CACHE CREEK OFF-CHANNEL AGGREGATE MINING PONDS – 2019 MERCURY MONITORING

Final Report

Monitoring and Report by

Darell G. Slotton, Ph.D.*
and
Shaun M. Ayers

* *(530) 574-3491*
dgslotton@gmail.com

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SUMMARY OF THE 2019 MONITORING AND ITS FINDINGS

- This Fall 2019 monitoring was the fifth year of fish mercury testing (Year 5) 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, 2019 was Year 3 of mercury monitoring. The monitoring is required by Section 10-5.517 of the Yolo County Code, which was recently revised and updated. 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.

Fish Mercury Monitoring Summary Table

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

Green = At or below ambient
Red = Above ambient
INC = Inconclusive

- As summarized in the table above, the Cemex Phase 3-4, Teichert-Esparto Reiff, and Syar B-1 pits have had "three or more years out of five elevated over the ambient". The program requires that the County take certain steps following the third year of exceedance for a pit:

  – Require an additional five years of fish mercury monitoring and water column profiling. 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 Expanded Analysis – 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 collecting 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, were collected from all seven of the identified ponds. A total of 126 adult, angling-sized fish (mainly bass) were sampled individually for fillet muscle mercury analysis in this 2019 monitoring. Additionally, a total of 487 small, young, biosentinel fish were split into 67 multi-individual, whole fish composite samples by site, species, and size. These were also analyzed for mercury.

- The new 2019 data are compared with results from 2015-2018, 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 Fall 2019 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 young-of-year, multiple composite samples were taken of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. The Fall 2019 small fish samples all showed a relative increase in mercury – to levels similar to 2016-2017. This indicates a relative rise in methylmercury exposure levels in the pond in 2019. The adult bass samples, in contrast, showed a *decline* in average mercury in 2019 from 2018, after slowly rising between 2015 and 2018. This was not unexpected and is a good example – for all of the ponds and monitoring – of how mercury data can differ between small/young fish and larger, angling sized fish, and the insights each can give. Despite some relative ups and downs, the Cemex–Phase 1 Pond remained the lowest in fish mercury, overall, of the ponds being monitored. Concentrations were statistically similar to or lower than most corresponding baseline Cache Creek samples of similar size. 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.

- **Cemex–Phase 3-4 Pond:** Twenty adult Largemouth Bass were sampled, and young-of-year, multiple composite samples were taken of Mosquitofish and juvenile Green Sunfish. Fish mercury, while remaining relatively high, showed a slight decrease in 2019, from 2018 and 2017. The changes were not statistically significant. As seen at Cemex–Phase 1, a decline in adult bass mercury followed years with lower than normal prey fish (small fish) mercury. The 2019 small fish data indicate a reversal of that trend, which should begin to show in the adult bass levels next year. Overall fish mercury at this pond remained elevated over comparable creek baseline samples for the majority of sample types, as in previous years. In particular, adult bass larger than 12" stayed at levels well above consumption guidelines. The pond was found to be relatively "elevated for three or more years of five" over creek baselines, triggering the addition of "expanded analysis" and, following a period of data gathering, development of a mercury management plan. Expanded analysis work began in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports.

- **Teichert-Esparto–Reiff Pond:** As in prior years, several large fish species were present; we took samples of adult Largemouth Bass (10), White Catfish (10), Common Carp (9), and Green Sunfish (1). We also collected young-of-year, multiple composite samples of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. This pond remained highly elevated in mercury in 2019. All of the various fish samples were significantly higher in mercury than corresponding Cache Creek baseline samples. However, all of the different 2019 fish samples also showed a decrease in levels from 2018, with the largest declines in the adult fish. This followed a decrease that began last year in young-of-year fish and following the near-extermination by bass of the very high-mercury Red Shiners as a primary food item. Changes over the monitoring years also appear to have been influenced by changes in pond management, with fish mercury decreasing when active slurry inflows were part of operations. In any case, despite the recent declines, the pond remained in the "elevated over baseline" category and triggered 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-Esparto–Mast Pond:** continued to have a single fish species present, Mosquitofish. We collected composite samples of all the sizes present. In 2019, mercury levels increased to levels similar to 2017, after lower concentrations were found in 2018. In comparison to baseline Cache Creek Mosquitofish samples, all samples from 2017 and 2019 were statistically high above baseline and 2018 fish, though lower, were statistically elevated over two of three creek data sets. Mast Pond is therefore tentatively identified as "elevated in three or more years of five" over baseline at this point. However, with mining largely concluded at the Teichert-Esparto property in 2019, the Reiff and two Mast basins were breached together in 2020, forming one large pond. This will continue to be monitored as a single Teichert-Esparto Pond, including expanded analysis and development of a management plan.

- **Teichert-Woodland–Storz Pond:** A sample of 10 very small adult bass (the main size present) and 2 larger bass was taken, together with young-of-year, multiple composite samples of Mosquitofish and juvenile Largemouth Bass. Adult bass showed a drop in mercury levels in 2019. This followed a drop in mercury levels in their food items (small fish) in 2018. While most of the small fish returned to typical (low) levels for this site, in 2019 Storz was the lowest in adult bass mercury of the six monitored ponds that contained bass. This pond continued to rank as "not elevated over baseline" and is not flagged for expanded analysis or management planning.

- **Syar–B1 Pond:** Twenty adult Largemouth Bass were sampled, and two adult Green sunfish. Young-of-year, multiple composite samples were taken of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. Fish mercury remained lower than in 2015-2016, after a substantial decline in 2017. Adult Largemouth Bass remained down from previous (very high) levels, by more than 40%. Juvenile bass, Green Sunfish, and Mosquitofish also all remained at lower levels, relative to 2015-2016. Despite the drop in recent years, B1 Pond fish mercury was still statistically higher in 2019 than most baseline Cache Creek comparisons, for all species sampled. Because of the overall status of the B1 Pond as "elevated over baseline in three or more years of five", water column profiling and collection of bottom sediments was started here in 2018, in support of the development of a pond management plan. That work is detailed in accompanying reports.

- **Syar–West Pond:** Twenty adult Largemouth Bass were sampled, and one each adult Green Sunfish and Bluegill Sunfish. Young-of-year, multiple composite samples were taken of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. Fish mercury data were mixed in 2019. This followed 2018, when all the samples, particularly the small fish, were down from the year before. The 2019 adult bass showed a continued gradual decline in mercury (not statistically significant), while all 3 small fish indicator species in 2019 showed statistically significant *increases* in mercury – to levels about midway between those seen in 2018 (lowest) and 2017 (highest). As discussed in other sections, large fish mercury is a slowly moving average of multiple years of accumulation, while the small fish mercury of any given year measures only recent exposure. The adult bass were still showing the signs of lower mercury prey from last year (averaging into their lifetime accumulations) but, by the end of the 2019 warm season, the small fish showed that methylmercury conditions were increasing toward average levels for this pond. In comparison to corresponding baseline/historic samples from Cache Creek, small fish in 2019 were statistically higher in mercury for 8 of 10 comparisons. Adult Largemouth Bass, though, were statistically elevated over creek levels in just 2 of 7 comparisons. On average across all sample types, the 2019 fish sets were statistically elevated over baseline in 2019, as in 2017. As that was not the case in 2018, there have not been "three or more years of five elevated over baseline" as specified in the Ordinance. Therefore, the Syar–West Pond fish data do not trigger expanded analysis or pond management considerations at this time. However, expanded analyses have been conducted here since 2018 as a second control/reference pond. This pond is significantly deeper than the other ponds currently, and is representative of the range of final depths projected at several of the sites.

Status of Other Components of the Mercury Monitoring Program

Water Column Profiling

Pit	2015	2016	2017	2018	2019
Cemex – Phase 1 *(Control)*				✓	✓
Cemex – Phase 3-4				✓	✓
Teichert-Esparto – Reiff				✓	✓
Teichert-Esparto – Mast					
Teichert-Woodland – Storz					
Syar – B1				✓	✓
Syar – West *(Control)*				✓	✓

Bottom Sediment Collection (single event)

<table>
<tr><th>Pit</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><td>Cemex – Phase 1 (Control)</td><td></td><td></td><td></td><td colspan="2">✓</td></tr>
<tr><td>Cemex – Phase 3-4</td><td></td><td></td><td></td><td colspan="2">✓</td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td></td><td></td><td></td><td colspan="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></tr>
<tr><td>Syar – B1</td><td></td><td></td><td></td><td colspan="2">✓</td></tr>
<tr><td>Syar – West (Control)</td><td></td><td></td><td></td><td colspan="2">✓</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></tr>
<tr><td>Fish Mercury Monitoring</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Water Column Profiling</td><td></td><td></td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Bottom Sediments (1x)</td><td></td><td></td><td></td><td colspan="2">✓</td></tr>
</table>

INTRODUCTION

This monitoring was conducted for Yolo County in the fall of 2019, 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 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. Future mercury monitoring and reporting, including this 2019 report, will comply with the updated ordinance requirements. The complete 2019 Ordinance is attached, without breaks or commentary, in Appendix A at the end of this report. Below, in this introduction, most of the updated Ordinance is excerpted, including the parts that most directly affect this fish mercury monitoring program. 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 December 2019 update and have been followed to this point. The protocols were revised, expanded, and updated recently (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.

(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. One 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).
At this point, three of the seven 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 required lower mercury control/reference site. The expanded analyses have included one-time sediment testing and the start of ongoing, seasonal water column profiling as specified in the Ordinance. This work is in the data gathering stage. The findings are intended to help 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. At the Syar Ponds, people fishing have confirmed that they understand the mercury issue and the importance of limiting fishing to catch-and-release.

(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).
As noted above in (c)(1), expanded analysis is in progress at the three identified ponds and one control/reference pond, gathering data to help develop lake management plans. Also, another five years of annual monitoring are required at these sites.

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

(3) Post-Reclamation Phase Results. 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) General. 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 is underway; 2019 data are presented in the companion report on water profiling.

(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. 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) 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).

As noted above, this work is in the data gathering stage. Findings are intended to help 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 2019. Four of the ponds have been monitored since 2015 and, for them, this was Year 5 of sampling: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. Three additional ponds were added to the monitoring in 2017; for these, 2019 was Year 3: Teichert-Esparto–Mast, Teichert-Woodland–Storz, and Syar–West. Both large and small fish samples of multiple species, as available, were collected and analyzed from all of the ponds.

The purpose of this report is to present the new 2019 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 (2019) with monitoring results found at the same sites in the previous monitoring years (2015-2018).

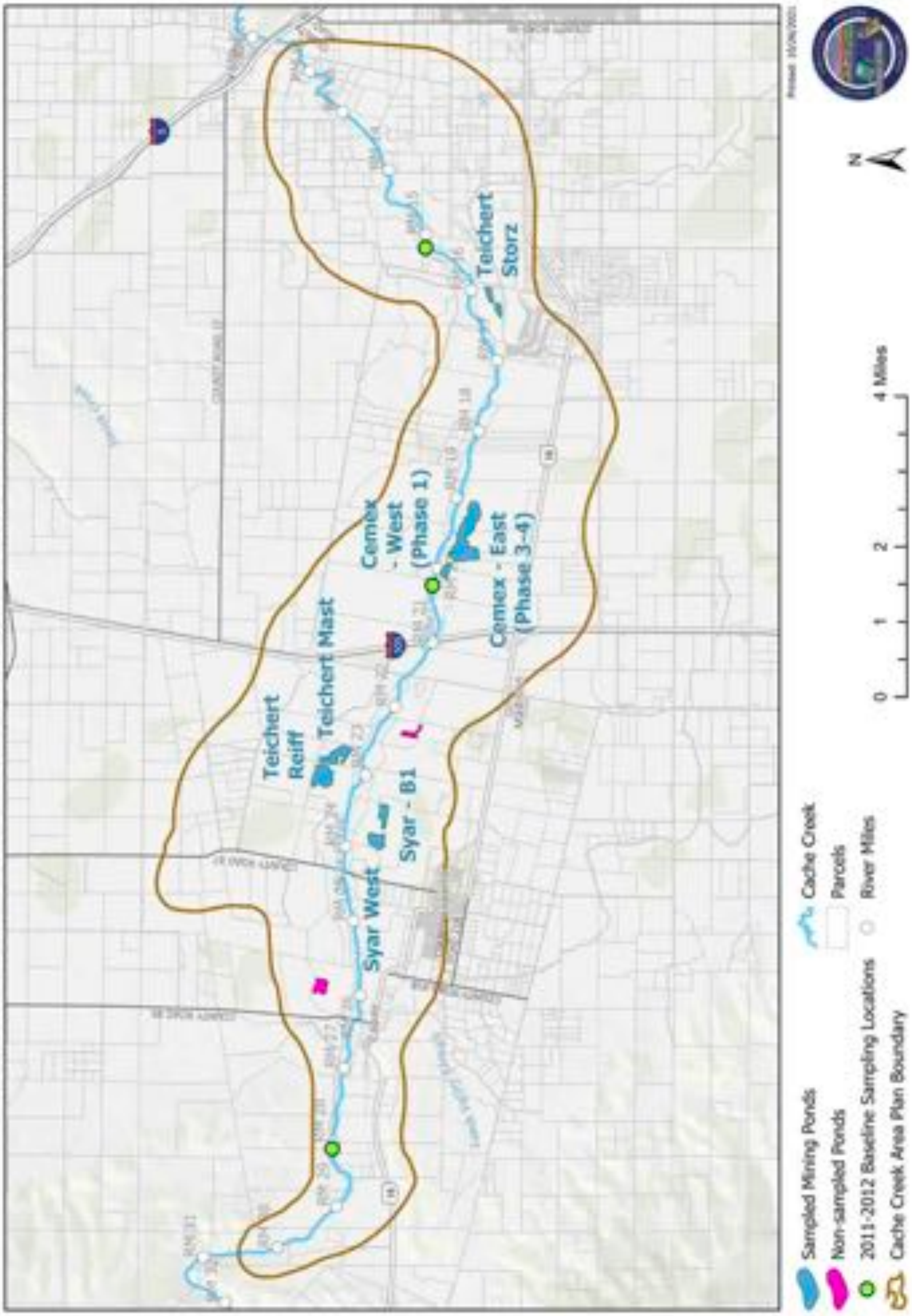
In the sections below we will discuss the methods used, followed by a presentation of the 2019 fish mercury data, by individual pond site. Each data table is accompanied by a matching figure with the same number that graphically shows the information. For each site, we first present the analytical results 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 2015-2018 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 has photos of the Fall 2019 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 5
Cemex	Madison	**Phase 3-4**	≤ 2002	Lake and habitat	2015	Year 5
Teichert	Esparto	**Reiff**	≤ 2002	Lake and habitat	2015	Year 5
Teichert	Esparto	**Mast**	2007-2008	Lake and habitat	2017	Year 3
Teichert	Woodland	**Storz**	2010-2011	Lake and habitat	2017	Year 3
Syar	Madison	**B1**	≤ 2002	Lake and habitat	2015	Year 5
Syar	Madison	**West**	≤ 2002	Lake and habitat	2017	Year 3

Figure A. Map of aggregate mining ponds and Cache Creek baseline monitoring locations



METHODS

Field sampling was coordinated with staff of the three mining companies: Teichert, Cemex, and Syar. Access ramps for boat launching were constructed at some of the ponds, which was a big help. We used our sampling boat to move around each of the ponds and collect the fish.

The fish samples were taken with a variety of techniques. Adult fish were collected with gill nets in a variety of mesh sizes, also with baited set lines laid at the bottom of ponds (catfish), and by angling (bass). Gill nets and set lines, deployed in both daylight and nighttime conditions, were carefully monitored to remove captured fish, to minimize unnecessary mortality. 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, laboratory digestion tubes, to be used in the analysis, 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 raisin) is taken from the left fillet. The sample is carefully placed into a pre-weighed digestion tube. Tubes are sealed with Parafilm™ and stored on ice in sealed, freezer-weight bags. Later, at the laboratory, the tubes with sample pieces are again weighed and the exact weight of each sample is determined by subtracting the empty tube weight.

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. Samples were then weighed, measured, and assembled into composite groupings of similar-sized fish. 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. For all mercury analyses, samples were weighed into 20 ml digestion tubes and digested at 90 °C in a mixture of concentrated nitric and sulfuric acids with potassium permanganate, in a two-stage process. Digested samples were then analyzed for total mercury by cold vapor atomic absorption (CVAA) spectrophotometry, using a dedicated Perkin Elmer Flow Injection Mercury System (FIMS) with an AS-90 autosampler. The method is a variant of EPA Method 245.6, with modifications developed by our laboratory (Slotton et al. 2015).

Extensive Quality Assurance / Quality Control (QA/QC) samples were included in all analytical runs and tracked with control charts. These included an 8 point aqueous standard curve for each batch and, for each 20 field samples: 3 method blanks, 3 standard reference materials with certified levels of mercury, 3 continuing calibration samples, a laboratory duplicate, a spiked field sample, a spike duplicate, and an aqueous calibration sample. QA/QC Results for this project were all well within control limits.

FALL 2019 RESULTS

1. CEMEX – PHASE 1 POND

(Google Earth 2019)

1. CEMEX–PHASE I POND *(Tables 1-8, Figures 1-8)*

Summary

Twenty adult Largemouth Bass were sampled, and young-of-year, multiple composite samples were taken of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. The Fall 2019 small fish samples all showed a relative increase in mercury – to levels similar to 2016-2017. This indicates a relative rise in methylmercury exposure levels in the pond in 2019. The adult bass samples, in contrast, showed a *decline* in average mercury in 2019 from 2018, after slowly rising between 2015 and 2018. This was not unexpected and is a good example – for all of the ponds and monitoring – of how mercury data can differ between small/young fish and larger, angling sized fish, and the insights each can give. Despite some relative ups and downs, the Cemex–Phase 1 Pond remained the lowest in fish mercury, overall, of the ponds being monitored. Concentrations were statistically similar to or lower than most corresponding baseline Cache Creek samples of similar size. 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.

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 app. 400 m long and 150 m wide. In 2019, depths ranged between 5.8 and 6.4 m (19-21 feet). This pond went through some changes over the recent years of monitoring. Active mining was still underway in 2015, the first monitoring year. 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, our understanding was that 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, with process slurry effluent discharging to the Phase 1 Pond, generally keeping this shallow pond turbid. This (2019) was Year 5 of monitoring at this site.

We sampled the pond during day, twilight, and night conditions with a full 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 extensive fishing effort for other species, they were not found in 2019. 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 (1-3"), and juvenile Largemouth Bass (3-5"). Four multi-individual composite samples were analyzed from each of these small fish species.

In total, this added up to 20 large fish muscle samples and 12 composite small fish samples, 32 separate fish mercury samples, analyzed from the Cemex–Phase 1 Pond in the Fall 2019 monitoring. The analytical results from each individual large fish muscle sample and each small, young fish composite sample can be seen in Tables 1 and 2 and, graphically, in Figures 1 and 2. Then, for each large and small fish species taken, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2018 results and the most closely comparable historic creek data (Tables 3-8, Figures 3-8).

Large, Angling-sized Fish

Largemouth Bass

The Phase 1 Pond adult Bass samples had fillet muscle mercury ranging from 0.220-1.092 ppm, averaging 0.404 ppm. This was down somewhat from 2018 (0.481 ppm), and more similar to previous years. Though generally low overall, bass at this pond showed a steady increase in mercury between 2015 (0.278 ppm) and 2018 (0.481 ppm). The year-to-year changes were not statistically significant at the 95% level of confidence but, in total, the increase in those years was significant. The recent decline in concentrations in 2019 reversed that pattern.

The 2019 bass samples ranged in size between 248 and 320 mm (about 10-13"). Adult Bass represent the top predator fish in this region and will typically have the highest mercury levels at any given site. Concentrations generally increased with fish size, as is typical. However, the increase with size was very gradual among the bulk of the fish, which were smaller than approximately 310 mm (12"), as compared to the fish larger than this. This shows as a cluster of similar mercury data points in Figure 1 (averaging 0.354 ppm), with significantly higher mercury in the fish over 12" (averaging 0.848 ppm). This kind of distribution can result from one or both of these mechanisms:

1) The larger – and older – fish accumulated much of their high mercury during earlier years, when mercury exposure levels may have been higher, and the smaller, younger fish picked up their mercury more recently under lower exposure conditions.

2) The pond's local food web may result in a shift in bass diet at around 12" size, from lower mercury items like aquatic insects and tiny fish to exclusively larger fish.

In any case, the Phase 1 Pond bass were lower in mercury than 6 of 7 similar baseline/historic samples from Cache Creek (and statistically lower than three). As noted in previous reports, the Phase 1 (West) Pond 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 2019 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, recently, back to slurry inputs.

Channel Catfish

White Catfish

In each of the previous monitoring years, several specimens of catfish were taken. This year though, despite extensive collection attempts, none were found. We suspect that there may have only been a small number of large catfish resident in this pond, and those may have been removed by fishermen in the last year.

Green Sunfish

No adult Green Sunfish were found in 2019.

Small, Young Fish

Juvenile Largemouth Bass

This year, we were able to obtain a strong set of multi-individual juvenile bass composite samples. These whole-body composites had uniformly low mercury levels of 0.103-0.132 ppm, with a mean of 0.114 ppm. Levels have been consistently low at this pond, across the five years monitored to this point. Within this range of relatively low juvenile bass mercury concentrations, the 2019 set were higher than the single individual sampled last year (0.068 ppm) and the composite sets from 2015 (0.044 ppm) and 2016 (0.094 ppm). They were lower in 2019 than the last good set of composite samples, taken in 2017 (0.146 ppm). All of the differences were significant statistically, due to the low variability in levels among each year's fish. Relative to baseline Cache Creek comparison juvenile bass, the 2019 Cemex–Phase 1 fish were significantly lower in mercury than the River Mile 28 set and significantly above the River Mile 15 set.

Mosquitofish

The Mosquitofish multiple-fish composites had whole-body mercury ranging from 0.058-0.165 ppm, averaging 0.096 ppm. The five-year trend is very similar to that in the juvenile bass: levels gradually increased between 2015 and 2017 (0.075-0.135 ppm), dropped significantly last year (2018, 0.083 ppm), and rose somewhat in 2019 (not significantly). The 2019 set remained significantly lower than the 2017 fish, and statistically similar to all the other years. Relative to the creek baseline comparisons, the mean mercury was slightly lower than 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

The juvenile Green Sunfish composites had whole-body mercury ranging from 0.066-0.109 ppm, averaging 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 (0.089 ppm). Each year was significantly different from the others, though all were relatively low levels. As compared to the creek baseline samples, the 2019 levels were statistically similar to two of five comparisons and significantly lower than three.

Table 1. Cemex–Phase 1 Pond: Large fish sampled, Fall 2019

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	248	9.8	185	0.4	**0.220**
Largemouth Bass	258	10.2	210	0.5	**0.303**
Largemouth Bass	268	10.6	225	0.5	**0.338**
Largemouth Bass	269	10.6	220	0.5	**0.298**
Largemouth Bass	270	10.6	205	0.5	**0.367**
Largemouth Bass	271	10.7	230	0.5	**0.369**
Largemouth Bass	273	10.7	255	0.6	**0.334**
Largemouth Bass	274	10.8	220	0.5	**0.489**
Largemouth Bass	276	10.9	230	0.5	**0.332**
Largemouth Bass	279	11.0	270	0.6	**0.351**
Largemouth Bass	279	11.0	250	0.6	**0.414**
Largemouth Bass	279	11.0	215	0.5	**0.330**
Largemouth Bass	281	11.1	260	0.6	**0.371**
Largemouth Bass	283	11.1	245	0.5	**0.443**
Largemouth Bass	284	11.2	260	0.6	**0.395**
Largemouth Bass	285	11.2	282	0.6	**0.303**
Largemouth Bass	290	11.4	320	0.7	**0.291**
Largemouth Bass	299	11.8	310	0.7	**0.431**
Largemouth Bass	318	12.5	310	0.7	**0.605**
Largemouth Bass	320	12.6	245	0.5	**1.092**

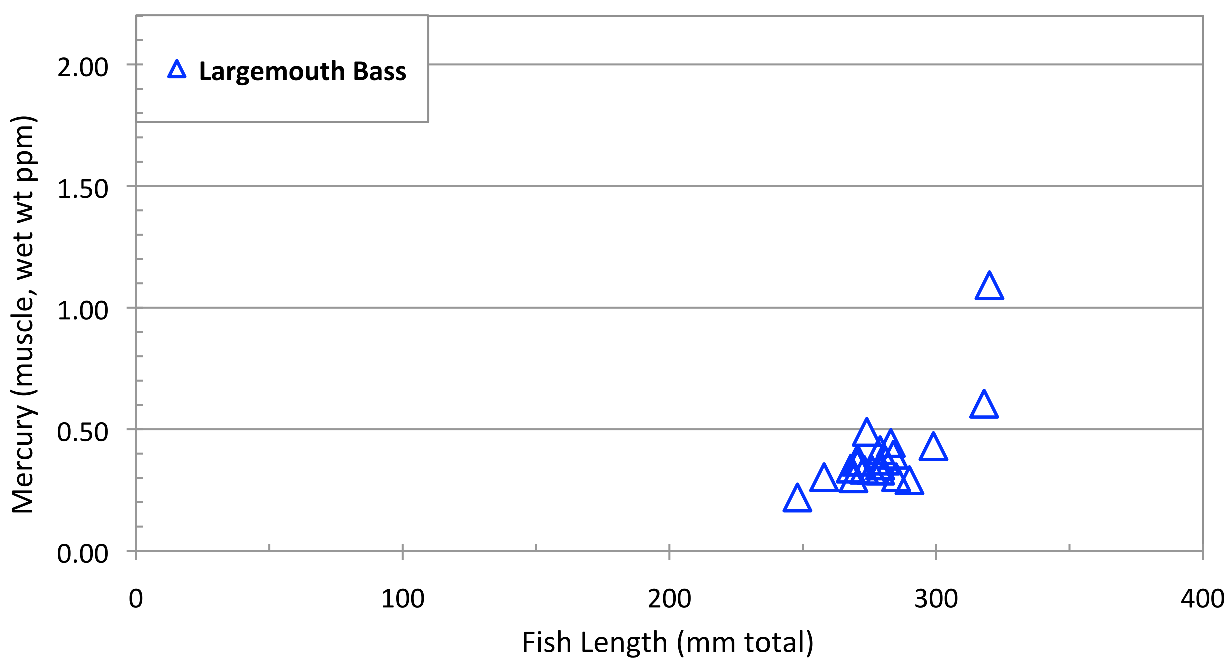


Figure 1. Cemex–Phase 1 Pond: Large fish sampled, Fall 2019
(fillet muscle mercury in individual fish)

Table 2. Cemex–Phase 1 Pond: Small Fish Sampled, Fall 2019
(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	93	3.6	10.5	0.37	**0.116**
Largemouth Bass (juv)	4	104	4.1	15.6	0.55	**0.132**
Largemouth Bass (juv)	5	109	4.3	17.2	0.61	**0.103**
Largemouth Bass (juv)	5	120	4.7	23.2	0.82	**0.103**
Green Sunfish (juv)	10	34	1.3	0.71	0.03	**0.075**
Green Sunfish (juv)	10	40	1.6	1.14	0.04	**0.066**
Green Sunfish (juv)	10	47	1.9	1.86	0.07	**0.109**
Green Sunfish (juv)	2	56	2.2	3.23	0.11	**0.108**
Mosquitofish	10	28	1.1	0.18	0.007	**0.058**
Mosquitofish	10	32	1.2	0.35	0.012	**0.069**
Mosquitofish	10	37	1.4	0.56	0.020	**0.092**
Mosquitofish	10	42	1.6	0.78	0.028	**0.165**

