators like bass. This may be something to consider for future mercury-remediation plans – at any of the ponds.

White Catfish (Tables/Figures 19 and 21)

Six adult White Catfish were taken in 2021, in the size range of 387-473 mm (15-19") and 820-1250 g (1.8-2.7 lbs), larger on average than earlier samples. Muscle mercury ranged between 0.215 and 0.894 ppm, averaging 0.501 ppm. This was up from last year (2020: 0.408 ppm), but statistically similar to that year and 2019 (0.637 ppm). Even with the larger fish collected in 2021 and the rise in mercury from 2020, the average catfish mercury levels across the last three years have all been significantly lower than peak average levels found in 2016-2017 (0.996-1.287 ppm). However, relative to Cache Creek comparison data, the Esparto Pond 2021 White Catfish mercury levels remained elevated.

Carp (Tables/Figures 19 and 22)

Normal carp collections were closed off by drought conditions in 2021. Two adult Carp were taken in the large size range of 545-590 mm (21-23") and 2100-3050 g (4.6-6.7 lbs). Muscle mercury levels were a divergent 0.825 ppm in the larger fish and an extremely elevated 2.379 ppm in the other. The 2021 average of these two samples was 1.602 ppm, far above the averages from prior years. With just two very divergent samples, we cannot apply our normal statistics for comparisons, but the very high level in the smaller of the fish sampled, in particular, is consistent with the elevated 2021 mercury trends seen in the other species. In comparison with baseline Cache Creek samples, the Esparto Pond 2021 carp were elevated in mercury. The large 2021 carp had mercury levels similar to and even higher than the co-occurring bass. As we have noted in previous reports, this seems odd at first, as carp typically feed lower on the food chain (on lower-mercury food items) than the top-predator bass and would be expected to accumulate less mercury. Last year, we confirmed that this was probably due to differences in age; Largemouth Bass were fairly recent colonizers of this pond complex, first appearing in significant numbers in 2017. The resident carp, though, were clearly much older fish than the young population of bass, giving them many more years to slowly accumulate higher mercury than would be found in carp the same age as the bass. Last year, much smaller, younger carp were collected here for the first time. Carp of a similar age as the co-occurring bass had much lower mercury than the bass; still significantly above Creek baselines though.

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Small, Young Fish

Mosquitofish (Tables/Figures 23 and 24)

Mosquitofish have been difficult to collect in some years, but we were able to obtain multi-individual composite samples in 2021 from both the Reiff and Mast Northwest basins of the site. Three sets of 12 Mosquitofish each were sampled from the Reiff basin, and three sets of 3-10 fish each from the Mast Northwest side. Sizes broadly matched previous collections here and at other sites through the years. Mercury in the three Reiff composite sets ranged from 0.526-0.638 ppm, averaging 0.579 ppm. This was dramatically up, more than double the already elevated levels found last year in the combined pond (2020: 0.267 ppm) and in Reiff Pond alone before 2020 (0.094-0.262 ppm). The increase was highly significant statistically. However, the Mosquitofish samples from the central (Mast NW) basin averaged 0.207 ppm, in the range seen over the previous five years in the combined pond and in Reiff alone. The 2021 Mast NW Basin samples were in fact significantly lower in mercury than the 2018 and 2020 sets. In relation to Cache Creek comparison samples though, the 2021 concentrations from the Mast NW Basin were, on average, elevated; they were statistically similar to one of three baseline sets and still significantly higher than two of the three. The much higher mercury 2021 Mosquitofish from the Reiff Basin were significantly elevated, far above all the baseline creek comparisons.

Red Shiner (Tables/Figures 23 and 25)

Red Shiners were not found in sufficient numbers for sampling in 2019 or 2020. The growing population of Largemouth Bass had preferentially consumed them down to very scarce numbers. But since the combining of the Reiff and Mast Basins in 2020, they have rebounded to collectible densities. Twelve Shiners were taken in the Reiff Basin and nine in the Mast NW Basin. Each set was divided into three size-class composite samples spanning the same size range (40-60 mm). The Mast NW samples ranged from 0.486 to an astounding (for such small, young fish) 1.379 ppm, averaging 0.951 ppm. The Reiff basin samples were even higher (significantly) on average, all in the range of 1.257-1.373 ppm and averaging 1.310 ppm. Compared to Cache Creek baseline samples, all of the Esparto Ponds Red Shiners in 2021 were significantly, highly elevated in mercury.

Juvenile Largemouth Bass (Tables/Figures 23 and 26)

Young-of-year Bass were very scarce in our collections this year; 4 individuals were taken from the Reiff Basin and none from Mast NW. The 4 young bass were analyzed individually. These samples had whole-body mercury ranging from 0.981-1.163 ppm, averaging 1.064 ppm. Like the Red Shiners, this was extremely high and was significantly above the already elevated levels found in prior years. Relative to baseline juvenile bass comparison data from Cache Creek, 2021 juvenile Largemouth Bass mercury in the Reiff Basin continued to be elevated; significantly, far higher in mercury than the two creek sample sets available: River Mile 28 (0.142 ppm) and River Mile 15 (0.050 ppm).

Juvenile Sunfish (Tables/Figures 23 and 26)

Juvenile Green Sunfish were taken here in 2015 and 2018-2020 but, in 2021, the only sunfish present in our collections were three individuals of Bluegill Sunfish from the Reiff Basin. These were analyzed individually, whole-body like the other composites. At these small sizes, the different sunfish species are functionally equivalent and comparable in their mercury accumulation; the 2021 Bluegill Sunfish samples are presented with the previous Green Sunfish data in the tables and figures. The 2021 juvenile Bluegill had whole-body mercury at 0.451-0.508 ppm, averaging 0.479 ppm. This was significantly higher (about double) than the previous range for young sunfish here (0.187-0.252 ppm). As compared to Cache Creek baseline comparison samples, the 2021 Reiff juvenile sunfish were significantly, far higher in mercury than all of the baseline sets (0.084-0.169 ppm).

Table 19. Teichert – Esparto Pond: Individual large fish sampled, 2021

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	210	8.3	85	0.2	**1.175**
Largemouth Bass	222	8.7	90	0.2	**1.149**
Largemouth Bass	235	9.3	130	0.3	**1.091**
Largemouth Bass	240	9.4	135	0.3	**1.309**
Largemouth Bass	249	9.8	155	0.3	**1.365**
Largemouth Bass	253	10.0	170	0.4	**1.667**
Largemouth Bass	255	10.0	150	0.3	**1.279**
Largemouth Bass	258	10.2	160	0.4	**1.588**
Largemouth Bass	260	10.2	175	0.4	**1.051**
Largemouth Bass	260	10.2	150	0.3	**1.622**
Largemouth Bass	265	10.4	180	0.4	**1.559**
Largemouth Bass	269	10.6	160	0.4	**1.715**
Largemouth Bass	270	10.6	205	0.5	**1.612**
Largemouth Bass	280	11.0	215	0.5	**1.602**
Largemouth Bass	302	11.9	245	0.5	**1.802**
Largemouth Bass	308	12.1	242	0.5	**1.635**
Largemouth Bass	312	12.3	300	0.7	**2.380**
Largemouth Bass	328	12.9	345	0.8	**2.539**
Largemouth Bass	363	14.3	470	1.0	**2.346**
Largemouth Bass	363	14.3	520	1.1	**2.472**
White Catfish	387	15.2	820	1.8	**0.445**
White Catfish	408	16.1	940	2.1	**0.894**
White Catfish	422	16.6	980	2.2	**0.399**
White Catfish	425	16.7	1,050	2.3	**0.666**
White Catfish	470	18.5	1,250	2.8	**0.215**
White Catfish	473	18.6	1,220	2.7	**0.388**
Carp	545	21.5	2,100	4.6	**2.379**
Carp	590	23.2	3,050	6.7	**0.825**

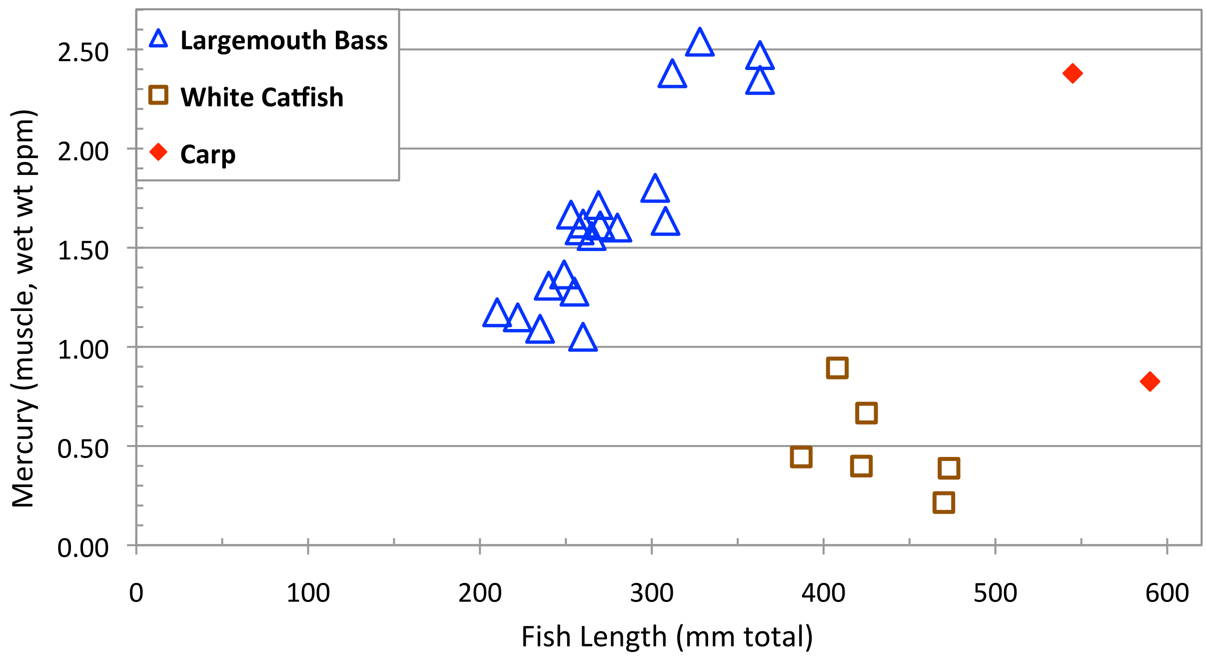

Figure 19. **Teichert – Esparto Pond: large fish sampled, 2021**
(fillet muscle mercury in individual fish)

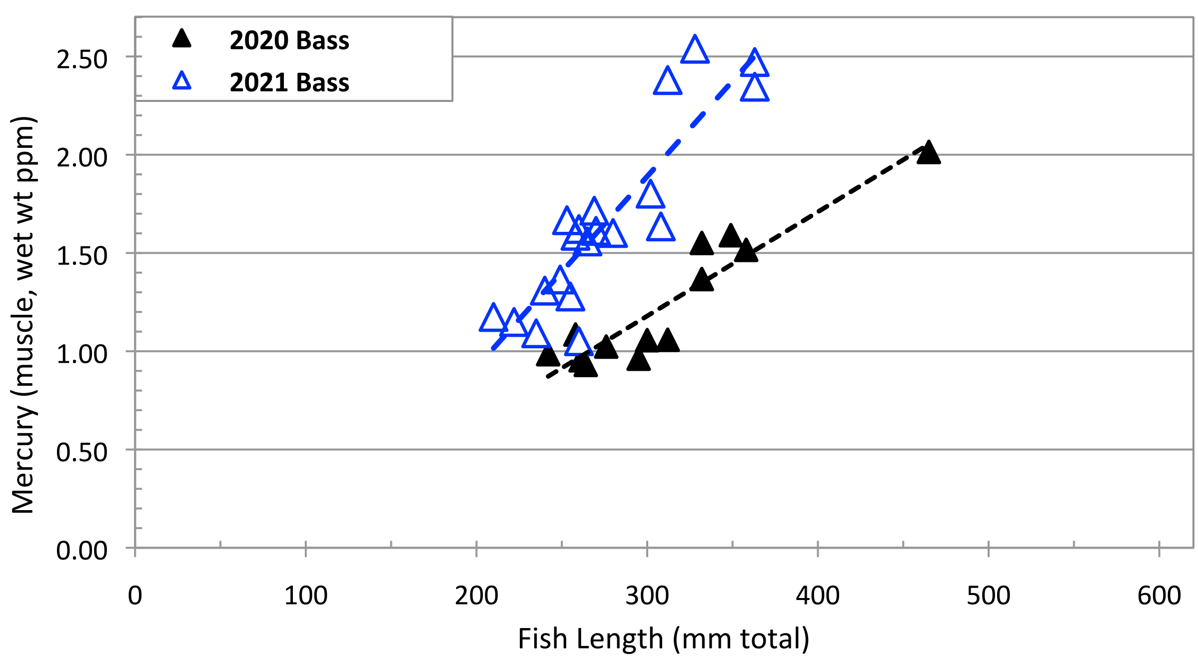

Figure 19(b). **Teichert – Esparto 2020/2021 Largemouth Bass mercury comparison**
(fillet muscle mercury in individual fish)

Table 20. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Teichert-Esparto – Reiff	**2017**	**5**	189	78	**1.679**	± 0.180
Teichert-Esparto – Reiff	**2018**	**10**	251	181	**1.997**	± 0.170
Teichert-Esparto – Reiff	**2019**	**10**	295	353	**1.183**	± 0.314
Teichert – Esparto	**2020**	**13**	311	453	**1.238**	± 0.204
Teichert – Esparto (Mast NW)	**2021**	**20**	275	214	**1.648**	± 0.215
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

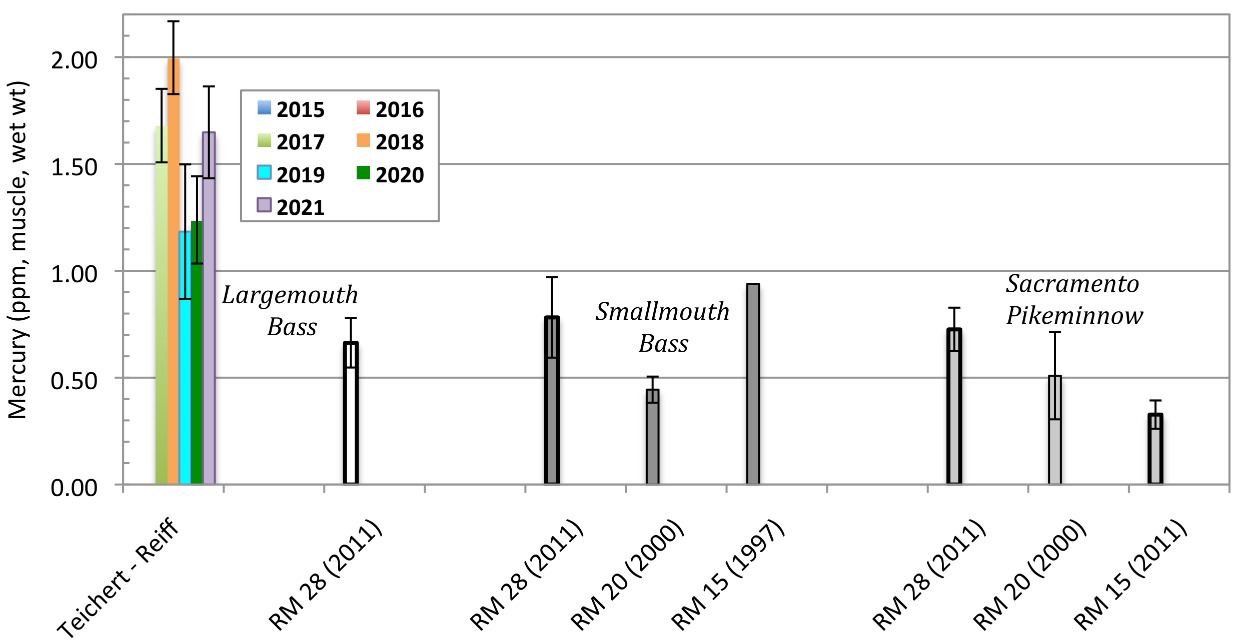

Figure 20. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 21. White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
White Catfish						
Teichert-Esparto – Reiff	**2015**	**20**	347	658	**0.737**	± 0.156
Teichert-Esparto – Reiff	**2016**	**20**	297	341	**0.996**	± 0.153
Teichert-Esparto – Reiff	**2017**	**16**	355	677	**1.287**	± 0.197
Teichert-Esparto – Reiff	**2018**	**–**				
Teichert-Esparto – Reiff	**2019**	**10**	337	535	**0.637**	± 0.134
Teichert – Esparto	**2020**	**10**	369	742	**0.408**	± 0.123
Teichert – Esparto (Mast NW)	**2021**	**6**	431	1,043	**0.501**	± 0.253
Historic/Baseline Data						
Channel Catfish						
Rumsey	2000	1	411	565	0.225	
River Mile 28	**2011**	**5**	**239**	**102**	**0.229**	**± 0.102**
River Mile 20	2000	1	368	380	0.225	
River Mile 03	1997	10	336	304	0.174	± 0.019

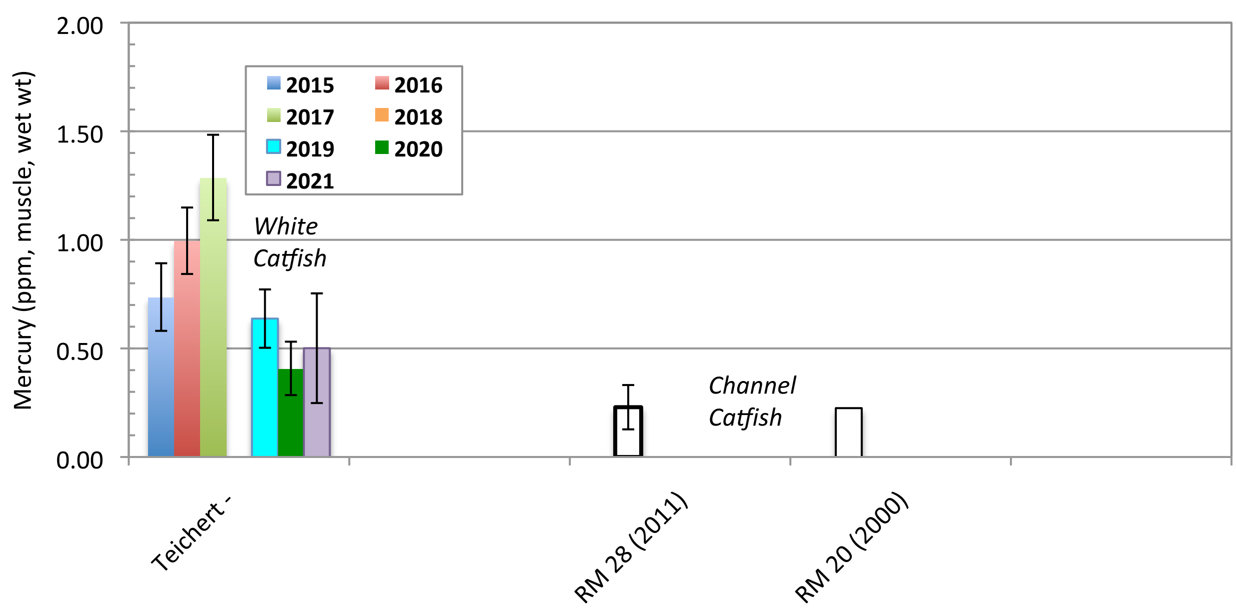

Figure 21. White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 22. Carp summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Carp						
Teichert-Esparto – Reiff	**2015**	**2**	421	918	**0.351**	
Teichert-Esparto – Reiff	**2016**	**5**	430	975	**0.854**	± 0.387
Teichert-Esparto – Reiff	**2017**	**9**	481	1,499	**1.122**	± 0.321
Teichert-Esparto – Reiff	**2018**	**–**				
Teichert-Esparto – Reiff	**2019**	**9**	483	1,475	**0.988**	± 0.279
Teichert – Esparto	**2020**	**7**	381	1,086	**0.636**	± 0.334
Teichert – Esparto (Mast NW)	**2021**	**2**	568	2,575	**1.602**	
Historic/Baseline Data (most comparable species available)						
Sacramento Sucker						
Rumsey	2000	6	328	396	0.198	± 0.113
River Mile 20	2000	5	253	174	0.154	± 0.034
River Mile 15	**2011**	**8**	**276**	**231**	**0.143**	**± 0.011**
River Mile 08	2000	4	319	336	0.339	
River Mile 03	1997	5	343	402	0.263	± 0.068

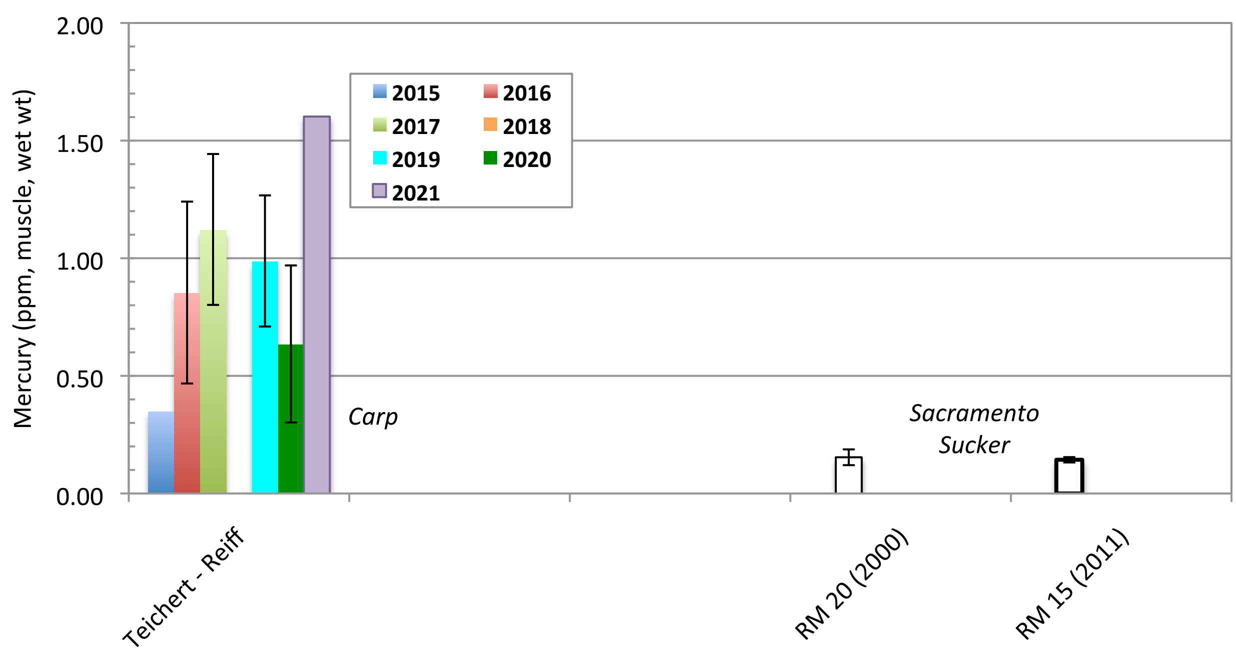

Figure 22. Carp summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 23. Teichert – Esparto Ponds: Small Fish Sampled, 2021
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	Av. Fish Length (inches)	Av. Fish Weight (g)	Av. Fish Weight (oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Reiff (west side basin)						
Largemouth Bass (juv)	1	86	3.4	8.15	0.29	**1.099**
Largemouth Bass (juv)	1	94	3.7	9.95	0.35	**1.014**
Largemouth Bass (juv)	1	97	3.8	10.8	0.38	**1.163**
Largemouth Bass (juv)	1	113	4.4	18.9	0.67	**0.981**
Bluegill Sunfish (juv)	1	36	1.4	0.71	0.025	**0.477**
Bluegill Sunfish (juv)	1	38	1.5	0.98	0.034	**0.451**
Bluegill Sunfish (juv)	1	43	1.7	1.80	0.063	**0.508**
Mosquitofish	12	33	1.3	0.42	0.015	**0.526**
Mosquitofish	12	37	1.5	0.75	0.026	**0.572**
Mosquitofish	12	41	1.6	1.03	0.036	**0.638**
Red Shiners	4	47	1.9	1.26	0.044	**1.373**
Red Shiners	4	55	2.2	1.89	0.067	**1.257**
Red Shiners	4	59	2.3	2.15	0.076	**1.298**
Mast NW (central basin)						
Mosquitofish	10	27	1.1	0.23	0.008	**0.216**
Mosquitofish	10	32	1.3	0.40	0.014	**0.175**
Mosquitofish	3	39	1.5	0.79	0.028	**0.229**
Red Shiners	5	43	1.7	0.77	0.027	**0.486**
Red Shiners	3	51	2.0	1.30	0.046	**0.987**
Red Shiners	1	60	2.4	2.22	0.078	**1.379**