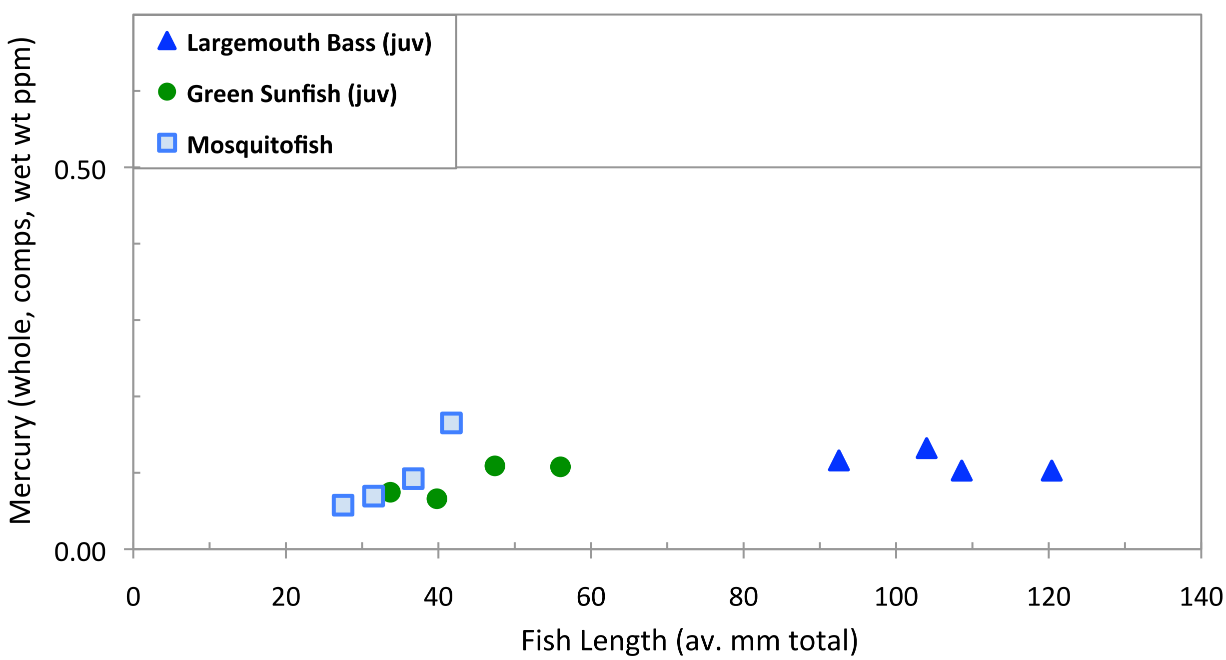


Figure 2. Cemex–Phase 1 Pond: Small, young fish sampled, Fall 2019
(mercury in whole-body, multi-individual composite samples)

Table 3. 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
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**

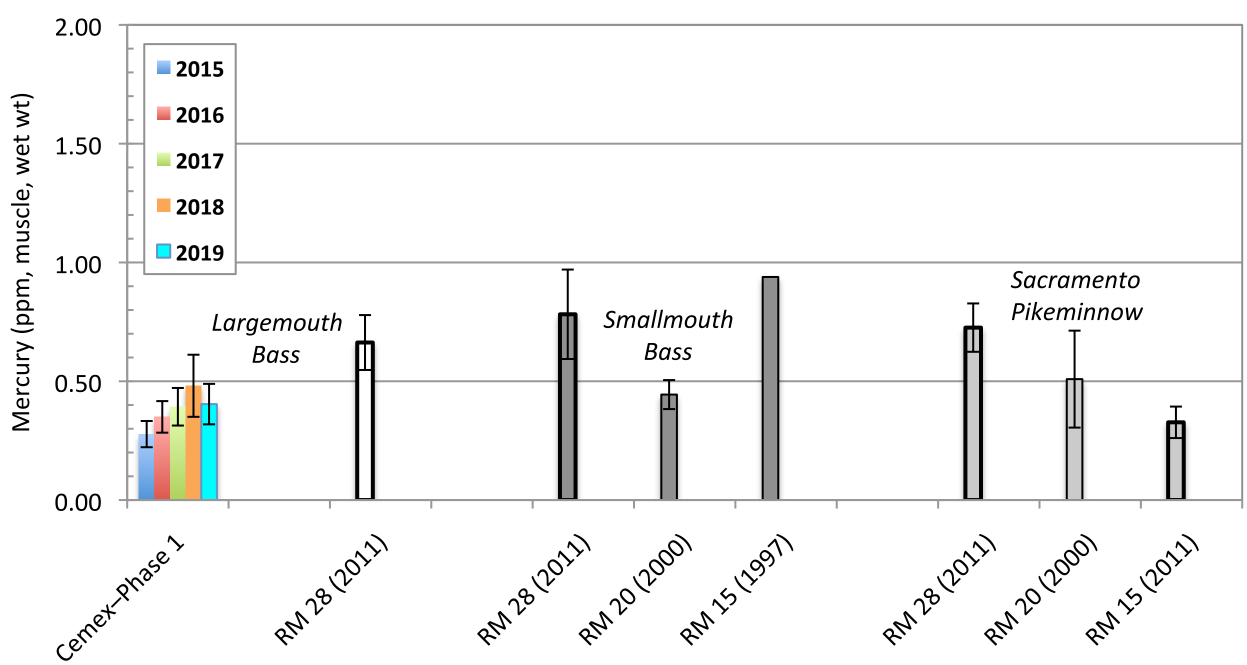


Figure 3. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 4. Channel and 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.
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**	± 0.587
Cemex – Phase 1	2019	*(no catfish of either species were found in 2019)*				
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	1,115	**0.571**	
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	

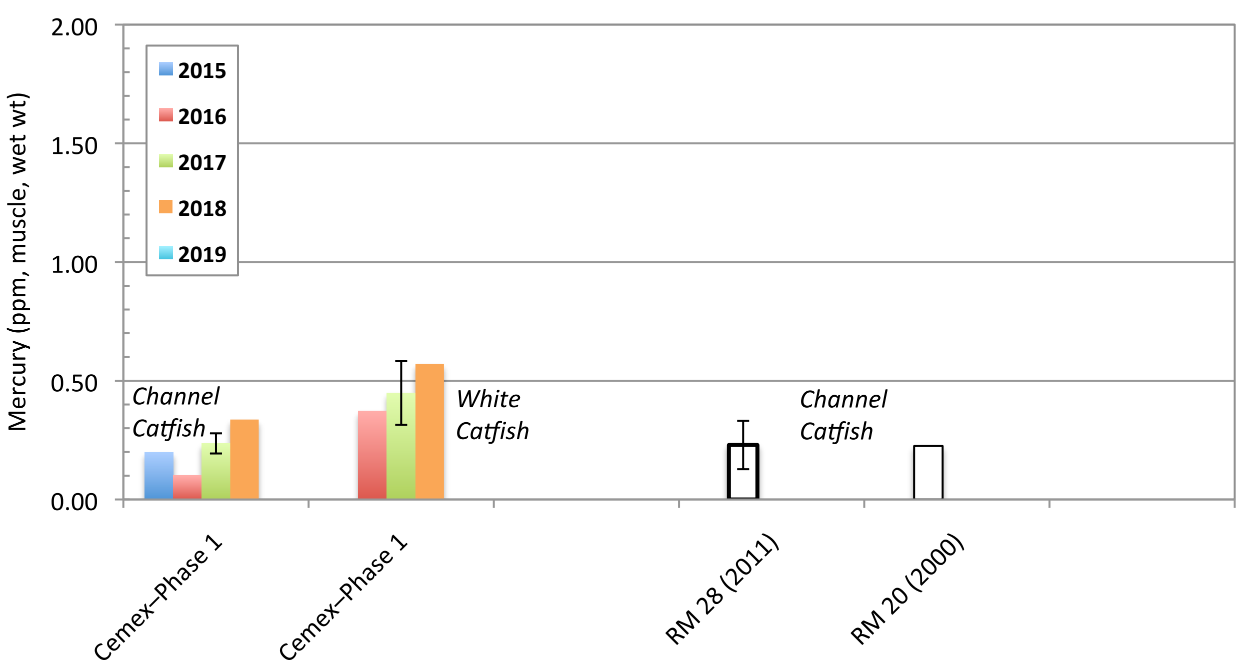


Figure 4. Channel and White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 5. Green 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						
Cemex – Phase 1	2016	–				
Cemex – Phase 1	2017	**5**	105	35	**0.273**	± 0.094
Cemex – Phase 1	2018	1	200	165	**0.227**	
Cemex – Phase 1	2019	–				
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**

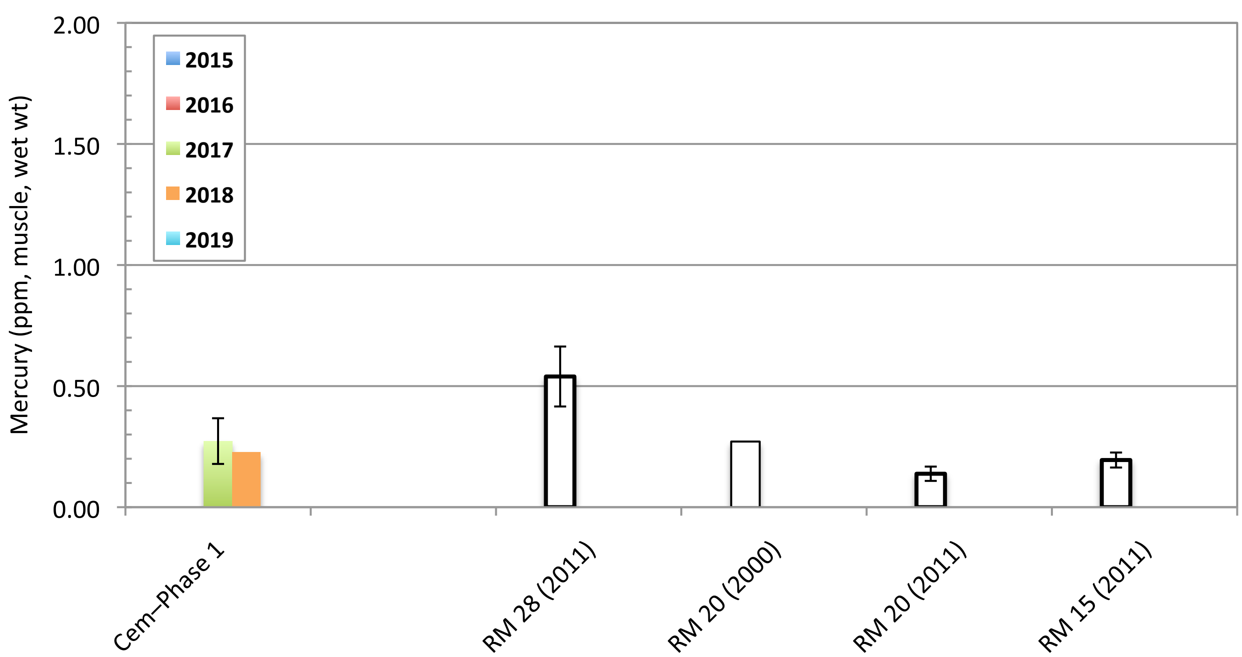


Figure 5. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

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

Table 6. 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
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**

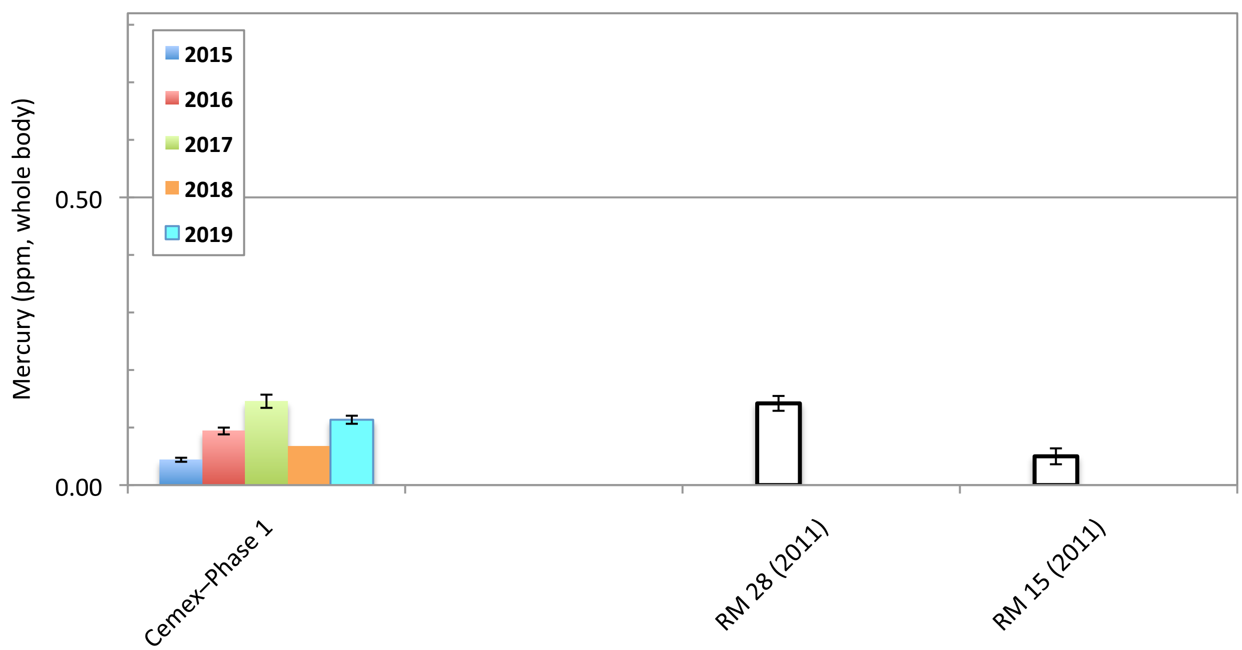


Figure 6. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 7. 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
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**

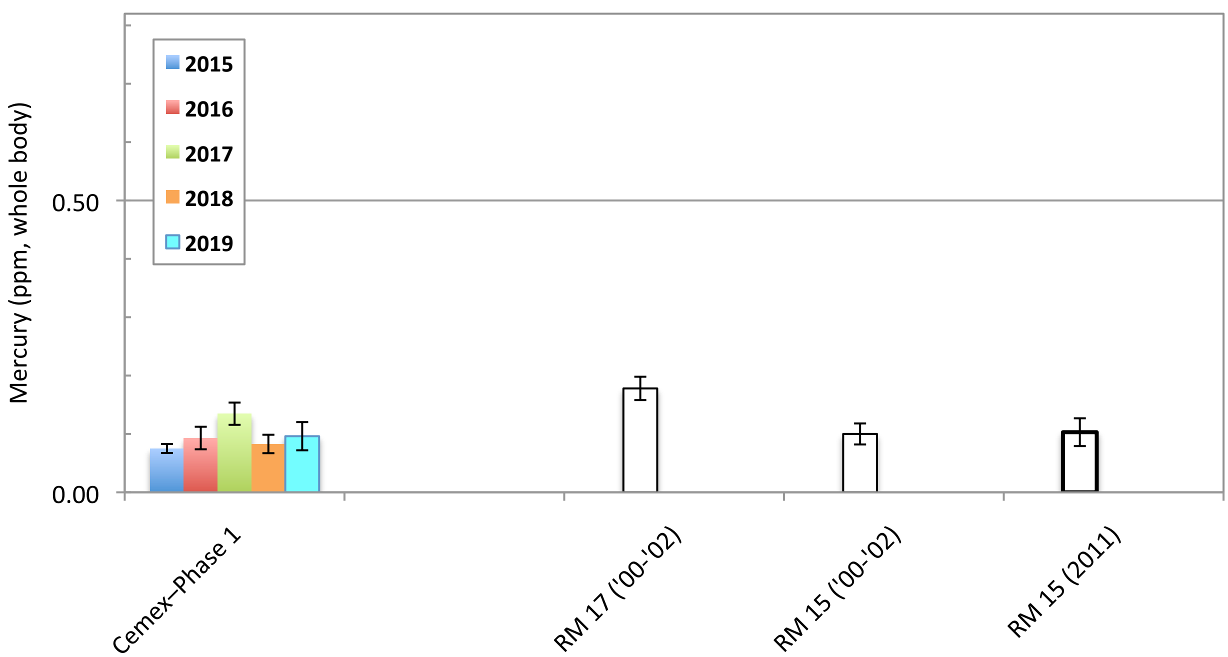


Figure 7. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 8. 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. Dev.
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
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**

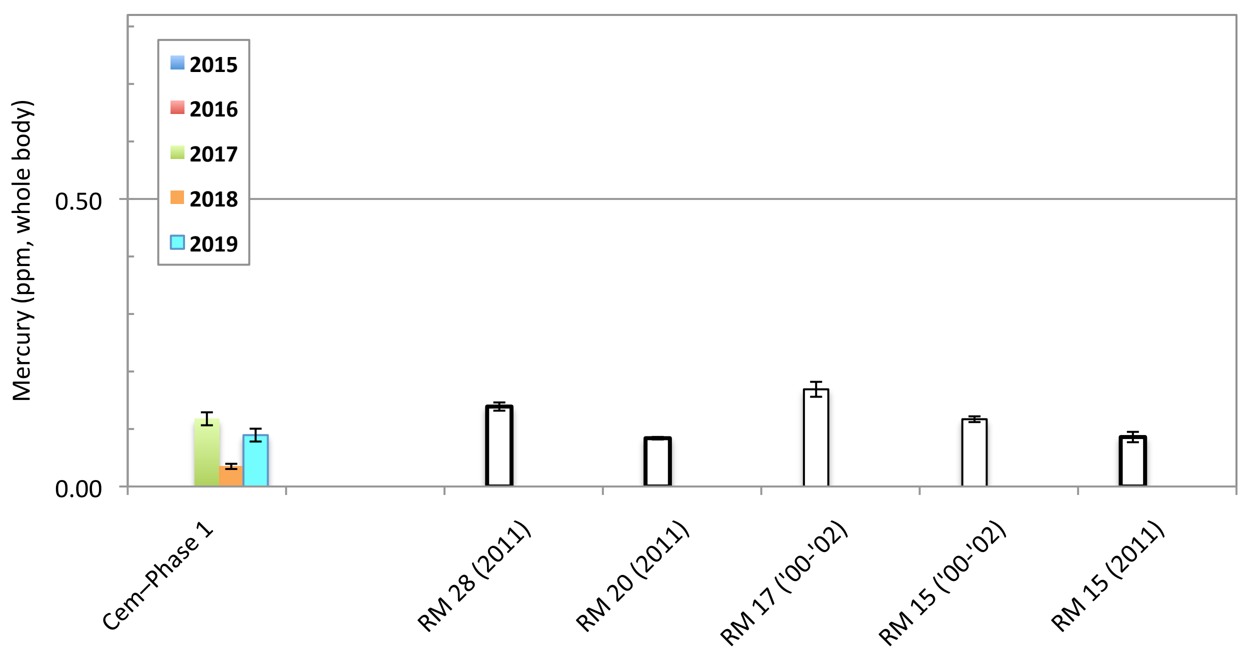


Figure 8. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

2. CEMEX–PHASE 3-4 POND

(Google Earth 2019)

2. CEMEX–PHASE 3-4 POND *(Tables 9-15, Figures 9-15)*

Summary

Twenty adult Largemouth Bass were sampled, and young-of-year, multiple composite samples were taken of Mosquitofish and juvenile Green Sunfish. Fish mercury, while remaining relatively high, showed a slight decrease in 2019, from 2018 and 2017. The changes were not statistically significant. As seen at Cemex–Phase 1, a decline in adult bass mercury followed years with lower than normal prey fish (small fish) mercury. The 2019 small fish data indicate a reversal of that trend, which should begin to show in the adult bass levels next year. Overall fish mercury at this pond remained elevated over comparable creek baseline samples for the majority of sample types, as in previous years. In particular, adult bass larger than 12" stayed at levels well above consumption guidelines. The pond was found to be relatively "elevated for three or more years of five" over creek baselines, triggering the addition of "expanded analysis" and, following a period of data gathering, development of a mercury management plan. Expanded analysis work began in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports.

This pond is the more recent (approx. 2002), and more actively mined, of the two Cemex ponds. It is also located just south of Cache Creek and east of Highway 505. It is east of the Cemex–Phase 1 (West) Pond. The Phase 3-4 Pond is a large, elongated water body that is app. 1,200 m long (1.2 km) and 300 m wide. Maximum depth was app. 10-12 m (33-38 feet) in 2019. This pond was actively mined in 2019. Mining was confined to the smaller, western basin. This (2019) was Year 5 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 4 composites. Juvenile bass were extremely scarce and are represented by a single sample. Predation pressure at this site is very high.

In total, 20 large fish muscle samples and 9 small fish composite samples, 29 separate mercury samples, were analyzed from the Cemex–Phase 3-4 Pond in the Fall 2019 monitoring. The analytical results from each individual large fish muscle sample and each small, young fish composite sample can be seen in Tables 9 and 10 and, graphically, in Figures 9 and 10. Then, for each sample type, the new data are shown in reduced form (means, error bars, etc.) and compared to 2015-2018 results and comparable historic creek data (Tables 11-15, Figures 11-15).

Large, Angling-sized Fish

Largemouth Bass

The Phase 3-4 Pond adult Largemouth Bass samples had fillet muscle mercury ranging from 0.305-1.733 ppm, averaging 0.819 ppm. This was down from 2018 (0.918 ppm) and 2017 (1.093 ppm); the difference was not statistically significant. The 2019 average was similar to 2015-2016 levels (0.840, 0.858 ppm). The 2019 samples ranged between 228 and 397 mm (about 9-16"); this pond contains a healthy population of bass across a wider size range than in the Phase 1 pond. Very similar to the Phase 1 pond bass this year, the larger individuals over about 310 mm (12") had significantly higher mercury levels, averaging 1.111 ppm. The larger set of fish increased in mercury with size, on a steep trajectory (Figure 9). In contrast, the set of smaller sizes under 12" had a nearly flat, low mercury trend, averaging 0.381 ppm. The main causes for this split (recent drop in exposure levels or/and a shift in diet to higher mercury food at larger size) are discussed with the previous pond, Cemex–Phase 1. In any case, the lower mercury levels in the younger, smaller bass indicate that more recent mercury exposure conditions for the fish may be down from earlier years. At the same time, the much higher levels in the fish over 12" suggests treating the larger sizes almost as another species, with regard to future human consumption guidelines etc. Adult bass represent the top predator fish in this region and will typically have the highest mercury levels at any given site, with the highest levels in the largest, oldest fish. The 2019 Cemex–Phase 3-4 bass, averaged across the full size range, continued to have higher mercury than 6 of 7 corresponding baseline creek data sets; the difference was statistically significant for 3 of these. The fish over 12" were higher than all creek comparisons.

Green Sunfish

We have not been able to collect this species in useful numbers since 2015, despite considerable effort. For completion, the earlier data are included in Table 12 and Figure 12.

Small, Young Fish

Juvenile Largemouth Bass

We were able to obtain just one juvenile bass in 2019, even with extensive seining. This 125 mm (5") individual had whole body mercury at 0.336 ppm. This was in the range found at this pond in 2015-2017 when we were able to get better samples (0.249-0.372 ppm). All of the juvenile bass data from this site have been far above the baseline creek comparisons (0.050-0.142 ppm).

Juvenile Green Sunfish

As compared to the juvenile bass, we were able to collect strong, multi-individual sets of juvenile Green Sunfish (Table 14, Figure 14). The samples had whole-body mercury ranging from 0.140-0.213 ppm and averaging 0.185 ppm. This was up significantly from 2018 (0.112 ppm), to a level about mid-range for these samples between 2015 and 2018. The increase came after a three year decline in 2016-2018. Compared to baseline juvenile Green Sunfish mercury from Cache Creek, Phase 3-4 Pond fish in 2019 were higher than all five available creek comparisons. The difference was statistically significant for four of the five.

Mosquitofish

As for the young Green Sunfish, we were able to collect strong composite samples of Mosquitofish in 2019, as in all previous years here. The 2019 composites had whole-body mercury ranging from 0.108-0.248 ppm, averaging 0.183 ppm. This was statistically similar to levels in 2015, 2016, and 2018 (0.157-0.228 ppm). It was significantly lower than levels found in 2017 (0.286 ppm). Relative to the baseline Cache Creek comparison samples, the 2019 Cemex–Phase 3-4 Mosquitofish were statistically similar in mercury to the River Mile 17 sample sets (0.178 ppm) and higher than the two sets from River Mile 15 (0.100-0.103 ppm).

Table 9. Cemex–Phase 3-4 Pond: Large fish sampled, Fall 2019

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	228	9.0	140	0.3	0.309
Largemouth Bass	232	9.1	155	0.3	0.444
Largemouth Bass	263	10.4	230	0.5	0.340
Largemouth Bass	266	10.5	240	0.5	0.399
Largemouth Bass	272	10.7	225	0.5	0.389
Largemouth Bass	273	10.7	255	0.6	0.305
Largemouth Bass	290	11.4	340	0.7	0.413
Largemouth Bass	295	11.6	325	0.7	0.450
Largemouth Bass	317	12.5	370	0.8	0.851
Largemouth Bass	317	12.5	425	0.9	0.887
Largemouth Bass	320	12.6	425	0.9	1.035
Largemouth Bass	333	13.1	510	1.1	0.856
Largemouth Bass	338	13.3	510	1.1	0.854
Largemouth Bass	342	13.5	520	1.1	1.275
Largemouth Bass	348	13.7	520	1.1	1.108
Largemouth Bass	350	13.8	455	1.0	1.171
Largemouth Bass	352	13.9	530	1.2	1.286
Largemouth Bass	354	13.9	607	1.3	1.141
Largemouth Bass	362	14.3	545	1.2	1.136
Largemouth Bass	397	15.6	710	1.6	1.733

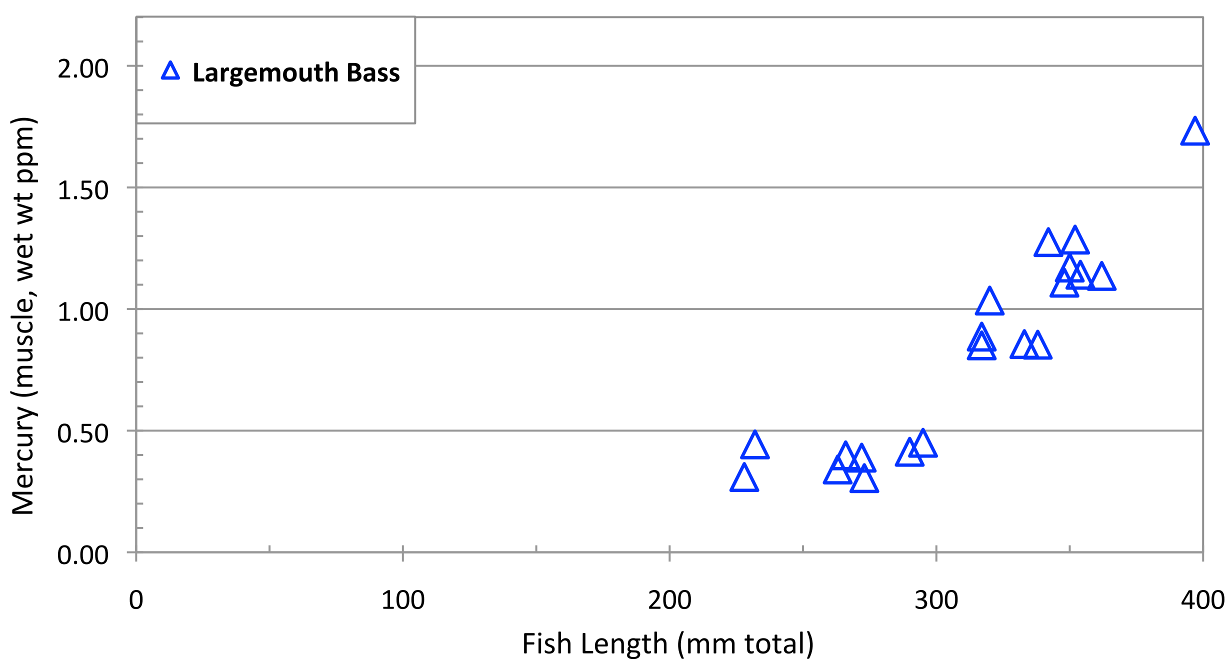


Figure 9. Cemex–Phase 3-4 Pond: Large fish sampled, Fall 2019
(fillet muscle mercury in individual fish)

Table 10. Cemex–Phase 3-4 Pond: Small Fish Sampled, Fall 2019
(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	125	4.9	23.15	0.82	**0.336**
Green Sunfish (juv)	10	33	1.3	0.65	0.02	**0.140**
Green Sunfish (juv)	10	38	1.5	1.00	0.04	**0.184**
Green Sunfish (juv)	10	46	1.8	1.87	0.07	**0.213**
Green Sunfish (juv)	10	55	2.2	2.84	0.10	**0.205**
Mosquitofish	10	28	1.1	0.26	0.009	**0.108**
Mosquitofish	10	32	1.3	0.41	0.014	**0.172**
Mosquitofish	10	37	1.5	0.67	0.024	**0.203**
Mosquitofish	10	42	1.7	0.98	0.035	**0.248**

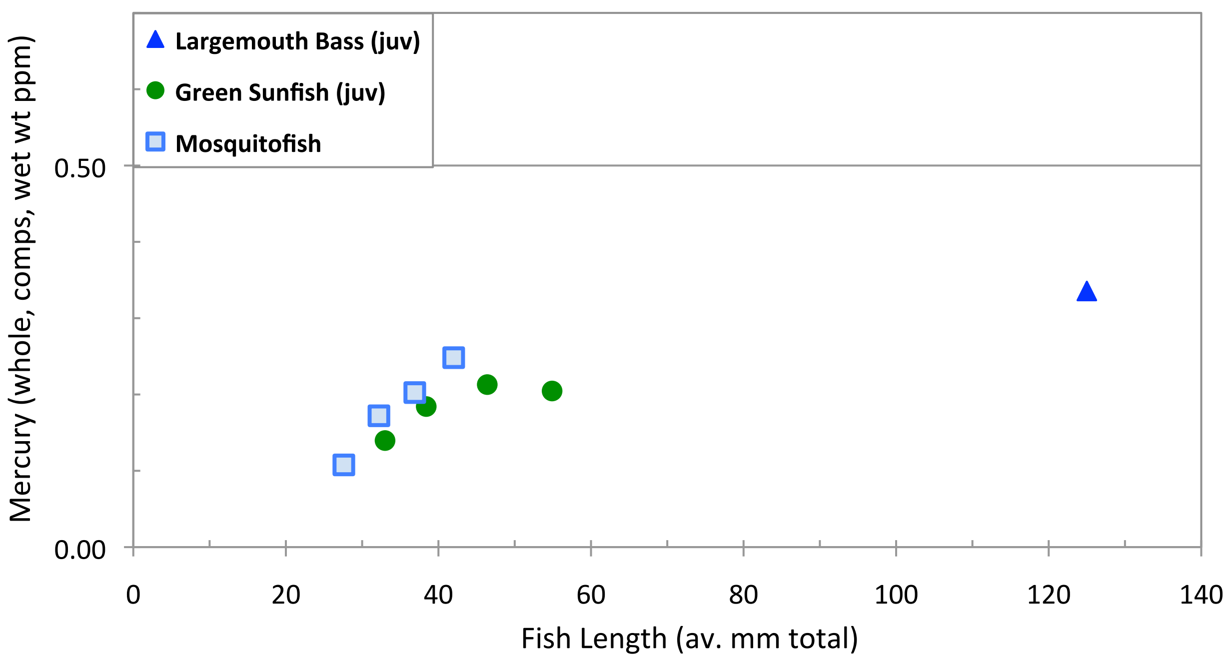


Figure 10. Cemex–Phase 3-4 Pond: Small, young fish sampled, Fall 2019
(mercury in whole-body, multi-individual composite samples)

Table 11. 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
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**

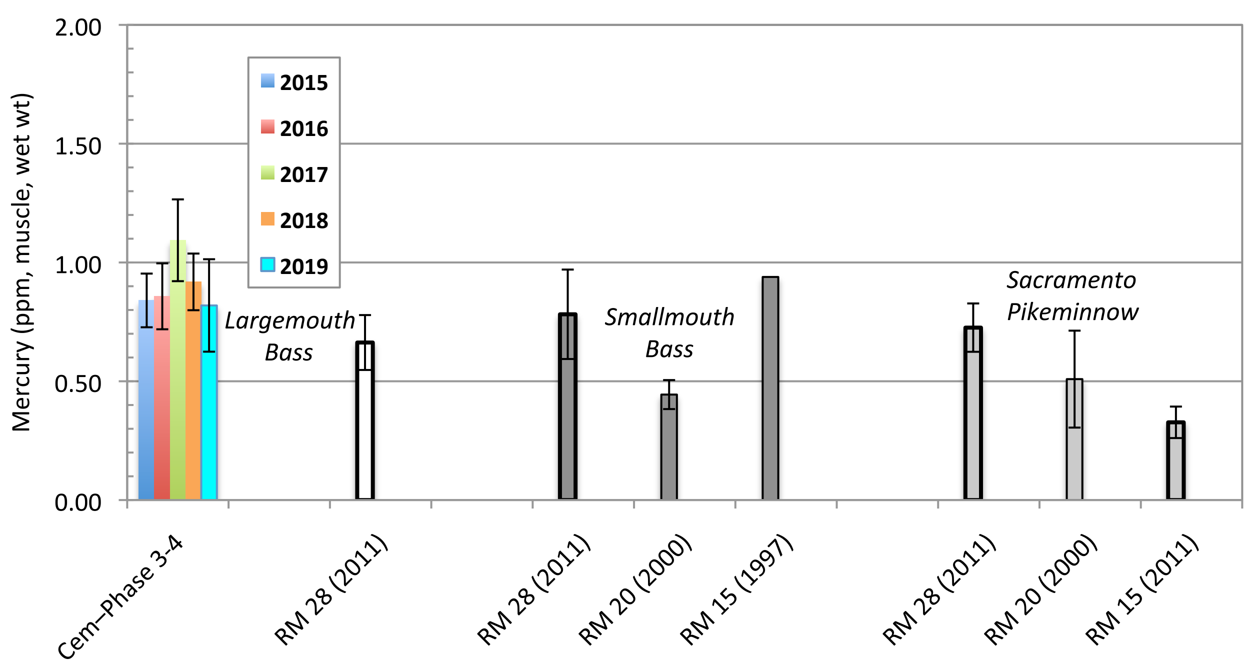


Figure 11. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 12. Green 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						
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	–				
Cemex – Phase 3-4	2019	–				
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**

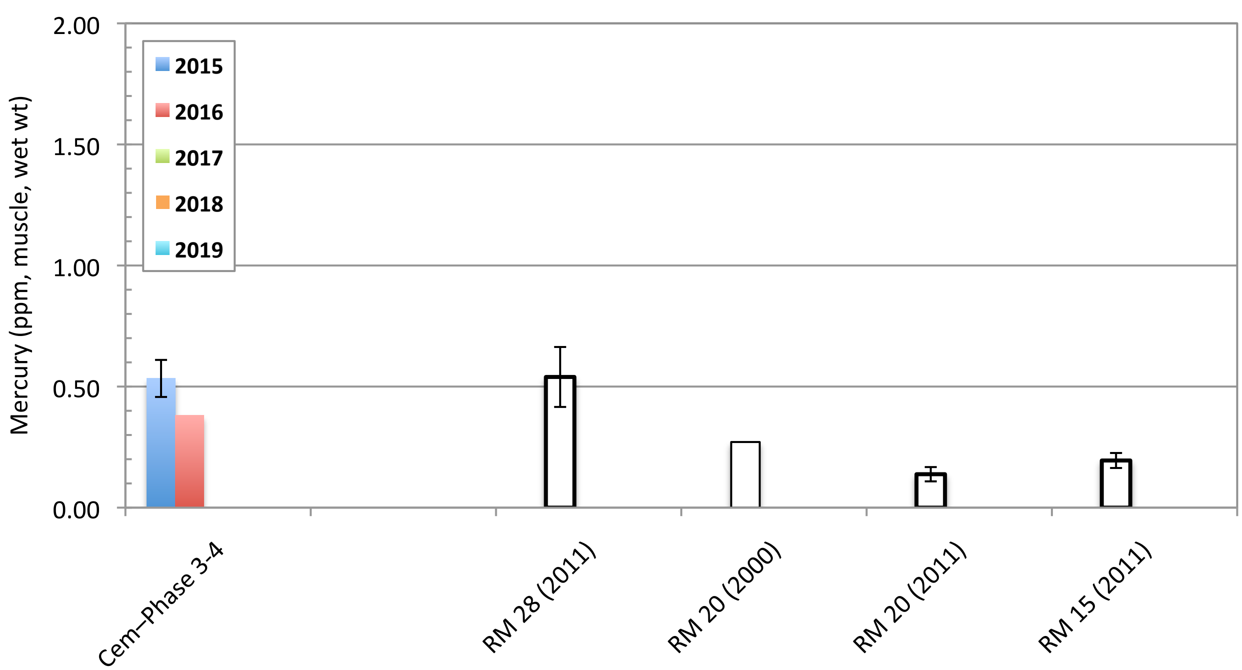


Figure 12. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

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

Table 13. 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. Dev.
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**	
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**

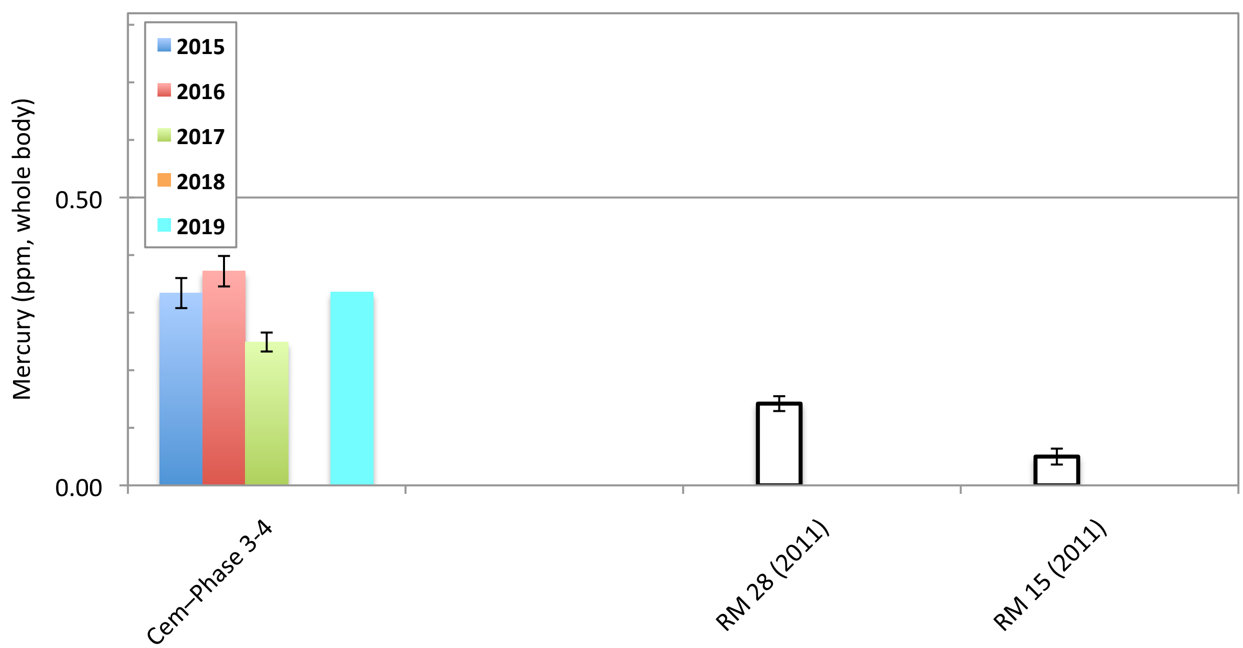


Figure 13. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 14. 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. Dev.
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
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**

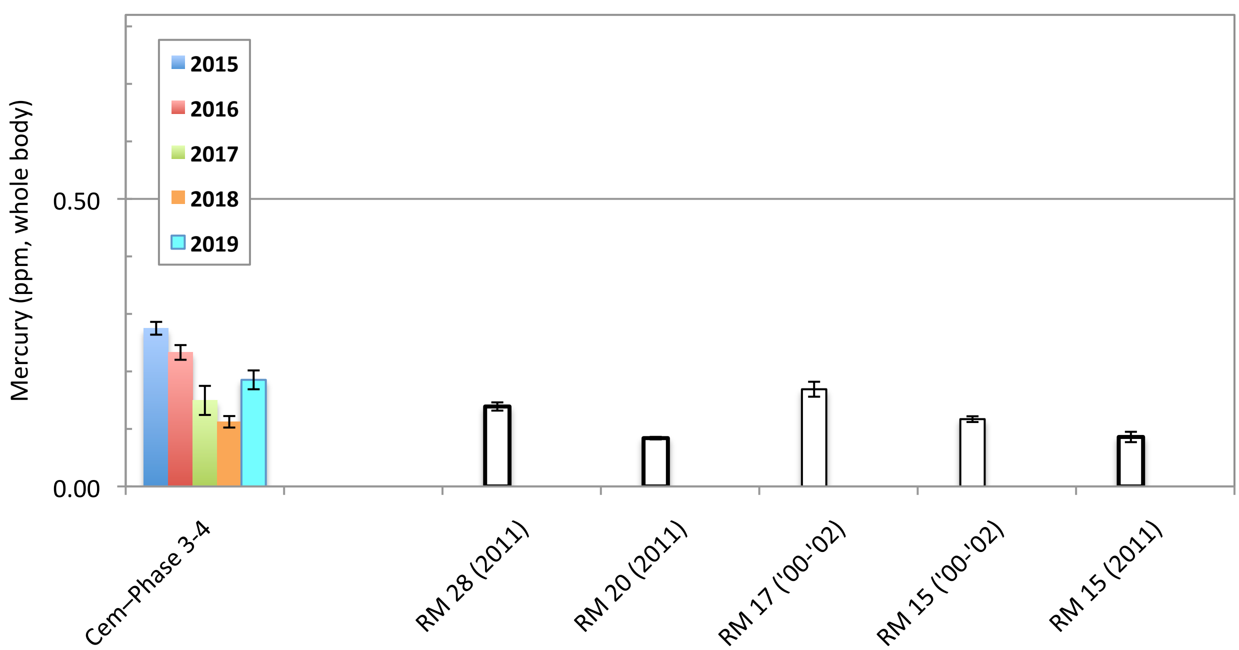


Figure 14. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 15. 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
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**

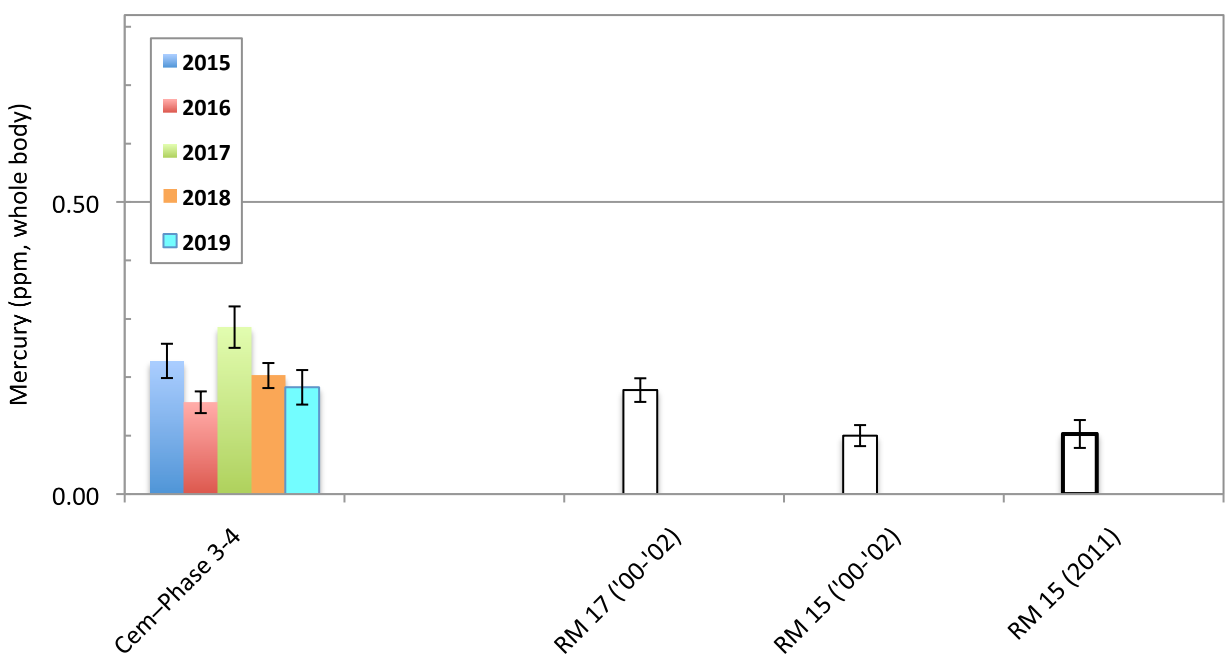


Figure 15. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

3. TEICHERT-ESPARTO – REIFF POND

(Google Earth 2019)

3. TEICHERT-ESPARTO – REIFF POND *(Tables 16-24, Figures 16-24)*

Summary

As in prior years, several large fish species were present; we took samples of adult Largemouth Bass (10), White Catfish (10), Common Carp (9), and Green Sunfish (1). We also collected young-of-year, multiple composite samples of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. This pond remained highly elevated in mercury in 2019. All of the various fish samples were significantly higher in mercury than corresponding Cache Creek baseline samples. However, all of the different 2019 fish samples also showed a decrease in levels from 2018, with the largest declines in the adult fish. This followed a decrease that began last year in young-of-year fish and following the near-extermination by bass of the very high-mercury Red Shiners as a primary food item. Changes over the monitoring years also appear to have been influenced by changes in pond management, with fish mercury decreasing when active slurry inflows were part of operations. In any case, despite the recent declines, the pond remained in the "elevated over baseline" category and triggered 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.

This pond is the largest of the Teichert wet pits. It is located at Teichert's Esparto Facility, just north of Cache Creek and west of Highway 505, between 505 and County Road 87. Reiff is a square-shaped pond that is approximately half a kilometer on a side. Depths ranged from 0-2 m shallows along the margins to a deeper central area that ranged from 5.2-7.6 m (17-25 feet) deep. First created in or before 2002, our understanding is that this pond did not have active mining in 2015 or 2016, but did receive plant silt/clay slurry. In 2017, active mining appeared to have been halted at the Esparto Plant in general, stopping the slurry inflows. Since 2018, mining resumed at the nearby Mast basins, with slurry discharge to Reiff, again keeping the shallow pond turbid. This (2019) was Year 5 of monitoring.

We sampled the pond primarily during day, twilight, and night conditions with a wide range of gear. The fish collected are listed in Tables 16 and 17. These included, for large, angling-sized fish, samples of 10 Largemouth Bass (*Micropterus salmoides*), 10 White Catfish (*Ameiurus catus*), 9 Common Carp (*Cyprinus carpio*), and 1 adult Green Sunfish (*Lepomis cyanellus*). Small fish samples included juvenile Largemouth Bass (3-5"), juvenile Green Sunfish (*Lepomis cyanellus*, 1-2"), and Mosquitofish (*Gambusia affinis*, 1-2"). We collected 4 multi-individual composite samples from each of these 3 species. Red Shiners (*Cyprinella lutrensis*), present in previous years, could not be found in 2019.

In total, this added up to 30 large fish muscle samples and 12 young, small fish composites, or 42 separate mercury samples analyzed from the Reiff Pond in the Fall 2019 monitoring. The analytical results from each individual large fish muscle sample and each small fish composite sample can be seen in Tables 16 and 17 and, graphically, in Figures 16 and 17. Then, for each large and small fish species taken, the new data are shown in reduced form (means, error bars, etc.) and compared to 2015-2018 results and the most closely comparable historic creek data (Tables 18-24, Figures 18-24).

Large, Angling-sized Fish

Largemouth Bass

We took a sample of 10 bass in 2019, leaving sample numbers for the other large species present in this pond (30 total large fish). The bass sizes present in 2019 (216-430 mm, 9-17") included fish larger than last year (2018: 237-270 mm, 9-11") and the year before (2017: 70-200 mm, 3-8"), indicating that this is a young, growing population. Average weight jumped from 78 g in 2017 to 181 g in 2018, and 353 g in 2019. We have discussed the appearance of different size:mercury trends in smaller/younger adult bass, as compared to larger/older fish, in the Cemex sections. The Teichert–Reiff 2019 bass set does include a distinct lower-mercury group of the smallest fish (under app. 260 mm or 10.5", average mercury 0.610 ppm), with the fish larger than this all much higher (average mercury 1.429 ppm). In this pond, though, the levels appeared to increase steadily with size/age, rather than showing some distinct shift. The average mercury, across the size range, was 1.183 ppm. This was the highest level of the currently monitored ponds and was significantly above all Cache Creek comparisons.

While this remained the highest bass mercury among the monitored ponds, it was down by nearly half from the previous two years (1.997 ppm in 2018). This was despite the larger/older sizes present in 2019, which would typically have *higher* mercury levels than the smaller/younger fish sampled in 2017-2018. It seems that, after an earlier spike in concentrations, mercury in Teichert–Reiff bass may be settling into lower equilibrium levels. This could be due to changes in the physical/chemical/microbiological mercury cycle of the pond, and we note that mining, pond re-configuration, and slurry inputs resumed in late 2018, clouding the water with suspended sediment. Suspended sediment particles contain 'sticky' binding sites that can strip some of the dissolved mercury from the water column, making it less available to the food web.

We also think that a shift in food web structure may have played a role here. Bass first became fairly prevalent in the pond 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 fish, averaging up to 0.695 ppm (Table 22, Figure 22). We think it is no coincidence that the Red Shiners disappeared just as the bass numbers and sizes increased. It looks like the growing bass targeted the very high-mercury Red Shiners as their choice food, reaching extremely high mercury levels themselves in the process. With the shiners now apparently all but exterminated by the growing bass population, this may leave only lower-mercury foods for the bass. 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

Ten adult White Catfish were taken in 2019, in the size range of 265-412 mm (10-16") and 200-1050 g (0.4-2.3 lbs). Muscle mercury ranged between 0.418 and 0.936 ppm, averaging 0.637 ppm. This was down by fully half from the last set of catfish we were able to fish for (1.287 ppm in 2017). The 2019 catfish mercury levels were the lowest found yet at this pond and were significantly down from the 2016 and 2017 peak levels. However, this was still significantly above the Cache Creek comparison data.

The sharp drop in catfish mercury was consistent with the bass trend, also indicating an overall decrease in mercury bioavailability to top predator fish.

Carp

Nine adult Carp were taken in 2019, in the size range of 423-545 mm (16-22") and 1050-2050 g (2.3-4.5 lbs). Muscle mercury ranged between 0.513 and 1.561 ppm, averaging 0.988 ppm. Like the bass, the carp showed a steeply increasing mercury trend vs. size (Figure 16) and similar overall levels to the 2019 bass. This is odd, as carp are typically lower on the food chain than the top-predator bass and would be expected to be lower in mercury. It could be due to age differences, with the carp likely being much older than the (young) bass, giving them time to slowly accumulate higher mercury than would be found in carp the same age as the bass.

Like the bass and catfish trends, carp mercury was lower in 2019 than the previous peak. But the decrease was not significant, and the carp remained in a similar, high level for this species. Again, this may be at least partly due to the age of the carp: even if mercury exposure has declined at Teichert–Reiff, a recent change would average into a much longer lifetime accumulation in the carp, as compared to the bass which only recently appeared in this pond.

Green Sunfish

One small adult Green Sunfish was taken, 106 mm (4.2") in length and 23 g (0.1 lb). Muscle mercury was 0.373 ppm. This was lower than one baseline creek comparison and higher than three.

Small, Young Fish

Mosquitofish

Mosquitofish have been difficult to collect in some years, but we were able to obtain good, multi-individual composite samples in 2019. Sizes closely matched previous collections here and at other sites, averaging 28-40 mm and 0.2-0.8 g. Mercury in the four composite sets ranged from 0.161-0.340 ppm, increasing sharply in the larger size classes and averaging 0.222 ppm. This was down from the last collection (2018, 0.262 ppm), though not significantly. It was also statistically similar to 2016 levels (0.212 ppm) and significantly above 2015 levels (0.094 ppm). The 2019 concentrations remained higher than corresponding Cache Creek baseline samples (0.094-0.172 ppm); the difference was statistically significant for two of the three comparisons.

Red Shiner

Red Shiners were not found in sufficient numbers for sampling in 2019. We suspect the growing population of Largemouth Bass has basically consumed them out of existence. Data from prior years are presented in Table 22 and Figure 22.

Juvenile Largemouth Bass

In contrast with the Red Shiners, juvenile Bass were present in ample numbers for good, multi-individual composites. These samples had whole-body mercury ranging from 0.270-0.321 ppm, averaging 0.297 ppm. This was significantly lower than the 2018 samples (0.445 ppm) and far below 2017 levels (0.798 ppm), all in similar, young-of-year fish. This suggests a drop in overall methylmercury exposure conditions since 2017. Relative to baseline juvenile bass comparison data from Cache Creek, despite the large decreases in 2018 and 2019, they remained significantly higher in mercury than the two creek sample sets available: River Mile 28 (0.142 ppm) and River Mile 15 (0.050 ppm).

Juvenile Green Sunfish

Good, multi-individual composites were also obtained of juvenile Green Sunfish, for the second year in a row. These samples had whole-body mercury at 0.147-0.274 ppm, averaging 0.187 ppm. This was down significantly from 2018 (0.252 ppm) and also lower than the single sample available here in 2015 (0.241 ppm). As compared to Cache Creek baseline comparison samples, the 2018 Reiff juvenile sunfish were higher in mercury than all of the baseline sets. The difference was significant for four of the five comparisons.

Table 16. Teichert-Esparto–Reiff Pond: Large fish sampled, Fall 2019

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	216	8.5	100	0.2	**0.480**
Largemouth Bass	227	8.9	125	0.3	**0.608**
Largemouth Bass	247	9.7	160	0.4	**0.741**
Largemouth Bass	278	10.9	222	0.5	**1.287**
Largemouth Bass	283	11.1	250	0.6	**1.141**
Largemouth Bass	285	11.2	265	0.6	**1.670**
Largemouth Bass	305	12.0	330	0.7	**1.514**
Largemouth Bass	325	12.8	460	1.0	**1.297**
Largemouth Bass	357	14.1	610	1.3	**1.349**
Largemouth Bass	430	16.9	1010	2.2	**1.747**
White Catfish	265	10.4	200	0.4	**0.446**
White Catfish	290	11.4	280	0.6	**0.751**
White Catfish	305	12.0	345	0.8	**0.444**
White Catfish	320	12.6	455	1.0	**0.767**
White Catfish	325	12.8	410	0.9	**0.418**
White Catfish	336	13.2	490	1.1	**0.534**
White Catfish	338	13.3	490	1.1	**0.511**
White Catfish	372	14.6	860	1.9	**0.845**
White Catfish	407	16.0	765	1.7	**0.722**
White Catfish	412	16.2	1050	2.3	**0.936**
Carp	423	16.7	1050	2.3	**0.567**
Carp	445	17.5	1100	2.4	**0.513**
Carp	458	18.0	1150	2.5	**0.873**
Carp	468	18.4	1275	2.8	**1.002**
Carp	485	19.1	1400	3.1	**1.116**
Carp	500	19.7	1700	3.7	**1.003**
Carp	505	19.9	1800	4.0	**0.776**
Carp	518	20.4	1750	3.9	**1.561**
Carp	545	21.5	2050	4.5	**1.485**
Green Sunfish	106	4.2	23	0.1	**0.373**

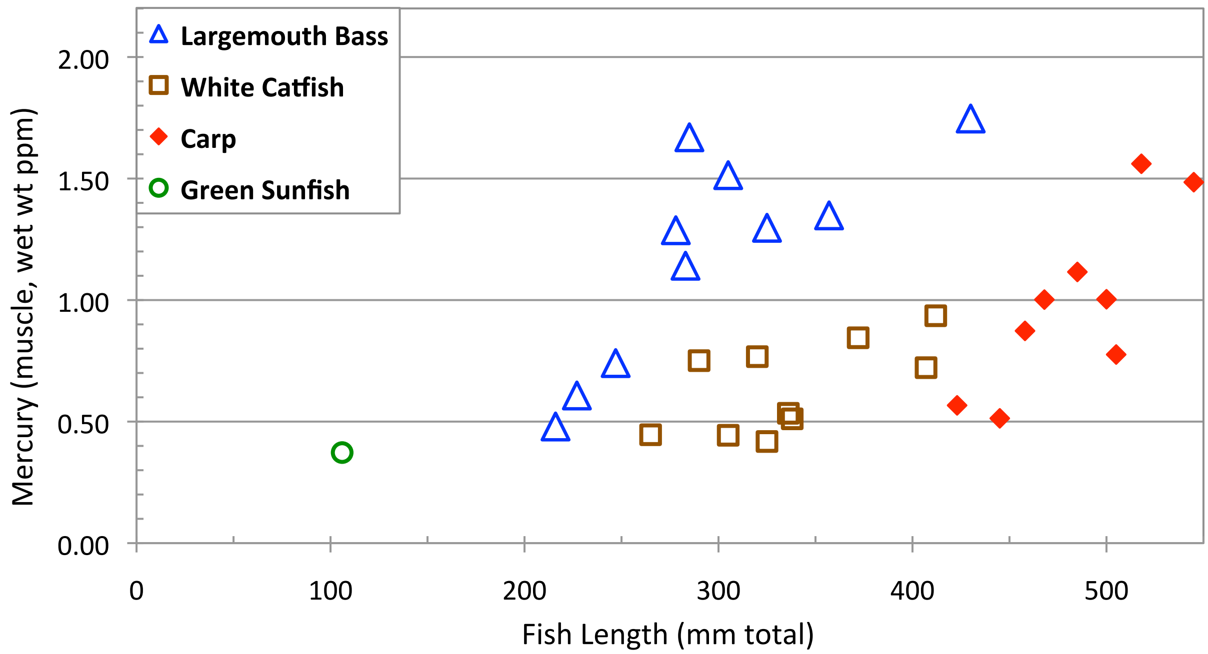


Figure 16. Teichert–Reiff Pond: large fish sampled, Fall 2019
(fillet muscle mercury in individual fish)