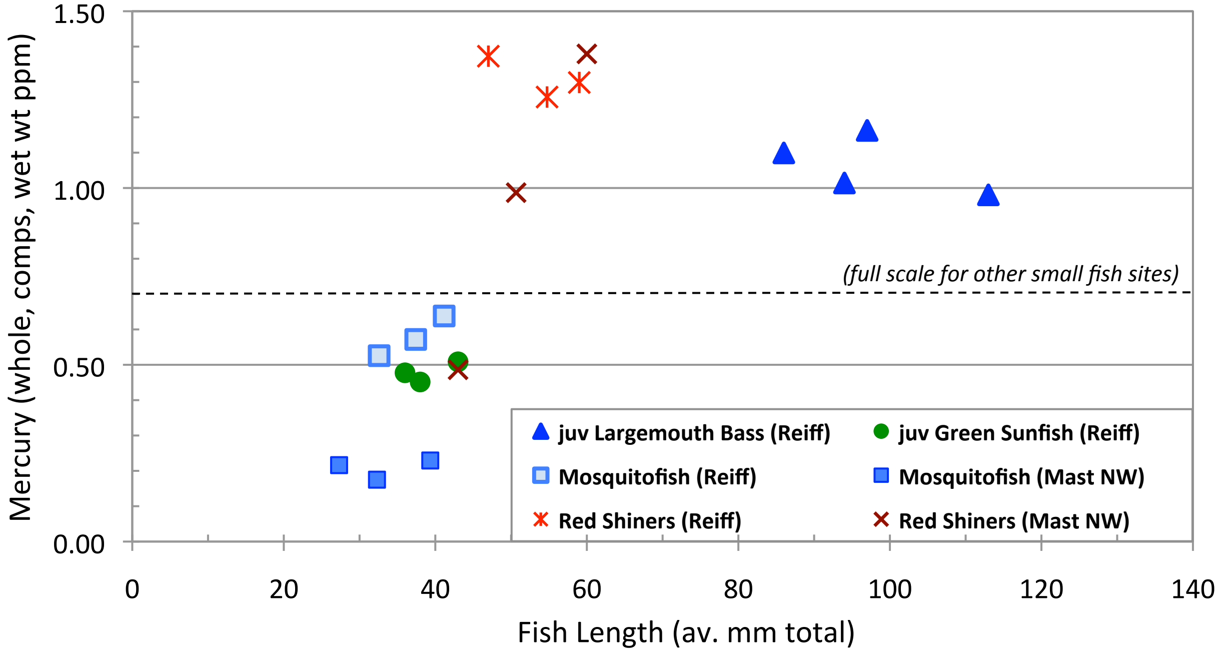

Figure 23. **Teichert – Esparto Ponds: small, young fish sampled, 2021**
(mercury in whole-body, multi-individual composite samples)

Small, Young Fish Samples *(note lower concentration scales)*

Table 24. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Teichert-Esparto – Reiff	**2015**	**4**	12	38	0.6	**0.094**	± 0.005
Teichert-Esparto – Reiff	**2016**	**4**	10	36	0.5	**0.212**	± 0.021
Teichert-Esparto – Reiff	**2017**	–	–	–	–	–	
Teichert-Esparto – Reiff	**2018**	**4**	10	35	0.5	**0.262**	± 0.026
Teichert-Esparto – Reiff	**2019**	**4**	5-10	33	0.4	**0.222**	± 0.041
Teichert – Esparto	**2020**	**4**	1-12	37	0.7	**0.267**	± 0.033
Teichert – Esparto (Reiff)	**2021**	**3**	12	37	0.7	**0.579**	± 0.033
Teichert – Esparto (Mast NW)	**2021**	**3**	3-10	33	0.5	**0.207**	± 0.016
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

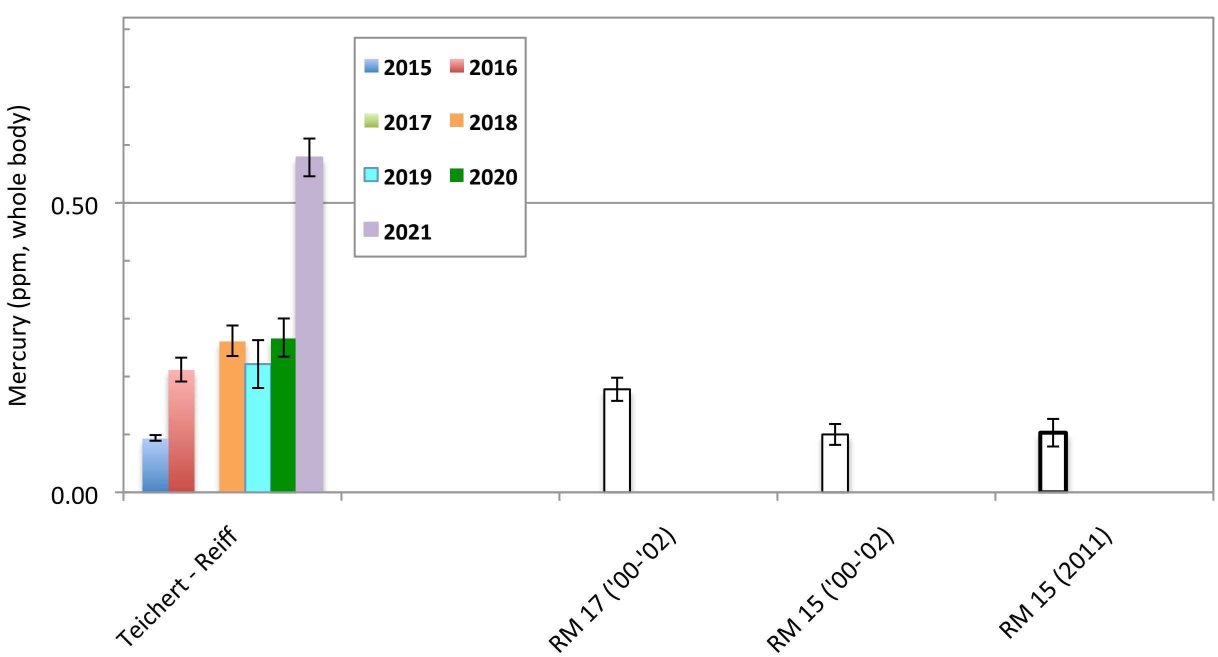

Figure 24. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 25. Red Shiner summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Red Shiners							
Teichert-Esparto – Reiff	**2015**	**4**	10	50	1.3	**0.152**	± 0.009
Teichert-Esparto – Reiff	**2016**	**4**	10	47	1.1	**0.412**	± 0.042
Teichert-Esparto – Reiff	**2017**	**4**	10	49	1.1	**0.695**	± 0.070
Teichert-Esparto – Reiff	**2018**	**4**	10	45	0.8	**0.556**	± 0.031
Teichert-Esparto – Reiff	**2019**	*(Shiners not found in 2019 or 2020)*					
Teichert – Esparto (Reiff)	**2021**	**3**	4	54	1.8	**1.310**	± 0.034
Teichert – Esparto (Mast NW)	**2021**	**3**	1-5	51	1.4	**0.951**	± 0.259
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**10**	**48**	**1.0**	**0.242**	**± 0.018**
River Mile 20	2000	3	9	42	0.6	0.166	± 0.002
River Mile 17	2000-2002	11	6-15	27-58	0.2-1.8	0.225	± 0.023
River Mile 15	1997	3	19	37	0.5	0.159	± 0.014
River Mile 15	2000-2002	13	6-12	30-60	0.2-2.0	0.131	± 0.005

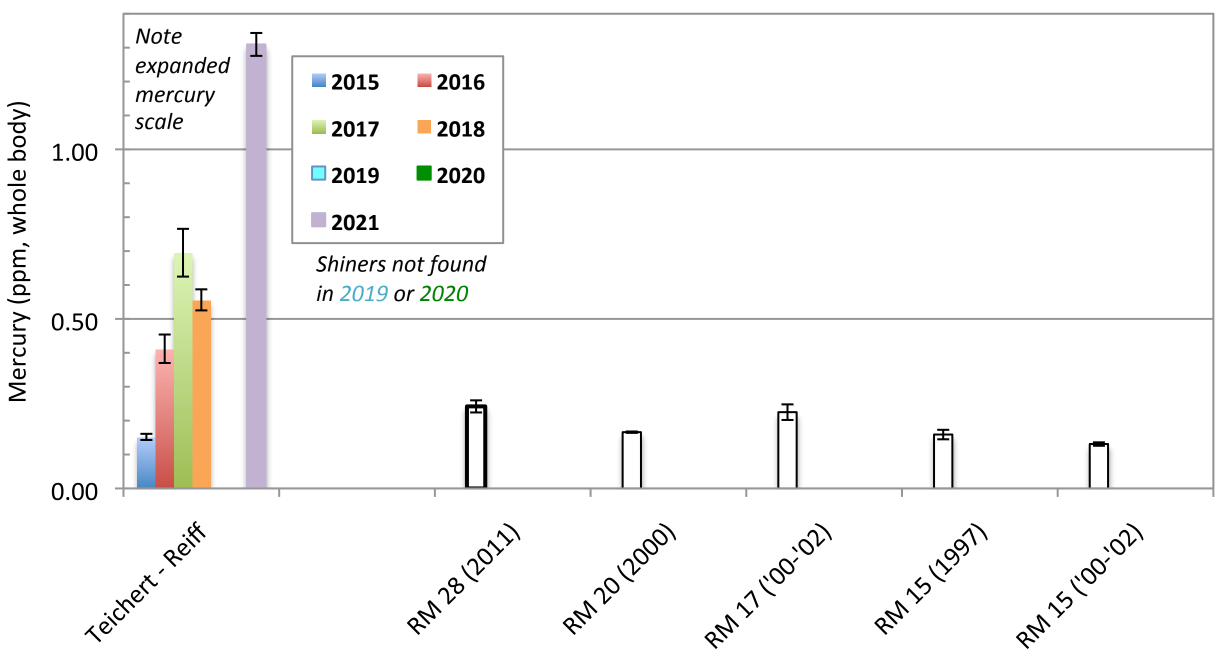

Figure 25. Red Shiner summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 26. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Teichert-Esparto – Reiff	**2015**	**–**	–				
Teichert-Esparto – Reiff	**2016**	**–**	–				
Teichert-Esparto – Reiff	**2017**	**4**	1-2	137	32	**0.798**	± 0.094
Teichert-Esparto – Reiff	**2018**	**4**	4-6	111	17	**0.445**	± 0.069
Teichert-Esparto – Reiff	**2019**	**4**	5	107	15	**0.297**	± 0.010
Teichert – Esparto	**2020**	**4**	3	92	9	**0.472**	± 0.027
Teichert – Esparto (Reiff)	**2021**	**4**	1	98	12	**1.064**	± 0.041
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

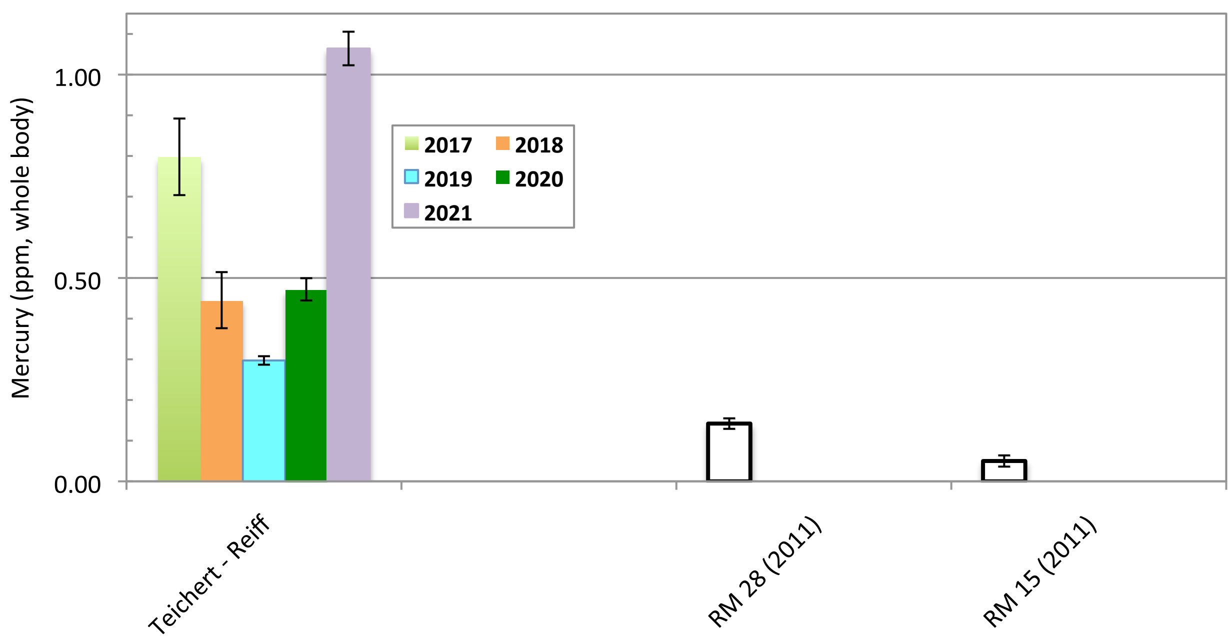

Figure 26. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 27. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Teichert-Esparto – Reiff	**2015**	**1**	1	68	5.1	**0.241**	
Teichert-Esparto – Reiff	**2016**	**–**	–				
Teichert-Esparto – Reiff	**2017**	–	–				
Teichert-Esparto – Reiff	**2018**	**4**	2	48	2.3	**0.252**	± 0.010
Teichert-Esparto – Reiff	**2019**	**4**	3-10	41	1.3	**0.187**	± 0.029
Teichert – Esparto	**2020**	**4**	3	35	0.7	**0.230**	± 0.018
Teichert – Esparto – (Reiff)	**2021**	**3**	1	39	1.2	**0.479**	± 0.016
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.014**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.004**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.045
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.028
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.018**

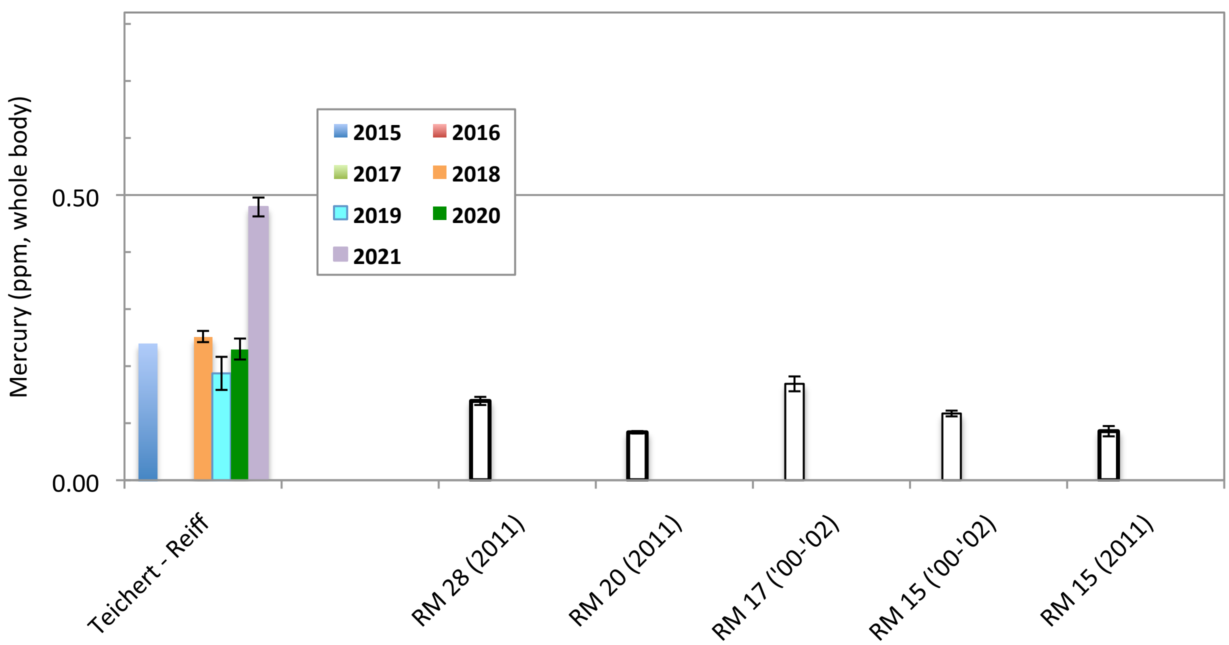

Figure 27. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

5. TEICHERT-WOODLAND – STORZ POND

(Google Earth 10/21/2020)

5. TEICHERT-WOODLAND – STORZ POND *(Tables and Figures 28-33)*

Summary

Drought conditions dried this pond down into two disconnected sub-basins in 2021. A sample of 18 small adult bass (the main size present) and 2 larger bass was taken. Small, young-of-year fish samples included multiple composites of Mosquitofish, juvenile Largemouth Bass, and juvenile Bluegill Sunfish. Mosquitofish were taken from both sub-basins to check for potential localized differences; no difference was found. The adult bass and all of the small fish samples remained in the lower range of mercury levels for this site, which has consistently been the first or second lowest mercury pond in the monitoring program. Relative to Cache Creek comparison data, Storz Pond continued to rank as "not elevated over baseline" in 2021 and is not flagged for expanded analysis or management planning. One-time-per-year routine water profiling was added to the monitoring in 2020, following recent revisions of the mining ordinance. With five years now with low mercury status, this site can shift to a schedule of fish and water testing once each two years rather than annually.

Summary 2021 Teichert-Woodland – Storz Results, in relation to baseline comparisons

≤ = at or below ambient   INC = inconclusive   > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	≤	≤	Largemouth Bass
		≤	Mosquitofish
		≤	Sunfish
Overall 2021 Findings	≤		

This pond is part of the Teichert–Woodland operations, located approximately 7 river miles downstream from the Reiff and Mast Ponds and Teichert–Esparto Plant. The Storz Pond is south of Cache Creek and just west of County Road 94b, near the Cache Creek Nature Preserve (which is located on the other, north, side of the creek). Our understanding is that it first become a wet pit in 2010-2011. The site has been relatively dormant and unmined over the course of mercury monitoring (since 2016); riparian and aquatic vegetation has colonized throughout, creating new habitat. The overall basin is approximately 150 m x 800 m (0.8 km) in size. Drought conditions dried this pond down into two disconnected, shallow sub-basins in 2021. Maximum depth in both parts was under 3 m (10 ft).

We began sampling this pond in 2016, but were unable to get our boat in at that time. By shore seining, we collected a good sample of Mosquitofish, (*Gambusia affinis*, 1-2") in 2016, but no additional species. In 2017, we were able to get our boat into the pond and sample more completely, making 2017 Year 1 of full sampling here. Since 2017, we have been able to collect Largemouth Bass (*Micropterus salmoides*) in addition to Mosquitofish. In 2021, 18 bass were taken in the small prevailing size range present of 200-235 mm (8-9"). An additional 2 bass were taken of a much larger size, 416-452 mm (16-18") and over ten times larger by weight. The 20 total bass were sampled for fillet muscle mercury. The bass were all taken in the Southwest Basin this year. Small fish were taken from both basins, to address the separation of the basins in the drought, with potentially different conditions in the separate ponds. Small fish collections were particularly difficult in 2021. Mosquitofish were sampled with 3 closely matching composites of 5-10 fish each from each side. The standard fourth size class (40-45 mm) was only available in the Northeast Basin. Three composite samples of juvenile Largemouth Bass were also taken in that basin. We were not able to collect juvenile bass from the Southwest Basin, despite extensive seining. In the Southwest Basin, in addition to the Mosquitofish, juvenile Bluegill Sunfish (*Lepomis macrochirus*) were found here for the first time and were sampled with 4 multi-individual composites.

In total, 20 large fish muscle samples and 14 small fish composite samples, or 34 separate mercury samples, were analyzed from the Teichert–Storz Pond(s) in the Fall 2021 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 28 and, graphically, in Figure 28. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2020 results and the most closely comparable historic creek data (Table 29 and Figure 29). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 30-33.

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 28 and 29)

As noted above, the bass samples included 18 fish from main cohort of fish present, in the small size range of 200-235 mm (8-9"), and two much larger individuals of 416 and 452 mm (16-18" and over ten times larger by weight). Fillet muscle mercury in the dominant size class ranged between 0.121 and 0.351 ppm, averaging 0.225 ppm, very low mercury levels for bass in this watershed. The two much larger fish had significantly higher mercury (0.534 and 0.809 ppm), averaging 0.672 ppm. Although the larger fish were higher in mercury than the smaller adults, the increase with size was muted, as compared to the trends at most of the other ponds. As can be seen in Figure 29, the average mercury levels in 2021 (0.269 ppm, including the two very large individuals), remained down significantly from the moderate levels of 2017 (0.657 ppm) and 2018 (0.611 ppm). As since 2019, the 2021 set of Storz fish was lower in mercury than bass samples from all the other monitored ponds. Comparing with historic baseline Cache Creek samples, the Storz Pond 2021 adult largemouth bass remained unelevated. They averaged lower mercury levels than all of the creek sample sets; the difference was statistically significant for five of seven comparisons.

Small, Young Fish

Mosquitofish (Tables/Figures 30 and 31)

Mosquitofish were the one species we could sample in both basins. Very similar samples were taken from each side in the first three standard size classes we use for them (25-30 mm, 30-35 mm, 35-40 mm). These ranged in mercury from 0.034-0.097 ppm, averaging 0.059 ppm in the Northeast Basin and 0.058 ppm in the Southwest, statistically identical and indicating no significant difference between the basins at this time. Including the standard fourth size class (40-45 mm) taken at the Northeast side, its average for inter-year comparisons rises to 0.082 ppm. This was in the low range for this generally low-mercury site, statistically similar to 2020 (0.059 ppm) and 2018 (0.087 ppm), and significantly lower than found in 2016, 2017, and 2019 (0.200-

0.282 ppm). It is interesting that there have been three years here with less than half the mercury levels found in the other three years. As compared to baseline creek samples, the 2021 Storz Mosquitofish mercury levels were not elevated; they were lower than all three of the creek data sets, which averaged 0.103-0.178 ppm. The differences were statistically significant for the Northeast Basin 4-size-class average in one of three baseline comparisons and, in for the Southwest Basin 3-size-class average, for all three.

Juvenile Largemouth Bass (Tables/Figures 30 and 32)

Juvenile bass were again very scarce, apparently due to cannibalism by larger bass, but we were able to collect 7 individuals from the Northeast Basin. These were analyzed in three whole-fish composite samples of 2-3 fish each. Mercury levels ranged from 0.100-0.129 ppm, averaging 0.118 ppm. This was within the range seen in the past two years (2019-2020: 0.097-0.131 ppm) and remained far below the levels found in the first full monitoring year (2017: 0.337 ppm). It was also significantly lower than at all but one of the other monitored ponds (Cemex–Phase 1, 0.096 ppm). As compared to baseline comparison samples from the creek, the 2021 Storz Pond juvenile Largemouth Bass were, on average, not elevated; they were significantly lower than the River Mile 28 set (0.142 ppm) and significantly higher than the River Mile 15 set (0.050 ppm).

Juvenile Bluegill Sunfish (Tables/Figures 30 and 33)

Sunfish were found here for the first time in 2021, in the Southwest Basin. At the small sizes collected for this monitoring, both of the sunfish species (Bluegill and Green) found across the region are functionally equivalent, accumulating mercury similarly and comparable to each other. Mercury in the multi-individual composites ranged from 0.015-0.024 ppm, averaging 0.020 ppm. The 2021 juvenile Bluegill Sunfish from Storz Pond were not elevated over baseline; they in fact had the lowest mercury levels found since 2015 in any of the seven ponds monitored or the Cache Creek baseline fish samples. All of the comparisons were statistically significant.