Table 17. Teichert-Esparto–Reiff Pond: Small Fish Sampled, Fall 2019
(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)	5	90	3.5	8.65	0.31	**0.321**
Largemouth Bass (juv)	5	101	4.0	12.37	0.44	**0.270**
Largemouth Bass (juv)	5	112	4.4	15.79	0.56	**0.296**
Largemouth Bass (juv)	5	124	4.9	22.13	0.78	**0.301**
Green Sunfish (juv)	10	31	1.2	0.49	0.02	**0.164**
Green Sunfish (juv)	8	36	1.4	0.82	0.03	**0.147**
Green Sunfish (juv)	4	47	1.8	1.58	0.06	**0.165**
Green Sunfish (juv)	3	53	2.1	2.47	0.09	**0.274**
Mosquitofish	10	28	1.1	0.22	0.008	**0.168**
Mosquitofish	10	30	1.2	0.28	0.010	**0.161**
Mosquitofish	10	34	1.3	0.41	0.014	**0.218**
Mosquitofish	5	40	1.6	0.73	0.026	**0.340**

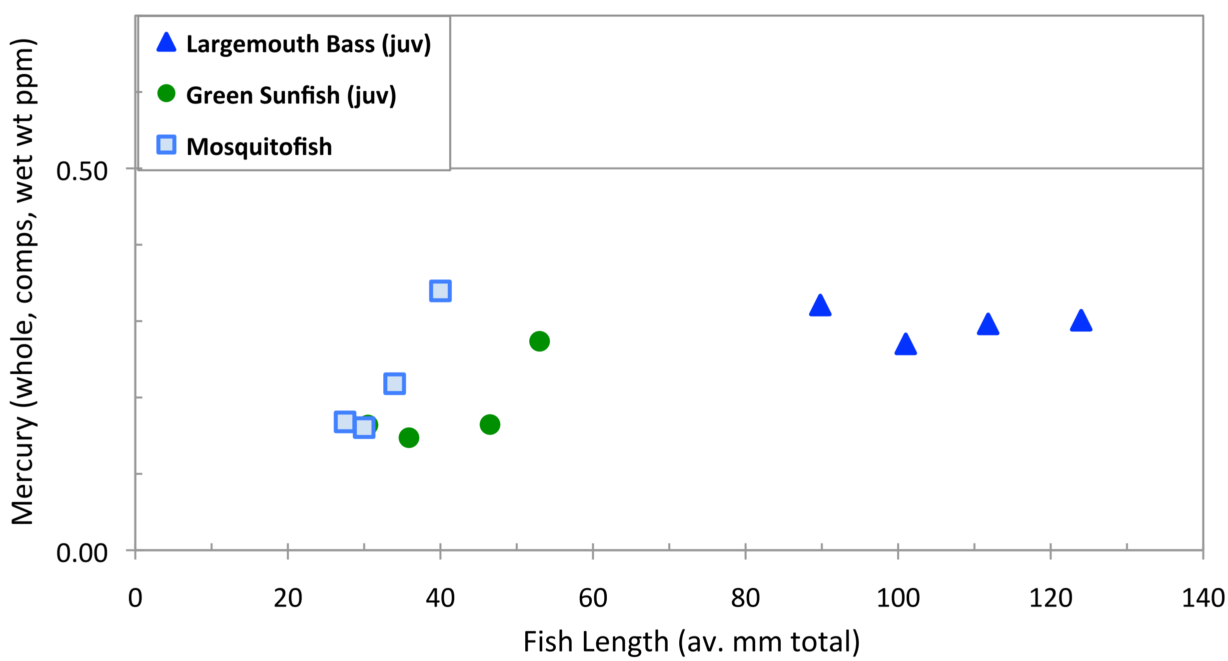


Figure 17. Teichert-Esparto–Reiff Pond: small, young fish sampled, Fall 2019
(mercury in whole-body, multi-individual composite samples)

Table 18. 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 – Reiff	2017	5	189	78	1.679	± 0.180
Teichert – Reiff	2018	10	251	181	**1.997**	± 0.170
Teichert – Reiff	2019	10	295	353	**1.183**	± 0.314
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**

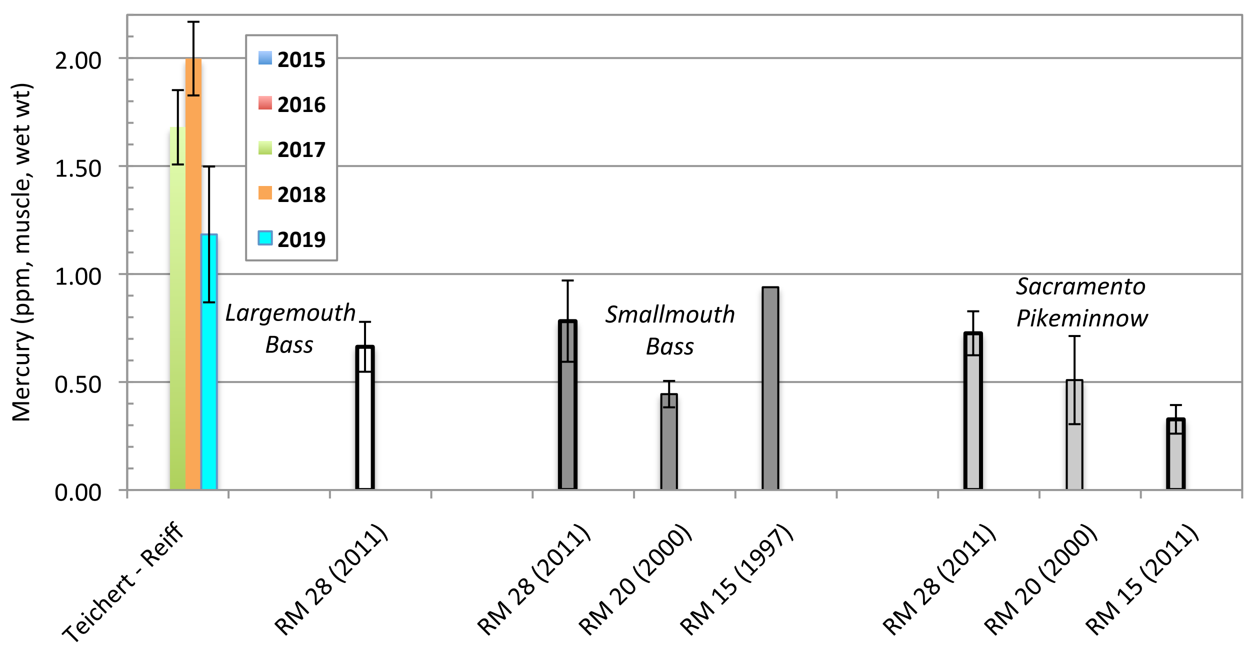


Figure 20. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 19. 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 – Reiff	2015	**20**	347	658	**0.737**	± 0.156
Teichert – Reiff	2016	**20**	297	341	**0.996**	± 0.153
Teichert – Reiff	2017	**16**	355	677	**1.287**	± 0.197
Teichert – Reiff	2018	(no samples)				
Teichert – Reiff	2019	**10**	337	535	**0.637**	± 0.134
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

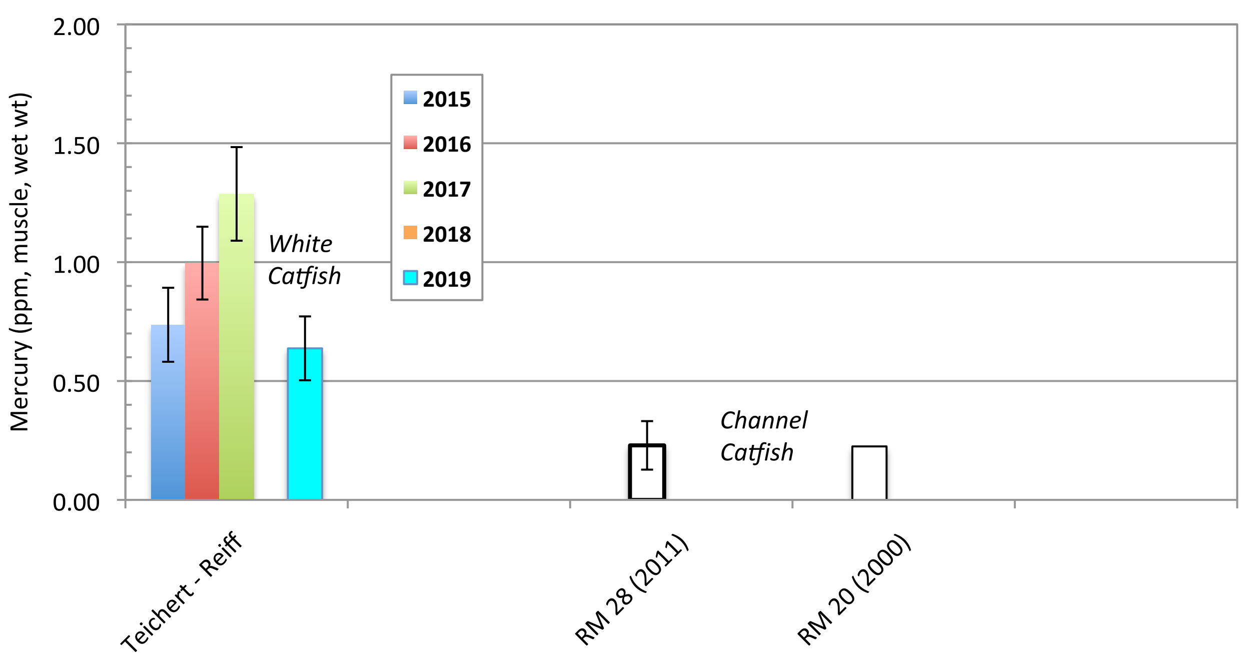


Figure 19. White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 20. 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 – Reiff	2015	**2**	421	918	**0.351**	
Teichert – Reiff	2016	**5**	430	975	**0.854**	± 0.387
Teichert – Reiff	2017	**9**	481	1,499	**1.122**	± 0.321
Teichert – Reiff	2018 (no samples)					
Teichert – Reiff	2019	**9**	483	1,475	**0.988**	± 0.279
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

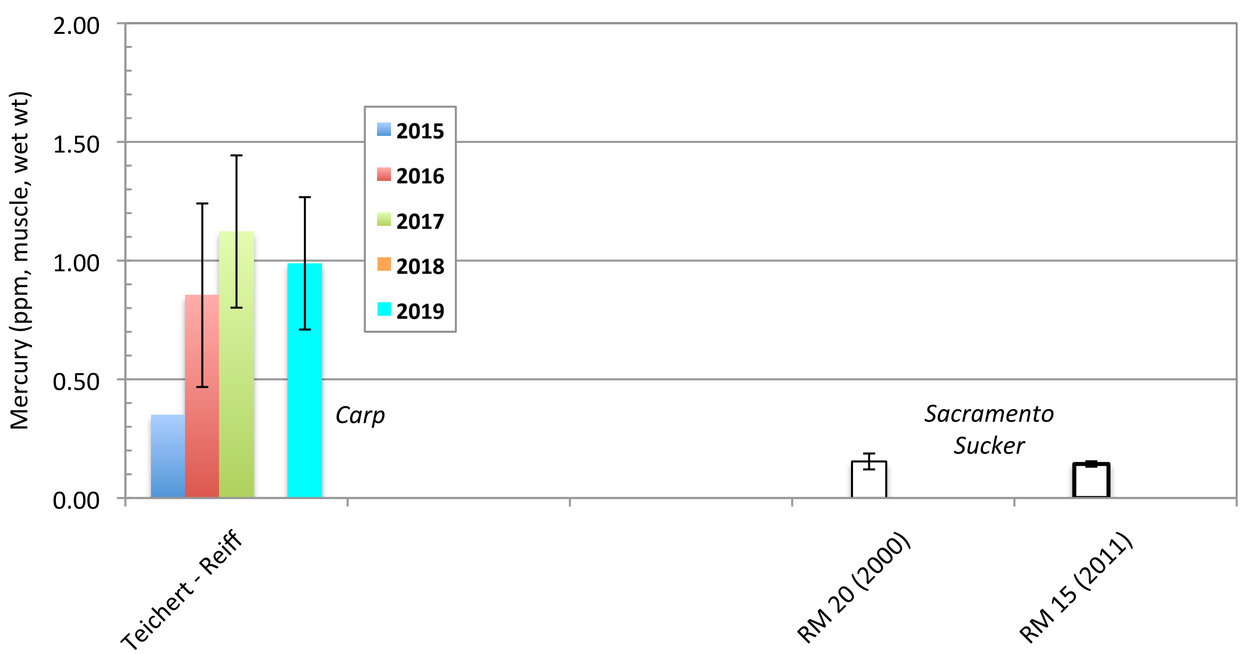


Figure 20. Carp summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

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

Table 21. 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. Dev.**
Mosquitofish							
Teichert – Reiff	2015	**4**	12	38	0.6	**0.094**	± 0.005
Teichert – Reiff	2016	**4**	10	36	0.5	**0.212**	± 0.021
Teichert – Reiff	2017	–	–	–	–	–	
Teichert – Reiff	2018	**4**	10	35	0.5	**0.262**	± 0.026
Teichert – Reiff	2019	**4**	5-10	33	0.4	**0.222**	± 0.041
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**

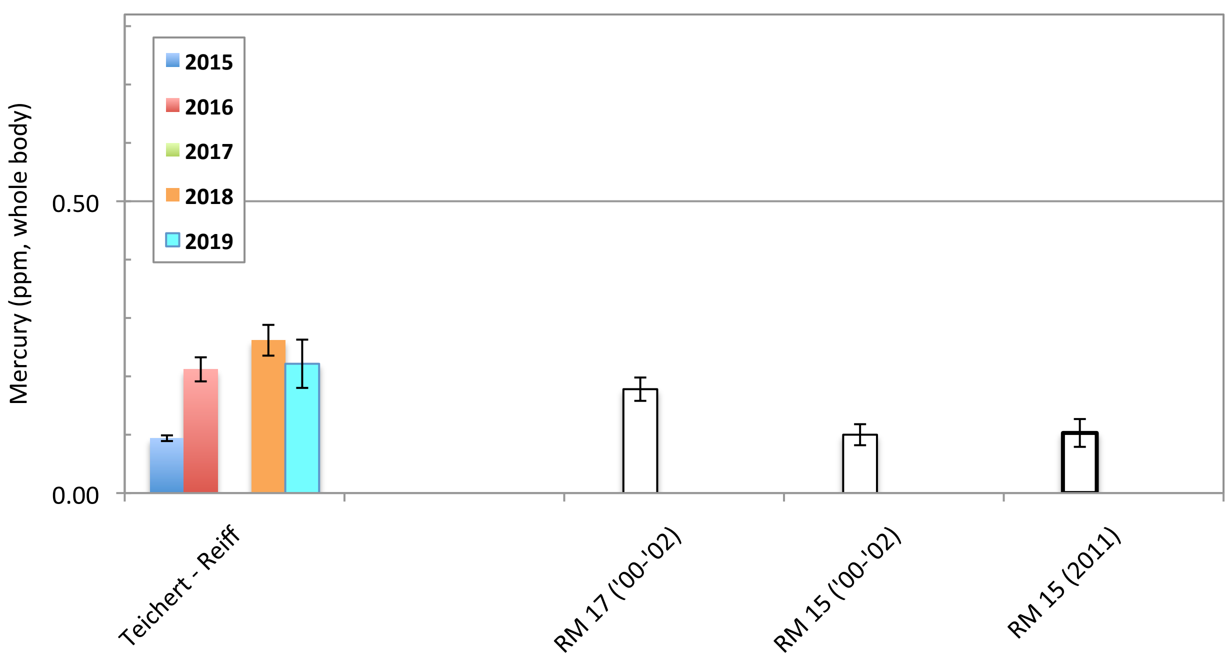


Figure 21. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 22. 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 – Reiff	2015	**4**	10	50	1.3	**0.152**	± 0.009
Teichert – Reiff	2016	**4**	10	47	1.1	**0.412**	± 0.042
Teichert – Reiff	2017	**4**	10	49	1.1	**0.695**	± 0.070
Teichert – Reiff	2018	**4**	10	45	0.8	**0.556**	± 0.031
Teichert – Reiff	2019	*(Shiners not found in 2019)*					
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

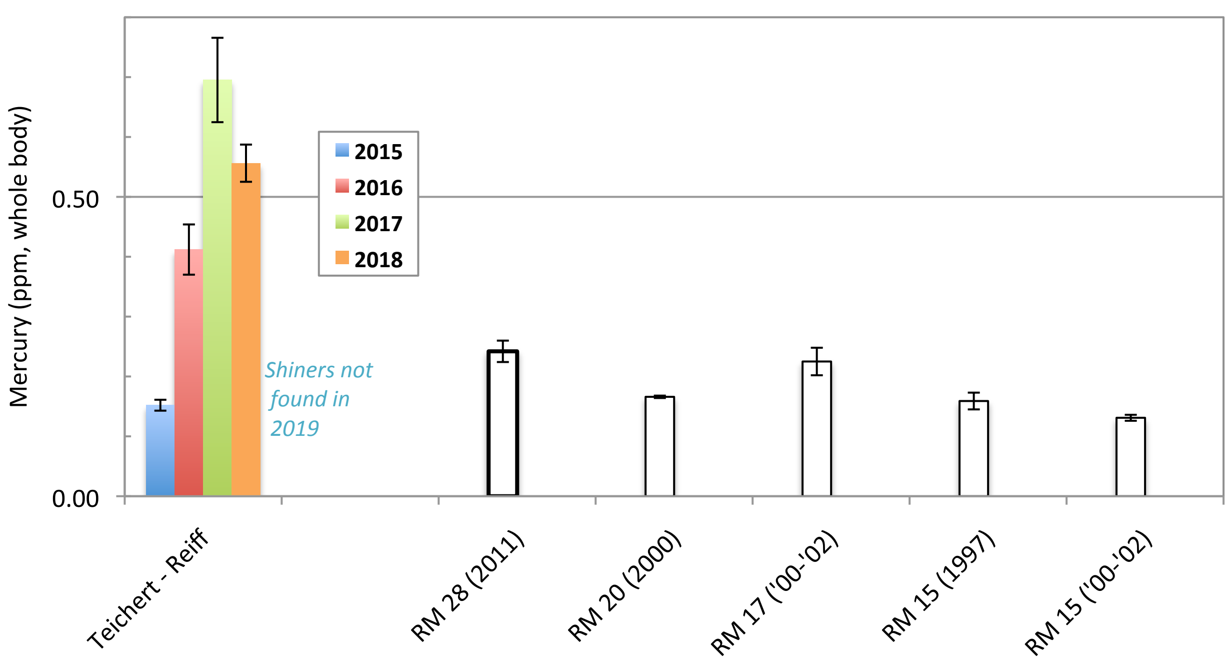


Figure 22. Red Shiner summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 23. 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 – Reiff	2015	–	–				
Teichert – Reiff	2016	–	–				
Teichert – Reiff	2017	**4**	1-2	137	32	**0.798**	± 0.094
Teichert – Reiff	2018	**4**	4-6	111	17	**0.445**	± 0.069
Teichert – Reiff	2019	**4**	5	107	15	**0.297**	± 0.010
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**

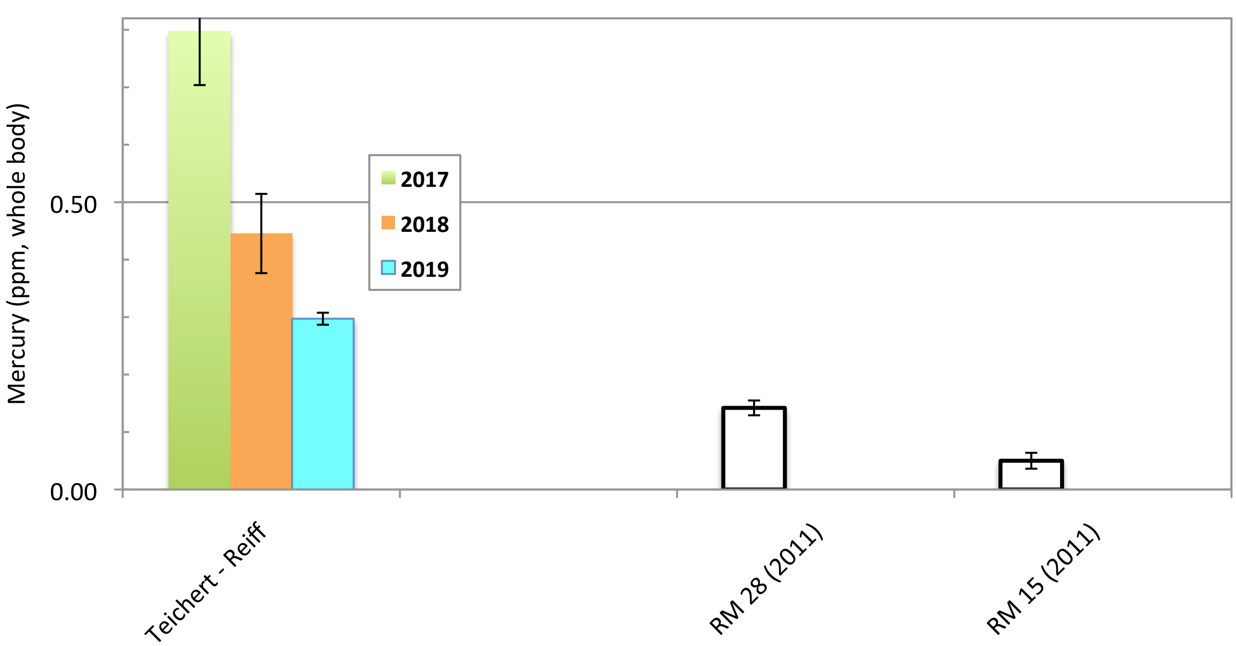


Figure 23. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 24. 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 – Reiff	2015	**1**	1	68	5.1	**0.241**	
Teichert – Reiff	2016	**–**	–				
Teichert – Reiff	2017	–	–				
Teichert – Reiff	2018	**4**	2	48	2.3	**0.252**	± 0.010
Teichert – Reiff	2019	**4**	3-10	41	1.3	**0.187**	± 0.029
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**

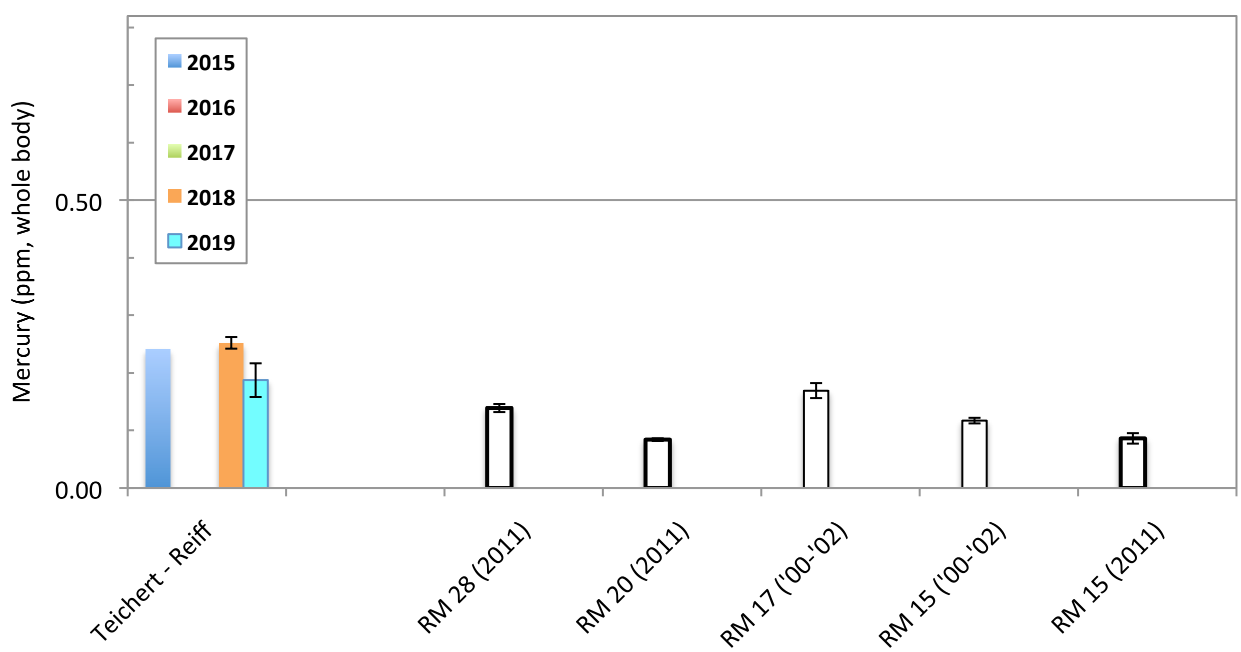


Figure 24. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

4. TEICHERT-ESPARTO–MAST POND

(Google Earth 2019)

4. TEICHERT-ESPARTO – MAST POND *(Tables 25-26, Figures 25-26)*

Summary

Mast Pond continued to have a single fish species present, Mosquitofish. We collected composite samples of all the sizes present. In 2019, mercury levels increased to levels similar to 2017, after lower concentrations were found in 2018. In comparison to baseline Cache Creek Mosquitofish samples, all samples from 2017 and 2019 were statistically high above baseline and 2018 fish, though lower, were statistically elevated over two of three creek data sets. Mast Pond is therefore tentatively identified as "elevated in three or more years of five" over baseline at this point. However, with mining largely concluded at the Teichert-Esparto property in 2019, the Reiff and two Mast basins were breached together in 2020, forming one large pond. This will continue to be monitored as a single Teichert-Esparto Pond, including expanded analysis and development of a management plan.

The Mast Pond is located at Teichert's Esparto Facility, just north of Cache Creek and west of Highway 505 between 505 and County Road 87. It is near the Reiff pond, which is northwest of Mast. Mast Pond, at the time of sampling in Fall 2019, was separated into two basins as in 2017-2018. The northwest basin was an elongated oval approximately 425 m long and 150 m wide. The southeast basin was an irregular shape approximately 400 m by 400 m. Depths were not measured. This pond was first created in or before 2002, along with Reiff. It was the site of extensive active mining in 2015 and 2016, which was halted in 2017. In 2017, active mining was halted at the Esparto Plant in general, with Teichert's focus shifting to the downstream Woodland Plant area. In late 2018, the Esparto Plant resumed mining at Mast Pond. This (2019) was Year 3 of monitoring for the Mast Pond.

We sampled both basins of the pond with a range of techniques, but again found no large fish in 2019. Extensive seining, set-lines, and gill-nets continued to yield just one species of small fish, Mosquitofish (*Gambusia affinis*), present in high densities. With no predatory fish at this time, Mast Mosquitofish were able to reach significantly larger sizes than at the other ponds. While still very small fish (1.9-2.2" and 1-2 g, vs. 1.1-1.8" and 0.2-0.9 g), they represent the largest fish class present at Mast Pond. As Mosquitofish were the only species available, we collected composites within the standard, inter-comparable sizes (4 composites of 10 fish each in classes between 25-43 mm or 1.0-1.7") from each of the two basins, and also 4 composites of the larger sizes. The Mosquitofish collected are listed in Table 25.

In total this added up to 12 small fish composite mercury samples analyzed from the Mast Pond in the Fall 2019 monitoring. The analytical results from each small fish composite sample can be seen in Table 25 and, graphically, in Figure 25. Then the data are shown in reduced form (means, error bars, etc.) and compared the most closely comparable historic creek data (Table 26, Figure 26).

Small, Young Fish

Mosquitofish

Standard, Intercomparable Sizes: The standard Mosquitofish multiple-fish composites, overall across both Mast basins, had whole-body mercury ranging from 0.109-0.618 ppm, averaging 0.287 ppm. Fish from the southeast basin ranged from 0.109-0.335 ppm, averaging 0.206 ppm. Samples from the northwest basin were significantly higher, ranging from 0.221-0.618 ppm and averaging 0.368 ppm. Following a significant decrease in average mercury in 2018 (0.182 ppm), the 2019 overall Mosquitofish average was back up to levels statistically similar to the initial 2017 sampling (0.312 ppm) and to the highest Mosquitofish levels found in any of the sampled ponds to-date. The 2019 average was also statistically elevated over all three of the Cache Creek baseline comparison sets.

Additional, Larger Sizes: The larger classes of Mosquitofish, ≥ 47 mm (1.9") and 0.04 g, were all similarly elevated in their mercury content, ranging between 0.540-0.623 ppm, with an overall mean of 0.564 ppm. Mercury in these larger, northwest basin fish was significantly higher than in the smaller, standard-sized fish from both basins. It was also significantly higher than, almost double, the levels from comparable large-size fish collected last year (0.295 ppm), and all standard-size Mosquitofish sampled from any of the ponds to-date. With no other small fish species, these over-sized Mosquitofish are the maximum exposure prey at Mast Pond for fish-eating birds, which tend to preferentially target the larger individuals of small fish species.

Table 25. Teichert-Esparto–Mast Pond: Small Fish Sampled, Fall 2019
(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)
Northwest Basin						
Standard, inter-comparable sizes						
Mosquitofish	10	27	1.0	0.25	0.009	**0.221**
Mosquitofish	10	32	1.2	0.43	0.015	**0.234**
Mosquitofish	10	37	1.4	0.61	0.022	**0.399**
Mosquitofish	10	41	1.6	0.95	0.034	**0.618**
Additional, larger sizes						
Mosquitofish	5	47	1.9	1.16	0.041	**0.551**
Mosquitofish	5	51	2.0	1.42	0.050	**0.543**
Mosquitofish	5	52	2.1	1.66	0.059	**0.540**
Mosquitofish	5	55	2.2	2.05	0.072	**0.623**
Southeast Basin						
Standard, inter-comparable sizes						
Mosquitofish	10	27	1.0	0.22	0.008	**0.109**
Mosquitofish	10	30	1.2	0.31	0.011	**0.150**
Mosquitofish	10	34	1.3	0.46	0.016	**0.228**
Mosquitofish	10	40	1.6	0.81	0.029	**0.335**

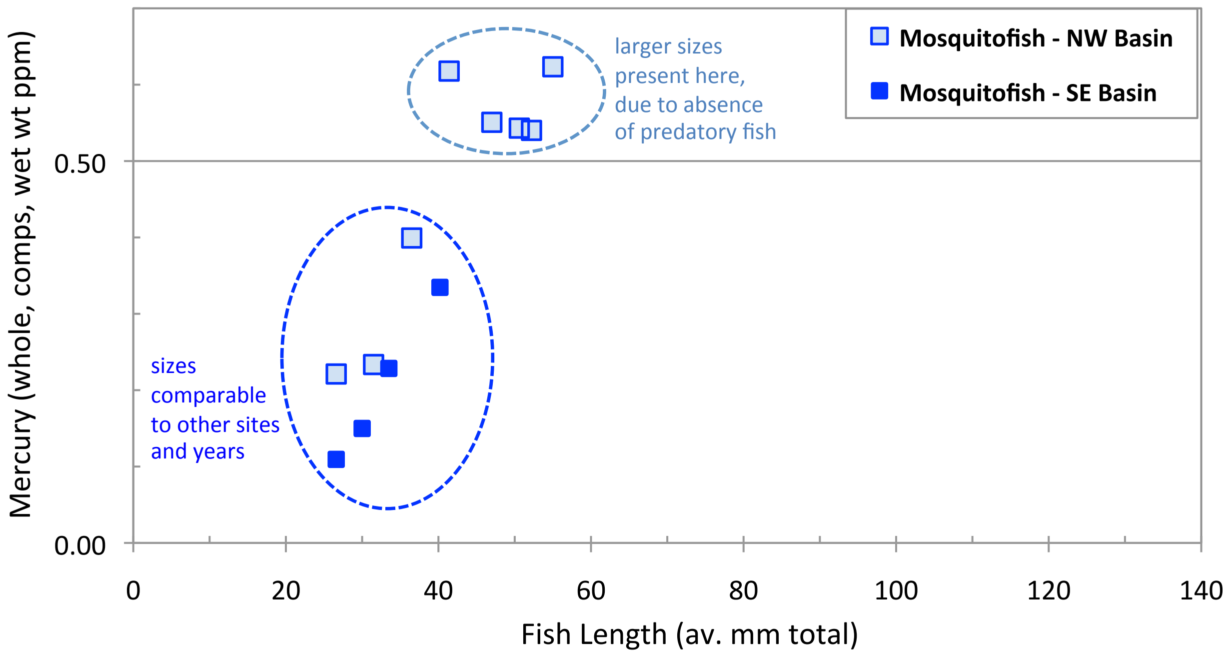


Figure 25. **Teichert-Esparto–Mast Pond: Small Fish Sampled, Fall 2019**
(mercury in whole-body, multi-individual composite samples)

Table 26. 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 *(standard sizes comparable to other sites and dates)*							
Teichert – Mast (NW)	2017	4	10	35	0.5	0.351	± 0.077
Teichert – Mast (SE)	2017	4	10	35	0.5	0.273	± 0.056
Teichert – Mast (ALL)	2017	8	10	35	0.5	0.312	± 0.046
Teichert – Mast (NW)	2018	**4**	10	34	0.4	**0.197**	± 0.019
Teichert – Mast (SE)	2018	**4**	10	35	0.5	**0.168**	± 0.024
Teichert – Mast (All)	2018	**8**	10	34	0.5	**0.182**	± 0.015
Teichert – Mast (NW)	2019	4	10	34	0.6	0.368	± 0.093
Teichert – Mast (SE)	2019	4	10	33	0.5	0.206	± 0.050
Teichert – Mast (ALL)	2019	8	10	34	0.5	0.287	± 0.058
(larger sizes present at Mast – due to absence of large, predatory fish; not comparable to other sites)							
Teichert – Mast 'giants'	2018	**6**	2-8	54	2.0	**0.295**	± 0.009
Teichert – Mast 'giants'	2019	**4**	5	51	1.6	**0.564**	± 0.020
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**

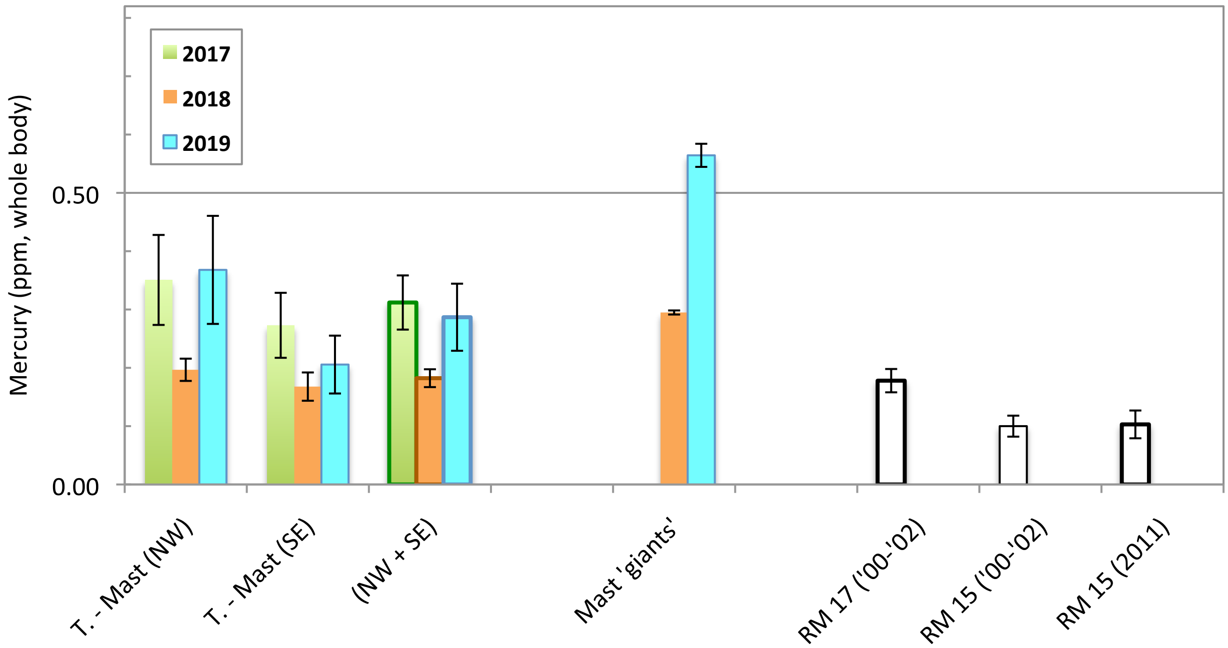


Figure 26. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

5. TEICHERT-WOODLAND – STORZ POND

(Google Earth 2019)

5. TEICHERT-WOODLAND – STORZ POND *(Tables 27-31, Figures 27-31)*

Summary

A sample of 10 very small adult bass (the main size present) and 2 larger bass was taken, together with young-of-year, multiple composite samples of Mosquitofish and juvenile Largemouth Bass. Adult bass showed a drop in mercury levels in 2019. This followed a drop in mercury levels in their food items (small fish) in 2018. While most of the small fish returned to typical (low) levels for this site, in 2019 Storz was the lowest in adult bass mercury of the six monitored ponds that contained bass. This pond continued to rank as "not elevated over baseline" and is not flagged for expanded analysis or management planning.

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. Depths in 2019 were shallow, ranging to approximately 6 m (20'). Storz consists of 2 sub-basins that alternate between being connected and split, depending on runoff inputs. In Fall 2019, they were connected. Together, they are approximately 150 m x 800 m in size.

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 2019, bass were present mainly in the narrow range of 182-218 mm (7-9") size range. Because of the small sizes and narrow range, we kept the sample of this group to 10 fish. An additional 2 bass were taken of a much larger size, 347-357 mm (13-14") and over five times larger by weight. The 12 bass were sampled for fillet muscle mercury. For small fish analyses, Mosquitofish were sampled with 4 size-class composites of 10 fish each, and juvenile Largemouth Bass with 4 individual samples. We were not able to collect additional juvenile bass, despite extensive seining.

In total, 12 large fish muscle samples and 8 small fish composite samples, or 20 separate mercury samples, were analyzed from the Teichert–Storz Pond in the Fall 2019 monitoring. The fish metrics and analytical results from each of the bass muscle and small fish composite samples are shown in Tables 27-28 and, graphically, in Figures 27-28. The data are shown in reduced form (means, error bars) and compared to the most closely comparable historic creek data in Tables 29-31 and Figures 29-31.

Large, Angling-sized Fish

Largemouth Bass

As noted above, the bass samples included 10 fish from main cohort of fish present, in the small size range of 182-218 mm (7-9"), and two much larger individuals at 347-357 mm (13-14" and over five times larger by weight). Fillet muscle mercury, across both size groups, ranged between 0.124 and 0.340 ppm, averaging 0.218 ppm. The small-size set averaged 0.198 ppm, and the larger fish 0.323 ppm. These were all very low mercury levels for bass in this watershed. Although the larger fish were higher in mercury than the smaller adults, the increase with size was very muted, as compared to the trends at most of the other ponds. As can be seen in Figure 29, the overall mercury levels (0.218 ppm) were down dramatically from the already moderate-low levels of 2018 (0.611 ppm) and 2017 (0.657 ppm). Teichert–Storz had previously been the second lowest fish mercury pond in the monitoring program. But this 2019 set of Storz fish was significantly lower in mercury than all other collections of bass, in this year or any previous monitoring year. They also had significantly lower mercury than all of the historic baseline Cache Creek comparisons. This follows from the significantly lower mercury seen in small prey fish the year before.

Small, Young Fish

Juvenile Largemouth Bass

Juvenile bass were again very scarce, apparently due to cannibalism by larger bass, but we were able to collect 4 individuals. These were analyzed individually as whole fish. Mercury levels ranged from 0.064-0.214 ppm, averaging 0.131 ppm. As with the larger adult bass, this was much lower than the last available samples (0.337 ppm in 2017). It was also significantly lower than at all but one of the other monitored ponds (Cemex–Phase 1, 0.114 ppm). As compared to the baseline comparison samples from the creek, it was similar to the River Mile 28 set (0.142 ppm) and significantly higher than the River Mile 15 set (0.050 ppm).

Mosquitofish

The Mosquitofish composite samples had whole-body mercury ranging from 0.154-0.239 ppm, averaging 0.200 ppm. This was lower than the 2016 sets (0.229 ppm) and significantly lower than the 2017 samples (0.282 ppm), but it was up significantly from the unusually low levels seen last year in 2018 (0.087). It is likely that the very low adult bass mercury levels we found in 2019 were linked, through diet, to the very low Mosquitofish mercury levels in the previous year. As compared to baseline creek samples, the 2019 Storz Pond Mosquitofish mercury levels were higher than all 3 of the creek data sets, which averaged 0.094-0.172 ppm. The Storz 2019 level was statistically similar to the River Mile 17 average and was significantly higher than the the two River Mile 15 sets. It is odd that mercury in this small prey fish was not particularly low at this site (for the species), when it was so notably low in the top predator bass. This highlights the complexities of mercury cycling in different environments, with different food webs. In any case, the absolute mercury concentrations were low (≤ 0.340 ppm) for all of the fish here, including the Mosquitofish.

Table 27. Teichert-Woodland–Storz Pond: Large fish sampled, Fall 2019

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	182	7.2	75	0.2	**0.204**
Largemouth Bass	183	7.2	65	0.1	**0.200**
Largemouth Bass	184	7.2	60	0.1	**0.124**
Largemouth Bass	193	7.6	85	0.2	**0.192**
Largemouth Bass	195	7.7	90	0.2	**0.183**
Largemouth Bass	197	7.8	90	0.2	**0.162**
Largemouth Bass	202	8.0	100	0.2	**0.192**
Largemouth Bass	203	8.0	97	0.2	**0.254**
Largemouth Bass	208	8.2	102	0.2	**0.164**
Largemouth Bass	218	8.6	135	0.3	**0.300**
Largemouth Bass	347	13.7	640	1.4	**0.340**
Largemouth Bass	357	14.1	815	1.8	**0.305**

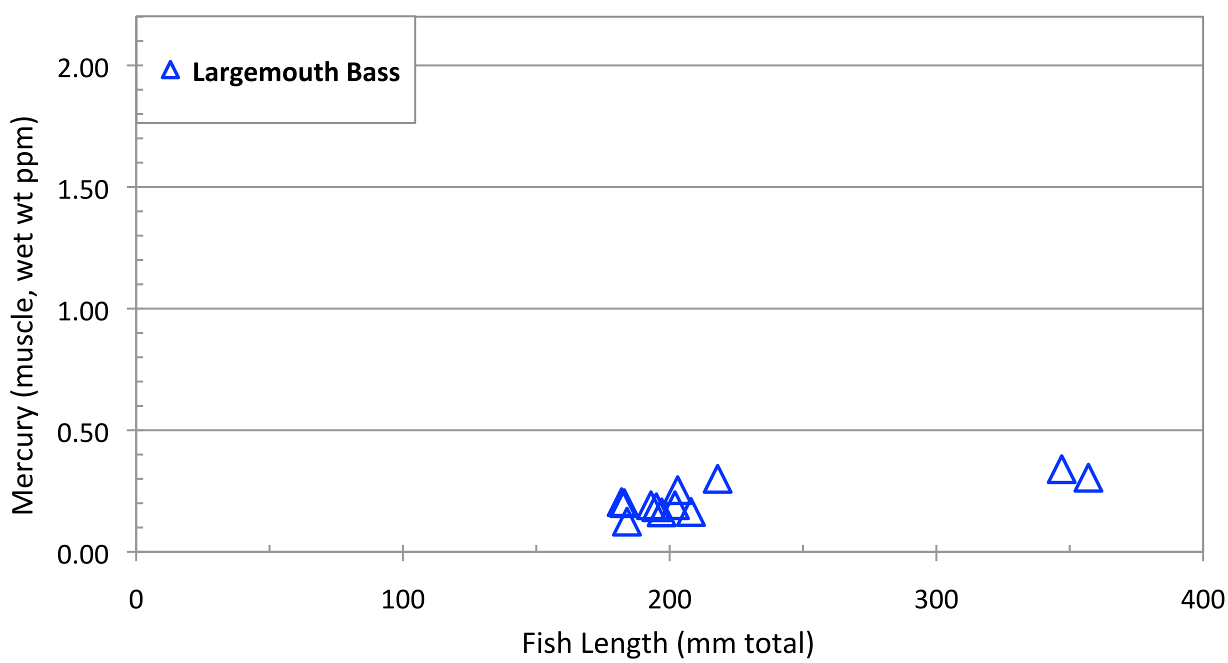


Figure 27. Teichert-Woodland–Storz Pond: Large Fish Sampled, Fall 2019
(mean fillet muscle mercury, with 95% confidence intervals)

Table 28. Teichert-Woodland–Storz Pond: Small Fish Sampled, Fall 2019
(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	122	4.8	24.81	0.88	**0.064**
Largemouth Bass (juv)	1	132	5.2	30.17	1.06	**0.214**
Largemouth Bass (juv)	1	132	5.2	29.60	1.04	**0.168**
Largemouth Bass (juv)	1	133	5.2	31.03	1.09	**0.079**
Mosquitofish	10	28	1.1	0.22	0.008	**0.154**
Mosquitofish	10	31	1.2	0.32	0.011	**0.199**
Mosquitofish	10	34	1.4	0.32	0.011	**0.208**
Mosquitofish	6	38	1.5	0.57	0.020	**0.239**

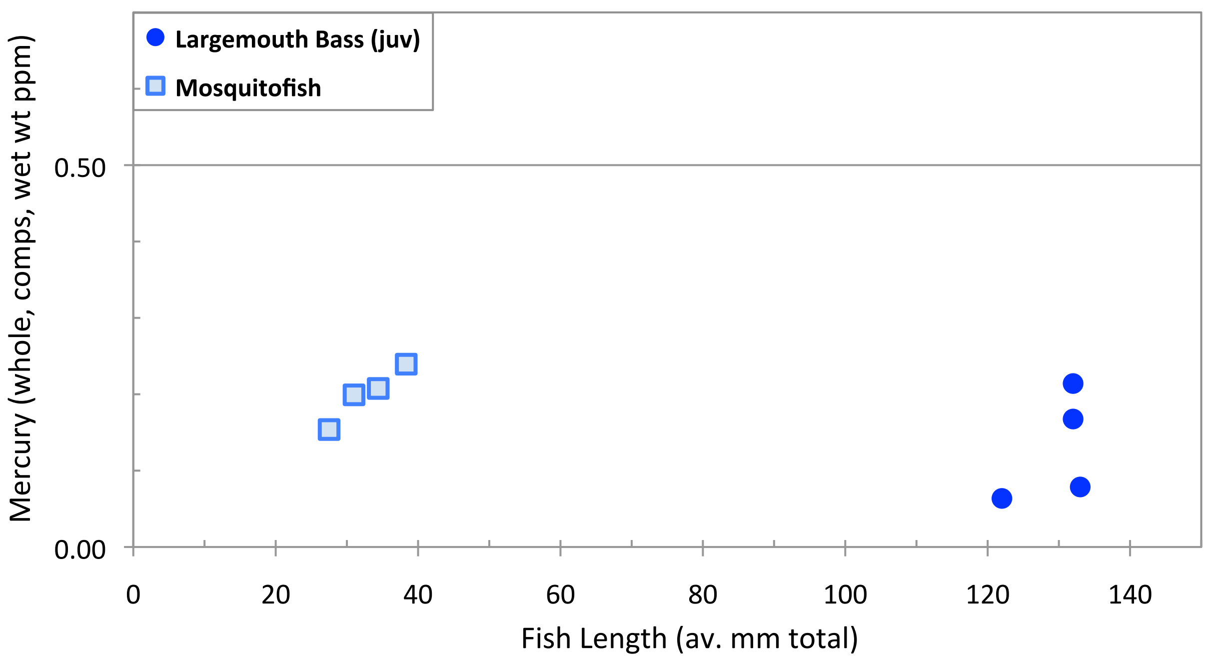


Figure 28. Teichert-Woodland–Storz Pond: Small Fish Sampled, Fall 2019
(mercury in whole-body, multi-individual composite samples)

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 – Storz	2017	**20**	245	203	**0.657**	± 0.038
Teichert – Storz	2018	20	255	197	**0.611**	± 0.082
Teichert – Storz	2019	12	222	196	**0.218**	± 0.042
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**

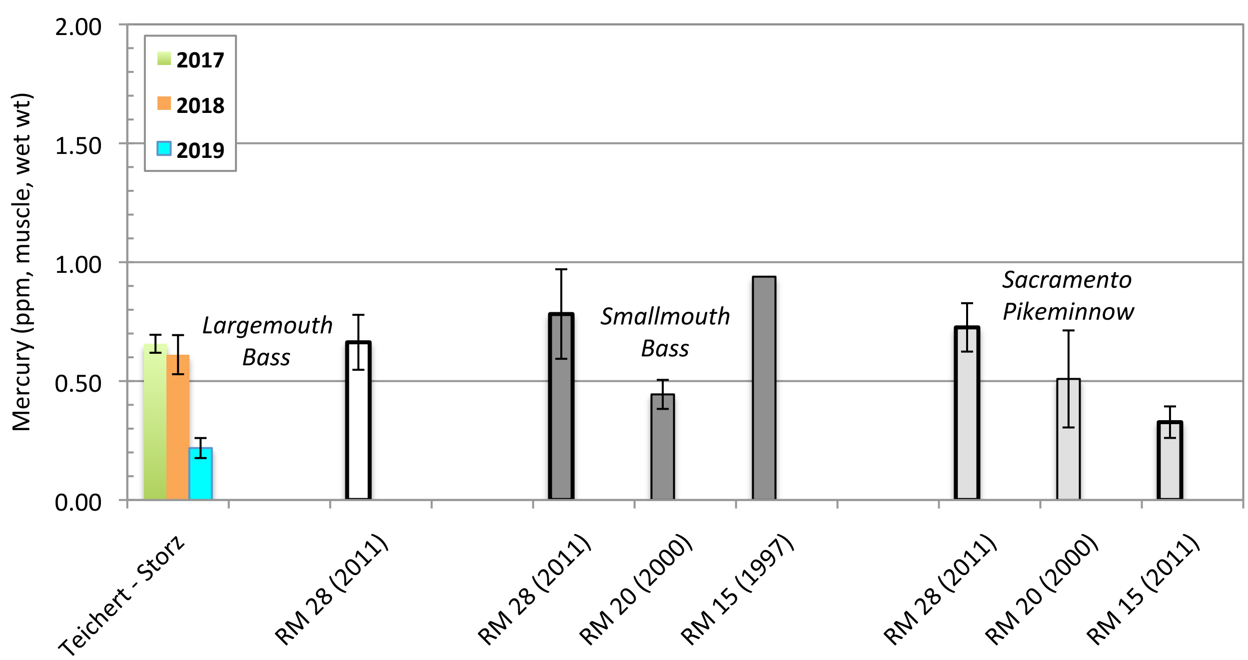


Figure 29. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

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

Table 30. 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 – Storz	2016	**4**	10	35	0.5	**0.229**	± 0.054
Teichert – Storz	2017	**4**	8-10	29	0.2	**0.282**	± 0.011
Teichert – Storz	2018	**4**	10	30	0.3	**0.087**	± 0.017
Teichert – Storz	2019	**4**	6-10	33	0.4	**0.200**	± 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**

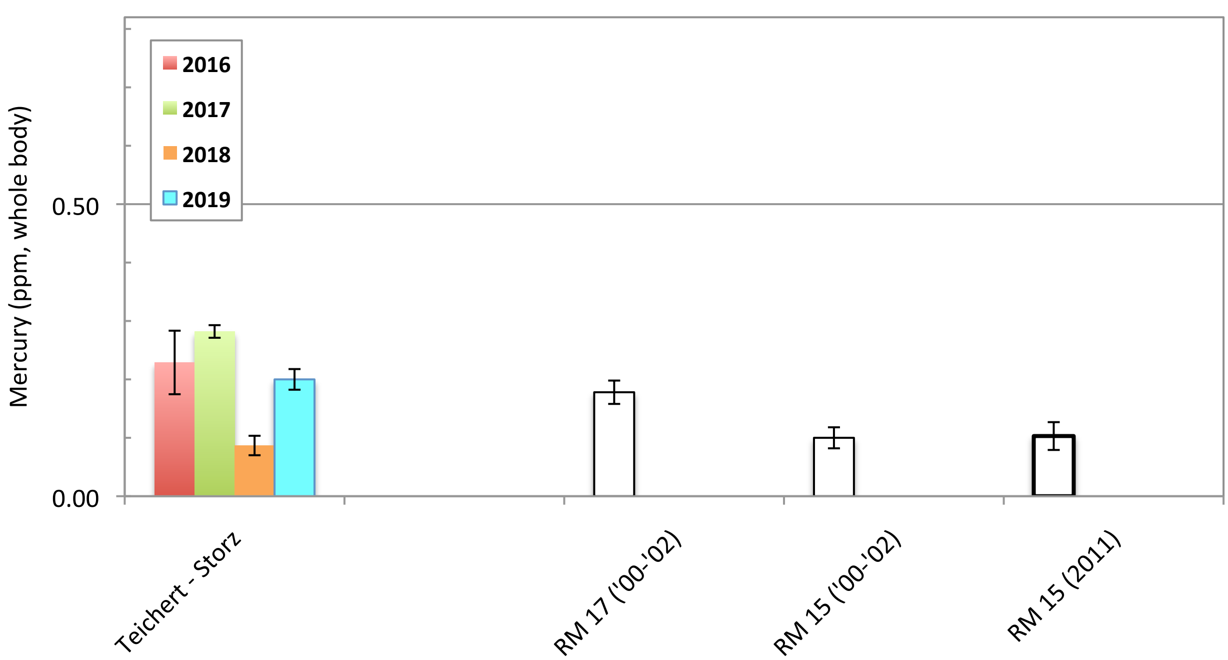


Figure 30. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 31. 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 – Storz	2017	**4**	1	143	35	**0.337**	± 0.030
Teichert – Storz	2018	–	–				
Teichert – Storz	2019	**4**	1	130	29	**0.131**	± 0.036
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**

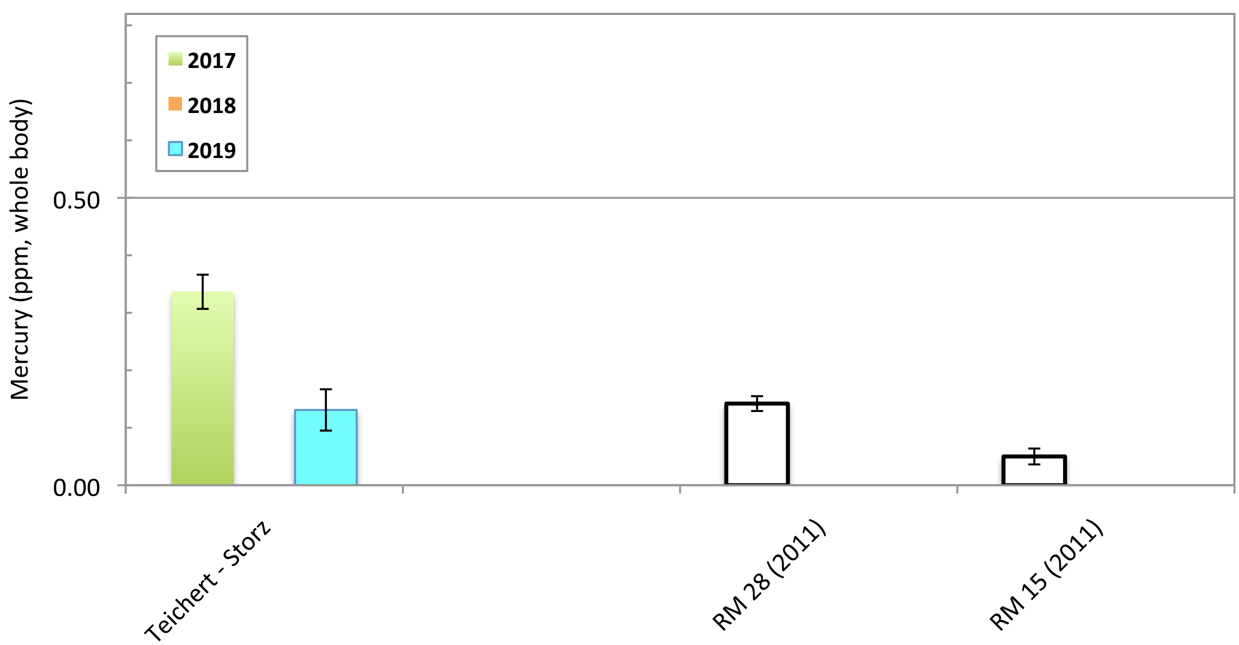


Figure 31. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

6. SYAR–B1 POND

(Google Earth 2019)

6. SYAR–B1 POND *(Tables 32-38, Figures 32-38)*

Summary

Twenty adult Largemouth Bass were sampled, and two adult Green sunfish. Young-of-year, multiple composite samples were taken of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. Fish mercury remained lower than in 2015-2016, after a substantial decline in 2017. Adult Largemouth Bass remained down from previous (very high) levels, by more than 40%. Juvenile bass, Green Sunfish, and Mosquitofish also all remained at lower levels, relative to 2015-2016. Despite the drop in recent years, B1 Pond fish mercury was still statistically higher in 2019 than most baseline Cache Creek comparisons, for all species sampled. Because of the overall status of the B1 Pond as "elevated over baseline in three or more years of five", 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.