Table 28. Teichert-Woodland – Storz Pond: Individual large fish sampled, 2021

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	200	7.9	78	0.2	**0.229**
Largemouth Bass	200	7.9	78	0.2	**0.225**
Largemouth Bass	203	8.0	68	0.1	**0.263**
Largemouth Bass	203	8.0	81	0.2	**0.181**
Largemouth Bass	204	8.0	90	0.2	**0.191**
Largemouth Bass	204	8.0	83	0.2	**0.169**
Largemouth Bass	205	8.1	85	0.2	**0.214**
Largemouth Bass	206	8.1	82	0.2	**0.228**
Largemouth Bass	206	8.1	92	0.2	**0.278**
Largemouth Bass	207	8.1	85	0.2	**0.218**
Largemouth Bass	211	8.3	92	0.2	**0.209**
Largemouth Bass	211	8.3	98	0.2	**0.312**
Largemouth Bass	214	8.4	93	0.2	**0.121**
Largemouth Bass	216	8.5	93	0.2	**0.198**
Largemouth Bass	217	8.5	105	0.2	**0.198**
Largemouth Bass	220	8.7	95	0.2	**0.277**
Largemouth Bass	233	9.2	122	0.3	**0.184**
Largemouth Bass	235	9.3	130	0.3	**0.351**
Largemouth Bass	416	16.4	1125	2.5	**0.534**
Largemouth Bass	452	17.8	1550	3.4	**0.809**

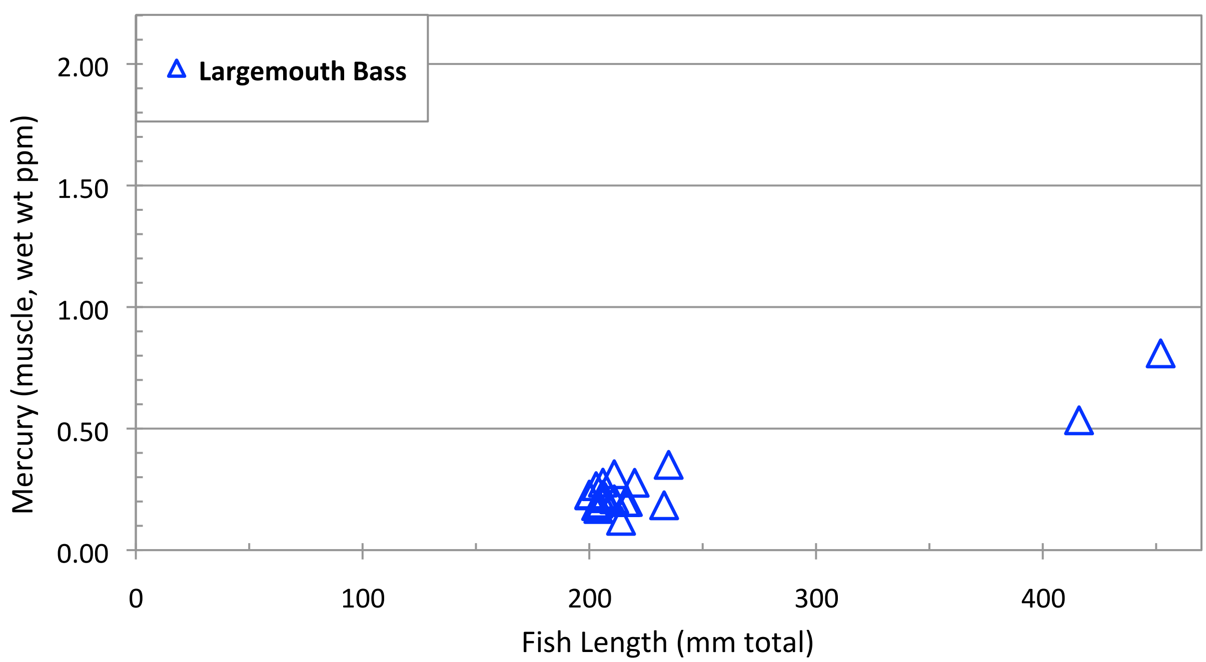

Figure 28. Teichert-Woodland – Storz Pond: Large Fish Sampled, 2021
(mean fillet muscle mercury, with 95% confidence intervals)

Table 29. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Teichert-Woodland – Storz	**2017**	**20**	245	203	**0.657**	± 0.038
Teichert-Woodland – Storz	**2018**	**20**	255	197	**0.611**	± 0.082
Teichert-Woodland – Storz	**2019**	**12**	222	196	**0.218**	± 0.042
Teichert-Woodland – Storz	**2020**	**20**	211	99	**0.193**	± 0.021
Teichert-Woodland – Storz	2021	20	233	216	0.269	± 0.072
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

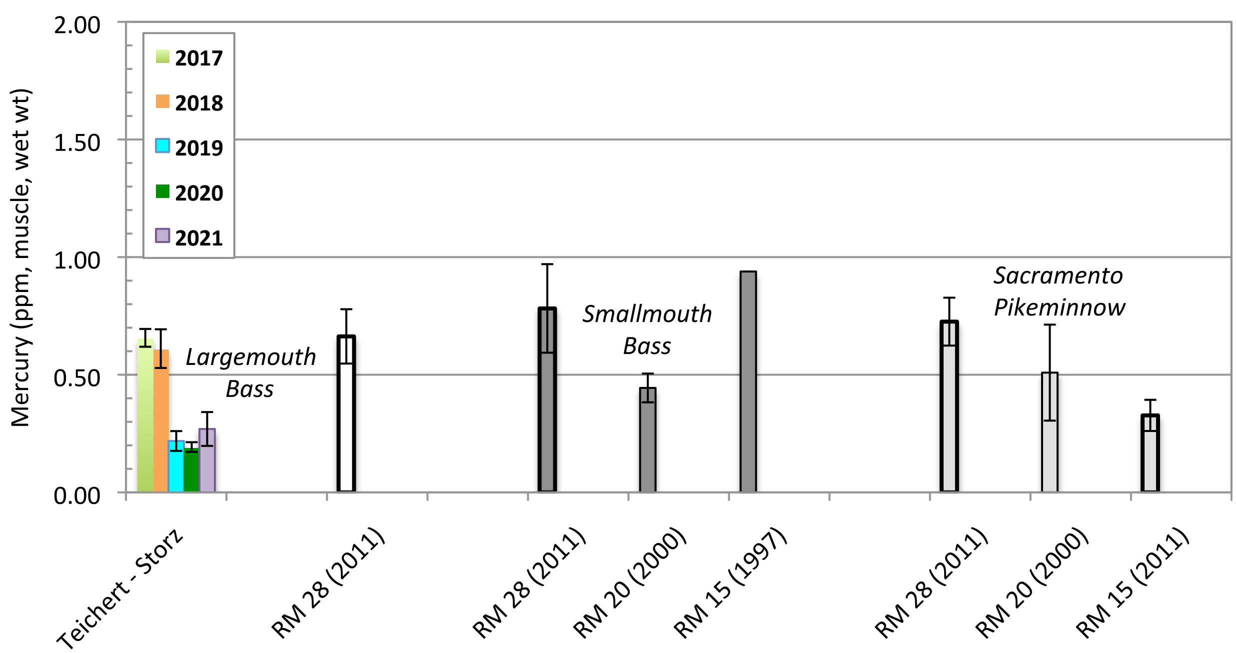

Figure 29. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 30. Teichert-Woodland – Storz Ponds: Small Fish Sampled, 2021
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	(inches)	Av. Fish Weight (g)	(oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Northeast Basin						
Largemouth Bass (juv)	2	115	4.5	22.3	0.79	**0.125**
Largemouth Bass (juv)	3	126	4.9	29.8	1.05	**0.129**
Largemouth Bass (juv)	2	135	5.3	34.7	1.22	**0.100**
Mosquitofish	10	28	1.1	0.22	0.008	**0.038**
Mosquitofish	10	33	1.3	0.41	0.014	**0.043**
Mosquitofish	10	38	1.5	0.64	0.023	**0.097**
Mosquitofish	10	41	1.6	1.02	0.036	**0.149**
Southwest Basin						
Bluegill Sunfish (juv)	10	28	1.1	0.49	0.017	**0.015**
Bluegill Sunfish (juv)	10	32	1.3	0.58	0.021	**0.018**
Bluegill Sunfish (juv)	5	38	1.5	1.34	0.047	**0.023**
Bluegill Sunfish (juv)	3	54	2.1	2.59	0.091	**0.024**
Mosquitofish	10	28	1.1	0.21	0.007	**0.034**
Mosquitofish	10	32	1.3	0.38	0.013	**0.065**
Mosquitofish	5	38	1.5	0.52	0.018	**0.074**

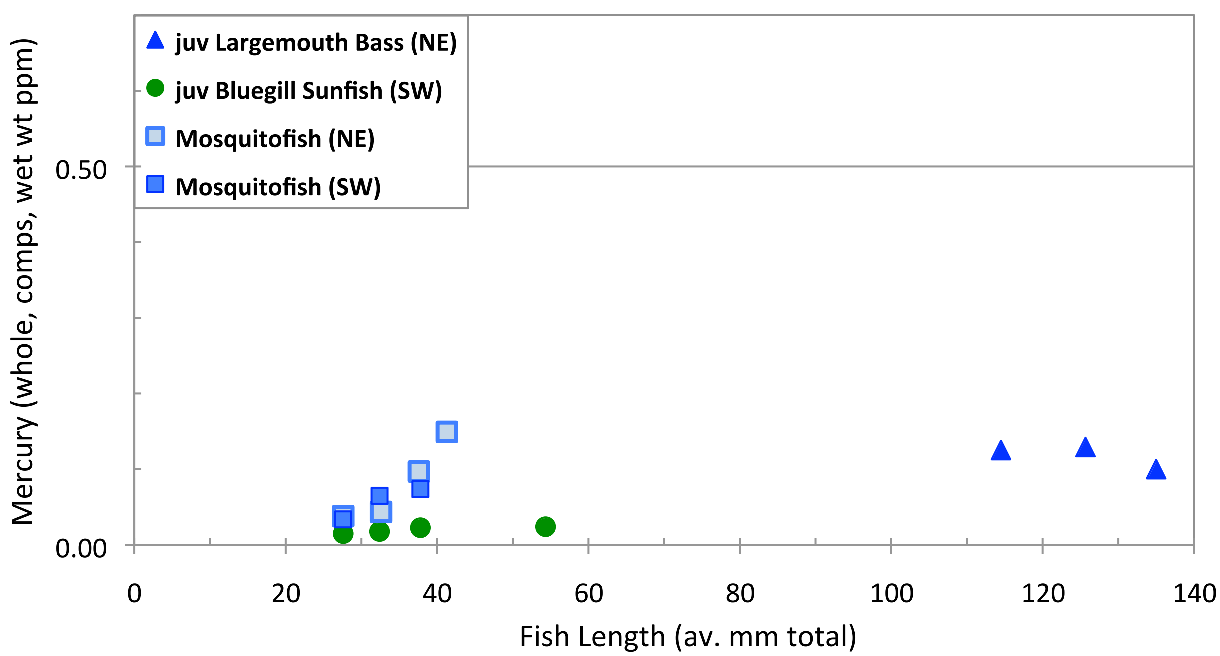

Figure 30. Teichert-Woodland – Storz Ponds: Small Fish Sampled, 2021
(mercury in whole-body, multi-individual composite samples)

Table 31. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Teichert-Woodland – Storz	**2016**	**4**	10	35	0.5	**0.229**	± 0.054
Teichert-Woodland – Storz	**2017**	**4**	8-10	29	0.2	**0.282**	± 0.011
Teichert-Woodland – Storz	**2018**	**4**	10	30	0.3	**0.087**	± 0.017
Teichert-Woodland – Storz	**2019**	**4**	6-10	33	0.4	**0.200**	± 0.018
Teichert-Woodland – Storz	**2020**	**4**	12	32	0.4	**0.059**	± 0.008
Teichert-Woodland – Storz NE	**2021**	**4**	10	35	0.6	**0.082**	± 0.026
Teichert-Woodland – Storz SW	**2021**	**3**	5-10	33	0.4	**0.057**	± 0.012
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

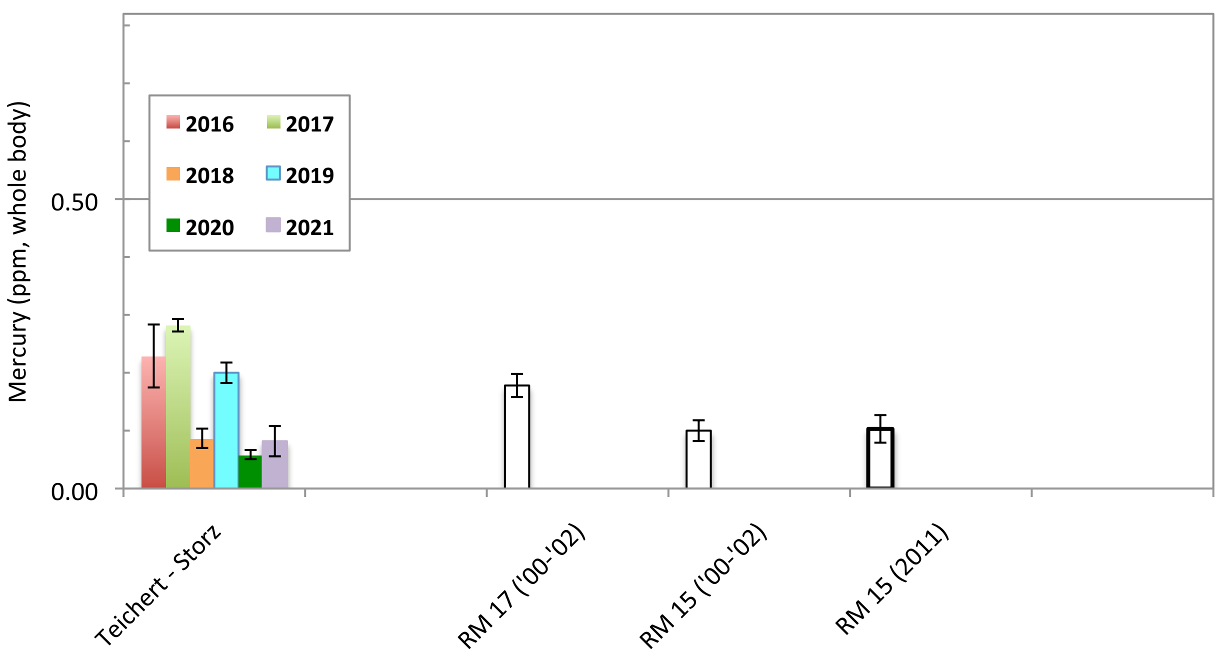

Figure 31. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 32. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Teichert-Woodland – Storz	**2017**	**4**	1	143	35	**0.337**	± 0.030
Teichert-Woodland – Storz	**2018**	–	–				
Teichert-Woodland – Storz	**2019**	**4**	1	130	29	**0.131**	± 0.036
Teichert-Woodland – Storz	**2020**	**4**	1	172	63	**0.097**	± 0.005
Teichert-Woodland – Storz	**2021**	**3**	2-3	125	29	**0.118**	± 0.009
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

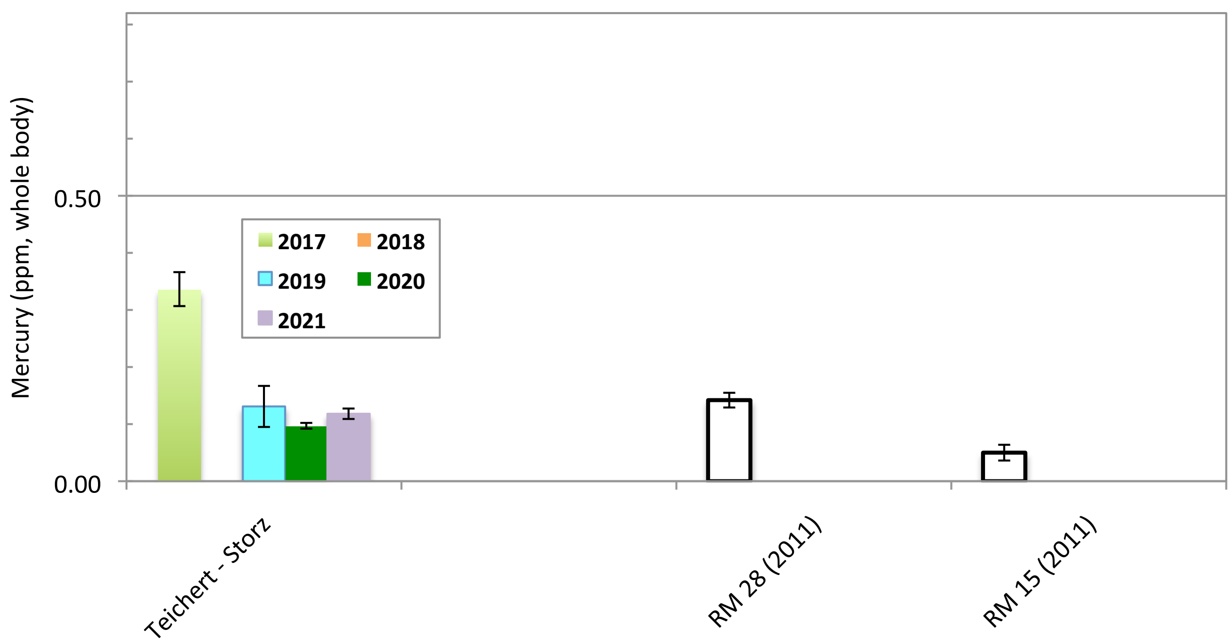

Figure 32. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 33. Juvenile Bluegill Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Bluegill Sunfish (juveniles)							
Teichert-Woodland – Storz	**2017**	–	–				
Teichert-Woodland – Storz	**2018**	–	–				
Teichert-Woodland – Storz	**2019**	–	–				
Teichert-Woodland – Storz	**2020**	**–**	**–**				
Teichert-Woodland – Storz SW	**2021**	**4**	3-10	38	1.3	**0.020**	± 0.002
Historic/Baseline Data (juvenile Green Sunfish)							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.014**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.004**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.045
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.028
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.018**

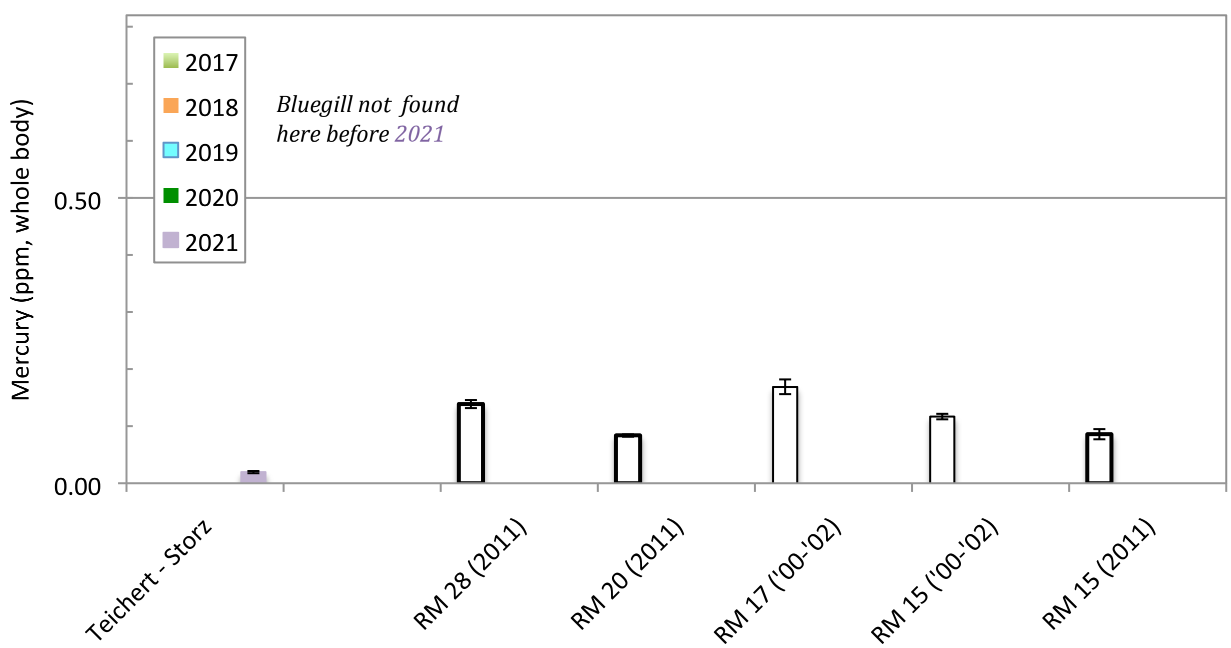

Figure 33. Juvenile Bluegill Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

6. SYAR – B1 POND

(Google Earth 10/21/2020)

6. SYAR–B1 POND *(Tables and Figures 34-41)*

Summary

Drought conditions affected both Syar Ponds significantly in 2020-2021, dropping water levels to far below normal. In addition to impacts on the ponds, it also made access and some fish collections difficult or not possible. Sixteen adult Largemouth Bass were sampled, one adult Bluegill Sunfish and for the first time here, four Channel Catfish. Young-of-year small fish were sampled with multiple composites of Mosquitofish, juvenile Largemouth Bass, and juvenile Bluegill Sunfish. Fish mercury was up in 2021 over the previous year for most sample types but remained significantly lower than the peak levels found here in 2015-2016. Despite the relatively lower levels in recent years, B1 Pond fish mercury in 2021 remained significantly higher on average than most baseline Cache Creek comparisons, most importantly in the Largemouth Bass. Because of the overall status of the B1 Pond as "elevated over baseline in three or more years of five" (all years since 2015), water column profiling and collection of bottom sediments was started here in 2018, in support of the development of a lake management plan. That work is detailed in accompanying reports.

Summary 2021 Syar – B1 Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

Large/Adult Fish			Young-of-Year Fish
Largemouth Bass	>	>	Largemouth Bass
Channel Catfish	≤	>	Mosquitofish
Sunfish	INC	>	Sunfish
Overall 2021 Findings	>		

The Syar Cache Creek mining operation, begun before 2002, has been idle since 2011 and remained inactive throughout the 7 years it has been monitored (2015-2021). The site is located south of Cache Creek and west of Highway 505, between 505 and County Road 87. There are two mid-sized ponds at the site. We were provided access to the eastern pond of the two since 2015, and refer to that as the Syar–B1 Pond. It has an irregular shape about 500 m (0.5 km) long and 100-200 m wide. Beginning in 2017, we have also sampled the western pond (Syar–West), discussed in the next section. This (2021) was Year 7 of monitoring for the Syar–B1 Pond. The B1 Pond is located in a steep-sided surrounding depression. The shorelines are mostly steep, with the main area of the pond at a similar depth, within a meter or two of maximum depth. Drought conditions strongly impacted this site: maximum depth dropped from 7.9 m (26 feet) in October 2020 to 6.7 m (22 feet) in May 2021 to 3.0 m (10 feet) in September 2021.

As at the other sites, we sampled the B1 Pond on multiple days and with a range of techniques. The 2021 collections included a set of 16 Largemouth Bass (*Micropterus salmoides*), 4 Channel Catfish (*Ictalurus punctatus*) for the first time, and 1 adult Bluegill Sunfish (*Lepomis macrochirus*) for fillet muscle samples. The small, young fish present were juvenile Largemouth Bass (3-4"), juvenile Bluegill Sunfish (1-2") and Mosquitofish (*Gambusia affinis*, 1-2"). Each of these were sampled with 3-4 multi-individual composite samples as available, for 11 total.

In total, 21 large fish muscle samples and 11 young, small fish composite samples, or 32 separate mercury samples, were analyzed from the Syar–B1 Pond in the Fall 2021 monitoring. The fish metrics and analytical results from each individual large fish muscle sample can be seen in Table 34 and, graphically, in Figure 34. Then, for each large fish species taken, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2020 results and the most closely comparable historic creek data (Tables and Figures 35-37). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 38-41.

———

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 34 and 35)

The B1 Pond adult Largemouth Bass samples included 16 fish across the range of adult sizes present: 279-435 mm (11-17") in length and 250-1050 g (0.5-2.3 lbs) in weight. In 15 of the 16 samples fillet muscle mercury ranged from 0.824-1.412 ppm, averaging 1.210 ppm. One fish was notably higher, at 2.281 ppm. The overall average was 1.277 ppm. This was up from the previous four years (2017-2020: 0.904-1.095 ppm), though the difference was not statistically significant. It remained lower than the levels found in 2015-2016 when the bass averaged 1.628 and 1.640 ppm, extremely high fish mercury levels. However, as compared to baseline samples from Cache Creek, the 2021 B1 Pond adult Largemouth Bass remained clearly elevated in mercury; they were significantly higher than all comparison sets.

Green Sunfish / Bluegill Sunfish (Tables/Figures 34 and 36)

With the drought conditions in 2021 impacting boat access, we were not able to effectively sample sunfish in either of the Syar ponds. Only one adult Bluegill was taken. Muscle mercury was 0.335 ppm. This was lower for this site than all previous averages. Relative to Cache Creek comparisons, it was lower than one of four and higher than three. With just the single sample, we cannot make statistical comparisons; the 2021 Syar-B1 Sunfish mercury finding is 'inconclusive'.

Channel Catfish (Tables/Figures 34 and 37)

We found Channel Catfish here for the first time, while using baited set lines targeting bass. Four fairly large individuals were taken: 585-620 mm (23-25") in length and 1700-2300 g (3.7-5.1 lbs) in weight. Muscle mercury levels were surprisingly low at this site (for mid-high trophic level fish like channel catfish); the smallest fish had the highest concentration, at just 0.336 ppm. The three largest catfish had even lower concentrations of 0.164-0.191 ppm. Mercury concentration decreased with fish size, counter to typical trends. The overall average was 0.220 ppm, statistically similar to all comparable Cache Creek baseline samples. Syar-B1 2021 Channel Catfish mercury was therefore in the "at or below baseline" category. This was in contrast with the bass data from 2021 and all prior years, which were highly elevated. Possible explanations include: a) lower mercury diet items, (b) different (slower) metabolism, or (c) recent transfer/stocking from a lower mercury source by fishermen. This last would be consistent with the reverse size to mercury trend found.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 38 and 39)

The juvenile bass samples had whole-body mercury levels of 0.327-0.424 ppm, averaging 0.363 ppm. After five years of steady decline from 2015 (0.589 ppm) to 2020 (0.259 ppm), this was the first increase over the previous year. The increase above 2020 levels was significant, and was statistically similar to the three years before that (2017-2019: 0.338-0.461 ppm). It remained significantly lower than the highest levels seen here (2015-2016: 0.524-0.589 ppm). Relative to baseline comparison data from Cache Creek, the 2021 BI Pond juvenile Largemouth Bass remained elevated; significantly higher than the two sample sets available: River Mile 28 (0.142 ppm) and River Mile 15 (0.050 ppm).

Juvenile Sunfish (Tables/Figures 38 and 40)

Last year, Bluegill Sunfish became the dominant juvenile sunfish species present here, largely replacing Green Sunfish. Four extensive size-class composite samples were taken. As mentioned for some of the other sites, at these small sizes the two sunfish species are functionally equivalent, accumulating mercury in a comparable way. The 2021 juvenile Bluegill Sunfish composites had whole-body mercury of 0.203-0.232 ppm, averaging 0.222 ppm. This was up somewhat (significantly) from last year (2020: 0.181 ppm), though within the fairly consistent range seen in the last five years (2017-2021: 0.181-0.245 ppm). Similar to the juvenile bass, the juvenile sunfish here in 2017-2021 have had significantly lower mercury than in the initial monitoring years of 2015 and 2016 (0.325-0.414 ppm). Relative to baseline juvenile Green Sunfish comparison numbers from Cache Creek though, the 2021 B1 Pond juvenile sunfish remained elevated. The difference was statistically significant for all of the five comparisons.

Mosquitofish (Tables/Figures 38 and 41)

The Mosquitofish samples had whole-body mercury ranging from 0.126-0.195 ppm, averaging 0.156 ppm. Like the other small fish species, this was up somewhat from 2020 (0.130 ppm); the difference was not statistically significant. Also like the other species, levels in recent years have remained significantly lower than in the initial monitoring years (2015-2017: 0.268-0.309 ppm). However, relative to the baseline Cache Creek data, the 2021 B1 Pond Mosquitofish mercury levels were once again elevated on average; significantly elevated over two of three comparison sets and lower than, but statistically similar to, the third.

Table 34. Syar – B1 Pond: Individual large fish sampled, 2021

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	279	11.0	250	0.6	**1.136**
Largemouth Bass	283	11.1	265	0.6	**1.185**
Largemouth Bass	290	11.4	245	0.5	**1.412**
Largemouth Bass	290	11.4	315	0.7	**1.364**
Largemouth Bass	292	11.5	290	0.6	**1.247**
Largemouth Bass	294	11.6	305	0.7	**1.222**
Largemouth Bass	294	11.6	295	0.7	**1.254**
Largemouth Bass	296	11.7	225	0.5	**1.241**
Largemouth Bass	298	11.7	340	0.7	**1.263**
Largemouth Bass	305	12.0	315	0.7	**1.039**
Largemouth Bass	313	12.3	385	0.8	**1.225**
Largemouth Bass	315	12.4	435	1.0	**0.824**
Largemouth Bass	342	13.5	435	1.0	**1.246**
Largemouth Bass	355	14.0	545	1.2	**1.388**
Largemouth Bass	373	14.7	505	1.1	**2.281**
Largemouth Bass	435	17.1	1,050	2.3	**1.102**
Channel Catfish	585	23.0	1,700	3.7	**0.336**
Channel Catfish	590	23.2	1,800	4.0	**0.191**
Channel Catfish	610	24.0	2,050	4.5	**0.187**
Channel Catfish	620	24.4	2,300	5.1	**0.164**
Bluegill Sunfish	157	6.2	65	0.1	**0.335**

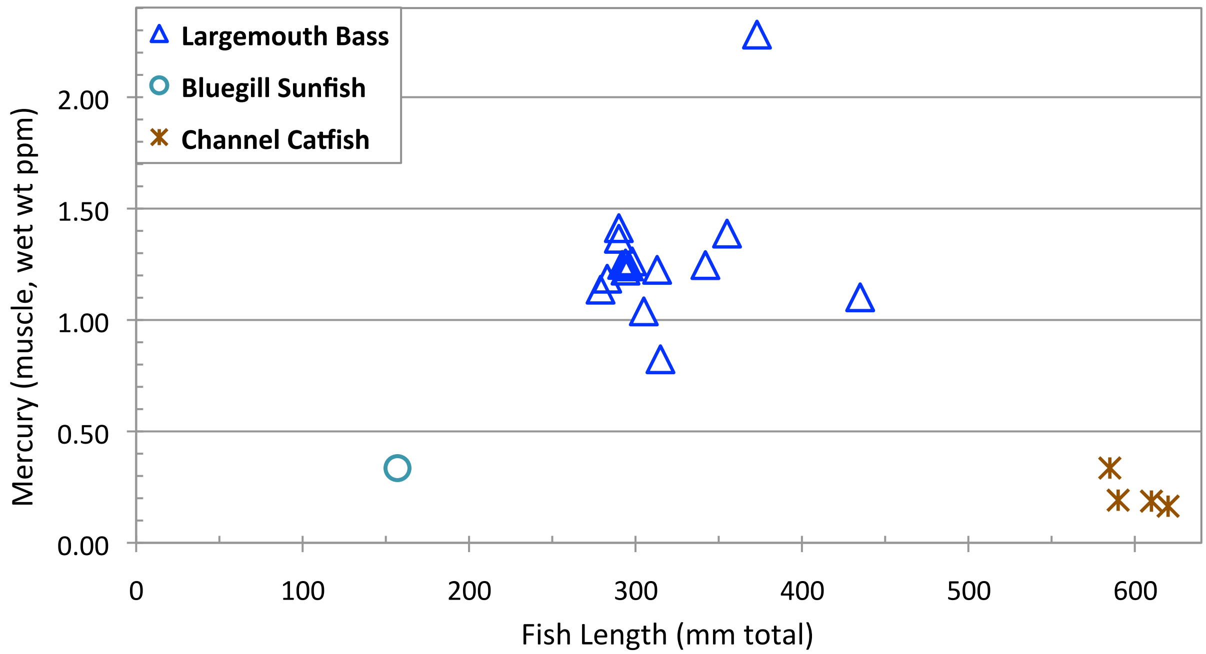

Figure 34. **Syar – B1 Pond: large fish sampled, 2021**
(fillet muscle mercury in individual fish)

Table 35. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Syar – B1	**2015**	**18**	281	355	**1.628**	± 0.332
Syar – B1	**2016**	**20**	318	489	**1.640**	± 0.152
Syar – B1	**2017**	**16**	260	265	**0.904**	± 0.239
Syar – B1	**2018**	**20**	295	335	**0.977**	± 0.198
Syar – B1	**2019**	**20**	307	377	**0.980**	± 0.192
Syar – B1	**2020**	**19**	299	346	**1.095**	± 0.165
Syar – B1	**2021**	**16**	316	388	**1.277**	± 0.217
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

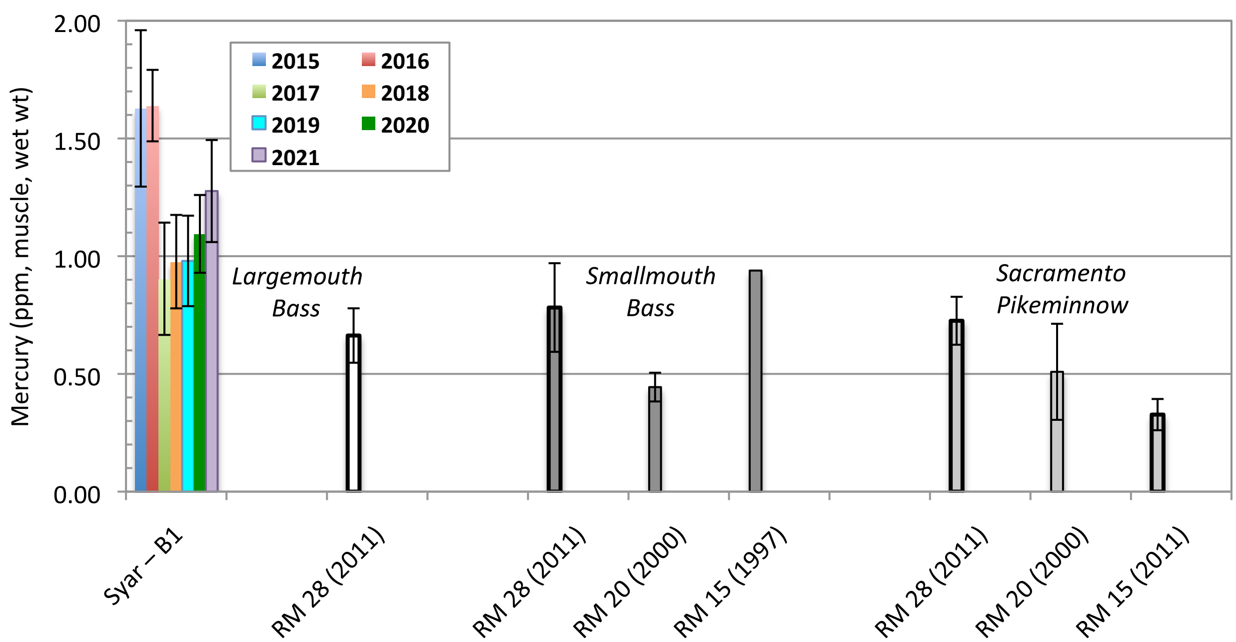

Figure 35. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 36. Green and Bluegill Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish						
Syar – B1	**2015**	**10**	118	25	**0.777**	± 0.086
Syar – B1	**2016**	**1**	83	12	**1.446**	
Syar – B1	**2017**	**–**				
Syar – B1	**2018**	**–**				
Syar – B1	**2019**	**2**	102	17	**0.457**	
Bluegill Sunfish						
Syar – B1	**2020**	**10**	157	63	**0.602**	± 0.051
Syar – B1	**2021**	**1**	157	65	**0.335**	
Historic/Baseline Data (Green Sunfish)						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

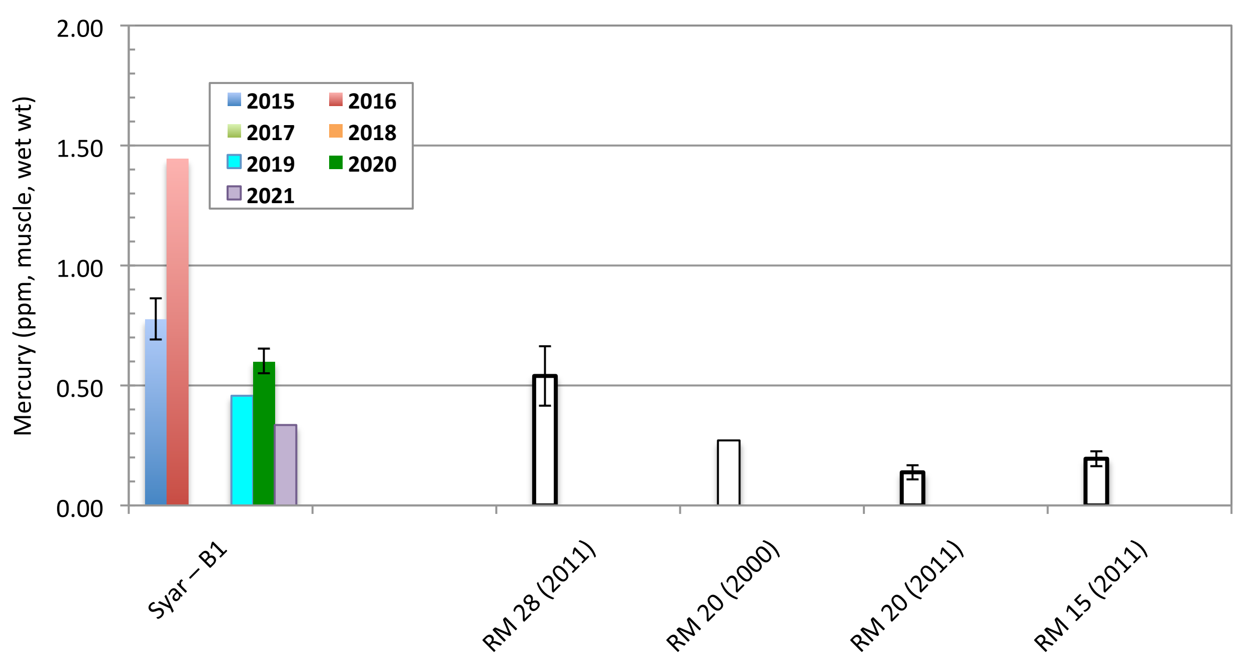

Figure 36. Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 37. Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Channel Catfish						
Syar – B1	**2021**	**4**	601	1,963	**0.220**	± 0.125
Historic/Baseline Data						
Channel Catfish						
Rumsey	2000	1	411	565	0.225	
River Mile 28	**2011**	**5**	**239**	**102**	**0.229**	**± 0.102**
River Mile 20	2000	1	368	380	0.225	
River Mile 03	1997	10	336	304	0.174	± 0.019

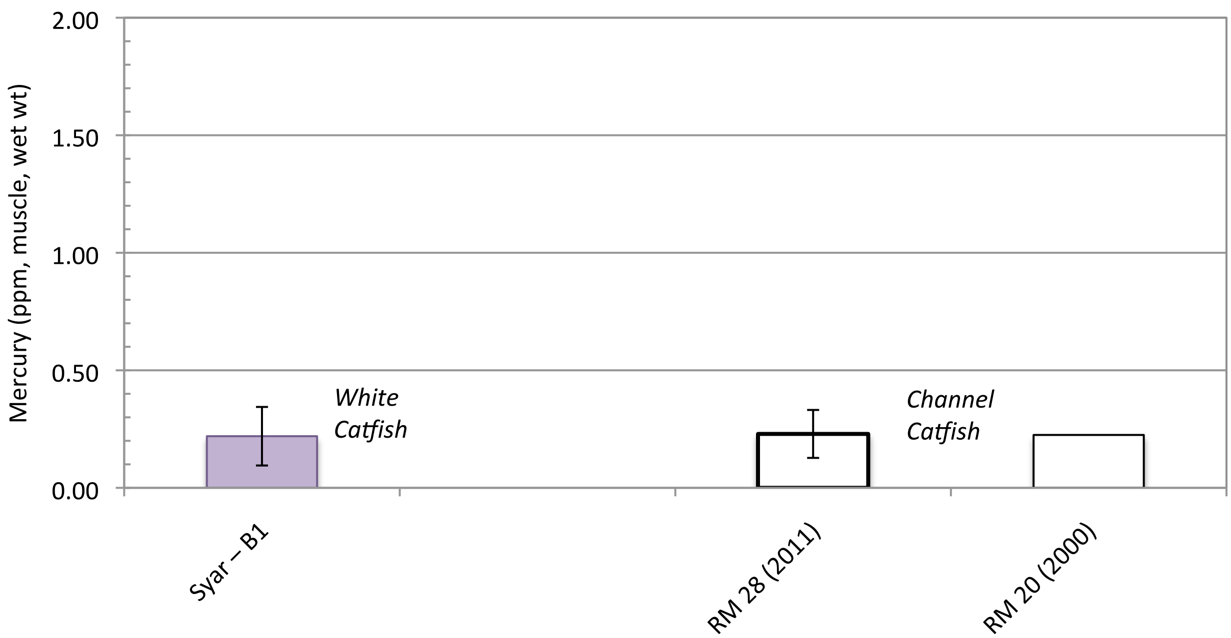

Figure 37. Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)
(Rumsey and River Mile 3 similar, but outside mining/planning area)

Small, Young Fish Samples *(note lower concentration scales)*

Table 38. Syar – B1 Pond: Small Fish Sampled, 2021
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	Av. Fish Length (inches)	Av. Fish Weight (g)	Av. Fish Weight (oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	1	73	2.9	4.77	0.17	**0.424**
Largemouth Bass (juv)	1	86	3.4	7.65	0.27	**0.327**
Largemouth Bass (juv)	1	87	3.4	8.30	0.29	**0.338**
Bluegill Sunfish (juv)	12	39	1.5	0.72	0.025	**0.224**
Bluegill Sunfish (juv)	12	43	1.7	1.11	0.039	**0.203**
Bluegill Sunfish (juv)	12	48	1.9	1.40	0.049	**0.228**
Bluegill Sunfish (juv)	10	53	2.1	2.07	0.073	**0.232**
Mosquitofish	10	27	1.1	0.20	0.007	**0.126**
Mosquitofish	10	33	1.3	0.34	0.012	**0.146**
Mosquitofish	10	36	1.4	0.52	0.018	**0.154**
Mosquitofish	4	41	1.6	0.85	0.030	**0.195**

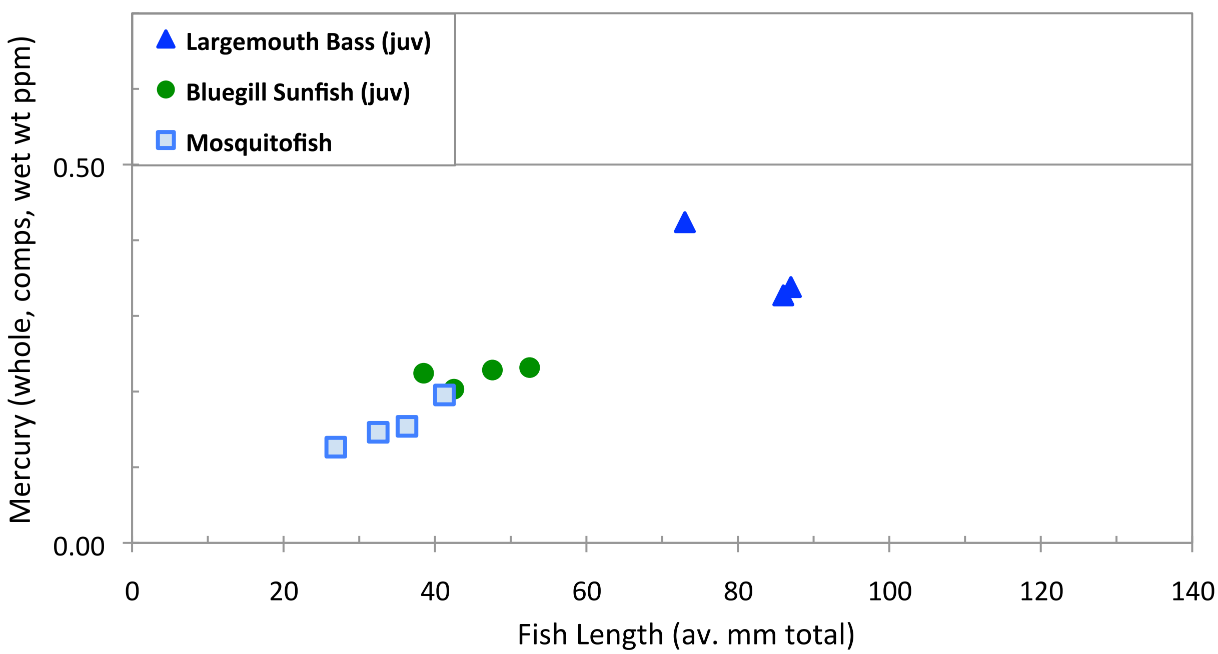

Figure 38. Syar – B1 Pond: small, young fish sampled, 2021
(mercury in whole-body, multi-individual composite samples)

Table 39. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Syar – B1	**2015**	**4**	7	159	44	**0.589**	± 0.030
Syar – B1	**2016**	**4**	10	74	5	**0.524**	± 0.119
Syar – B1	**2017**	**4**	1-2	102	18	**0.461**	± 0.175
Syar – B1	**2018**	**4**	2	88	9	**0.368**	± 0.040
Syar – B1	**2019**	**4**	1	87	7	**0.338**	± 0.021
Syar – B1	**2020**	**4**	1	87	9	**0.259**	± 0.055
Syar – B1	**2021**	**3**	1	82	7	**0.363**	± 0.031
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

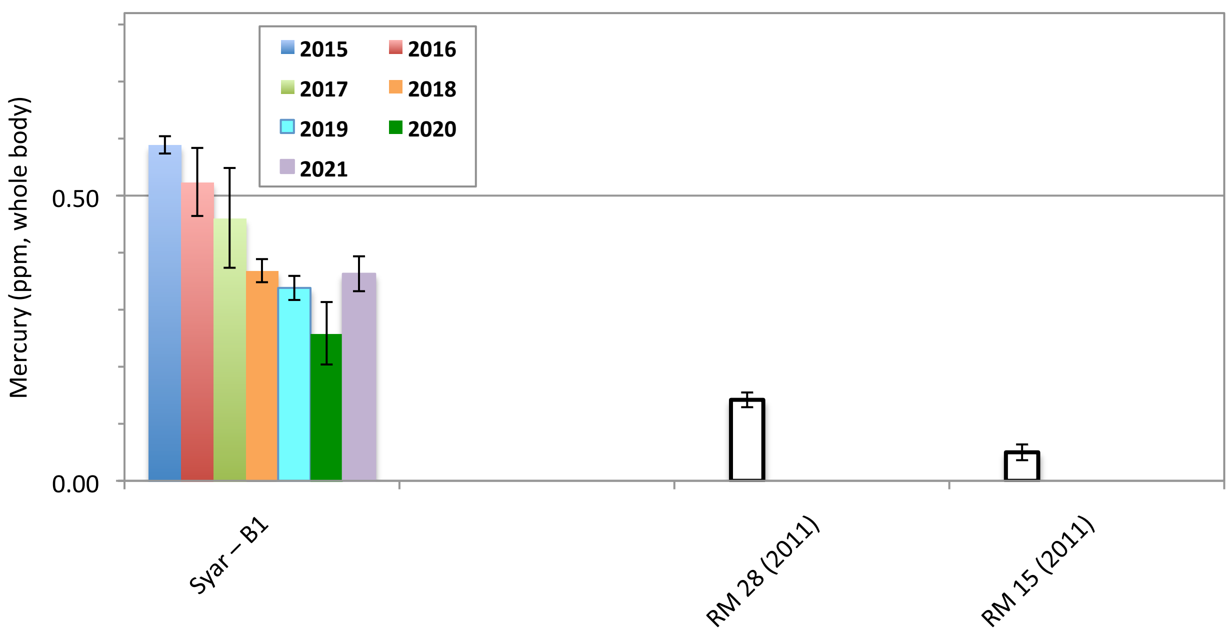

Figure 39. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 40. Juvenile Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Syar – B1	**2015**	**4**	8-9	47	1.7	**0.325**	± 0.097
Syar – B1	**2016**	**4**	4	50	1.9	**0.414**	± 0.076
Syar – B1	**2017**	**4**	6-7	40	1.0	**0.225**	± 0.069
Syar – B1	**2018**	**4**	10	37	0.8	**0.231**	± 0.044
Syar – B1	**2019**	**4**	8-10	45	1.5	**0.245**	± 0.016
Bluegill Sunfish (juveniles)							
Syar – B1	**2020**	**4**	12	44	1.3	**0.181**	± 0.018
Syar – B1	**2021**	**4**	10-12	45	1.3	**0.222**	± 0.006
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

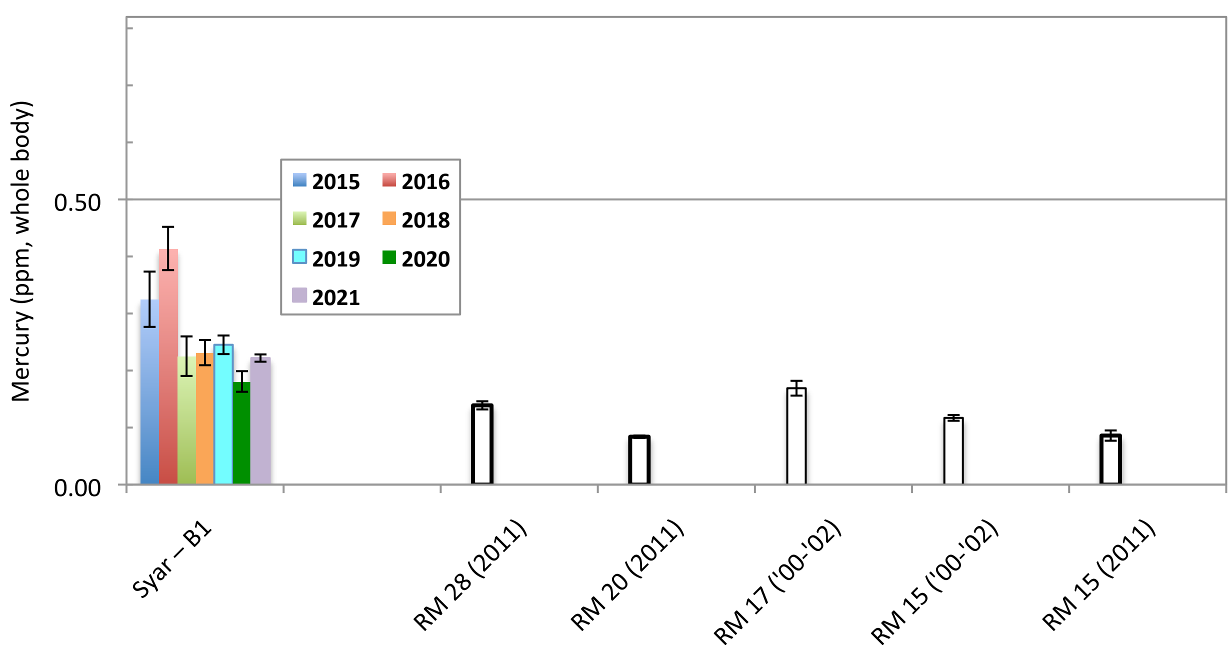

Figure 40. Juvenile Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 41. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Syar – B1	**2015**	**4**	5-10	31	0.3	**0.268**	± 0.043
Syar – B1	**2016**	**–**	–	–	–	**–**	
Syar – B1	**2017**	**4**	9-10	35	0.4	**0.309**	± 0.110
Syar – B1	**2018**	**4**	6-9	31	0.4	**0.163**	± 0.056
Syar – B1	**2019**	**3**	1-3	38	0.7	**0.214**	± 0.011
Syar – B1	**2020**	**4**	6-12	34	0.5	**0.130**	± 0.026
Syar – B1	**2021**	**4**	4-10	34	0.5	**0.156**	± 0.015
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

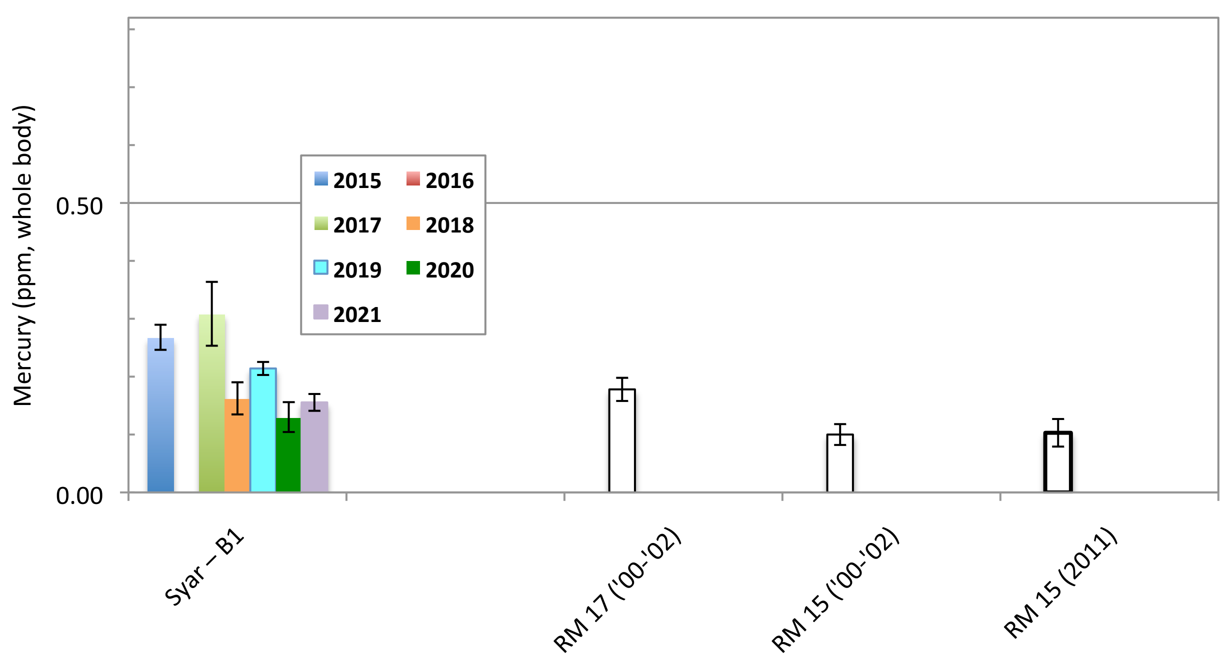

Figure 41. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

7. SYAR – WEST POND

(Google Earth 10/21/2020)

7. SYAR – WEST POND *(Tables and Figures 42-48)*

Summary

Drought conditions affected both Syar Ponds significantly in 2020-2021, dropping water levels to far below normal. In addition to impacts on the ponds, it also made access and some fish collections difficult or not possible. Thirteen adult Largemouth Bass were sampled. Young-of-year small fish samples included multiple composites of Mosquitofish, juvenile Bluegill Sunfish, and juvenile Largemouth Bass. Fish mercury was up in 2021 over the previous year for most sample types; most importantly, the adult bass samples averaged higher than the bass from all previous years. Syar-West fish mercury in 2021 was significantly higher on average than most baseline Cache Creek comparisons, as in 2017, 2019, and 2020. Because of the overall status of the West Pond as "elevated over baseline in three or more years of five" as of 2020, expanded analysis and development of a lake management plan is required. Expanded analyses have in fact been conducted here since 2018, as a second control/reference site. This pond is far deeper than the other ponds currently, and is representative of the range of final depths projected at several of the sites. With elevated fish mercury status as of 2020, this work will help in the development of a lake management plan.