The Syar Cache Creek mining operation, begun before 2002, has been idle since 2011 and remained inactive throughout the 5 years it has been monitored (2015-2019). 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. One has an irregular shape about 500 m long x 75-200 m wide. The other, located to the west, is approximately 300 m x 400 m in size. There is a narrow, shallow, 400 m long channel that can link the two basins under high rainfall, high water level conditions. This was not the case in 2015-2016 and throughout the previous drought years, when the ponds were independent of each other. We were provided access to the eastern pond of the two since 2015, and refer to that as the Syar–B1 Pond. Beginning in 2017, we also sampled the western pond (Syar–West Pond), discussed in the next section. This (2019) was Year 5 of monitoring for the Syar–B1 Pond.

The B1 Pond is located in a steep-sided surrounding depression. Maximum depth throughout the 2019 sampling year ranged between 7.9 and 10.7 m (26-35 feet). The shorelines are mostly steep, with the main area of the pond at a similar depth, within a meter or two of maximum depth.

As at the other sites, we sampled the B1 Pond during day, twilight, and night conditions on multiple days and with a range of techniques. We were able to obtain good samples of most of the fish species present. Fishing pressure has been heavy and obvious at this pond, mostly from Esparto teenagers. At this point, we have talked to enough of them that the word has spread to not eat the fish; there continues to be a lot of mostly catch and release fishing. That does, however, train the fish to be wary, making our collections more difficult, but we were still able, eventually, to get a decent collection of bass. The 2019 collections included a set of 20 Largemouth Bass (*Micropterus salmoides*) and 2 adult Green Sunfish (*Lepomis cyanellus*) fillet muscle samples. The small, young fish present were juvenile Largemouth Bass (3-4"), juvenile Green Sunfish (1-2") and Mosquitofish (*Gambusia affinis*, 1-2"). Each of these were sampled with 4 composite samples.

In total, 22 large fish muscle samples and 12 young, small fish composite samples, or 34 separate mercury samples, were analyzed from the Syar–B1 Pond in the Fall 2019 monitoring. The fish metrics and analytical results from each individual large fish muscle sample and each small, young fish composite sample can be seen in Tables 32 and 33 and, graphically, in Figures 32 and 33. Then, for each sample type, the new data are shown in reduced form (means, error bars, etc.) and compared to 2015-2018 results and the most closely comparable historic creek data (Tables 34-38, Figures 34-38).

Large, Angling-sized Fish

Largemouth Bass

The B1 Pond adult Largemouth Bass samples included 20 fish across the range of adult sizes present: 243-403 mm (10-16") in length and 155-960 g (0.3-2.1 lbs) in weight. They had fillet muscle mercury ranging from 0.517-2.057 ppm, averaging 0.977 ppm. This was statistically unchanged from 2018 (0.977 ppm) and 2017 (0.904 ppm) and remained significantly down, by approximately 40%, from the levels found in 2015-2016 when they averaged 1.628 and 1.640

ppm, which were extremely high fish mercury levels. After previously being significantly higher than all 7 comparable baseline/historic samples from Cache Creek, the 2017-2019 decline in bass mercury concentrations brought the B1 Pond fish into a range statistically similar to 3 of 7 baseline comparisons, though still somewhat higher than even the highest baseline samples. As noted last year, it can be seen in Figure 32 that the fish at or below app. 310 mm (12") in length clustered in a fairly narrow range of lower mercury levels (0.517-0.913, mean = 0.706 ppm, n = 11). The 9 fish larger than this had muscle mercury ranging to over 2.00 ppm (0.801-2.057, mean = 1.315 ppm, n = 9), generally increasing with size. The four highest mercury fish averaged 1.661 ppm. From a human (or wildlife) health perspective, the larger fish clearly present the greater hazard, as at the other ponds.

Green Sunfish

Two small adult Green Sunfish were collected in 2019, both app. 100 mm (4") in length. Muscle mercury was 0.400 and 0.514 ppm. Similar to the bass trend, this was down from the other sunfish data we have for this pond (0.777 ppm in 2015, 1.446 ppm in 2016). Relative to baseline creek Green Sunfish comparisons, the 2019 Syar–B1 level was lower than one and higher than the other three. Sample numbers have been too low since 2015 for statistical comparisons.

Small, Young Fish

Juvenile Largemouth Bass

The juvenile bass samples all had similar whole-body mercury levels, within the range of 0.292-0.381 ppm and averaging 0.338 ppm. This was down slightly from 2018 (0.368 ppm) and significantly lower than levels in 2015-2017 (0.461-0.589 ppm). The juvenile bass have come down in mercury each year since 2015. Relative to baseline juvenile bass comparison data from Cache Creek though, they still remained significantly higher than the two sample sets available: River Mile 28 (0.142 ppm) and River Mile 15 (0.050 ppm).

Juvenile Green Sunfish

The juvenile Green Sunfish composites had whole-body mercury of 0.216-0.287 ppm, averaging 0.245 ppm. This was very similar to corresponding collections from 2017-2018 (0.225-0.231

ppm). All three most recent years have been significantly lower than 2016 (0.414 ppm) and 2015 (0.325 ppm). Relative to baseline juvenile Green Sunfish comparison numbers from Cache Creek though, they remained higher despite the decline of the last three years. The difference was statistically significant for all of the 5 comparisons.

Mosquitofish

The Mosquitofish samples had whole-body mercury ranging tightly from 0.196-0.235 ppm, averaging 0.214 ppm. This was up from 2018 (0.163 ppm), but still significantly lower than previous corresponding collections in 2017 (0.309 ppm) and 2015 (0.268 ppm). The 2019 Syar–B1 Mosquitofish mercury levels remained statistically elevated, relative to the three comparable Cache Creek sample sets from River Miles 15 and 17 (0.094-0.172 ppm).

Table 32. Syar–B1 Pond: Large fish sampled, Fall 2019

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	243	9.6	155	0.3	**0.517**
Largemouth Bass	254	10.0	185	0.4	**0.778**
Largemouth Bass	266	10.5	225	0.5	**0.644**
Largemouth Bass	267	10.5	200	0.4	**0.832**
Largemouth Bass	272	10.7	240	0.5	**0.832**
Largemouth Bass	272	10.7	230	0.5	**0.614**
Largemouth Bass	276	10.9	255	0.6	**0.817**
Largemouth Bass	280	11.0	265	0.6	**0.913**
Largemouth Bass	280	11.0	235	0.5	**0.544**
Largemouth Bass	283	11.1	260	0.6	**0.570**
Largemouth Bass	293	11.5	285	0.6	**0.703**
Largemouth Bass	317	12.5	415	0.9	**1.034**
Largemouth Bass	330	13.0	485	1.1	**0.994**
Largemouth Bass	342	13.5	555	1.2	**1.148**
Largemouth Bass	343	13.5	470	1.0	**1.606**
Largemouth Bass	347	13.7	555	1.2	**0.801**
Largemouth Bass	354	13.9	520	1.1	**1.214**
Largemouth Bass	354	13.9	500	1.1	**2.057**
Largemouth Bass	372	14.6	545	1.2	**1.510**
Largemouth Bass	403	15.9	960	2.1	**1.471**
Green Sunfish	98	3.9	14	0.0	**0.514**
Green Sunfish	105	4.1	20	0.0	**0.400**

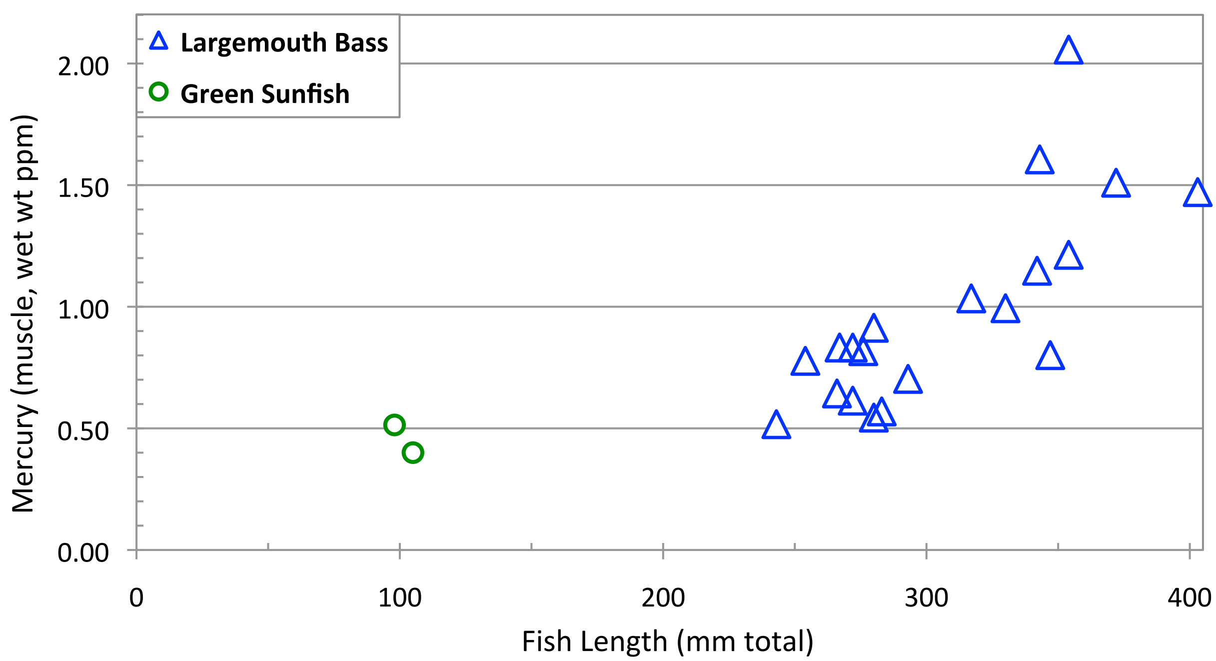


Figure 32. Syar–B1 Pond: large fish sampled, Fall 2019
(fillet muscle mercury in individual fish)

Table 33. Syar–B1 Pond: Small Fish Sampled, Fall 2019
(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	80	3.1	5.15	0.18	**0.381**
Largemouth Bass (juv)	1	87	3.4	5.64	0.20	**0.314**
Largemouth Bass (juv)	1	88	3.5	8.64	0.30	**0.292**
Largemouth Bass (juv)	1	92	3.6	9.26	0.33	**0.366**
Green Sunfish (juv)	10	34	1.4	0.68	0.02	**0.216**
Green Sunfish (juv)	8	43	1.7	1.21	0.04	**0.223**
Green Sunfish (juv)	10	49	1.9	1.65	0.06	**0.254**
Green Sunfish (juv)	10	55	2.2	2.57	0.09	**0.287**
Mosquitofish	3	32	1.3	0.39	0.014	**0.196**
Mosquitofish	2	36	1.4	0.53	0.019	**0.212**
Mosquitofish	1	45	1.8	1.05	0.037	**0.235**

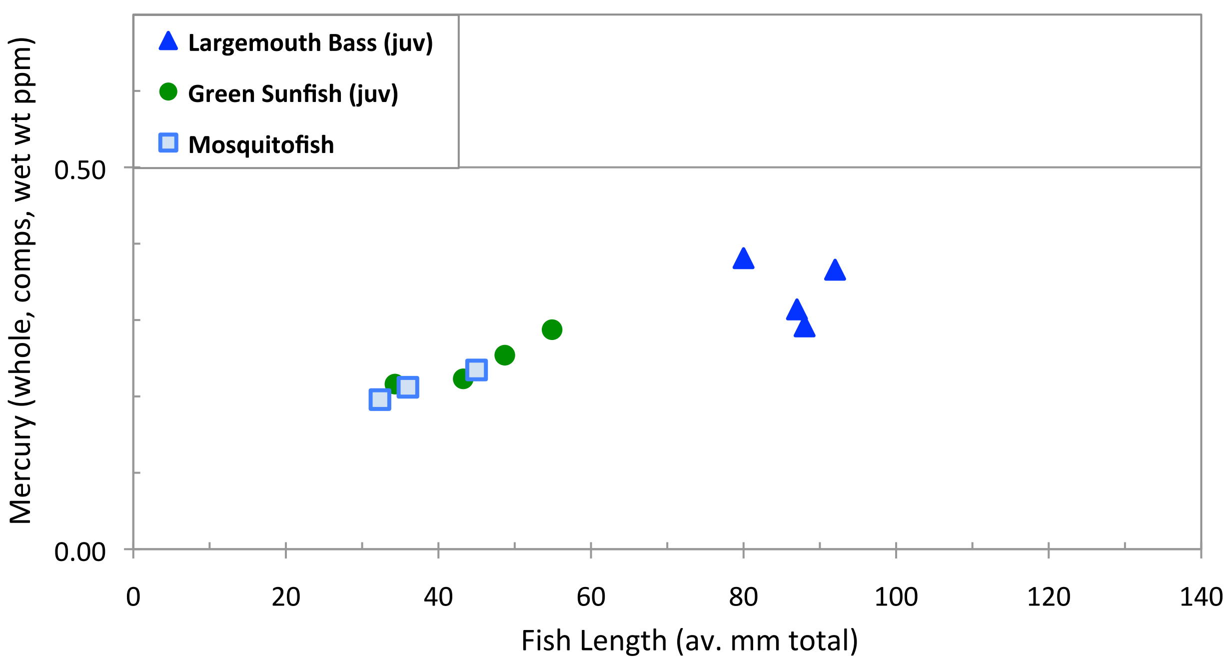


Figure 33. Syar–B1 Pond: small, young fish sampled, Fall 2019
(mercury in whole-body, multi-individual composite samples)

Table 34. 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
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**

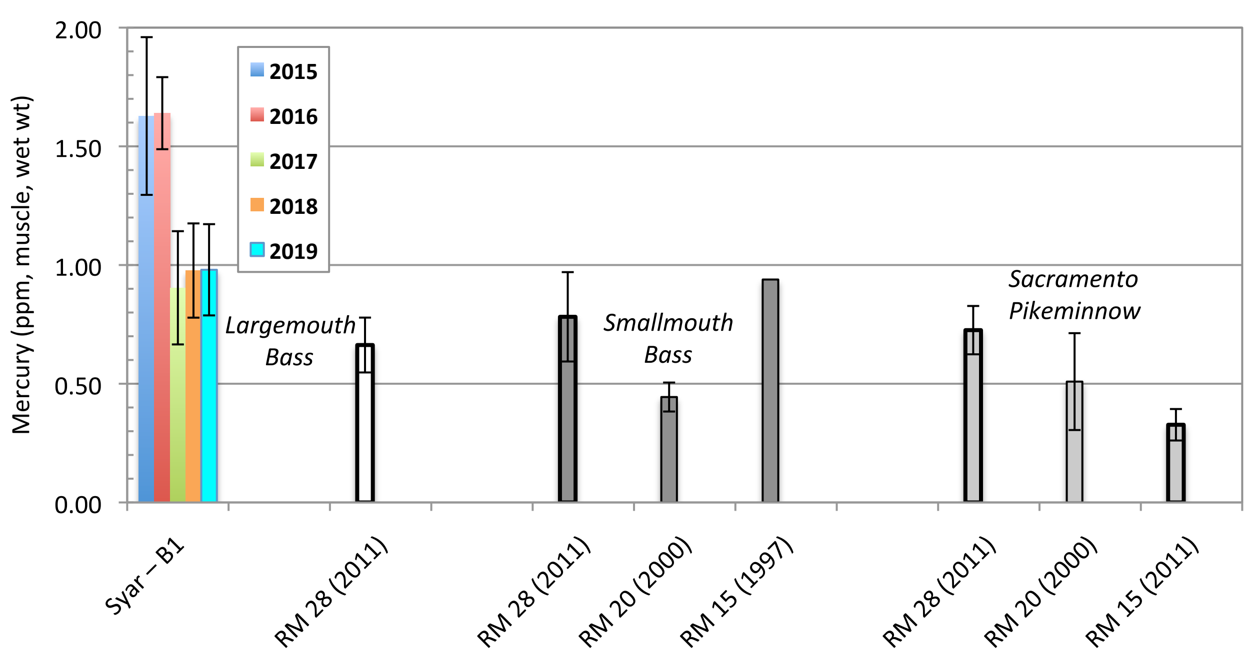


Figure 34. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 35. Green 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**	
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**

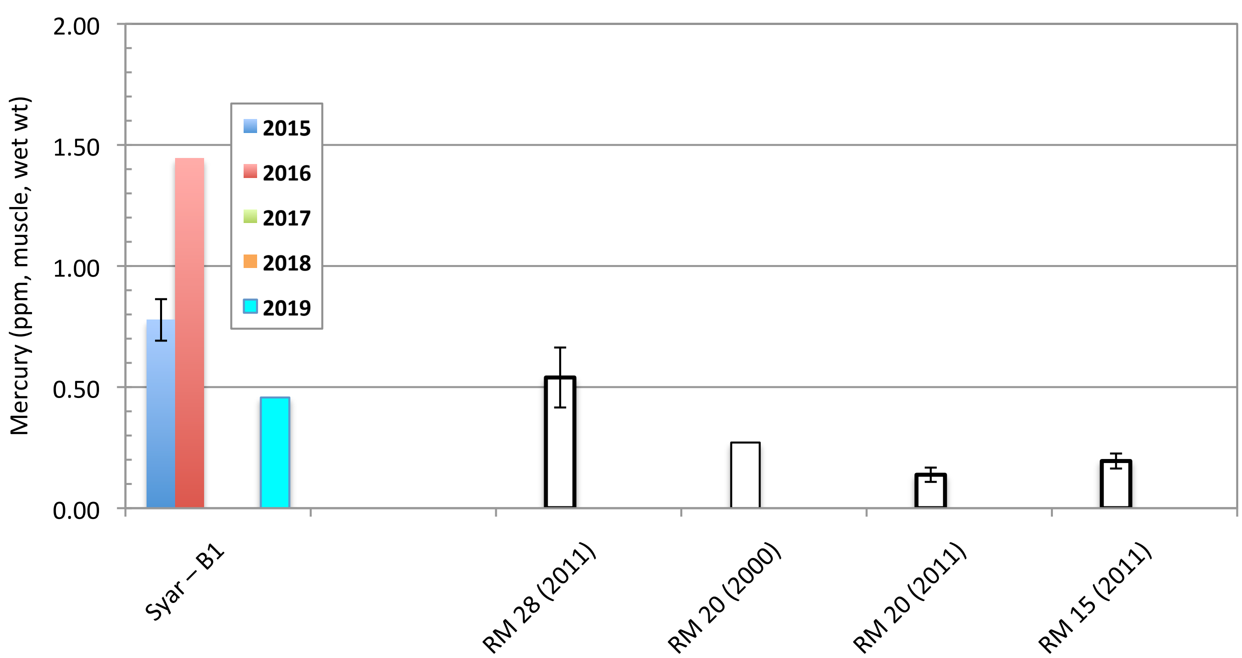


Figure 35. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

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

Table 36. 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	2018	**4**	1	87	7	**0.338**	± 0.021
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**

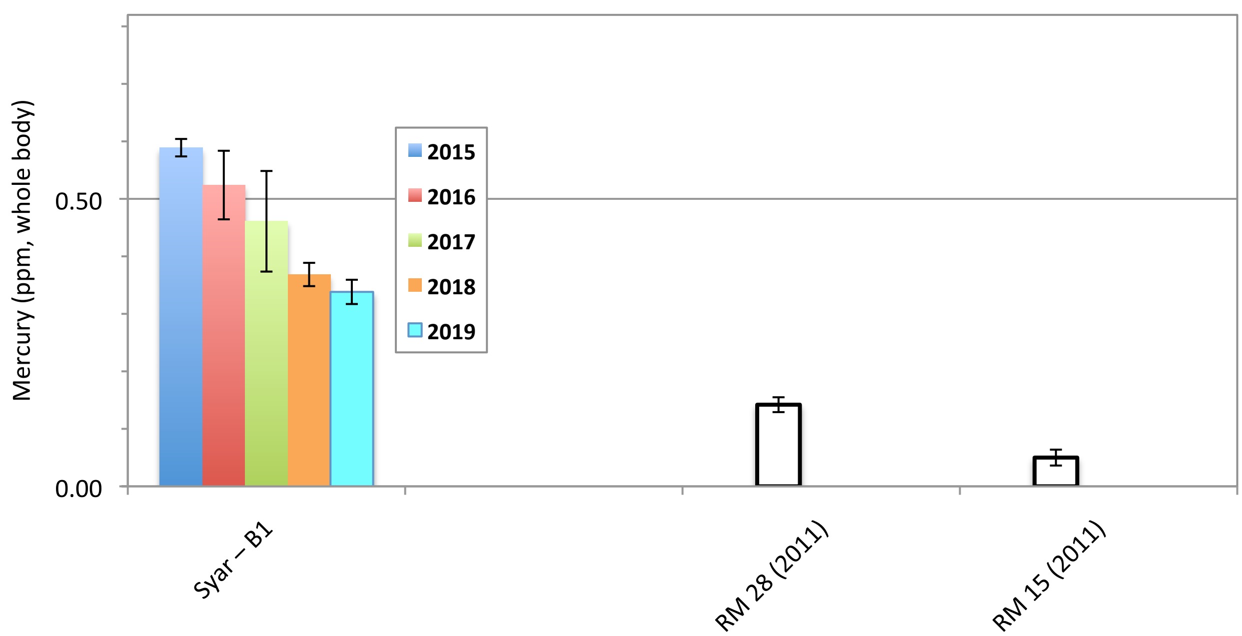


Figure 36. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 37. 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)							
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
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**

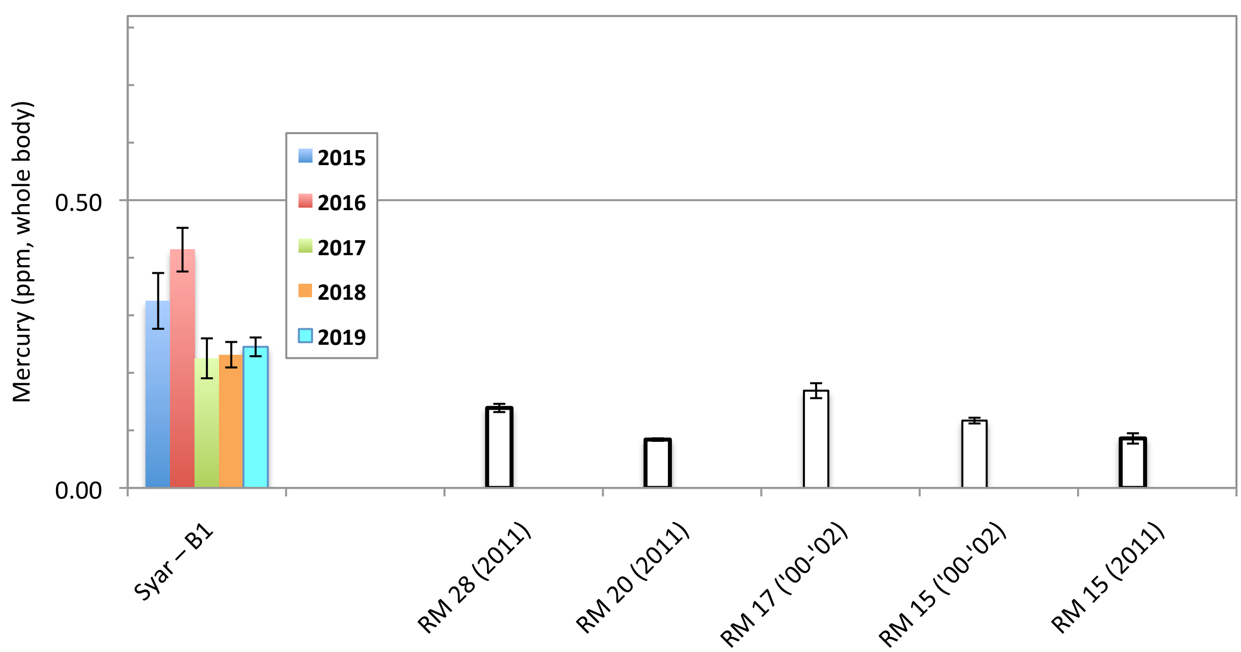


Figure 37. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 38. 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
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**

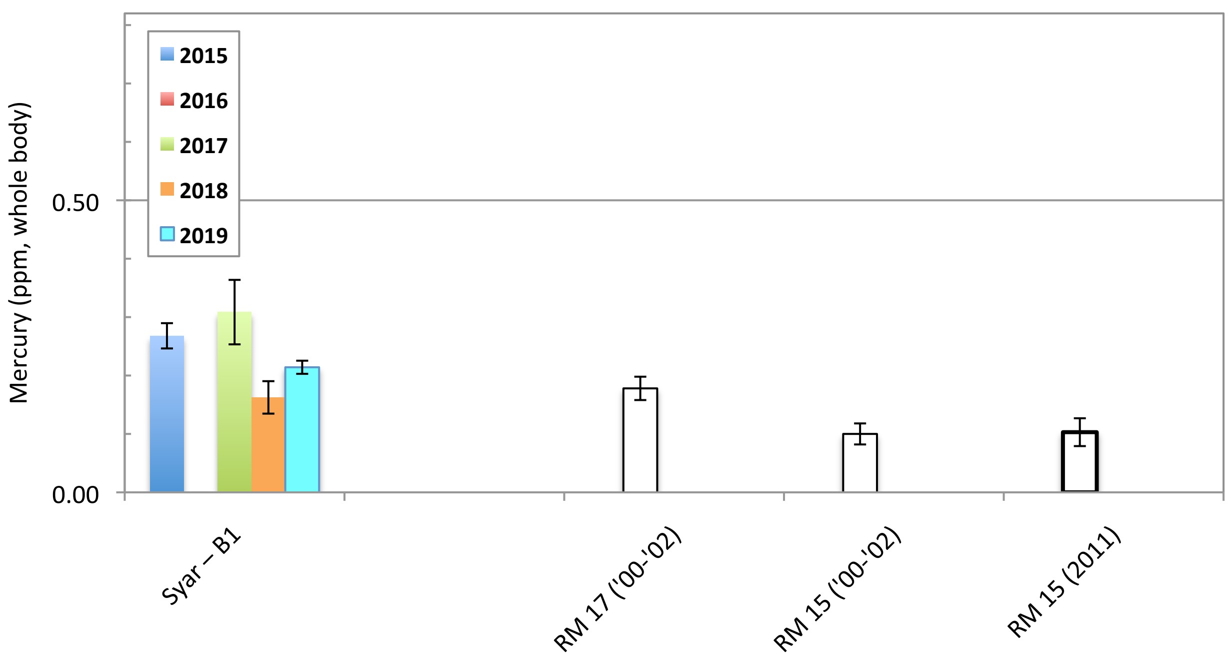


Figure 38. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

7. SYAR–WEST POND

(Google Earth 2019)

7. SYAR–WEST POND *(Tables 39-45, Figures 39-45)*

Summary

Twenty adult Largemouth Bass were sampled, and one each adult Green Sunfish and Bluegill Sunfish. Young-of-year, multiple composite samples were taken of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. Fish mercury data were mixed in 2019. This followed 2018, when all the samples, particularly the small fish, were down from the year before. The 2019 adult bass showed a continued gradual decline in mercury (not statistically significant), while all 3 small fish indicator species in 2019 showed statistically significant *increases* in mercury – to levels about midway between those seen in 2018 (lowest) and 2017 (highest). As discussed in other sections, large fish mercury is a slowly moving average of multiple years of accumulation, while the small fish mercury of any given year measures only recent exposure. The adult bass were still showing the signs of lower mercury prey from last year (averaging into their lifetime accumulations) but, by the end of the 2019 warm season, the small fish showed that methylmercury conditions were increasing toward average levels for this pond. In comparison to corresponding baseline/historic samples from Cache Creek, small fish in 2019 were statistically higher in mercury for 8 of 10 comparisons. Adult Largemouth Bass, though, were statistically elevated over creek levels in just 2 of 7 comparisons. On average across all sample types, the 2019 fish sets were statistically elevated over baseline in 2019, as in 2017. As that was not the case in 2018, there have not been "three or more years of five elevated over baseline" as specified in the Ordinance. Therefore, the Syar–West Pond fish data do not trigger expanded analysis or pond management considerations at this time. However, expanded analyses have been conducted here since 2018 as a second control/reference pond. 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.

As described in the previous section, this pond is located about half a kilometer west of the B1 Pond. It is approximately 300 m x 400 m in size. The West Pond is considerably deeper overall than the B1 Pond, with extensive areas more than 15 m (50 feet) deep. This pond was added to the monitoring in 2017, in line with the Ordinance. This (2019) was Year 3 of monitoring for the Syar–West Pond.