Summary 2021 Syar – West Results, in relation to baseline comparisons

≤ = at or below ambient   INC = inconclusive   > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	>	>	Largemouth Bass
		≤	Mosquitofish
		>	Sunfish
Overall 2021 Findings	>		

This pond is located about half a kilometer west of the B1 Pond; the overall Syar site and its history is described above in the section on the B1 Pond. The West Pond is approximately 300 m x 400 m in size. It has been dormant and unmined since 2011. The site was added to the monitoring program in 2017, in line with the Ordinance. This (2021) was Year 5 of monitoring for Syar-West. The basin is considerably deeper than all of the other ponds in the monitoring program at this time, with extensive areas more than 15 m (50 feet) deep – under normal conditions. As at the B1 Pond and the Teichert Ponds, the second year of drought strongly impacted Syar-West: maximum depth dropped from 16.5 m (54 feet) in September 2020 to 15.5 m (51 feet) in May 2021 to 10.1 m (33 feet) in October 2021.

Drought conditions impacted our ability to collect fish here. The dropping water level created a vertical, cliff edge around the pond. This made it impossible to access with a boat, or to do routine shoreline seining. We were able to obtain collect 13 Largemouth Bass (*Micropterus salmoides*) by spearfishing, free diving. These were sampled for filet muscle mercury. Small, young-of-year fish were taken by swim-seining; they included juvenile Bluegill Sunfish (*Lepomis macrochirus*, 1-2") and Mosquitofish (*Gambusia affinis*, 1-2"), each sampled with 4 multi-individual composites, plus 3 individual-fish composites of juvenile Largemouth Bass (3-4"), for 11 total composite samples.

In total, 13 large fish muscle samples and 11 small fish composite samples, or 24 separate mercury samples, were analyzed from the Syar–West Pond in the Fall 2021 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 42 and, graphically, in Figure 42. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2020 results and the most closely comparable historic creek data (Table 43 and Figure 43); Sunfish data from previous years are given in Table/Figure 44. Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 45-48.

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 42 and 43)

Thirteen bass were sampled, across the size range of 284-440 mm (11-17") in length and 290-1470 g (0.6-3.2 lbs) in weight. The 2021 sample set averaged larger individuals than in other years here. Fillet muscle mercury ranged from 0.601-1.456 ppm, averaging 1.122 ppm. This was higher than in all prior monitoring years, and statistically elevated over the lowest levels seen here (2019: 0.672 ppm). Results may be at least partly a function of the larger average fish size/age, though levels were fairly flat across the sizes taken. Levels in 2021 were statistically similar to those found in similar bass from the nearby B1 Pond (1.277 ppm); bass data from both sites are plotted together in Figure 42(b). Relative to historic/baseline creek comparisons, the 2021 West Pond adult Largemouth Bass sample were elevated in mercury; they were higher than all of the seven comparison data sets; the elevation was statistically significant for all of the comparisons.

Green Sunfish / Bluegill Sunfish (Tables/Figures 42 and 44)

With no boat access in 2021, we were not able to sample sunfish effectively in either of the Syar ponds. Data from other years are presented.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 45 and 46)

We were able to collect just two, small juvenile bass from the Syar–West Pond. They had whole-body mercury of 0.168-0.185 ppm, averaging 0.176 ppm. This was higher statistically than the lowest levels found here to-date (2018: 0.153 ppm). But it was down significantly from the last samples available (2019: 0.273 ppm) and those from 2017 (0.418 ppm). As compared to corresponding samples from the adjacent B1 Pond (2021: 0.363 ppm), levels were significantly lower. Relative to baseline juvenile bass comparison data from Cache Creek, the 2021 West Pond juvenile bass remained elevated; significantly higher than both sets.

Juvenile Sunfish (Tables/Figures 45 and 47)

As found in the two Syar ponds since 2020, juvenile Bluegill Sunfish have mostly replaced Green Sunfish. As noted earlier, at the small sizes used for this monitoring, the two sunfish species are functionally equivalent and inter-comparable in their mercury accumulation. We collected multiple-fish composite samples in the same size ranges used for the other sunfish. The 2021 fish had whole-body mercury ranging narrowly from 0.244-0.277 ppm, averaging 0.254 ppm. This was the highest average found to-date here; the difference was statistically significant over the prior three years (2018-2020: 0.102-0.187 ppm) and statistically similar to 2017 (0.237 ppm). In comparison to matching 2021 samples from the adjacent B1 Pond (0.222 ppm), West Pond mercury levels were significantly higher in 2021. Relative to baseline/historic juvenile Green Sunfish from Cache Creek, the 2021 West Pond samples were significantly elevated in mercury levels over all five comparison sets.

Mosquitofish (Tables/Figures 45 and 48)

We were able to collect four size-class composite samples of 5-10 Mosquitofish each. The composites had whole-body mercury ranging from 0.097-0.175 ppm, averaging 0.121 ppm. This was down significantly from 2019 (0.165 ppm) and 2017 (0.236 ppm), and was statistically similar to the lowest levels found here to-date (2018: 0.088 ppm). In comparison to matching 2021 samples from the adjacent B1 Pond (0.156 ppm), West Pond mercury levels were lower; the difference was significant statistically. As compared to baseline Cache Creek sampling, the 2021 West Pond Mosquitofish mercury levels were not elevated; they were statistically similar to two of the baseline sets and significantly lower than one.

Table 42. Syar – West Pond: Individual large fish sampled, 2021

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	284	11.2	290	0.6	**1.051**
Largemouth Bass	300	11.8	380	0.8	**0.881**
Largemouth Bass	307	12.1	340	0.7	**1.221**
Largemouth Bass	318	12.5	385	0.8	**1.209**
Largemouth Bass	328	12.9	430	0.9	**0.601**
Largemouth Bass	330	13.0	490	1.1	**1.241**
Largemouth Bass	343	13.5	465	1.0	**1.228**
Largemouth Bass	347	13.7	470	1.0	**1.256**
Largemouth Bass	377	14.8	690	1.5	**1.151**
Largemouth Bass	378	14.9	675	1.5	**1.096**
Largemouth Bass	417	16.4	1,100	2.4	**1.003**
Largemouth Bass	425	16.7	1,010	2.2	**1.191**
Largemouth Bass	440	17.3	1,470	3.2	**1.456**

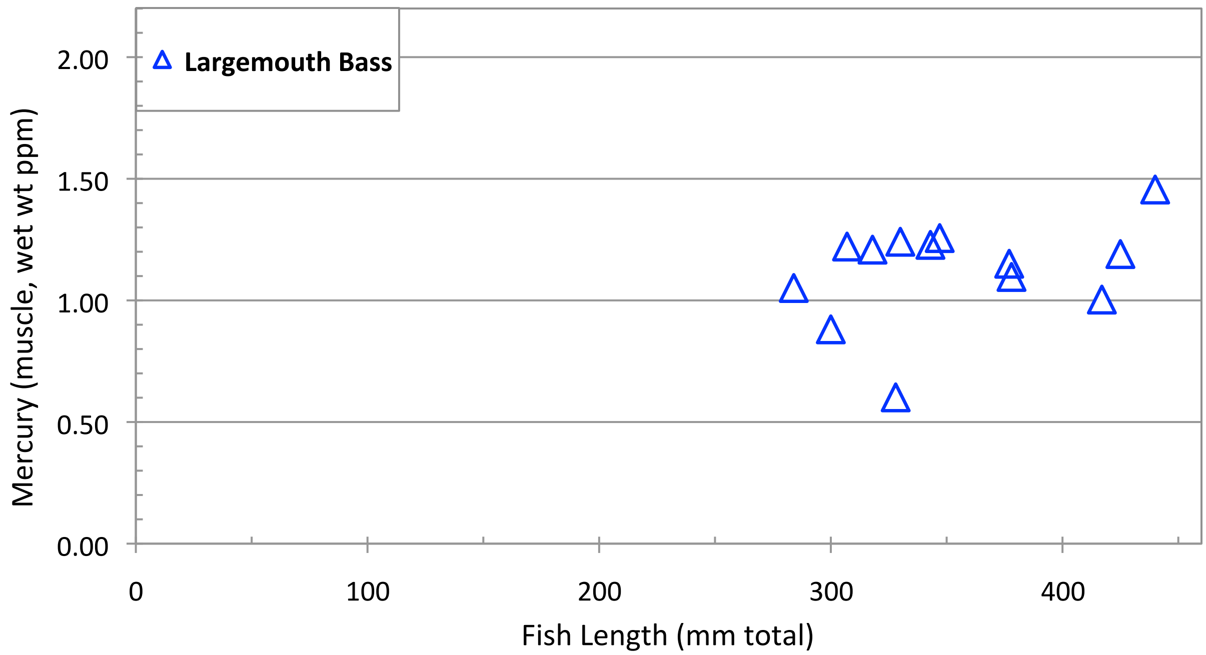

Figure 42. Syar – West Pond: large fish sampled, 2021
(fillet muscle mercury in individual fish)

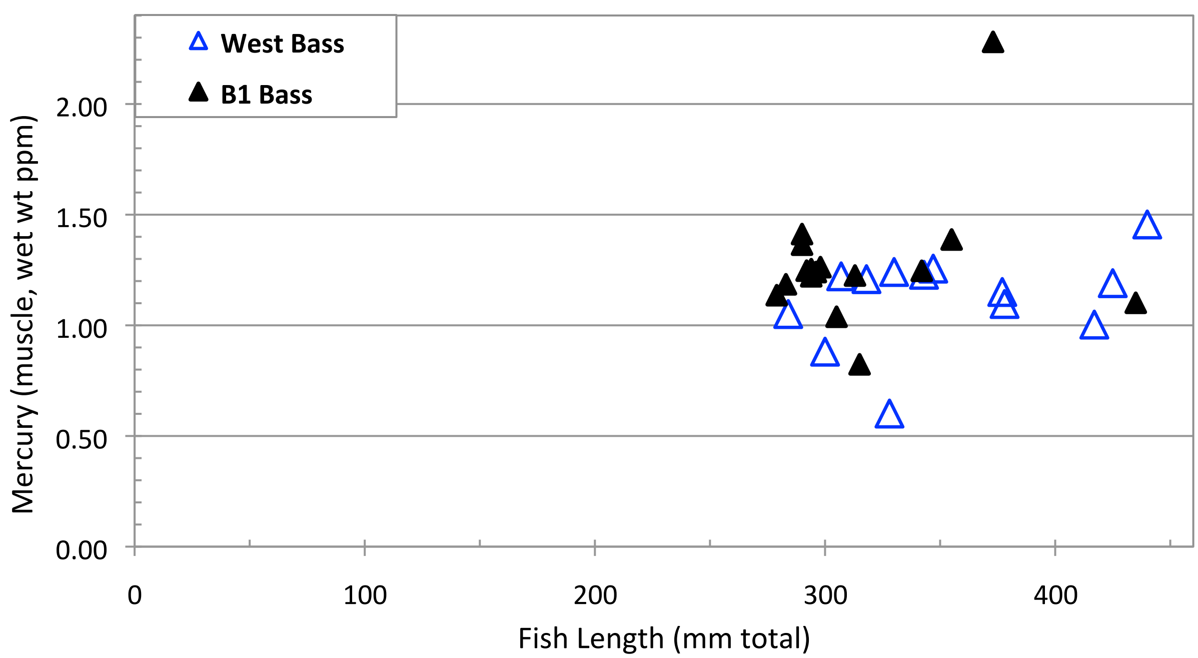

Figure 42(b). Syar – West Pond AND B1 Pond Bass comparison, 2021
(fillet muscle mercury in individual fish)

Table 43. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Syar – West	**2017**	**17**	283	320	**0.925**	± 0.205
Syar – West	**2018**	20	278	292	**0.798**	± 0.229
Syar – West	**2019**	20	275	271	**0.672**	± 0.105
Syar – West	**2020**	19	295	304	**0.902**	± 0.159
Syar – West	**2021**	**13**	353	630	**1.122**	± 0.161
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

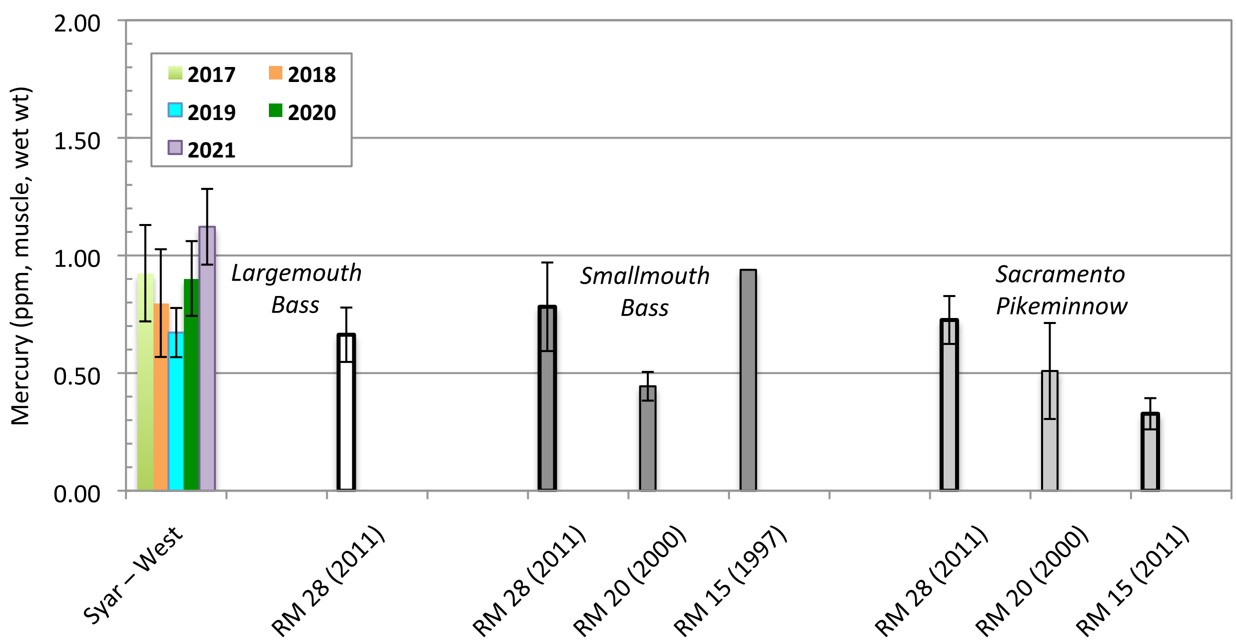

Figure 43. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 44. Green and Bluegill Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish						
Syar – West	**2017**	**4**	93	12	**0.579**	± 0.089
Syar – West	**2018**	–				
Syar – West	**2019**	**1**	126	41	**0.238**	
Bluegill Sunfish						
Syar – West	**2020**	10	185	121	**0.612**	± 0.068
Syar – West	**2021**	–				
Historic/Baseline Data						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

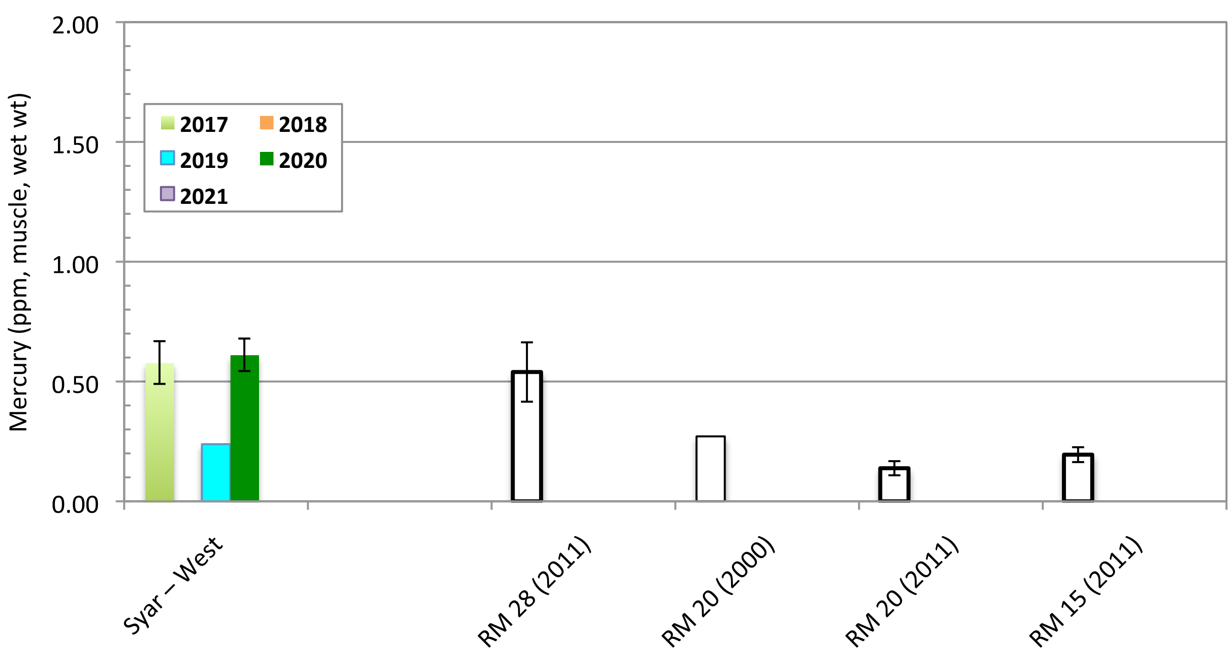

Figure 44. Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 45. Syar – West Pond: Small Fish Sampled, 2021
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	(inches)	Av. Fish Weight (g)	(oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	1	53	2.1	2.04	0.072	**0.168**
Largemouth Bass (juv)	1	56	2.2	2.89	0.102	**0.185**
Bluegill Sunfish (juv)	10	37	1.4	0.53	0.019	**0.244**
Bluegill Sunfish (juv)	10	41	1.6	0.81	0.029	**0.251**
Bluegill Sunfish (juv)	10	47	1.9	1.15	0.041	**0.245**
Bluegill Sunfish (juv)	10	54	2.1	2.11	0.074	**0.277**
Mosquitofish	10	28	1.1	0.21	0.007	**0.097**
Mosquitofish	10	33	1.3	0.36	0.013	**0.097**
Mosquitofish	10	36	1.4	0.50	0.018	**0.116**
Mosquitofish	5	40	1.6	0.71	0.025	**0.175**

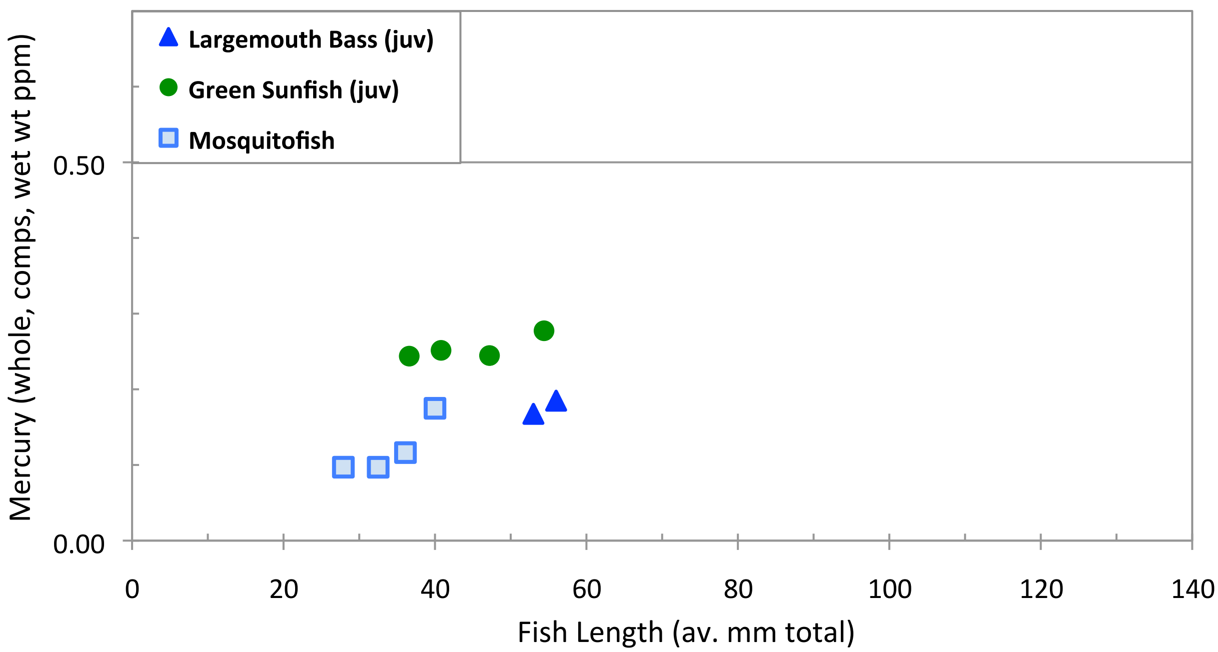

Figure 45. Syar – West Pond: small, young fish sampled, 2021

Table 46. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Syar – West	**2017**	**2**	1	123	27	**0.418**	± 0.030
Syar – West	**2018**	**4**	2	77	6	**0.153**	± 0.024
Syar – West	**2019**	**2**	1	96	11	**0.273**	± 0.006
Syar – West	**2020**	*(none taken)*					
Syar – West	**2021**	**2**	1	55	2	**0.176**	± 0.007
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

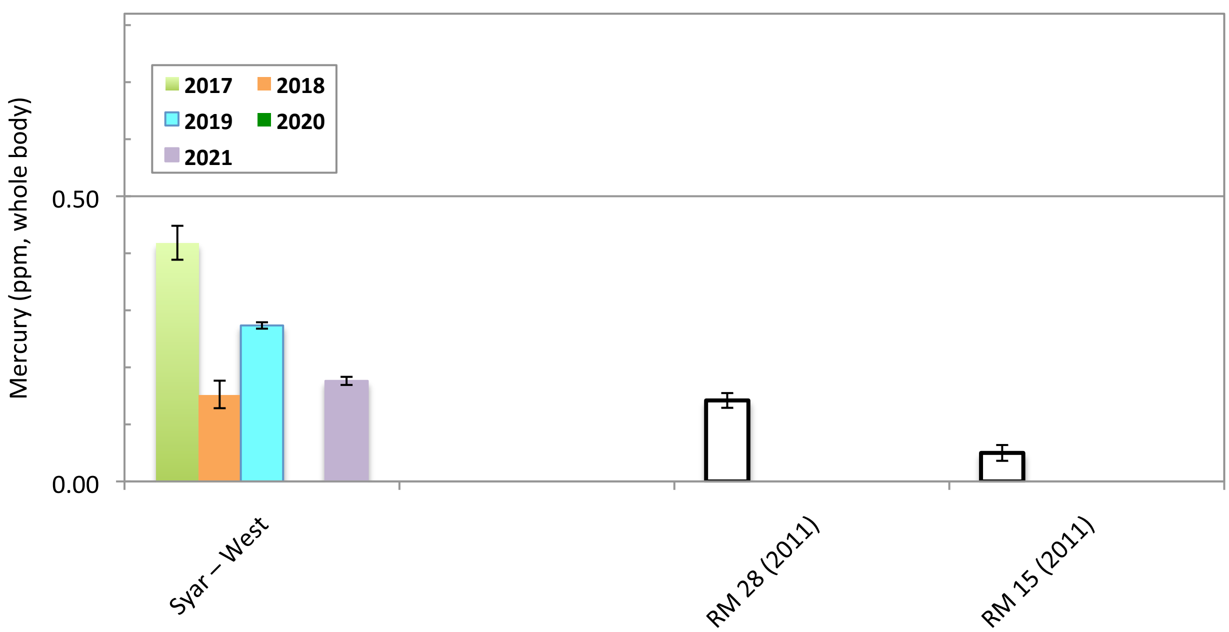

Figure 46. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 47. Juvenile Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Syar – West	**2017**	**4**	5-10	45	1.7	**0.237**	± 0.077
Syar – West	**2018**	**4**	2-4	34	0.6	**0.102**	± 0.017
Syar – West	**2019**	**4**	8-10	46	1.5	**0.177**	± 0.010
Bluegill Sunfish (juveniles)							
Syar – West	**2020**	**4**	10-12	42	1.2	**0.187**	± 0.024
Syar – West	**2021**	**4**	10	45	1.1	**0.254**	± 0.008
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

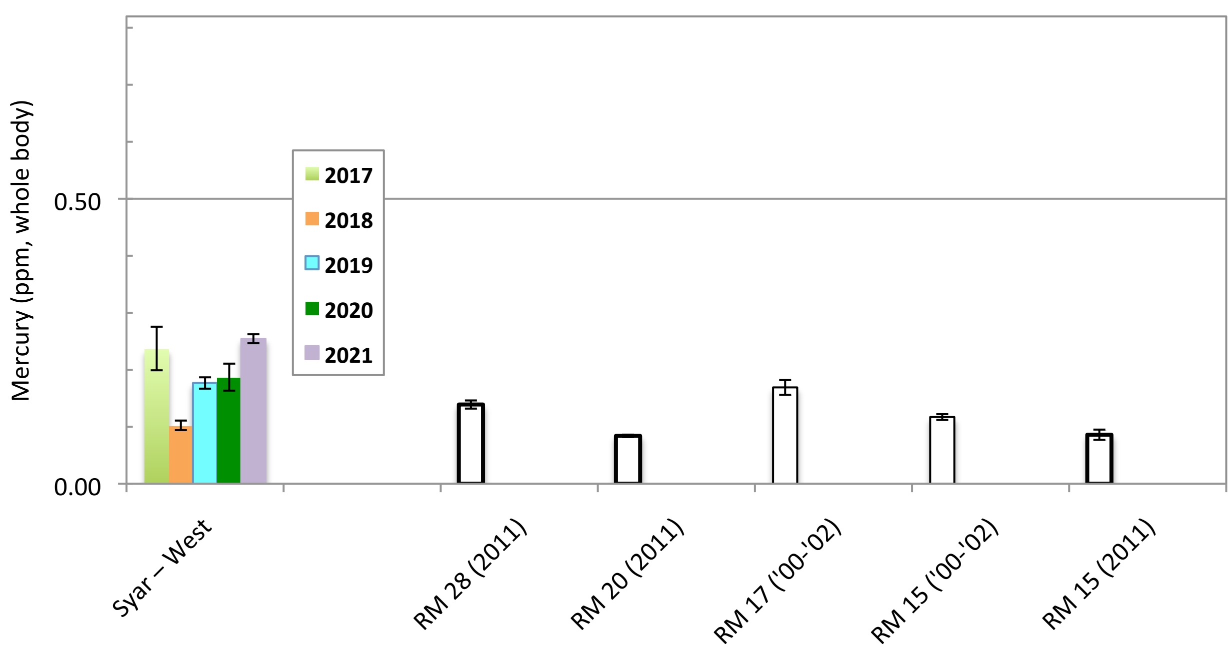

Figure 47. Juvenile Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 48. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Syar – West	**2017**	**4**	10	34	0.4	**0.236**	± 0.034
Syar – West	**2018**	**4**	6-7	29	0.3	**0.088**	± 0.012
Syar – West	**2019**	**3**	2-3	36	0.6	**0.165**	± 0.032
Syar – West	**2020**	**4**	8-12	35	0.5	**0.109**	± 0.018
Syar – West	**2021**	**4**	5-10	34	0.4	**0.121**	± 0.018
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

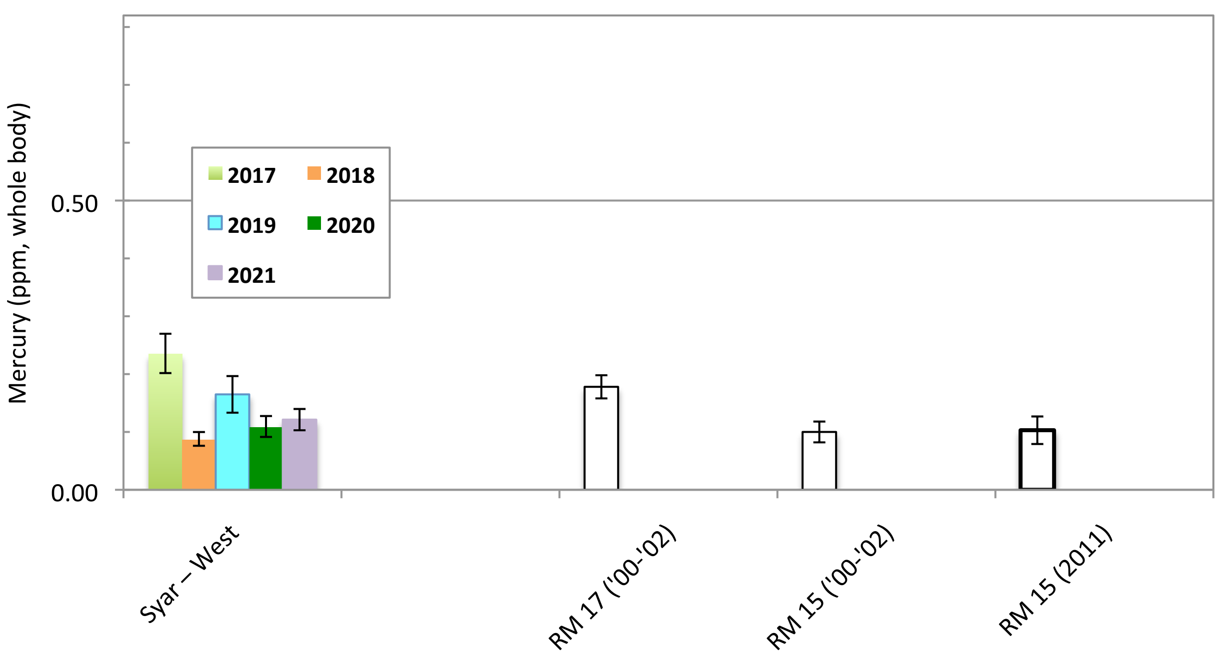

Figure 48. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

8. COMPARISON OF ALL THE MONITORED SITES AND HISTORICAL DATA, BY FISH SPECIES

This section is presented to consolidate the monitoring data and place the various findings into relative context. For each sample type, data are first presented in a table and then graphically with an accompanying figure. These presentations allow the reader (and these researchers) to assess overall trends, across all of the monitored ponds and over time.

Table 49. Largemouth Bass summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Largemouth Bass						
Cemex – Phase 1	**2015**	**18**	305	393	**0.278**	± 0.055
Cemex – Phase 1	**2016**	**20**	313	383	**0.350**	± 0.066
Cemex – Phase 1	**2017**	**17**	299	357	**0.393**	± 0.079
Cemex – Phase 1	**2018**	**20**	298	331	**0.481**	± 0.131
Cemex – Phase 1	**2019**	**20**	280	247	**0.404**	± 0.085
Cemex – Phase 1	**2020**	**20**	267	253	**0.352**	± 0.075
Cemex – Phase 1	**2021**	**20**	274	262	**0.381**	± 0.079
Cemex – Phase 3-4	**2015**	**20**	344	526	**0.840**	± 0.113
Cemex – Phase 3-4	**2016**	**20**	344	557	**0.858**	± 0.139
Cemex – Phase 3-4	**2017**	**20**	334	479	**1.093**	± 0.172
Cemex – Phase 3-4	**2018**	**20**	331	463	**0.918**	± 0.119
Cemex – Phase 3-4	**2019**	**20**	312	402	**0.819**	± 0.195
Cemex – Phase 3-4	**2020**	**20**	310	399	**0.656**	± 0.094
Cemex – Phase 3	**2021**	**20**	358	575	**0.971**	± 0.092
Cemex – Phase 4	**2021**	**20**	325	418	**0.782**	± 0.105
Teichert-Esparto – Reiff	**2017**	**5**	189	78	**1.679**	± 0.180
Teichert-Esparto – Reiff	**2018**	**10**	251	181	**1.997**	± 0.170
Teichert-Esparto – Reiff	**2019**	**10**	295	353	**1.183**	± 0.314
Teichert – Esparto	**2020**	**13**	311	453	**1.238**	± 0.204
Teichert – Esparto	**2021**	**20**	275	214	**1.648**	± 0.215
Teichert-Woodland – Storz	**2017**	**20**	245	203	**0.657**	± 0.038
Teichert-Woodland – Storz	**2018**	**20**	255	197	**0.611**	± 0.082
Teichert-Woodland – Storz	**2019**	**12**	222	196	**0.218**	± 0.042
Teichert-Woodland – Storz	**2020**	**20**	211	99	**0.193**	± 0.021
Teichert-Woodland – Storz	**2021**	**20**	233	216	**0.269**	± 0.072
Syar – B1	**2015**	**18**	281	355	**1.628**	± 0.332
Syar – B1	**2016**	**20**	318	489	**1.640**	± 0.152
Syar – B1	**2017**	**16**	260	265	**0.904**	± 0.239
Syar – B1	**2018**	**20**	295	335	**0.977**	± 0.198
Syar – B1	**2019**	**20**	307	377	**0.980**	± 0.192
Syar – B1	**2020**	**19**	299	346	**1.095**	± 0.165
Syar – B1	**2021**	**16**	316	388	**1.277**	± 0.217
Syar – West	**2017**	**17**	283	320	**0.925**	± 0.205
Syar – West	**2018**	**20**	278	292	**0.798**	± 0.229
Syar – West	**2019**	**20**	275	271	**0.672**	± 0.105
Syar – West	**2020**	**19**	295	304	**0.902**	± 0.159
Syar – West	**2021**	**13**	353	630	**1.122**	± 0.161

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(Table 49, continued)

Site	**Year**	**Number of Fish**	**Av Length** (mm total)	**Av Weight** (grams)	**Av Hg** (µg/g = ppm, wet wt)	**95% C.I.**
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

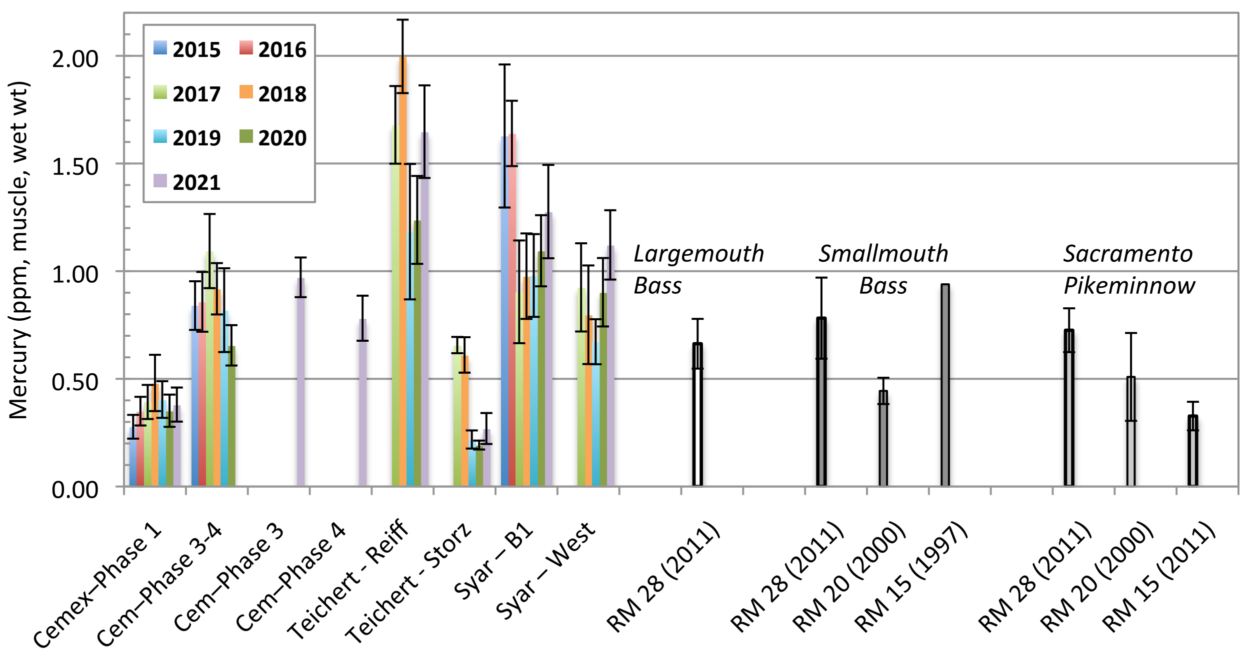

Figure 49. Largemouth Bass summary data, and historic creek comparisons *(mean fillet muscle mercury, with 95% confidence intervals)*

Table 50. Catfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Channel Catfish						
Cemex – Phase 1	**2015**	**2**	595	2,130	**0.198**	
Cemex – Phase 1	**2016**	**2**	412	1,150	**0.100**	
Cemex – Phase 1	**2017**	**2**	531	1,440	**0.236**	
Cemex – Phase 1	**2018**	**3**	533	1,973	**0.337**	± 0.58
	(Catfish – both species – not found at Cemex–Phase 1 since 2018)					
Syar – B1	**2021**	**4**	601	1,963	**0.220**	± 0.125
White Catfish						
Cemex – Phase 1	**2016**	**3**	661	2,900	**0.372**	
Cemex – Phase 1	**2017**	**6**	615	2,120	**0.448**	± 0.134
Cemex – Phase 1	**2018**	**1**	398	1115	**0.571**	
Teichert-Esparto – Reiff	**2015**	**20**	347	658	**0.737**	± 0.156
Teichert-Esparto – Reiff	**2016**	**20**	297	341	**0.996**	± 0.153
Teichert-Esparto – Reiff	**2017**	**16**	355	677	**1.287**	± 0.197
Teichert-Esparto – Reiff	**2018**	*(unable to sample in 2018)*				
Teichert-Esparto – Reiff	**2019**	**10**	337	535	**0.637**	± 0.134
Teichert – Esparto	**2020**	**10**	369	742	**0.408**	± 0.123
Teichert – Esparto	**2021**	**6**	431	1,043	**0.501**	± 0.253
Historic/Baseline Data						
Channel Catfish						
Rumsey	2000	1	411	565	0.225	
River Mile 28	**2011**	**5**	**239**	**102**	**0.229**	**± 0.102**
River Mile 20	2000	1	368	380	0.225	
River Mile 03	1997	10	336	304	0.174	± 0.019

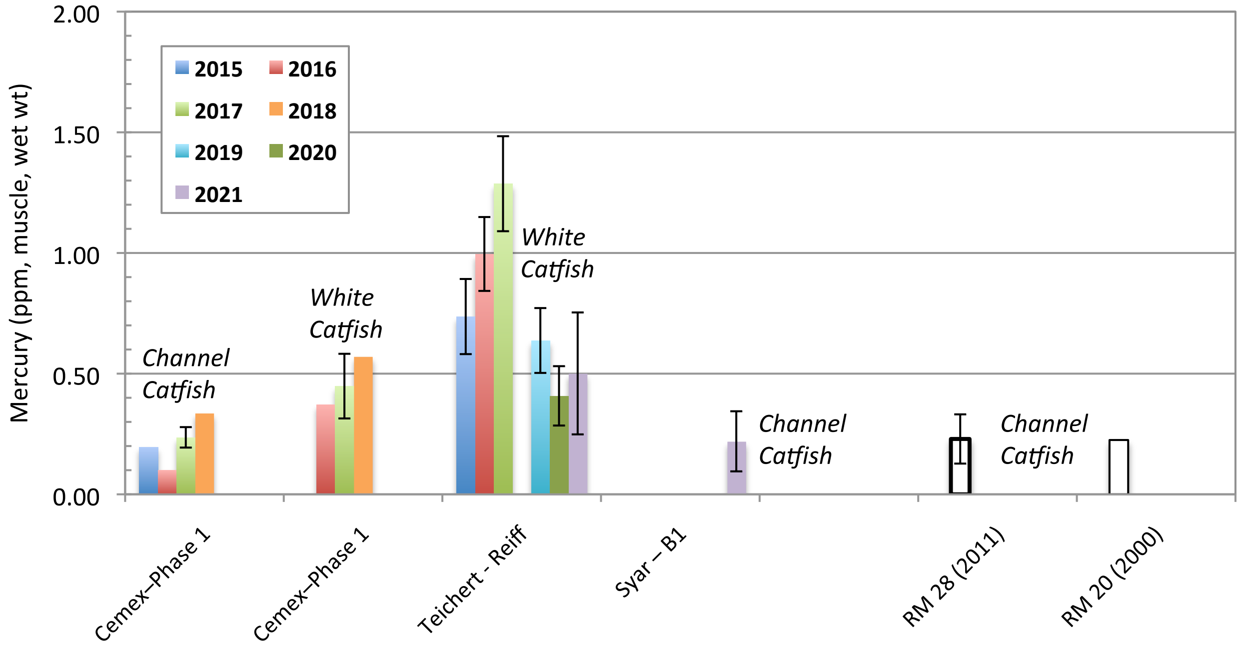

Figure 50. Catfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)
(Rumsey and River Mile 3 were outside the mining/planning area)

Table 51. Sunfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish *(unless noted Bluegill)*						
Cemex – Phase 1	2017	5	105	35	0.273	± 0.094
Cemex – Phase 1	2018	1	200	165	0.227	
Cemex – Phase 3-4	2015	10	133	67	0.534	± 0.076
Cemex – Phase 3-4	2016	1	101	16	0.382	
Cemex – Phase 3-4	2017	–				
Cemex – Phase 3-4	2018	–				
Teichert-Esparto – Reiff	2015	1	140	40	0.328	
Teichert-Esparto – Reiff	2016	–				
Teichert-Esparto – Reiff	2017	–				
Teichert-Esparto – Reiff	2018	–				
Teichert-Esparto – Reiff	2019	1	106	23	0.373	
Syar – B1	2015	10	118	25	0.777	± 0.086
Syar – B1	2016	1	83	12	1.446	
Syar – B1	2017	–				
Syar – B1	2018	–				
Syar – B1	2019	2	102	17	0.457	
Syar – B1 *Bluegill*	2020	10	157	63	0.602	± 0.072
Syar – B1 *Bluegill*	2021	1	157	65	0.335	
Syar – West	2017	4	93	12	0.579	± 0.089
Syar – West	2018	–				
Syar – West	2019	1	126	41	0.238	
Syar – West *Bluegill*	2020	10	185	121	0.612	± 0.095
Historic/Baseline Data						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

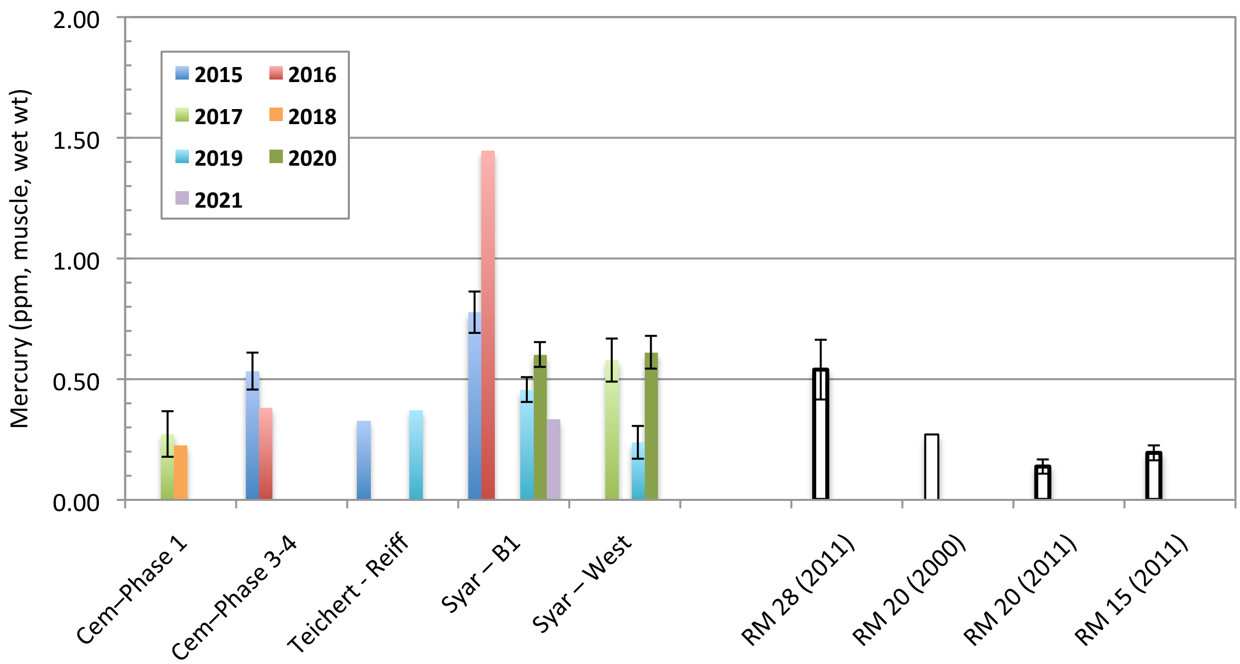

Figure 51. Sunfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 52. Carp summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Carp						
Teichert-Esparto – Reiff	**2015**	**2**	421	918	**0.351**	
Teichert-Esparto – Reiff	**2016**	**5**	430	975	**0.854**	± 0.387
Teichert-Esparto – Reiff	**2017**	**9**	481	1,499	**1.122**	± 0.321
Teichert-Esparto – Reiff	**2018**	*(unable to sample)*				
Teichert-Esparto – Reiff	**2019**	**9**	483	1,475	**0.988**	± 0.279
Teichert – Esparto	**2020**	**7**	381	1,086	**0.636**	± 0.334
Teichert – Esparto	**2021**	**2**	568	2,575	**1.602**	
Historic/Baseline Data (most comparable species available)						
Sacramento Sucker						
Rumsey	2000	6	328	396	0.198	± 0.113
River Mile 20	2000	5	253	174	0.154	± 0.034
River Mile 15	**2011**	**8**	**276**	**231**	**0.143**	**± 0.011**
River Mile 08	2000	4	319	336	0.339	
River Mile 03	1997	5	343	402	0.263	± 0.068

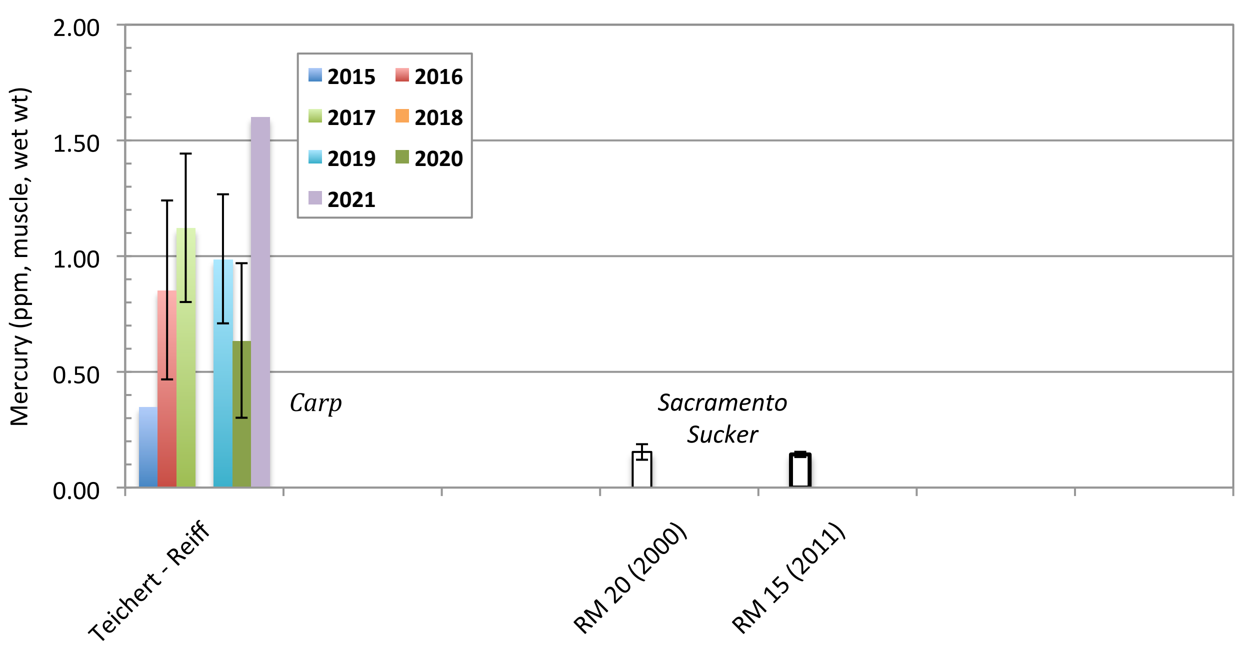

Figure 52. Carp summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 53. Juvenile Bass summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Cemex – Phase 1	**2015**	**4**	8	109	17	**0.044**	± 0.004
Cemex – Phase 1	**2016**	**4**	3	102	17	**0.094**	± 0.006
Cemex – Phase 1	**2017**	**4**	2	117	22	**0.146**	± 0.011
Cemex – Phase 1	**2018**	**1**	1	78	6	**0.068**	
Cemex – Phase 1	**2019**	**4**	4-5	106	17	**0.114**	± 0.007
Cemex – Phase 1	**2020**	**5**	2-4	100	13	**0.104**	± 0.008
Cemex – Phase 1	**2021**	**4**	2-3	79	7	**0.096**	± 0.006
Cemex – Phase 3-4	**2015**	**4**	7	108	16	**0.334**	± 0.026
Cemex – Phase 3-4	**2016**	**4**	2	114	18	**0.372**	± 0.026
Cemex – Phase 3-4	**2017**	**4**	2-3	108	16	**0.249**	± 0.016
Cemex – Phase 3-4	**2018**	–	–				
Cemex – Phase 3-4	**2019**	**1**	1	125	23	**0.336**	
Cemex – Phase 3-4	**2020**	**1**	1	124	23	**0.144**	
Cemex – Phase 3	**2021**	**3**	1	110	12	**0.302**	± 0.016
Cemex – Phase 4	**2021**	**4**	2-4	94	12	**0.160**	± 0.015
Teichert-Esparto – Reiff	**2017**	**4**	1-2	137	32	**0.798**	± 0.094
Teichert-Esparto – Reiff	**2018**	**4**	4-6	111	17	**0.445**	± 0.069
Teichert-Esparto – Reiff	**2019**	**4**	5	107	15	**0.297**	± 0.010
Teichert – Esparto	**2020**	**4**	3	92	9	**0.472**	± 0.027
Teichert – Esparto	**2021**	**4**	1	98	12	**1.064**	± 0.041
Teichert-Woodland – Storz	**2017**	**4**	1	143	35	**0.337**	± 0.030
Teichert-Woodland – Storz	**2018**	–	–				
Teichert-Woodland – Storz	**2019**	**4**	1	130	29	**0.131**	± 0.036
Teichert-Woodland – Storz	**2020**	**4**	1	172	63	**0.097**	± 0.005
Teichert-Woodland – Storz	**2021**	**3**	2-3	125	29	**0.118**	± 0.009
Syar – B1	**2015**	**4**	7	159	44	**0.589**	± 0.015
Syar – B1	**2016**	**4**	10	74	5	**0.524**	± 0.060
Syar – B1	**2017**	**4**	1-2	102	18	**0.461**	± 0.087
Syar – B1	**2018**	**4**	2	88	9	**0.368**	± 0.020
Syar – B1	**2019**	**4**	1	87	7	**0.338**	± 0.021
Syar – B1	**2020**	**4**	1	87	9	**0.259**	± 0.055
Syar – B1	**2021**	**3**	1	82	7	**0.363**	± 0.031