As at the other sites, we sampled the West Pond during day, twilight, and night conditions on multiple days with a range of techniques. We were able to obtain useful samples of most of the fish species present. These included fillet muscle samples of a full set of 20 Largemouth Bass (*Micropterus salmoides*). We also took 1 adult Green Sunfish (*Lepomis cyanellus*) and 1 adult Bluegill Sunfish (*Lepomis macrochirus*). The small, young fish present were juvenile juvenile Green Sunfish (1-2", 4 multi-individual composite samples), Mosquitofish (*Gambusia affinis*, 1-2", 3 composites), and juvenile Largemouth Bass (3-4", 2 individuals).

In total, 22 large fish muscle samples and 9 small fish composite samples, or 31 separate mercury samples, were analyzed from the Syar–West Pond in the Fall 2019 monitoring. The analytical results from each individual large fish muscle sample and each small, young fish composite sample can be seen in Tables 39 and 40 and, graphically, in Figures 39 and 40. Then, for each sample type, the new data are shown in reduced form (means, error bars, etc.) and compared to the most closely comparable historic creek data (Tables 41-45, Figures 41-45).

Large, Angling-sized Fish

Largemouth Bass

Twenty bass were sampled, across the size range present: 218-354 mm (9-14") in length and 105-550 g (0.2-1.2 lbs) in weight. We suspect that the lack of larger fish may be due to removal through the constant fishing pressure here. The bass samples had fillet muscle mercury ranging from 0.462-1.356 ppm, averaging 0.672 ppm. This was down from 2018 (0.798 ppm), and statistically down from 2017 (0.925 ppm), though this may be at least partly due to smaller average fish size/age. As noted in the nearby B1 Pond, the bulk of the fish (≤ app. 310 mm, 12") clustered in a narrower range of concentrations (0.462-0.981, mean = 0.617 ppm, n=18), while the three highest mercury fish, including the two largest, averaged 1.105 ppm. This was statistically similar to the levels found in similar bass from the B1 Pond. Relative to historic/baseline creek comparisons, the full 2019 Syar–Phase 1 bass sample was statistically similar to 5 of the 7 comparison data sets and remained significantly higher than 2 of 7.

Green Sunfish

One adult Green Sunfish was sampled. This 126 mm (5") fish had muscle mercury at 0.238 ppm. This was down, by more than half, from the only other sample taken here (2017, 0.579 ppm).

Bluegill Sunfish

One adult Bluegill Sunfish was sampled. This 148 mm (6") fish had muscle mercury at 0.368 ppm.

Small, Young Fish

Juvenile Largemouth Bass

We were able to collect just 2 juvenile bass from the Syar–West pond. They had closely matching whole-body mercury of 0.268-0.279 ppm, averaging 0.273 ppm. This was up significantly from 2018 (0.153 ppm), though still significantly lower than 2017 levels (0.418 ppm). This may be partly a function of different fish sizes available for collection in the three years. As compared to corresponding samples from the adjacent B1 Pond (0.338 ppm), levels were significantly lower, though closer than in 2018. Relative to baseline juvenile bass comparison data from Cache Creek, the 2018 juvenile bass were significantly higher than both sets.

Juvenile Green Sunfish

Juvenile Green Sunfish were more abundant than the other small fish; we collected strong, multiple-fish composite samples. They had whole-body mercury ranging narrowly from 0.156-0.195 ppm, averaging 0.177 ppm. As just discussed for juvenile bass, this was a significant increase from 2018 (0.102 ppm), but still significantly lower than levels from 2017 (0.237 ppm). Also as seen in the juvenile bass, the Syar–West juvenile Green Sunfish were significantly lower in mercury than corresponding samples from the nearby B1 Pond (0.245 ppm). Relative to baseline/historic juvenile Green Sunfish comparisons from Cache Creek, the 2019 Syar–West samples were statistically similar in mercury levels to one baseline set and significantly higher than four.

Mosquitofish

Mosquitofish were very scarce in 2019; we were able to collect three composite samples of 2-3 fish each. The composites had whole-body mercury ranging from 0.127-0.228 ppm, averaging 0.165 ppm. Consistent with the other Syar–West 2019 small fish findings, this was up significantly from 2018 (0.088 ppm), but still significantly lower than 2017 (0.236 ppm). It was also significantly lower than the corresponding samples from the B1 Pond (0.214 ppm). As compared to baseline Cache Creek sampling, the 2019 Syar–West Pond Mosquitofish mercury levels were statistically similar to one of the baseline sets and significantly higher than two.

Table 39. Syar–West Pond: Large fish sampled, Fall 2019

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	218	8.6	110	0.2	**0.600**
Largemouth Bass	218	8.6	105	0.2	**0.683**
Largemouth Bass	234	9.2	150	0.3	**0.566**
Largemouth Bass	243	9.6	190	0.4	**0.543**
Largemouth Bass	250	9.8	200	0.4	**0.482**
Largemouth Bass	250	9.8	185	0.4	**0.468**
Largemouth Bass	257	10.1	205	0.5	**0.555**
Largemouth Bass	269	10.6	225	0.5	**0.793**
Largemouth Bass	275	10.8	245	0.5	**0.595**
Largemouth Bass	276	10.9	275	0.6	**0.462**
Largemouth Bass	277	10.9	255	0.6	**0.655**
Largemouth Bass	287	11.3	285	0.6	**0.981**
Largemouth Bass	289	11.4	300	0.7	**0.450**
Largemouth Bass	290	11.4	295	0.7	**0.503**
Largemouth Bass	295	11.6	380	0.8	**0.793**
Largemouth Bass	296	11.7	325	0.7	**0.648**
Largemouth Bass	300	11.8	330	0.7	**0.737**
Largemouth Bass	307	12.1	385	0.8	**0.600**
Largemouth Bass	323	12.7	420	0.9	**0.977**
Largemouth Bass	354	13.9	550	1.2	**1.356**
Green Sunfish	126	5.0	41	0.1	**0.238**
Bluegill Sunfish	148	5.8	69	0.2	**0.368**

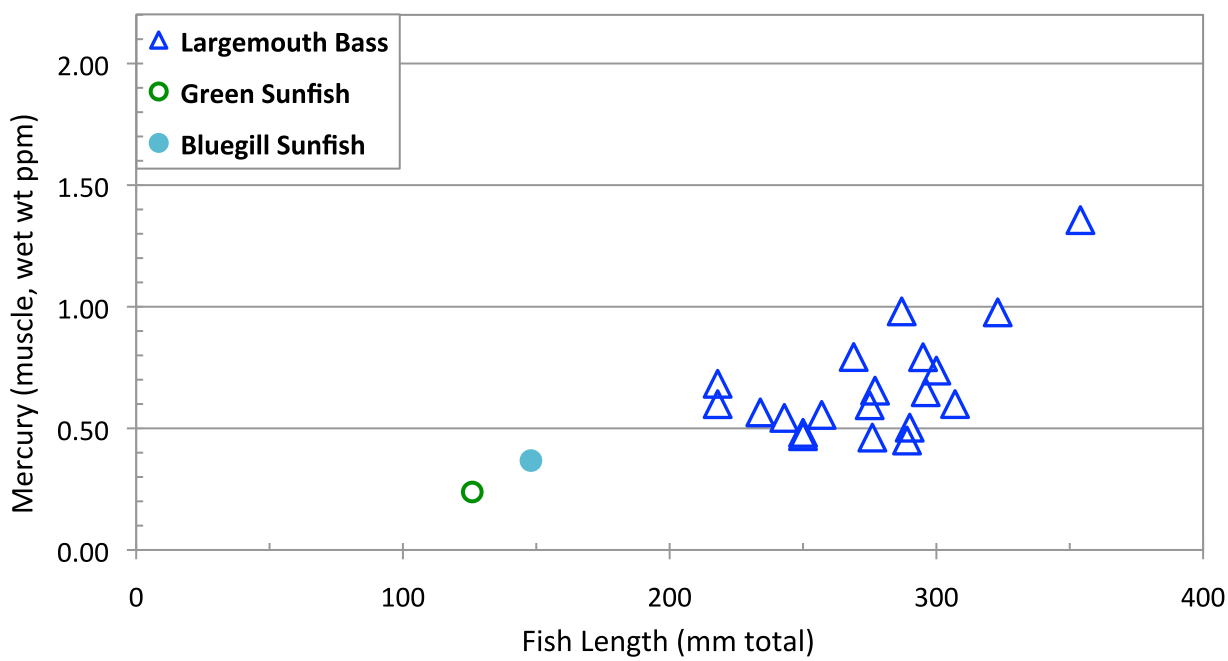


Figure 39. Syar–West Pond: large fish sampled, Fall 2019
(fillet muscle mercury in individual fish)

Table 40. **Syar–West Pond: Small Fish Sampled, Fall 2019**
(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	92	3.6	10.95	0.39	**0.279**
Largemouth Bass (juv)	1	100	3.9	11.87	0.42	**0.268**
Green Sunfish (juv)	10	36	1.4	0.74	0.03	**0.164**
Green Sunfish (juv)	10	42	1.6	1.00	0.04	**0.156**
Green Sunfish (juv)	10	48	1.9	1.74	0.06	**0.195**
Green Sunfish (juv)	8	57	2.3	2.61	0.09	**0.193**
Mosquitofish	3	28	1.1	0.26	0.009	**0.127**
Mosquitofish	3	35	1.4	0.51	0.018	**0.140**
Mosquitofish	2	45	1.8	1.20	0.042	**0.228**

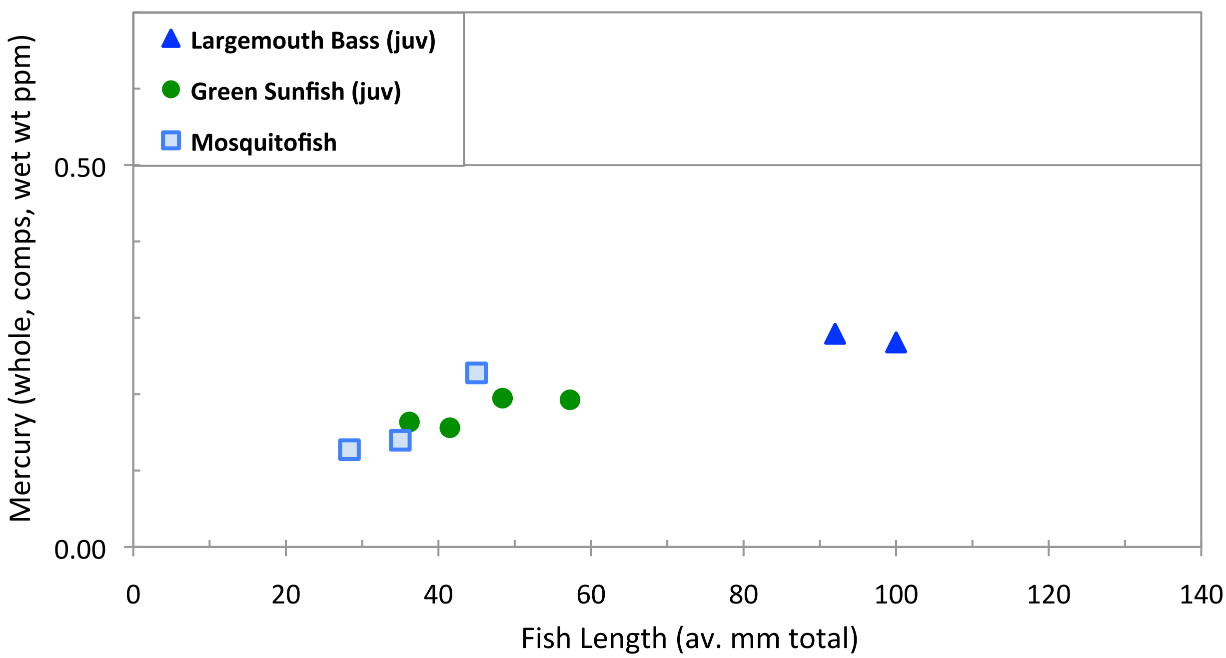


Figure 40. **Syar–West Pond: small, young fish sampled, Fall 2019**
(mercury in whole-body, multi-individual composite samples)

Table 41. 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 Pond	2017	**17**	283	320	**0.925**	± 0.205
Syar – West Pond	2018	20	278	292	**0.798**	± 0.229
Syar – West Pond	2019	20	275	271	**0.672**	± 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**

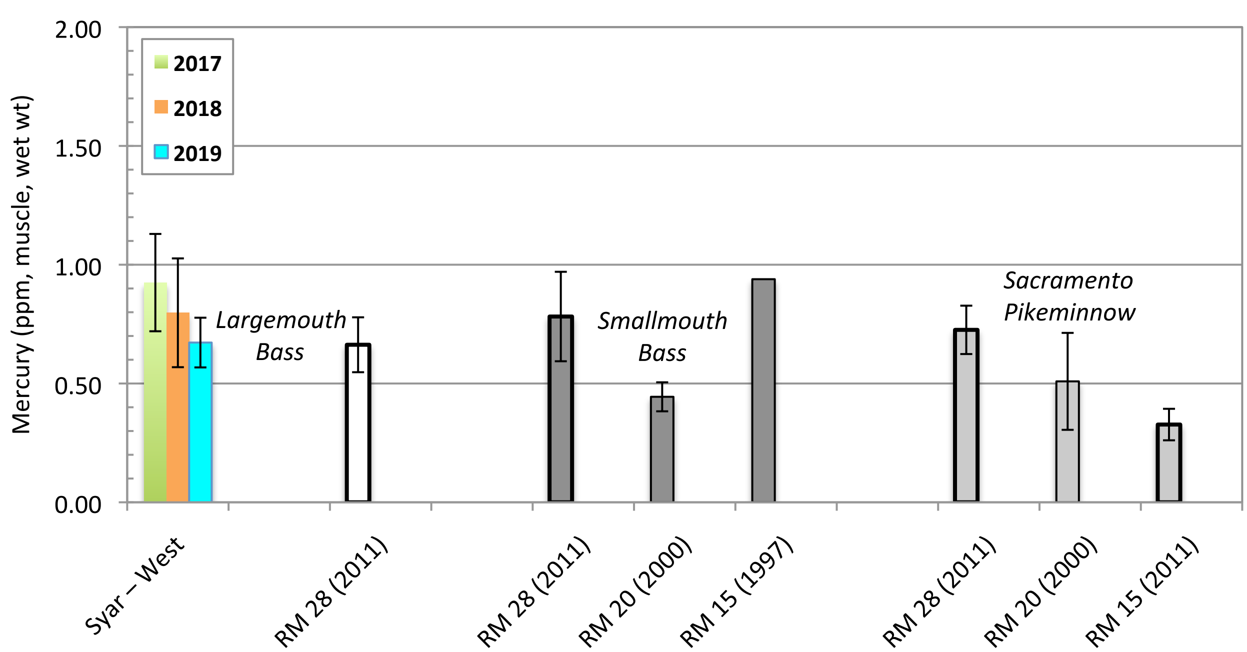


Figure 41. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 42. Green 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 Pond	2017	**4**	93	12	**0.579**	± 0.089
Syar – West Pond	2018	–				
Syar – West Pond	2019	**1**	126	41	**0.238**	
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**

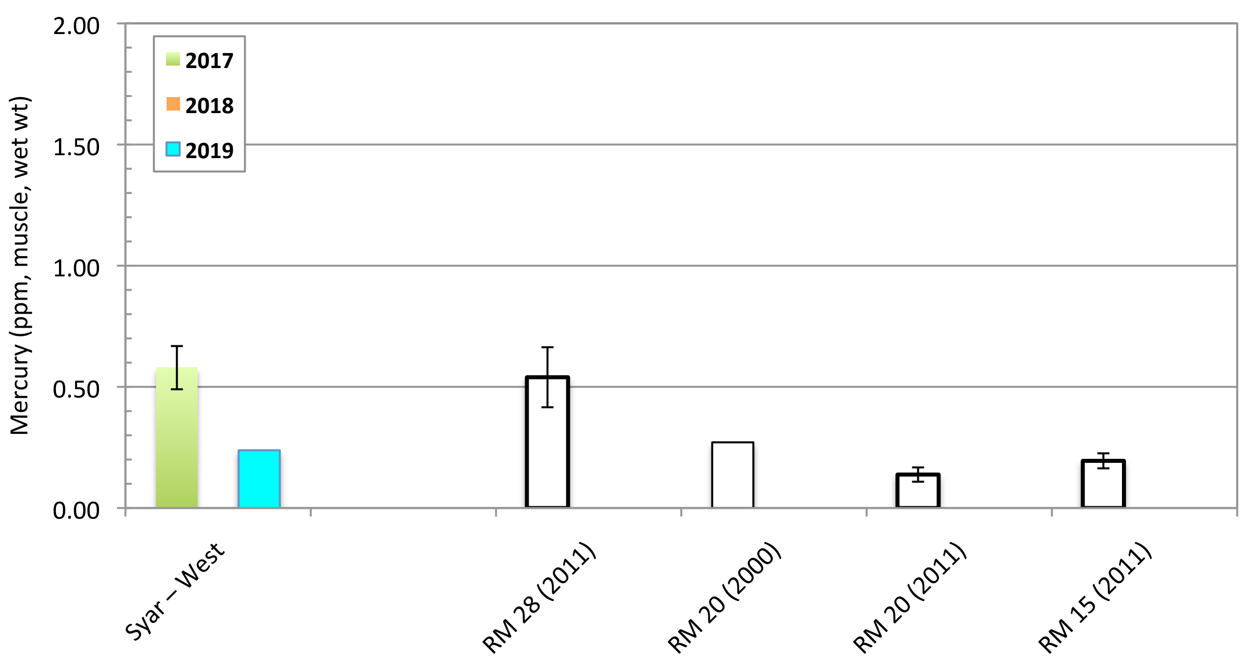


Figure 42. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

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

Table 43. 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 Pond	2017	**2**	1	123	27	**0.418**	± 0.030
Syar – West Pond	2018	**4**	2	77	6	**0.153**	± 0.024
Syar – West Pond	2019	**2**	1	96	11	**0.273**	± 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**

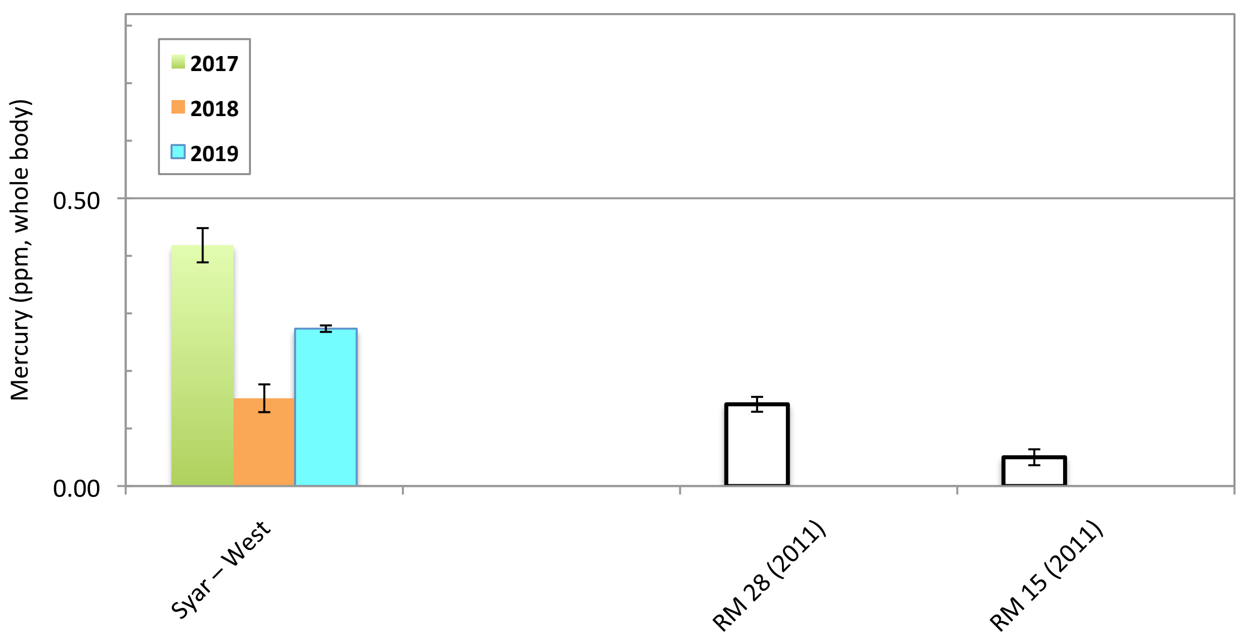


Figure 43. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 44. 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)							
Syar – West Pond	2017	**4**	5-10	45	1.7	**0.237**	± 0.077
Syar – West Pond	2018	**4**	2-4	34	0.6	**0.102**	± 0.017
Syar – West Pond	2019	**4**	8-10	46	1.5	**0.177**	± 0.010
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**

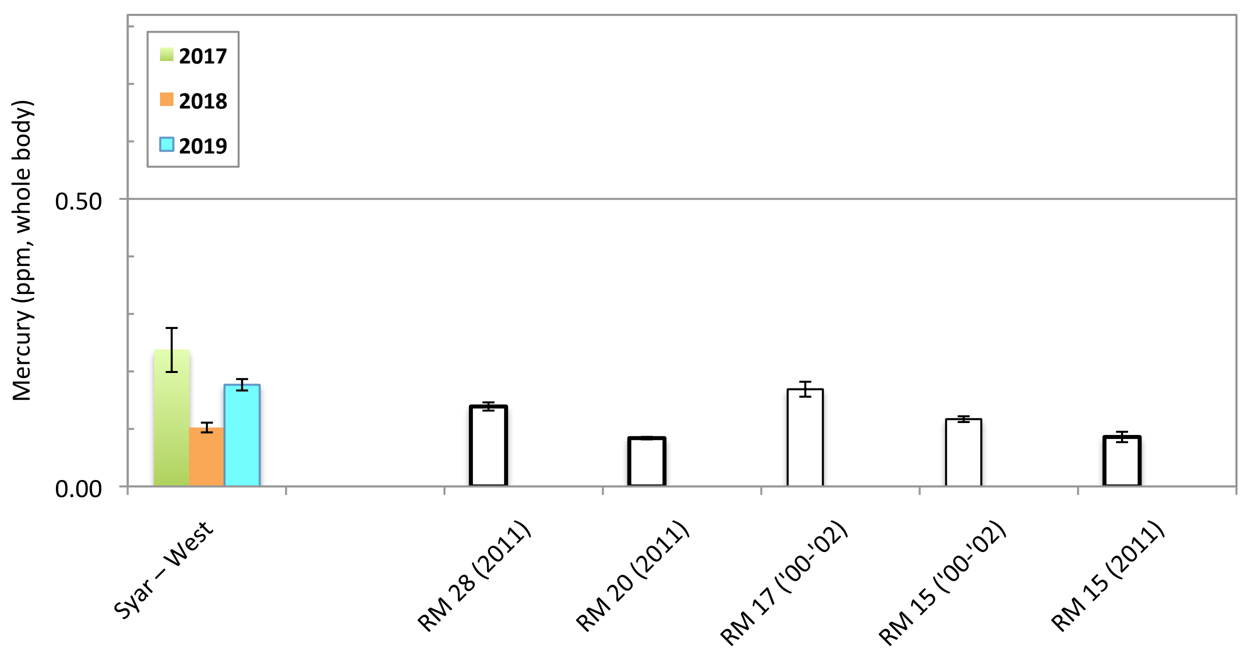


Figure 44. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 45. 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 Pond	2017	**4**	10	34	0.4	**0.236**	± 0.034
Syar – West Pond	2018	**4**	6-7	29	0.3	**0.088**	± 0.012
Syar – West Pond	2019	**3**	2-3	36	0.6	**0.165**	± 0.032
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**

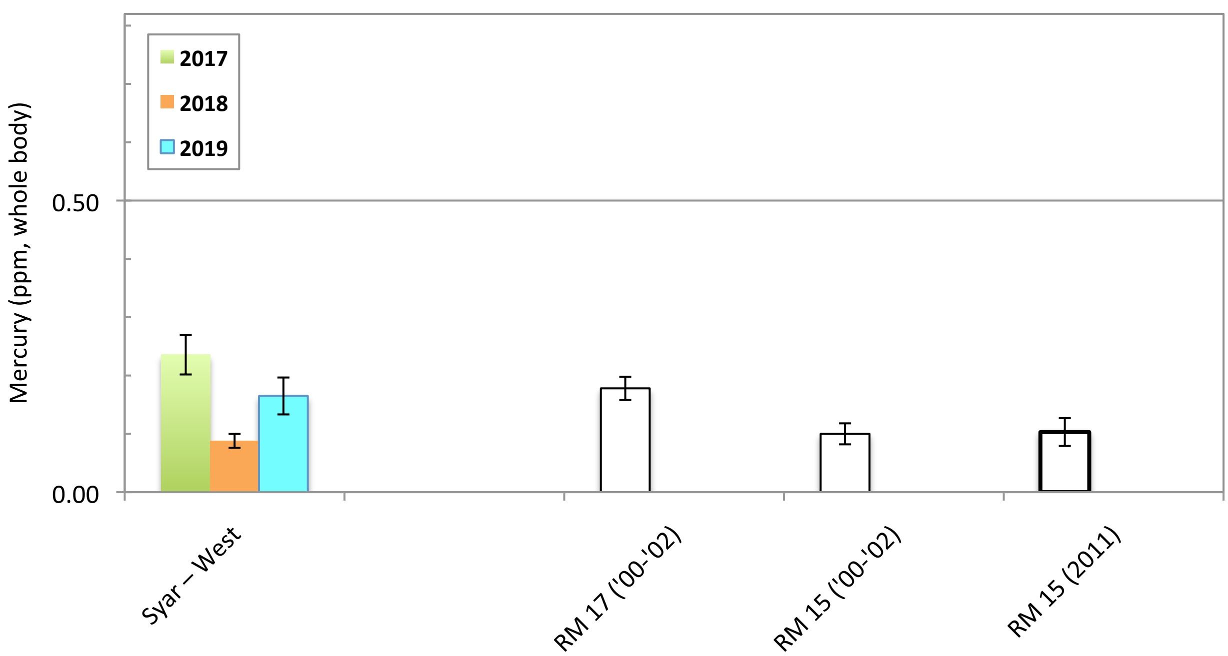


Figure 45. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

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 46. 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 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
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 – Storz	**2017**	**20**	245	203	**0.657**	± 0.038
Teichert-Esparto – Storz	**2018**	**20**	255	197	**0.611**	± 0.082
Teichert-Esparto – Storz	**2019**	**12**	222	196	**0.218**	± 0.042
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 – 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

(continued next page)

(Table 46, continued)

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**

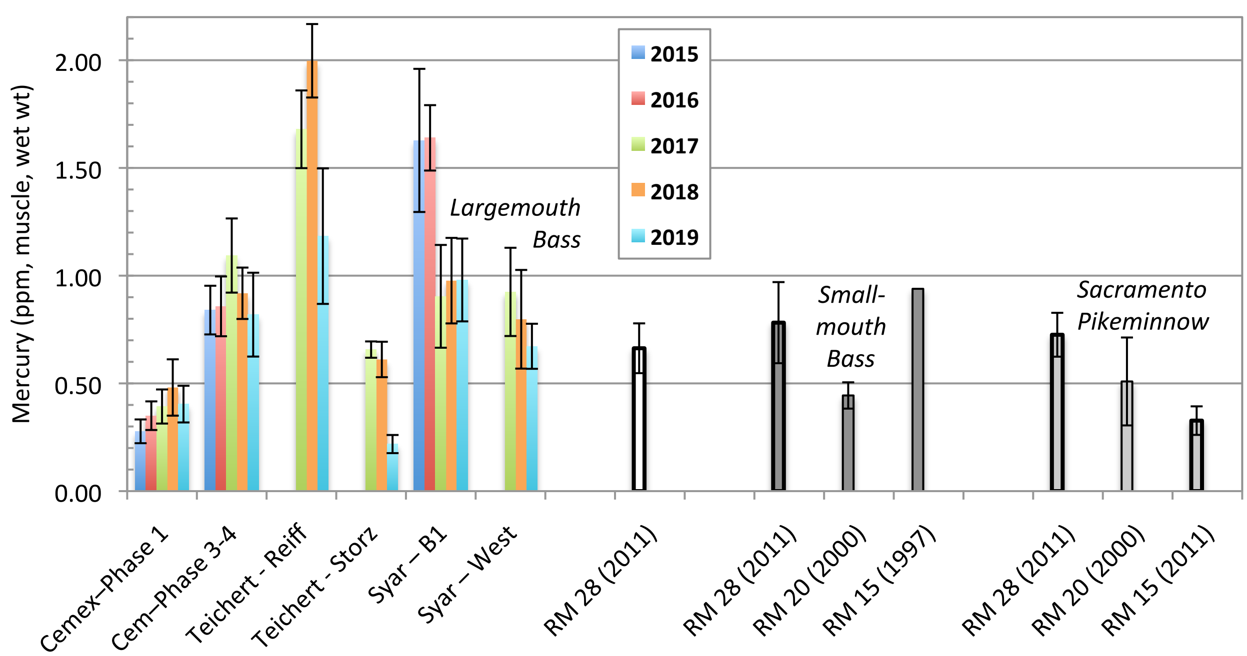


Figure 46. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 47. 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**	± 0.587
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**	**–**				
Teichert-Esparto – Reiff	**2019**	**10**	337	535	**0.637**	± 0.134
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