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(Table 53, continued)

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Syar – West	**2017**	**2**	1	123	27	**0.418**	± 0.030
Syar – West	**2018**	**4**	2	77	6	**0.153**	± 0.024
Syar – West	**2019**	**2**	1	96	11	**0.273**	± 0.006
Syar – West	**2020**	**4**	4-5	106	17	**0.114**	± 0.007
Syar – West	**2021**	**2**	1	55	2	**0.176**	± 0.007
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

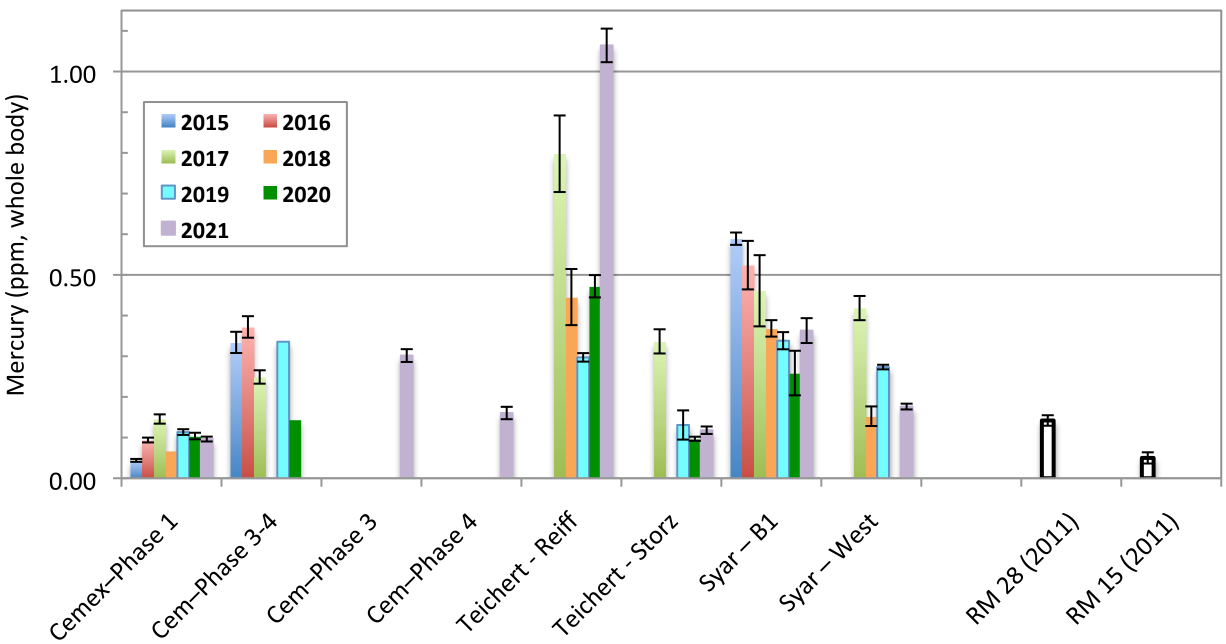

Figure 53. Juvenile Bass summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 54. Juvenile Sunfish summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish *(unless noted Bluegill)* **– juveniles**							
Cemex – Phase 1	**2017**	**4**	8-10	47	1.9	**0.118**	± 0.011
Cemex – Phase 1	**2018**	**4**	2	51	2.1	**0.035**	± 0.005
Cemex – Phase 1	**2019**	**4**	2-10	44	1.7	**0.089**	± 0.011
Cemex – Phase 1	**2020**	**3**	1-3	50	2.7	**0.089**	± 0.009
Cemex – Phase 1	**2021**	**3**	1-9	33	2.3	**0.090**	± 0.011
Cemex – Phase 3-4	**2015**	**4**	10	47	1.8	**0.275**	± 0.011
Cemex – Phase 3-4	**2016**	**4**	4-5	49	2.0	**0.233**	± 0.013
Cemex – Phase 3-4	**2017**	**4**	2-6	36	0.7	**0.150**	± 0.025
Cemex – Phase 3-4	**2018**	**4**	1	34	0.5	**0.112**	± 0.010
Cemex – Phase 3-4	**2019**	**4**	10	43	1.6	**0.185**	± 0.016
Cemex – Phase 3-4	**2020**	**4**	1-12	38	0.9	**0.117**	± 0.024
Cemex – Phase 3	**2021**	**3**	2-5	33	0.6	**0.159**	± 0.029
Cemex – Phase 4	**2021**	**4**	3-10	44	0.5	**0.160**	± 0.020
Teichert-Esparto – Reiff	**2015**	**–**	1	68	2.7	**0.241**	
Teichert-Esparto – Reiff	**2016**	**–**	–				
Teichert-Esparto – Reiff	**2017**	**–**	–				
Teichert-Esparto – Reiff	**2018**	**4**	2	48	2.3	**0.252**	± 0.010
Teichert-Esparto – Reiff	**2019**	**4**	3-10	41	1.3	**0.187**	± 0.029
Teichert – Esparto	**2020**	**4**	3	35	0.7	**0.230**	± 0.018
Teichert – Esparto	**2021**	**3**	1	39	1.2	**0.479**	± 0.016
Teichert-Woodland – Storz *Bluegill*	**2021**	**4**	3-10	38	1.3	**0.020**	± 0.002
Syar – B1	**2015**	**4**	8-9	47	1.7	**0.325**	± 0.048
Syar – B1	**2016**	**4**	4	50	1.9	**0.414**	± 0.038
Syar – B1	**2017**	**4**	6-7	40	1.0	**0.225**	± 0.035
Syar – B1	**2018**	**4**	10	37	0.8	**0.231**	± 0.022
Syar – B1	**2019**	**4**	8-10	45	1.5	**0.245**	± 0.016
Syar – B1 *Bluegill*	**2020**	**4**	12	44	1.3	**0.181**	± 0.018
Syar – B1 *Bluegill*	**2021**	**4**	10-12	45	1.3	**0.222**	± 0.006
Syar – West	**2017**	**4**	5-10	45	1.7	**0.237**	± 0.038
Syar – West	**2018**	**4**	2-4	34	0.6	**0.102**	± 0.008
Syar – West	**2019**	**4**	8-10	46	1.5	**0.177**	± 0.010
Syar – West *Bluegill*	**2020**	**4**	10-12	42	1.2	**0.187**	± 0.024
Syar – West *Bluegill*	**2021**	**4**	10	45	1.1	**0.254**	± 0.008

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(Table 54, continued)

Site	Year	n (comps)	**n** (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	**Hg** (µg/g = ppm, wet wt)	Std. Error
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

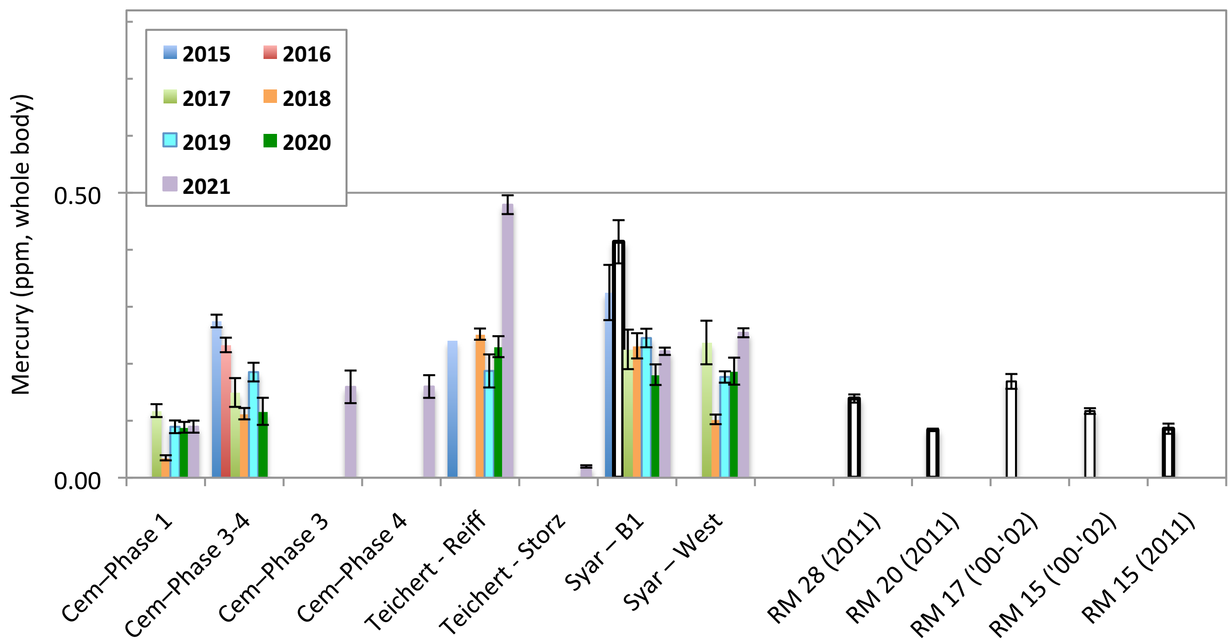

Figure 54. Juvenile Sunfish summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 55. Mosquitofish summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Cemex – Phase 1	2015	4	10	39	0.6	0.075	± 0.008
Cemex – Phase 1	2016	4	10	34	0.4	0.093	± 0.019
Cemex – Phase 1	2017	4	10	33	0.4	0.135	± 0.019
Cemex – Phase 1	2018	4	6-10	34	0.5	0.083	± 0.016
Cemex – Phase 1	2019	4	10	34	0.5	0.096	± 0.024
Cemex – Phase 1	2020	4	12	35	0.5	0.102	± 0.021
Cemex – Phase 1	2021	4	8-10	34	0.5	0.115	± 0.018
Cemex – Phase 3-4	2015	4	10	37	0.6	0.228	± 0.029
Cemex – Phase 3-4	2016	4	10	37	0.6	0.157	± 0.019
Cemex – Phase 3-4	2017	4	6-10	34	0.5	0.286	± 0.035
Cemex – Phase 3-4	2018	4	3-10	34	0.5	0.203	± 0.021
Cemex – Phase 3-4	2019	4	10	35	0.6	0.183	± 0.029
Cemex – Phase 3-4	2020	4	3-12	33	0.4	0.112	± 0.018
Cemex – Phase 3	2021	4	10	35	0.5	0.137	± 0.022
Cemex – Phase 4	2021	4	6-10	35	0.5	0.122	± 0.015
Teichert-Esparto – Reiff	2015	4	12	38	0.6	0.094	± 0.005
Teichert-Esparto – Reiff	2016	4	10	36	0.5	0.212	± 0.021
Teichert-Esparto – Reiff	2017	–	–				
Teichert-Esparto – Reiff	2018	4	10	35	0.5	0.262	± 0.026
Teichert-Esparto – Reiff	2019	4	5-10	33	0.46	0.222	± 0.041
Teichert – Esparto	2020	4	1-12	37	0.7	0.267	± 0.033
Teichert – Esparto	2021	3	12	37	0.7	0.579	± 0.033
Teichert-Esparto – Mast	2017	8	10	35	0.5	0.312	± 0.046
Teichert-Esparto – Mast	2018	8	10	34	0.5	0.182	± 0.015
Teichert-Esparto – Mast	2019	8	10	34	0.5	0.287	± 0.058
Teichert-Woodland – Storz	2016	4	10	35	0.5	0.229	± 0.054
Teichert-Woodland – Storz	2017	4	8-10	29	0.2	0.282	± 0.011
Teichert-Woodland – Storz	2018	4	10	30	0.3	0.087	± 0.017
Teichert-Woodland – Storz	2019	4	6-10	33	0.4	0.200	± 0.018
Teichert-Woodland – Storz	2020	4	12	32	0.4	0.059	± 0.008
Teichert-Woodland – Storz	2021	4	10	35	0.6	0.082	± 0.026
Syar – B1	2015	4	5-10	31	0.3	0.268	± 0.022
Syar – B1	2016	–	–				
Syar – B1	2017	4	9-10	35	0.4	0.309	± 0.055
Syar – B1	2018	4	6-9	31	0.4	0.163	± 0.028
Syar – B1	2019	3	1-3	38	0.7	0.214	± 0.011
Syar – B1	2020	4	6-12	34	0.5	0.130	± 0.026
Syar – B1	2021	4	4-10	34	0.5	0.156	± 0.015

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(Table 55, continued)

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Syar – West	**2017**	**4**	10	34	0.4	**0.236**	± 0.034
Syar – West	**2018**	**4**	6-7	29	0.3	**0.088**	± 0.012
Syar – West	**2019**	**3**	2-3	36	0.6	**0.165**	± 0.032
Syar – West	**2020**	**4**	8-12	35	0.5	**0.109**	± 0.018
Syar – West	**2021**	**4**	5-10	34	0.4	**0.121**	± 0.018
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

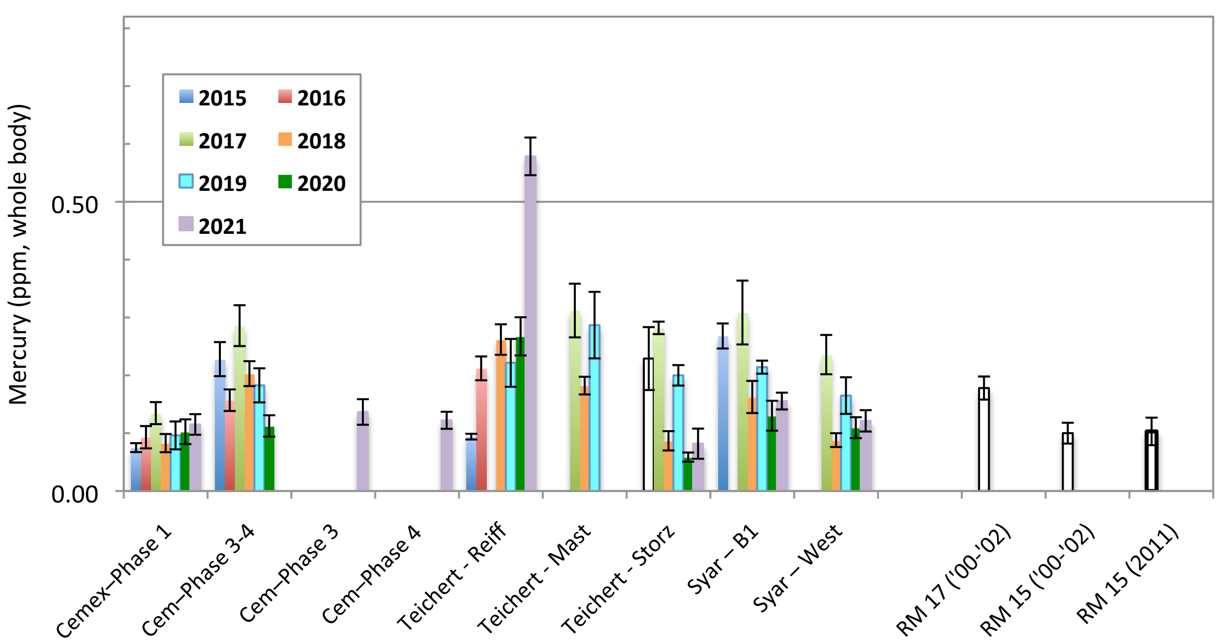

Figure 55. **Mosquitofish summary data (all sites), and historic creek comparisons** *(means of multiple whole-body, multi-individual composite samples)*

Table 56. Red Shiner summary data (all sites), and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Red Shiners							
Teichert-Esparto – Reiff	**2015**	**4**	10	50	1.3	**0.152**	± 0.009
Teichert-Esparto – Reiff	**2016**	**4**	10	47	1.1	**0.412**	± 0.042
Teichert-Esparto – Reiff	**2017**	**4**	10	49	1.1	**0.695**	± 0.070
Teichert-Esparto – Reiff	**2018**	**4**	10	45	0.8	**0.556**	± 0.031
Teichert-Esparto – Reiff	**2019**	*(Shiners not found in 2019 or 2020)*					
Teichert – Esparto (Reiff)	**2021**	**3**	4	54	1.8	**1.310**	± 0.034
Teichert – Esparto (Mast NW)	**2021**	**3**	1-5	51	1.4	**0.951**	± 0.259
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**10**	**48**	**1.0**	**0.242**	**± 0.018**
River Mile 20	2000	3	9	42	0.6	0.166	± 0.002
River Mile 17	2000-2002	11	6-15	27-58	0.2-1.8	0.225	± 0.023
River Mile 15	1997	3	19	37	0.5	0.159	± 0.014
River Mile 15	2000-2002	13	6-12	30-60	0.2-2.0	0.131	± 0.005

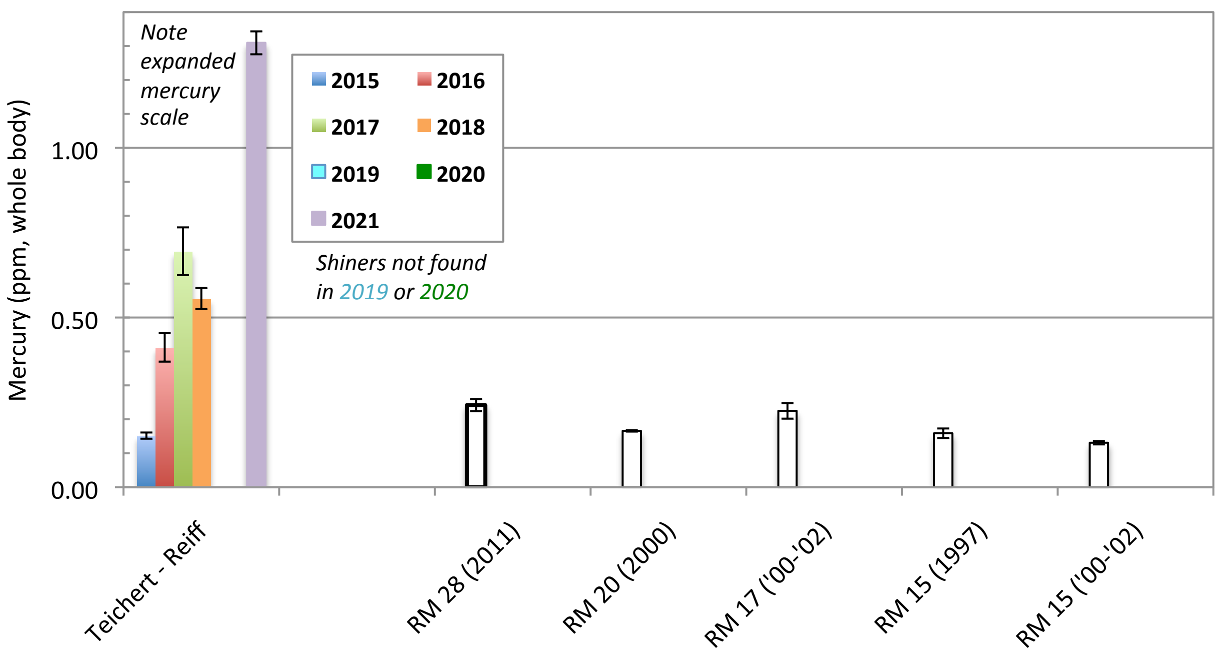

Figure 56. Red Shiner summary data (all sites), and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

DISCUSSION AND CONCLUSIONS

The Yolo County Ordinance for mercury in aggregate mining ponds was revised and updated in December 2019 (**Sec. 10-4.420.1 – 10-5.517 Mercury Bioaccumulation in Fish**). The full, updated text is attached below as Appendix A. Fish monitoring results have been assessed, since 2019, in relation to the updated Ordinance measures. The updated Ordinance calls for action based on three to five years of data, as follows:

> ***If, during the mining phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three of five monitoring years, annual monitoring shall continue for an additional five years, and the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).*** *Sec. 10–5.517(e)(2).*

The "exceeds the ambient mercury level" above refers to whether pond fish mercury levels are found to be significantly elevated above corresponding Cache Creek Baseline samples – in three of five monitoring years. The summary table below shows overall annual results of fish mercury testing in the monitored ponds, in relation to ambient fish mercury levels.

Fish Mercury Monitoring Summary – All Sites, 2015-2021

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Cemex – Phase 1</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td></tr>
<tr><td>Cemex – Phase 3</td><td rowspan="2">></td><td rowspan="2">></td><td rowspan="2">></td><td rowspan="2">></td><td rowspan="2">></td><td rowspan="2">≤</td><td>></td></tr>
<tr><td>Cemex – Phase 4</td><td>INC</td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td>INC</td><td>></td><td>></td><td>></td><td>></td><td rowspan="2">></td><td rowspan="2">></td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td>></td><td>INC</td><td>></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td>INC</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td></tr>
<tr><td>Syar – B1</td><td>></td><td>></td><td>></td><td>></td><td>></td><td>></td><td>></td></tr>
<tr><td>Syar – West</td><td></td><td></td><td>></td><td>≤</td><td>></td><td>></td><td>></td></tr>
</table>

≤ = at or below ambient INC = inconclusive > = elevated over ambient

Annual monitoring of fish mercury levels began in 2015 at four aggregate mining ponds: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. By 2018, with four years of data from the initial four monitored ponds, three were found to be elevated in fish mercury in three or more years: Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. These three ponds have remained elevated above baseline through nearly all of the monitoring. The Cemex–Phase 1 Pond, in contrast, has been consistently low in fish mercury (relatively). It was chosen as a control/reference pond, as specified in the ordinance. Beginning in 2018, "expanded analyses" were added to the program at these four ponds and routine fish monitoring was extended by five years.

Three other ponds were added to the fish monitoring in 2017: Teichert-Woodland–Storz, Syar–West, and Teichert-Esparto–Mast. Teichert-Esparto Mast was later combined with Reiff Pond into the current Esparto Pond, which continues to be monitored for fish mercury and expanded analyses. There are now five years of fish data for Teichert-Woodland–Storz and Syar–West. Storz has been identified as another consistently lower mercury site, not requiring expanded analyses other than routine water profiling once per year in fish monitoring years. With five years of non-elevated status, fish monitoring at Storz can shift to once every two years. Syar–West was flagged in 2020 for required expanded analyses beginning this year and an additional five years of fish testing. Expanded analyses actually began here earlier; Syar–West was tested as a second control/reference pond, important for its depth which more closely matches projected final post-reclamation pond depths at some of the sites. The timelines of water profiling and other project components are summarized in tables at the end of this section.

For the ponds flagged as significantly elevated over ambient in three of five years, the Ordinance states:

... the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g). *Sec. 10–5.517(e)(2).*

The "expanded analysis" task is meant to precede and provide guidance for the "preparation of a lake management plan". Because of the complexities of the methylmercury cycle and the unique configuration, depth, chemistry, and biology of each individual pond, additional information is needed to help craft site-specific management approaches that are likely to be effective. The first steps are to 1) broadly characterize the bottom sediments of the pond and 2) initiate seasonal water column profiling of a range of potentially relevant water quality parameters.

1. Characterize pond bottom sediment

For the ponds that have been flagged for expanded analysis and development of lake management plans, and the required control/reference pond, some basic information about the bottom sediments is essential, to see if there are any large differences between the ponds that could help account for the mercury bioaccumulation patterns. Sediment sampling was conducted in Fall 2018 at the 3 ponds identified as elevated in fish mercury at that time, plus the identified control site Cemex–Phase 1. The Syar–West pond was also sampled, making five ponds in total for initial sediment characterization. As specified in the Ordinance, for each pond, six independent bottom samples were taken from locations distributed across the pond, specifically of fine-grained surficial sediments (top 2 cm). These were analyzed for total mercury and organic matter content.