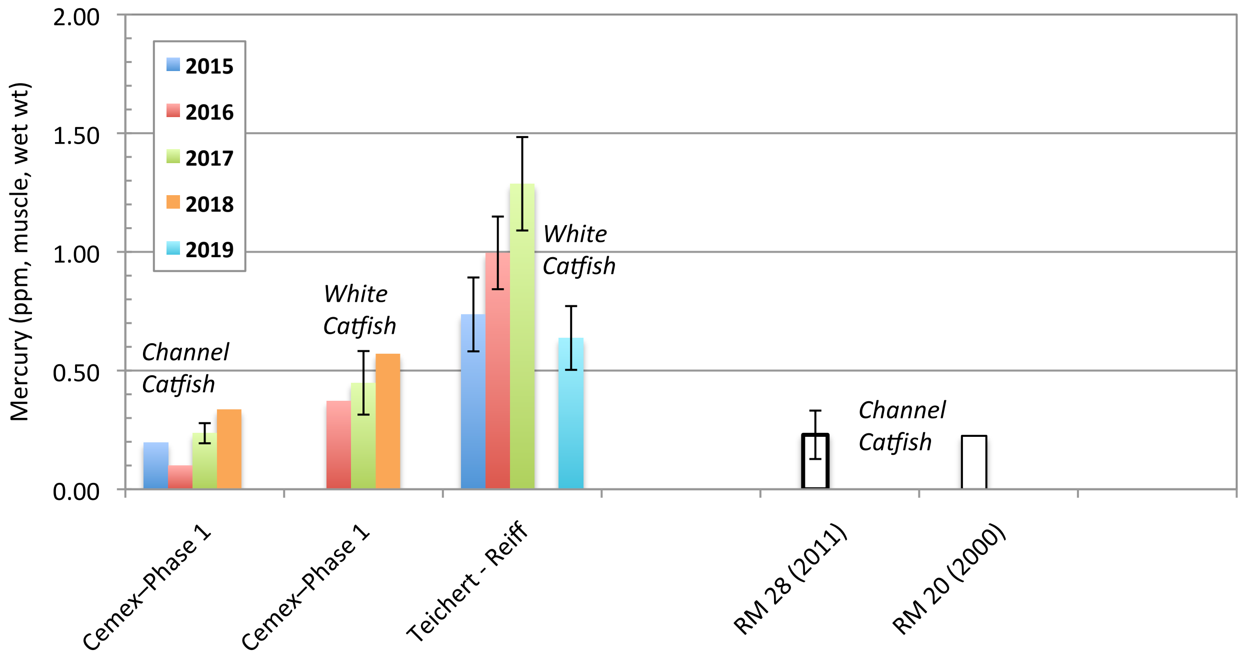


Figure 47. Catfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 48. Green 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						
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 – West	**2017**	**4**	93	12	**0.579**	± 0.089
Syar – West	**2018**	**–**				
Syar – West	**2019**	**1**	126	41	**0.238**	
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**

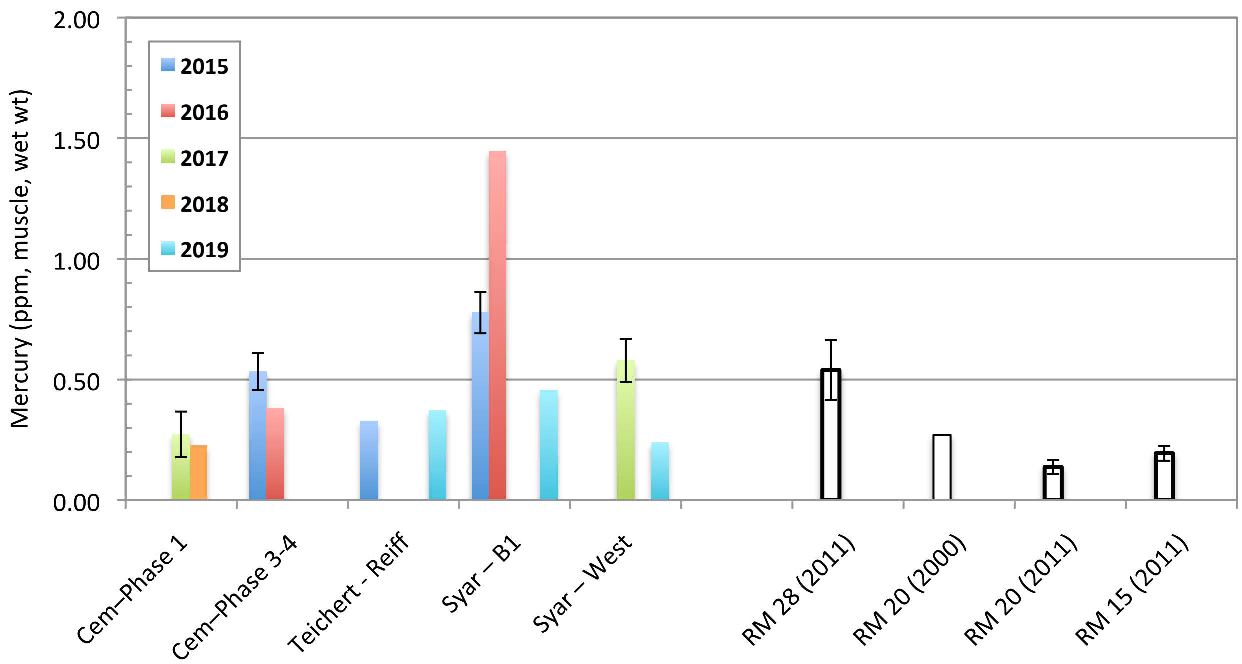


Figure 48. Green Sunfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 49. 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**	*(no samples)*				
Teichert-Esparto – Reiff	**2019**	**9**	483	1475	**0.988**	± 0.279
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

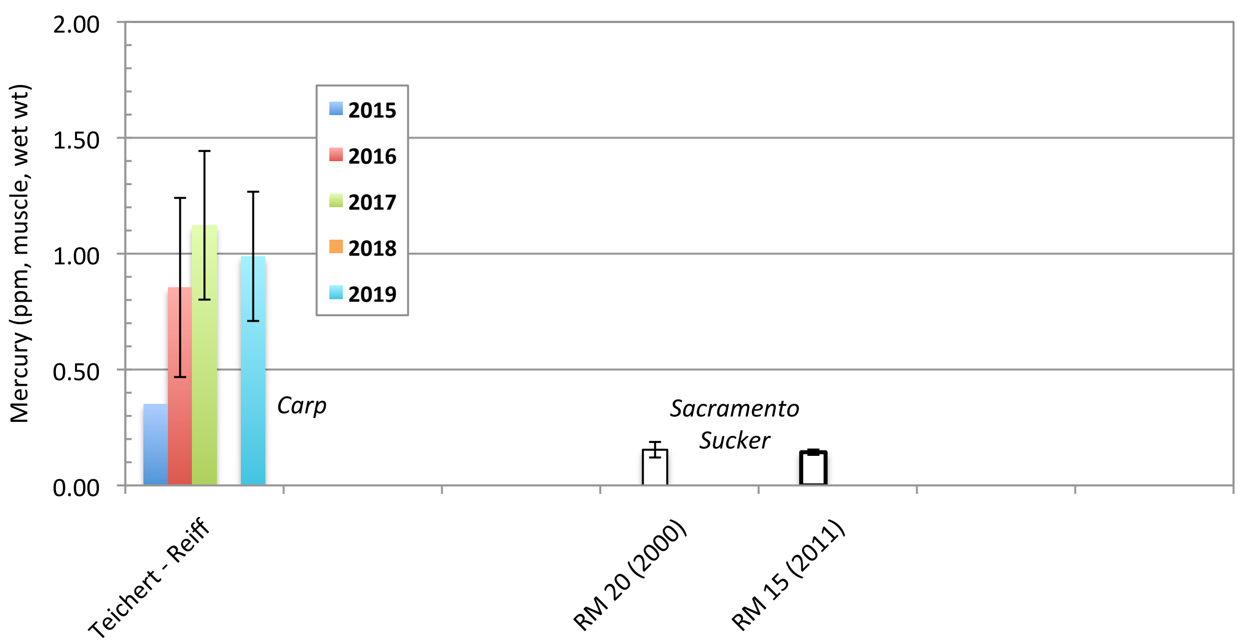


Figure 49. Carp summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

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

Table 50. 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
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 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**	
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-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
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 – 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
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**

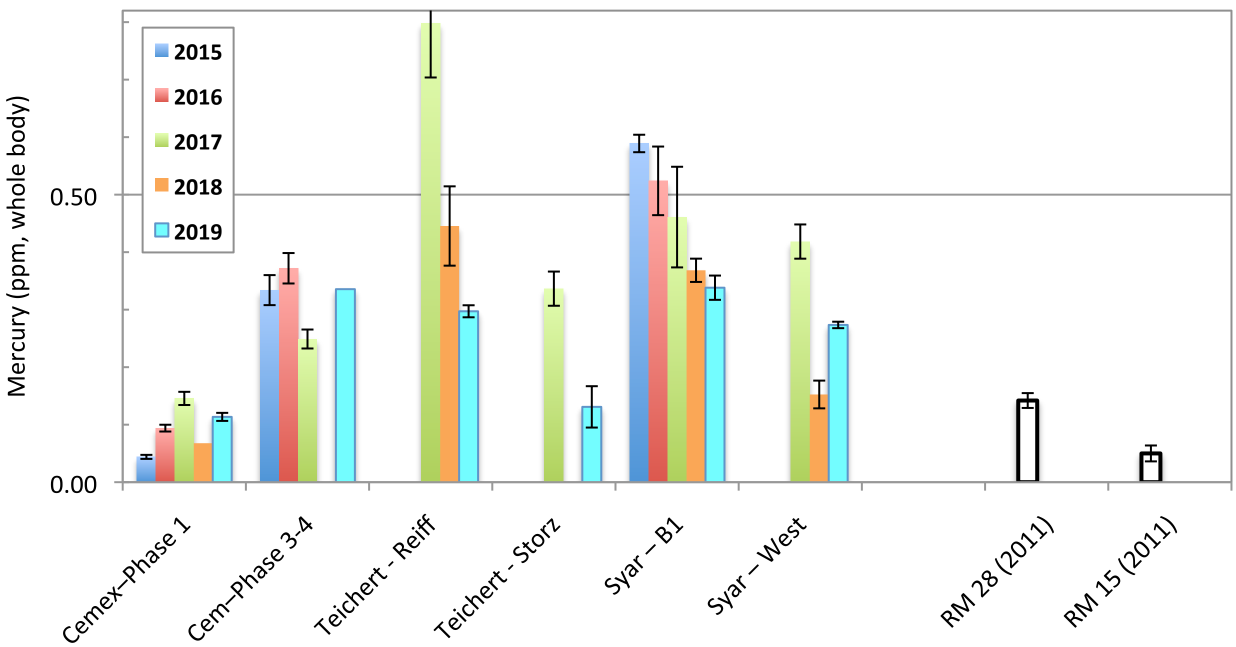


Figure 50. Juvenile Bass summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 51. Juvenile Green 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 (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 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
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
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 – 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
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**

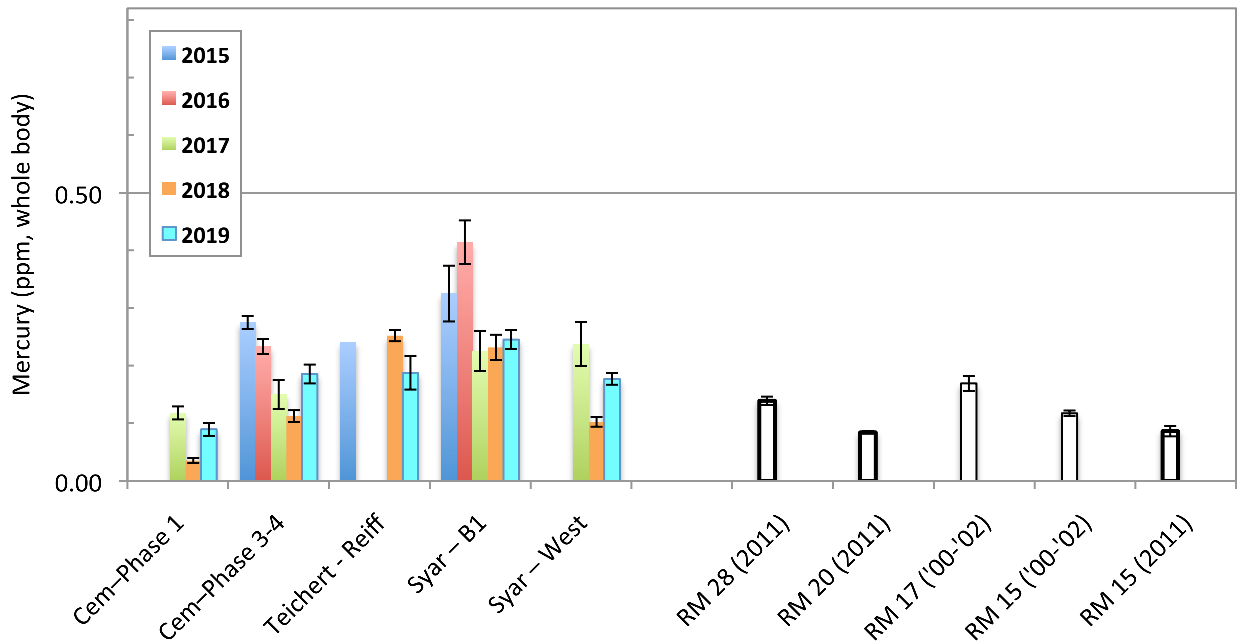


Figure 51. Juv. Green Sunfish summary data (all sites) and historic creek comparisons *(means of multiple whole-body, multi-individual composite samples)*

Table 52. 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 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
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 – 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
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 – West Pond	2017	**4**	10	34	0.4	**0.236**	± 0.034
Syar – West Pond	2018	**4**	6-7	29	0.3	**0.088**	± 0.012
Syar – West Pond	2019	**3**	2-3	36	0.6	**0.165**	± 0.032
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**

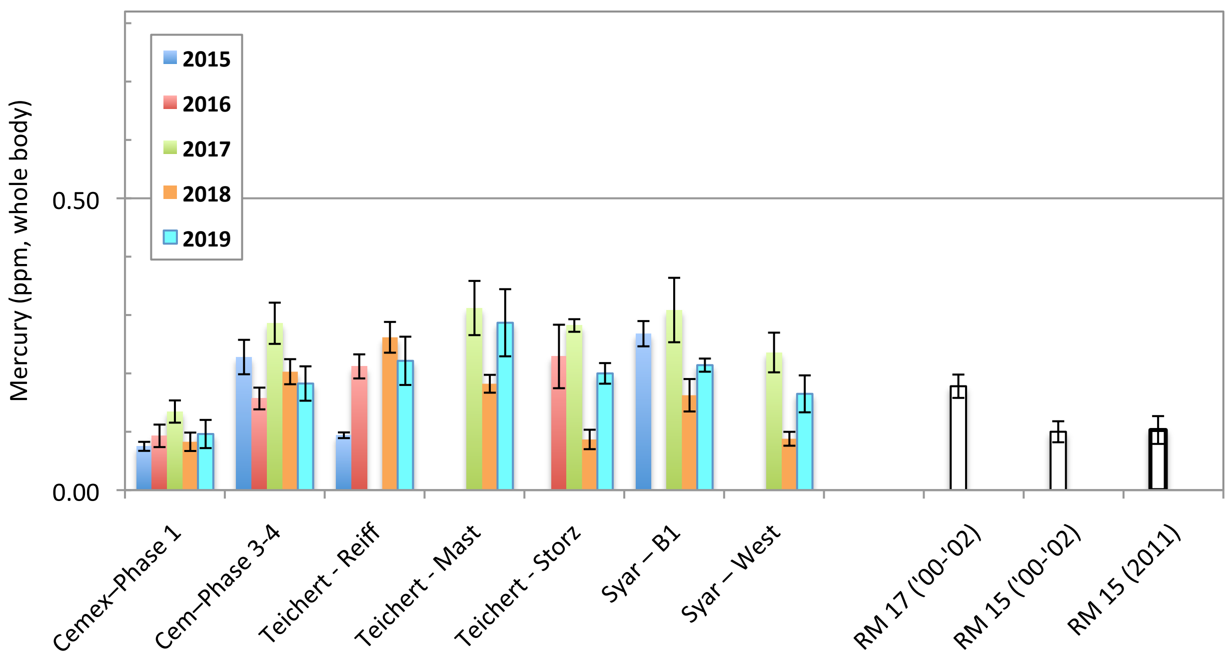


Figure 52. Mosquitofish summary data (all sites), and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 53. 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)*					
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

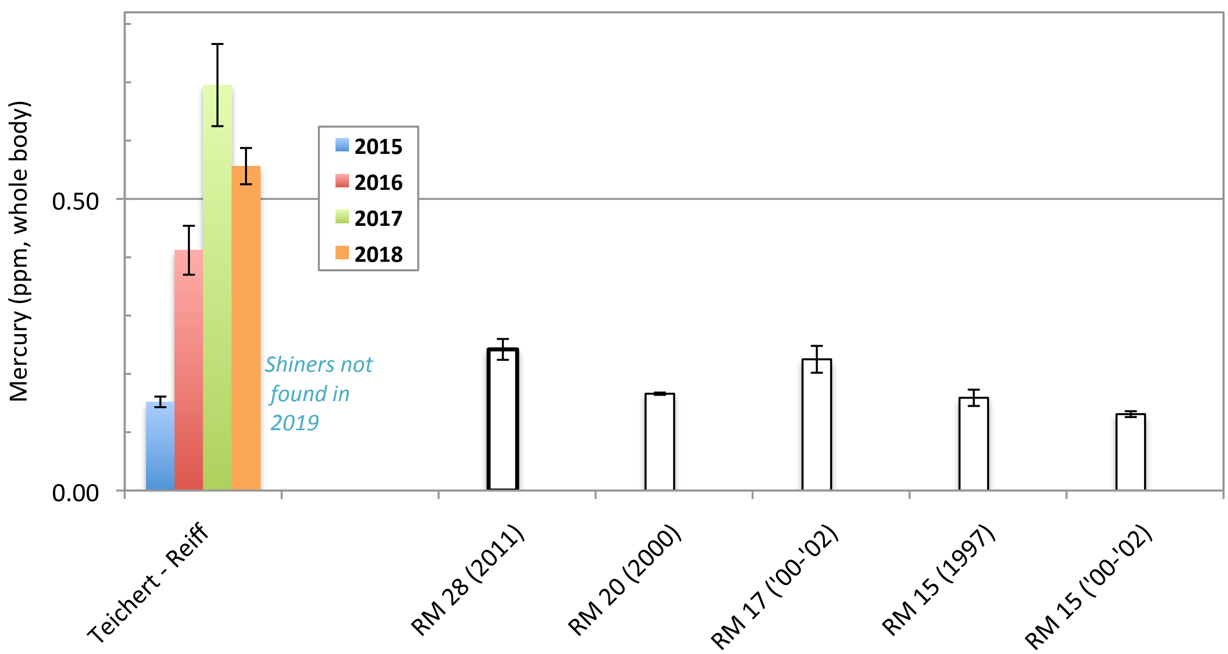


Figure 53. Red Shiner summary data (all sites), and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

DISCUSSION AND CONCLUSIONS

The Yolo County Ordinance for mercury in aggregate mining ponds was revised and updated in December 2019 (Yolo County Code 2019). The full, updated text is attached below as Appendix A. Beginning with this 2019 report, the fish monitoring results will be assessed 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 monitored pond fish mercury levels are found to be significantly elevated above corresponding Cache Creek Baseline samples – in three of five monitoring years. There are now five years of fish mercury monitoring data, beginning in 2015, from four aggregate mining ponds identified by the County for annual monitoring: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. Three other ponds were added to the program in 2017: Teichert-Woodland–Storz, Teichert-Esparto–Mast, and Syar–West. There are now three years of monitoring data from these. Table 54 presents the consolidated annual results of fish mercury testing in all of the monitored ponds, in relation to ambient fish mercury levels. Following the 2017 fish testing, with three years of data from the initial four monitored ponds, three of the ponds were found to be elevated in fish mercury: Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. These three ponds have remained consistently elevated above baseline in the monitoring years to-date. 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. The Syar–West Pond was chosen 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. Beginning in 2018, "expanded analyses" have been initiated at these five ponds and routine fish monitoring was extended by five years.

Table 54. Annual Pond Fish Mercury Levels (Overall) vs. Cache Creek Baselines
(significantly elevated, or not, at the 95% statistical confidence level)

Site	2015	2016	2017	2018	2019
Cemex–Phase 1	not elevated	not elevated	not elevated	not elevated	not elevated
Cemex–Phase 3-4	elevated	elevated	elevated	elevated	elevated
Teichert-Esparto–Reiff	*inconclusive*	elevated	elevated	elevated	elevated
Syar–B1	elevated	elevated	elevated	elevated	elevated
Ponds added to the monitoring program in 2017					
Teichert-Woodland–Storz	–	–	*inconclusive*	not elevated	not elevated
Teichert-Esparto–Mast	–	–	elevated	*inconclusive*	elevated
Syar–West	–	–	elevated	not elevated	elevated

As of this 2019 monitoring year, there are also now three years of data for the three new ponds added to the program in 2017. None of these have been flagged as significantly elevated in fish mercury in three of five years at this point. Teichert-Woodland–Storz has been consistently low, similar to Cemex–Phase 1 in all three years to date. Syar–West was elevated in one of three years and not elevated in the other two. The Teichert-Esparto–Mast Pond was clearly elevated in two of the last three years and was likely to be flagged in subsequent years as "elevated in three or more years" of five. However, with mining largely concluded at the Teichert-Esparto property in 2019, the Reiff and two Mast basins were breached in 2020, forming one large pond. This will continue to be monitored as a single Teichert-Esparto Pond, identified at this time as elevated over ambient.

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 was initiated in 2018, as described above. The three identified elevated-mercury ponds and the lower-mercury control/reference pond were tested seasonally, five times between May and October. Profiling continued at these sites in 2019, and the Syar-West Pond was also studied as a deep pond control. Results are presented in accompanying water reports for 2018 and 2019. Excerpting from the conclusions of the 2019 water profiling report:

"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. However, as last year, the data give some important clues. In particular, there were key differences in bottom water anoxia and general water clarity. 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)."

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"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."

Fish monitoring will continue at all of the aggregate mining ponds in the program, as will seasonal water column testing at the designated subset. Ongoing findings will help narrow down management options for the sites requiring eventual plans and action.

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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) Data Sharing. 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) 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 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) 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 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) Post-Reclamation Phase Results. 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) Expanded Analysis.

(1) General. 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.

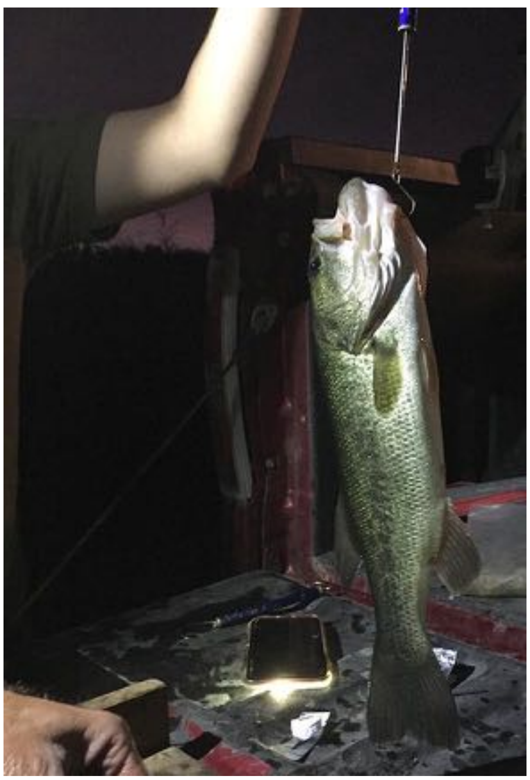
(D) If subsequent monitoring after implementation of lake management activities, during the post-reclamation phase, demonstrates levels of fish tissue mercury at or below the ambient mercury level for any three monitoring years (i.e., the management plan is effective), the operator shall be obligated 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 FALL 2019 FISH MONITORING

GENERAL FIELD WORK, AND EXAMPLES OF MAIN ADULT FISH

A1. Largemouth Bass and White Catfish



A2. Weighing – Largemouth Bass

A3. Measuring length – Carp

A4. Green Sunfish

A5. Wade-seining for small fish

A6. Boat-assisted seining with larger-mesh net

A7. Field-dissection of small analytical pieces of fillet muscle

A8. Fillet muscle sample into pre-weighed analytical tube

A9. Set of small muscle samples; fish released, vs. standard method that sacrifices fish

A10.
In laboratory, re-weighing tubes, to get exact weights of analytical pieces

A11. Samples ready for acid digestion and mercury analysis

CEMEX–PHASE 1 POND

A12. Cemex–Phase 1 Pond

A13. Largemouth Bass

A14. Small fish samples: Mosquitofish, juvenile Bass, juvenile Green Sunfish

CEMEX–PHASE 3-4 POND

A15. Cemex–Phase 3-4 Pond

A16. Largemouth Bass

A17. Cemex–Phase 3-4 small fish: Mosquitofish and juvenile Green Sunfish

TEICHERT-ESPARTO – REIFF POND

A18. Reiff Pond

A19. Largemouth Bass and White Catfish

A20. Reiff Pond – Carp

A21. Reiff Pond – collecting White Catfish, at night with baited setline

A22. Reiff Pond small fish – shore seining

A23. Reiff Pond small fish – Mosquitofish, juvenile Bass, juvenile Green Sunfish

TEICHERT-ESPARTO – MAST POND

A24. Mast Pond – Southeast Basin: Mosquitofish in seine, then separated into composite groups

A25. Mast Pond – Northwest basin: Mosquitofish in seine, then separated into composite groups, including over-size sets

TEICHERT-WOODLAND – STORZ POND

A26. Storz Pond

A27. Wade-seining for small fish

A28. Boat-assisted seining

A29. Storz Pond Largemouth Bass, including one 'lunker'

A30. Juvenile Largemouth Bass in shore seine

A31. Mosquitofish – in seine, and arranged into composite sets

SYAR–B1 POND

A32. Syar–B1 Pond

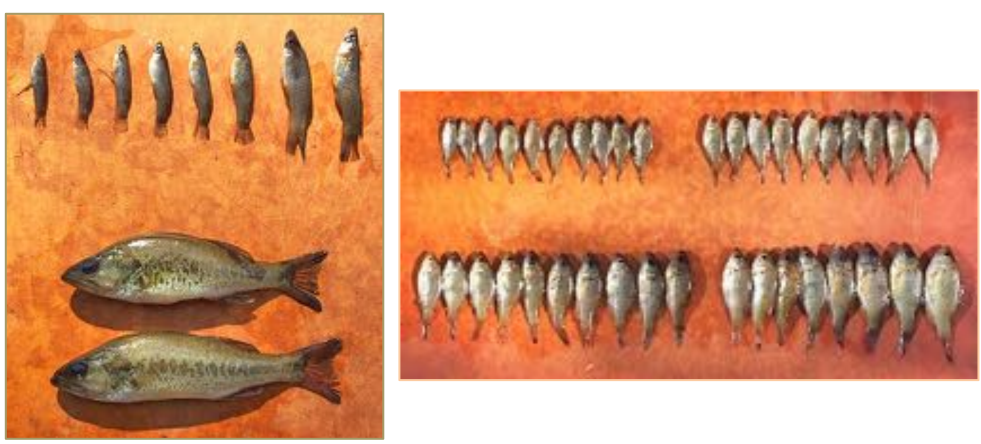
A33.
Large Fish:
Green Sunfish,
Largemouth Bass

A34. Small Fish: Mosquitofish, juvenile Bass, juv. Sunfish

SYAR–WEST POND

A35. Syar–West Pond

A36. Large fish: Largemouth Bass, Bluegill Sunfish, Green Sunfish (upper right)



A37. Small fish: Mosquitofish, juvenile Bass, juvenile Sunfish