The bottom sediment mercury data ranged between mean levels of 0.266 and 0.518 ppm, across all five ponds tested. These levels were similar to the 0.390 ppm average from the USGS Settling Basin studies. There was a small, approximate two-fold range between lowest and highest concentrations. The ponds were elevated above 'clean/background' levels, as is to be expected for this watershed. Sediment mercury around upstream source areas ranges into the hundreds of parts per million. The report for the 2018 sediment work concluded:

> "... But the two lowest sediment mercury sites, Cemex–Phase 1 and Teichert-Esparto–Reiff, included both the lowest and the highest fish mercury conditions. Clearly, the ranges of sediment mercury levels present in these ponds are <u>all</u> more than enough to potentially lead to elevated fish mercury levels. The low fish mercury at the Cemex–Phase 1 pond and very high fish mercury at Teichert-Esparto–Reiff, with nearly identical sediment mercury at both, strongly suggests that <u>other conditions</u> of the ponds are more important. This is an advance that will help guide potential management directions. These initial sediment characterization tests were looking for potentially dramatic sediment mercury trends that were much higher than baseline and/or vastly different between ponds. That has been ruled

> out. This points management ideas more toward modification of other pond conditions that may lead to differences in methylmercury production and transfer, and to the large differences seen in fish mercury levels. The accompanying water column profiling work seeks to identify some of these possible factors."

It is possible that additional or different sediment analyses may be warranted in the future to help determine appropriate management approaches.

2. Initiate water column profiling

For the ponds that have been flagged for expanded analysis and development of lake management plans, and the required control/reference pond, the Ordinance outlines:

> ***The analysis shall include expanded lake water column profiling (a minimum of five profiles per affected wet pit lake plus one or more nonaffected lakes for control purposes) conducted during the warm season (generally May through October) in an appropriate deep profiling location for each pit lake. The following water quality parameters shall be collected at regular depth intervals, from surface to bottom of each lake, following protocols identified in subsection (a): temperature, dissolved oxygen, conductivity, pH and oxidation-reduction potential (ORP), turbidity or total suspended solids, dissolved organic matter, and algal density by Chlorophyll or Phycocyanin.***

Water column profiling began in 2018, as described above. The three identified elevated-mercury ponds and the lower-mercury control/reference pond have been tested seasonally, five times per year between May and October. The Syar-West Pond was also studied as a deep pond control, added in 2019. Profiling continued at these sites in 2021. Results are presented in accompanying water reports. Excerpting from the conclusions of recent water profiling reports:

> "Some of the greatest accumulations or changes were found in the lower water of ponds that stratified thermally. Most of the monitored ponds were too shallow to stratify completely (isolate water layers from each other) in the warm season but two, Teichert-Esparto–Reiff and Syar–B1, stratified enough for many of the measured water parameters to shift

significantly, including oxygen, pH, and ORP, with deep accumulations of turbidity and algal cells."

"Among the three ponds identified as elevated in fish mercury – Syar–B1, Teichert-Esparto–Reiff, and Cemex–Phase 3-4 – there was not a single, consistent trend. While the two most elevated ponds, Syar–B1 and Teichert-Esparto–Reiff have consistently shown evidence of seasonal water column anoxia, that was not the case at Cemex-Phase 3-4. The new data from the much deeper Syar–West pond confirmed it as a site of strong seasonal water stratification and bottom water anoxia (loss of oxygen)."

"At this point with the new water profiling data, seasonal bottom water anoxia – or its absence – appears to be an important link to the observed fish mercury trends. Since seasonal anoxia is known to enhance the production of methylmercury and its movement into fish, management approaches that disrupt that pattern may reduce the problem. This is something to consider for ponds identified as elevated in fish mercury and requiring management. The profiling results to-date support management approaches that could provide summer mixing and the disruption of bottom water anoxia – specifically for ponds that require mercury management and that have seasonal anoxia. The case of Cemex–Phase 3-4 though, with high fish mercury but no seasonal anoxia, is a reminder that there may not be any single 'magic bullet' management approach; different approaches may be needed at different sites. Many different physical, chemical, and biological factors can influence the mercury cycle in each pond. Seasonal anoxia is the most straightforward one to tackle – when it is present. When it isn't, and fish mercury is still elevated, other mechanisms will need to be identified for possible alternate management approaches. This water column profiling is an important step to better understand the options."

———

The fish monitoring itself has also highlighted factors that could be significant for lake management. In particular, the bass mercury trend at Teichert–Esparto, in relation to changing prey species, supports the idea that food web structure may significantly impact mercury accumulation in the top predator fish. Additionally, fish mercury trends have been observed over the years in relation to the presence or absence of active mining or processing plant slurry flows. These processes that suspend sediment particles into the water have been associated with declines in fish mercury uptake rather than increases, presumably by placing alternate binding sites into the water for methylmercury, deflecting some of it from foodweb pathways. And, in contrast, clear water conditions with low suspended solids have tended to be associated with relative increases in fish mercury uptake.

Fish monitoring and seasonal water column testing will continue at the designated ponds. Ongoing findings will continue to narrow down management options for the sites requiring lake management plans and action. At this point (late 2022 at the time of this reporting), with 3-4 years of additional information at Cemex–Phase 3 and 4, Teichert–Esparto, Syar–B1, and Syar–West, it is time to develop Lake Management Plans for those sites.

Status of Other Components of the Mercury Monitoring Program

Water Column Profiling *(elevated sites and controls)*

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Cemex – Phase 1 (control)</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Cemex – Phase 3</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td><td>✓</td></tr>
<tr><td>Cemex – Phase 4</td><td>✓</td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td></td><td></td><td></td><td></td><td>(1x)</td></tr>
<tr><td>Syar – B1</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Syar – West (control to 2020)</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>

Bottom Sediment Collections *(single event, elevated sites and controls)*

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Cemex – Phase 1 (control)</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Cemex – Phase 3-4</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Syar – B1</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
<tr><td>Syar – West (deep control)</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td><td></td></tr>
</table>

Reports Completed

<table>
<tr><th>Report</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Fish Mercury Monitoring</td><td>Final</td><td>Final</td><td>Final</td><td>Final</td><td>Final</td><td>Draft</td><td>Draft</td></tr>
<tr><td>Water Column Profiling</td><td></td><td></td><td></td><td>Final</td><td>Final</td><td>Draft</td><td>Draft</td></tr>
<tr><td>Bottom Sediments (1x)</td><td></td><td></td><td></td><td colspan="2">Final</td><td></td><td></td></tr>
</table>

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Yolo County Code, Title 10. Chapter 5 (Surface Mining Reclamation), Section 10.5.517 – Mercury Bioaccumulation in Fish. 2019 Revision.

APPENDIX A

Yolo County, CA Code of Ordinances

Sec. 10-4.420.1 – 10-5.517 Mercury Bioaccumulation in Fish
– December 2019 Update and Revision –

Yolo County Mining Ordinance, Sec.10-4.420.1 Mercury Bioaccumulation in Fish.

Each mining area to be reclaimed to a permanent lake as part of each approved long-range mining plan shall be evaluated annually by the operator for five years after the pit fills with groundwater with an intensive fish mercury monitoring program described in Section 10-5.517 of the Reclamation Ordinance.

Reclamation Ordinance, Sec. 10-5.517. Mercury bioaccumulation in Fish.

As part of each approved long-term mining plan involving wet pit mining to be reclaimed to a permanent pond, lake, or water feature, the operator shall maintain, monitor, and report to the Director according to the standards given in this section. Requirements and restrictions are distinguished by phase of operation as described below.

(a) Mercury Protocols. The Director shall issue and update as needed "Lower Cache Creek Off-Channel Pits Mercury Monitoring Protocols" (Protocols), which shall provide detailed requirements for mercury monitoring activities. The Protocols shall include procedures for monitoring conditions in each pit lake, and for monitoring ambient mercury level in the lower Cache Creek channel within the CCAP planning area, as described below. The Protocols shall be developed and implemented by a qualified aquatic scientist or equivalent professional acceptable to the Director. The Protocols shall identify minimum laboratory analytical reporting limits, which may not exceed the applicable response threshold identified in subsection (e) below. Data produced from implementing the Protocols shall meet or exceed applicable standards in the industry.

(b) Ambient Mercury Level. The determination of the ambient or "baseline" fish mercury level shall be undertaken by the County every ten years in years ending in 0. This analysis shall be undertaken by the County for use as a baseline of comparison for fish mercury testing conducted in individual wet mining pits. The work to establish this baseline every ten years shall be conducted by a qualified aquatic systems scientist acceptable to the Director and provided in the form of a report to the Director. It shall be paid for by the mining permit operators on a fair-share basis. The results of monitoring and evaluation of available data shall be provided in the report to substantiate the conclusions regarding ambient concentrations of mercury in fish within the lower Cache Creek channel within the CCAP planning area.

(c) Pit Monitoring.

(1) Mining Phase (including during idle periods as defined in SMARA). The operator shall monitor fish and water column profiles in each pit lake once every year during the period generally between September and November for the first five years after a pit lake is created. Fish monitoring should include sport fish where possible, together

with other representative species that have comparison samples from the creek and/or other monitored ponds. Sport fish are defined as predatory, trophic level four fish such as bass, which are likely to be primary angling targets and have the highest relative mercury levels. The requirements of this subsection apply to any pit lake that is permanently wet and navigable by a monitoring vessel. If, in the initial five years after the pit lake is created, the applicable response threshold identified in subsection (e) is exceeded in any three of five monitoring years, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(2) Reclamation Phase. No monitoring is required after mining has concluded, during the period that an approved reclamation plan is being implemented, provided reclamation is completed within the time specified by SMARA or the project approval, whichever is sooner.

(3) Post-Reclamation Phase. After reclamation is completed, the operator shall monitor fish and water column profiles in each pit lake at least once every two years during the period of September-November for ten years following reclamation. Monitoring shall commence in the first calendar year following completion of reclamation activities. If fish monitoring results from the post-reclamation period exceed the applicable response threshold described in subsection (e) or, for ponds that have implemented mitigation management, results do not exhibit a general decline in mercury levels, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(4) Other Monitoring Obligation. If monitoring conducted during both the mining and post-reclamation phase did not identify any exceedances of the ambient mercury level for a particular pit lake, and at the sole discretion of the Director no other relevant factors substantially support that continued monitoring is merited, the operator shall have no further obligations.

(d) Reporting.

(1) Pit Monitoring Results. Reporting and evaluating of subsection (c) pit monitoring results shall be conducted by a qualified aquatic scientist or equivalent professional acceptable to the Director. Monitoring activities and results shall be summarized in a single report (addressing all wet pit lakes) and submitted to the Director within six months following each annual monitoring event. The report shall include, at a minimum: (1) results from subsection (b) (pit monitoring), in relation to subsection (a) (ambient mercury levels).

(2) Expanded Analysis Results. Reporting and evaluation of subsection (f) expanded analysis shall be conducted by a qualified aquatic scientist or equivalent professional acceptable to the Director. Results shall be summarized in a single report (addressing all affected wet pit lakes) and submitted to the Director within six months following

each annual monitoring event. The report shall include, at a minimum, the results of the expanded analysis undertaken pursuant subsection (f).

(3) <u>Data Sharing</u>. For pit lakes open to the public, the Director may submit the data on mercury concentrations in pit lake fish to the state Office of Environmental Health Hazard Assessment (or its successor) for developing site-specific fish consumption advisories.

(e) <u>Response Thresholds</u>.

(1) <u>Fish Consumption Advisory</u>. If at any time during any phase of monitoring the pit lake's average sport fish tissue mercury concentration exceeds the Sport Fish Water Quality Objective, as it may be modified by the state over time (as of 2019, the level was 0.2 mg/kg), the operator shall post fish consumption advisory signs at access points around the lake and around the lake perimeter. Catch-and-release fishing may still be allowed. Unless site-specific guidance has been developed by the state's Office of Health Hazard Assessment or the County, statewide fish consumption guidance shall be provided.

(2) <u>Mining Phase Results</u>. If, during the mining phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three of five monitoring years, annual monitoring shall continue for an additional five years, and the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(3) <u>Post-Reclamation Phase Results</u>. If during the first ten years of the post-reclamation phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three of five monitoring years, biennial monitoring shall continue for an additional ten years, and the operator shall undertake expanded analysis pursuant to subsection(f) and preparation of a lake management plan pursuant to subsection (g).

(f) <u>Expanded Analysis.</u>

(1) <u>General</u>. If during the mining or post-reclamation phase, any pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three years, the operator shall undertake expanded analyses. The analysis shall include expanded lake water column profiling (a minimum of five profiles per affected wet pit lake plus one or more nonaffected lakes for control purposes) conducted during the warm season (generally May through October) in an appropriate deep profiling location for each pit lake. The following water quality parameters shall be collected at regular depth intervals, from surface to bottom of each lake, following protocols identified in subsection (a): temperature, dissolved oxygen, conductivity, pH and oxidation-reduction potential (ORP), turbidity or total suspended solids, dissolved organic

matter, and algal density by Chlorophyll or Phycocyanin. The initial analysis shall also include one-time collections of fine grained (clay/silt) bottom sediments from a minimum of six well distributed locations for each affected lake, and from one or more non-affected lakes for control purposes, to be analyzed for mercury and organic content.

(2) Scope of Analysis. The purpose of the expanded analyses is to identify and assess potential factors linked to elevated methylmercury production and/or bioaccumulation in each pit lake. The scope of the expanded analyses shall include monitoring and analysis appropriate to fulfill this purpose, invoking best practices in the industry. In addition to the analyses described in subsection (f)(1) above, the analysis should also consider such factors as: electrical conductivity, bathymetry (maximum and average depths, depth-to-surface area ratios, etc.), and trophic status indicators (concentrations, Secchi depth, chlorophyll a, fish assemblages, etc.). Additional types of testing may be indicated and appropriate if initial results are inconclusive.

(3) Use of Results. The results of the expanded analyses undertaken pursuant to this subsection shall be used to inform the preparation of a lake management plan described below under subsection (g).

(g) Lake Management Activities

(1) General. If monitoring conducted during the mining or post-reclamation phases triggers the requirement to undertake expanded analysis and prepare and implement a lake management plan, the operator shall implement lake management activities designed by a qualified aquatic scientist or equivalent professional acceptable to the Director, informed by the results of subsection (f). Options for addressing elevated mercury levels may include (A) and/or (B) below at the Director's sole discretion and at the operator's sole expense.

(A) Lake Management Plan. Prepare a lake management plan that provides a feasible, adaptive management approach to reducing fish tissue mercury concentrations to at or below the ambient mercury level. Potential mercury control methods could include, for example: addition of oxygen to or physical mixing of anoxic bottom waters; alteration of water chemistry (modify pH or organic carbon concentration); and/or removal or replacement of affected fish populations. The lake management plan may be subject to external peer review at the discretion of the Director. Lake management activities shall be appropriate to the phase of the operation (e.g., during mining or post-reclamation). The Lake Management Plan shall include a recommendation for continued monitoring and reporting. All costs associated with preparation and implementation of the lake management plan shall be solely those of the operator. Upon acceptance by the Director, the operator shall immediately implement the plan. The lake management plan shall generally be implemented within three years of reported results from the expanded analyses resulting from subsection (f). If lake management does not achieve

acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator may prepare an alternate management plan with reasonable likelihood of mitigating the conditions.

(B) Revised Reclamation Plan. As an alternative to (A), or if (A) does not achieve acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator shall prepare and submit revisions to the reclamation plan (including appropriate applications and information for permit amendment) to fill the pit lake with suitable fill material to a level no less than five (5) feet above the average seasonal high groundwater level, and modify the end use to agriculture, habitat, or open space at the discretion of the Director, subject to Article 6 of the Mining Ordinance and/or Article 8 of the Reclamation Ordinance as may be applicable.

(2) Implementation Obligations.

(A) If a lake management plan is triggered during the mining or post-reclamation phase and the subsequent lake management activities do not achieve acceptable results and/or demonstrate declining mercury levels, the operator may propose different or additional measures for consideration by the Director and implementation by the operator, or the Director may direct the operator to proceed to modify the reclamation plan as described in subsection (g)(1)(B).

(B) Notwithstanding the results of monitoring and/or lake management activities during the mining phase, the operator shall, during the post-reclamation phase, conduct the required ten years of biennial monitoring.

(C) If monitoring conducted during the post-reclamation phase identifies three monitoring years of mercury concentrations exceeding the ambient mercury level, the operator shall implement expanded analyses as in subsection (f), to help prepare and implement a lake management plan and associated monitoring.

(D) If subsequent monitoring after implementation of lake management activities, during the post-reclamation phase, demonstrates levels of fish tissue mercury at or below the ambient mercury level for any three monitoring years (i.e., the management plan is effective), the operator shall be obligated to continue implementation of the plan and continue monitoring, or provide adequate funding for the County to do both, in perpetuity.

APPENDIX B

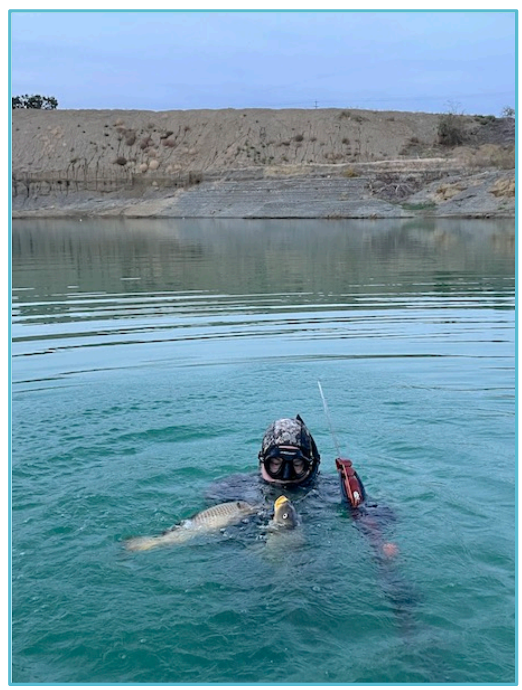
PHOTOS FROM THE
2021 FISH MONITORING

GENERAL FIELD WORK, AND EXAMPLES OF MAIN ADULT FISH

Seining for small fish

Baited set-lines for Catfish (White Catfish)

Angling for bass at key times



Spearfishing as last resort; 2021 Carp

Measuring weight and length

Largemouth Bass

(Channel) Catfish

Carp

On-site field dissection of small analytical pieces of fillet muscle; large fish released in good condition (unless taken spearfishing)

(photos this page from earlier reports)

Muscle sample into pre-weighed vial; stored on ice in field.

On return, careful re-weigh of vial with sample, to get exact sample weight.

Then into lab freezer, until mercury analysis

CEMEX – PHASE 1 POND

Water levels were maintained during drought in the Cemex ponds

Adult Largemouth Bass

Seining for small fish

Mosquitofish

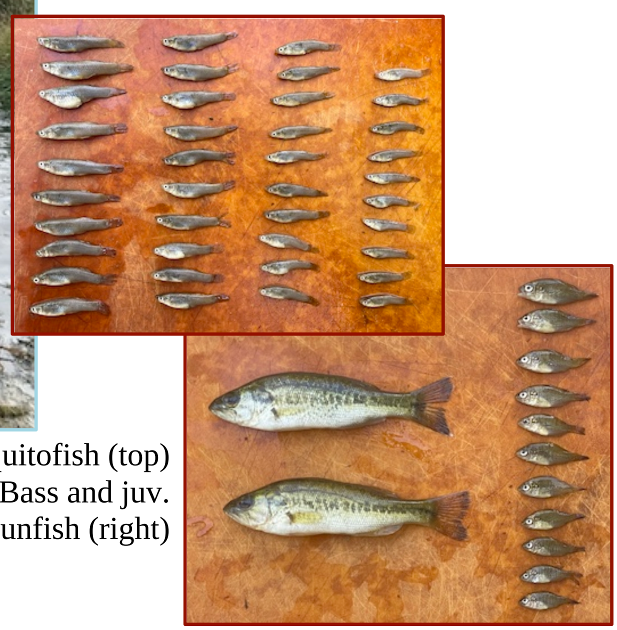
Juvenile bass and sunfish

CEMEX – PHASE 3 POND

Difficult access in 2021

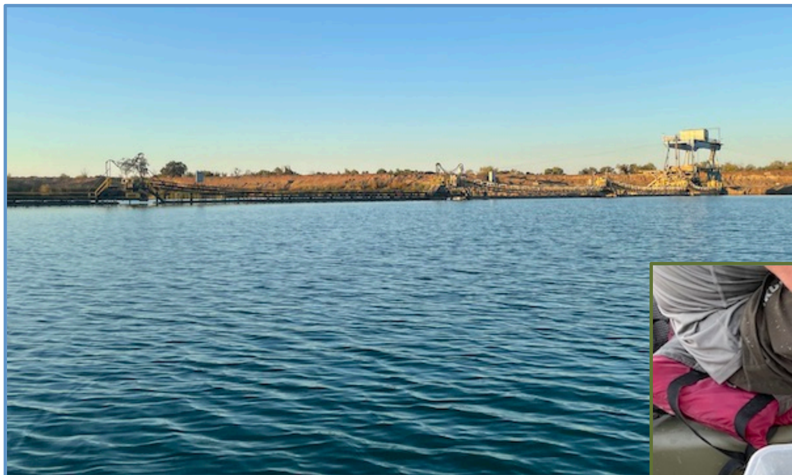
Adult Largemouth Bass

Seining for small fish



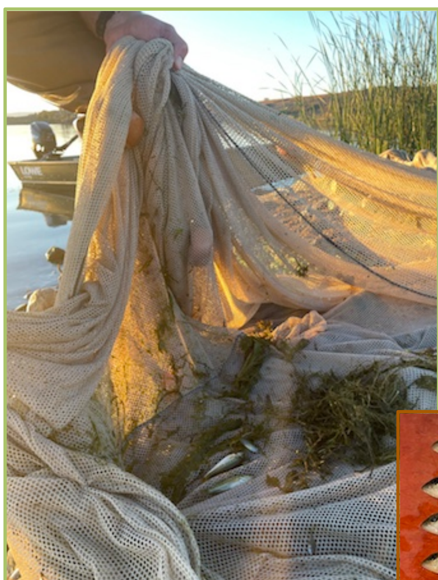
Mosquitofish (top)
Juvenile Bass and juv.
Green Sunfish (right)

CEMEX – PHASE 4 POND



The actively mined Cemex pond

Adult Largemouth Bass



Small fish in seine

Juvenile Bass

Juvenile Green Sunfish

TEICHERT – ESPARTO POND

June water level;
basins still linked
(photo from south)

By September, drought
(photo from north)

Adult Largemouth Bass

White Catfish

(Esparto Pond, continued)

Mosquitofish

Reiff Basin

Juvenile Bass,
Green Sunfish,
Red Shiners

Mosquitofish Red Shiners

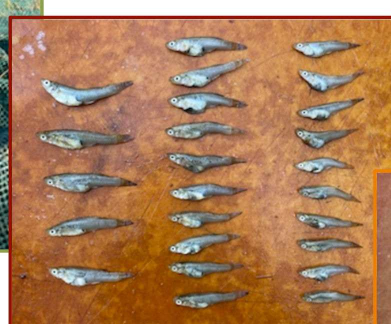
Mast Northwest (Central) Basin

TEICHERT-WOODLAND – STORZ POND

Southwest Basin

Adult Largemouth Bass

Seining for small fish



Mosquitofish

Juvenile Bluegill

(Storz Pond, continued)

Northeast Basin

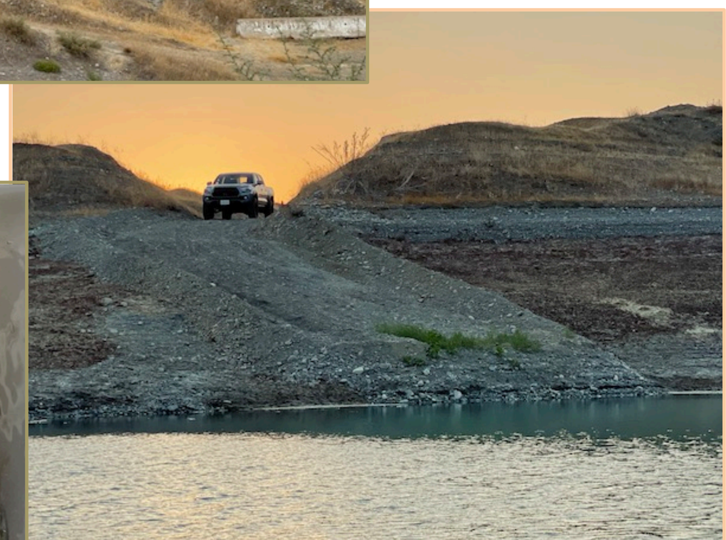
Seining for small fish

Mosquitofish

Juvenile Bass

SYAR – B1 POND

Drought Year 2, water level dropped deeply; see former water line



Channel Catfish, Largemouth Bass

Juvenile Bluegill

Swim-seining for small fish

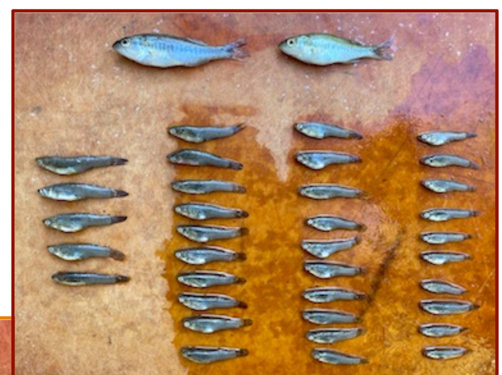
Juvenile Bass, Mosquitofish

SYAR–WEST POND

Drought-lowered water level created cliff-edge shores

Adult Bass taken spearfishing

Swim-seining for small fish



Juvenile Bass, Mosquitofish

Juvenile Bluegill