

USFWS 2019 Report on Environmental Contaminants RIPRAP Activities

Note: this is an annual report from the U.S. Fish and Wildlife Service regarding activities to address contaminant concerns outlined in the Upper Colorado River Endangered Fish Recovery Program RIPRAP. Contaminants remediation is conducted independently of and funded outside of the Recovery Program. This report is updated annually to document relevant activities and memorialize notable findings, actions, and reports. However, the extraordinary variety of issues and activities makes it impractical to update all the information annually; instead, this document should be considered a useful but incomplete record of past and ongoing contaminant-related efforts.

II.B. Support actions to reduce or eliminate contaminant impacts

Stewart Lake and Johnson Bottom Wetlands (Selenium Monitoring)

The Recovery Program, in collaboration with UDWR, FWS, and Texas A&M University, is currently researching Selenium uptake in razorback sucker at Stewart Lake and Johnson Bottom wetlands. Field samples of age-0 razorback sucker (incidental mortalities), larval razorback, and other surrogate species have been collected opportunistically since 2013. Selenium results are currently being analyzed in support of a revised Stewart Lake management plan, and will likely be included in a new biological opinion for the Bureau of Reclamation for Stewart Lake.

Pesticide Exposure Prevention (report in draft)

The Grand Junction office has in the past worked with the local mosquito control agency to prevent mosquitocide exposure of endangered Colorado River fish in backwater and wetland habitat in approximately 30 miles of the Colorado and Gunnison rivers. The total treatment area is approximately 73 square miles, or a total of 46,720 acres. In 2016 the Mosquito abatement office appointed a new director. Barb Osmundson met with them several times regarding mosquito control near critical habitat; Barb has since retired and future FWS interaction is uncertain.

Grand Valley Surface Water Sampling For Pesticides, Pharmaceuticals, Personal Care Products, Waste Water Indicators (report in draft)

Since 2009, EPA Region 8 has supported the Colorado Water Quality Control Division (WQCD) in the sampling and analyses of pesticides data, and analysis for a suite of pharmaceuticals and personal care products (PPCPs) and waste water indicators. As more is learned about the health and aquatic life effects those parameters have and at what concentrations, the WQCD can address new criteria in a meaningful way. The focus of the 2011 & 2012 projects were on the Denver Metro Area streams. During 2013, the project added other study areas, including sampling sites in the Grand Valley. Pesticides are of particular interest because of the Grand Valley's irrigated agricultural drainage into several washes. These washes empty into critical

habitat in the 18-mile reach of the Colorado River. The Grand Junction, Colorado environmental contaminants (EC) staff collected monthly samples from four Grand Valley tributaries from March-November, 2013 and 2014.

As a result, we now have two years of data on 6 – 8 tributaries that enter the 18-mile reach of the Colorado River. Thus far, results have shown an interesting variety of chemicals, including the presence of the herbicide 2,4-D in the tributaries, and an array of pharmaceuticals below wastewater treatment facilities. One of the areas of concern is the outflow from the Fruita wastewater treatment facility that flows into a backwater that endangered fish are known to use. Contaminants that were found in the wastewater effluent and downstream include a suite of pharmaceuticals including antidepressants, blood pressure medications, narcotics, and several others. In 2015 sampling efforts were moved from sites in the Grand Valley to sites in the Uncompahgre Valley between Delta and Montrose in western Colorado. Continued sampling was planned for the Uncompahgre Valley in 2016. Sites include tributaries that empty into the Uncompahgre and Gunnison rivers.

Relevant to wastewater concerns, Barb Osmundson (FWS, now retired) also got involved with one of the wastewater treatment plants in the Grand Valley (Persigo) that discharges into the Colorado River. She compiled pre-and post diffuser data. The effluent is released into a backwater where tagged fish have been located. The diffuser is an improvement to mix the effluent. Currently two of the four plants in the Grand Valley have diffusers. She had worked with Fruita and Clifton to encourage them to add diffusers; more recent discussions have considered alternatives for complying with the Mixing Zone Biological Opinion without adding a diffuser.

Colorado Pikeminnow Mercury Exposure

The Grand Junction EC staff conducted a study from 2008-2009 to assess mercury exposure to the endangered Colorado pikeminnow (CPM). The objectives of this investigation were to determine mercury concentrations in Colorado pikeminnow collected from several different river reaches within critical habitat by using biopsied muscle plugs, and to develop a regression equation between CPM length and mercury concentrations. This study involved a cooperative partnership of Service fisheries and EC staff from Colorado, Utah, and New Mexico, staff associated with both the San Juan and Upper Colorado River Recovery Programs, and state fisheries staff from Colorado and Utah. The combined reaches of the Green River sampled covered nearly 205 river miles. The combined reaches of the Colorado River sampled covered nearly 80 river miles. The White River sampled covered nearly 103 river miles, the Yampa River sampled covered nearly 22 river miles, and the San Juan River sampled covered nearly 40 miles. Ten Colorado pikeminnow muscle plug samples were taken from each river reach, with the exception of the San Juan River where 20 muscle plug samples were collected.

The Service presented the results of its 2008-2009 investigation at the annual Colorado River Endangered Fish Recovery Program Researchers Meeting in January, 2010. Results were also

presented to the Mercury Technical Advisory Council of the Colorado Division of Water Quality on December 6th, 2012. An interim report was submitted to the Service's R9, Division of Environmental Quality (Osmundson and Lusk 2012), and a final report published in 2018 (Osmundson, B.C., and J.D. Lusk. 2018).

Comparison to Roundtail Chub Mercury Exposure Studies

Prior to the Colorado Pikeminnow mercury exposure studies described above, the Utah EC office collaborated with Utah Division of Natural Resources to assess exposure and potential risk of mercury exposure in roundtail chub, a Utah state sensitive species, collected from the White River, Utah. Beckvar et al. 2005 had suggested a threshold-effect level of ≤ 0.2 $\mu\text{g/g}$ wet weight (ww) mercury in whole body fish as protective of juvenile and adult roundtail. Colorado pikeminnow within critical habitats, and larger fish collected from the San Juan River, are above this threshold that may be indicative of sub-lethal effects.

Seventy-eight percent of Colorado pikeminnow collected (98 out of 126) had observed whole body mercury concentrations that exceeded the Beckvar et al. (2005) threshold of effect level of 0.2 $\mu\text{g/g}$ wet weight (ww). Based on effect level ranges discussed in publications, 2 to 60 percent of the Colorado pikeminnow sampled have mercury concentrations in fish muscle or whole body that are associated with biochemical changes, tissue damage, and reduced reproduction in other fish species. Additionally, mercury exposure and accumulation was found in all subpopulations of Colorado pikeminnow sampled and throughout their critical habitat, which increases the relative risk of mercury contamination to the recovery of this species.

Because of the high mercury concentrations found in roundtail chubs (0.11 - 1.97 $\mu\text{g/g}$ ww, mean = 0.6 $\mu\text{g/g}$ ww) and Colorado pikeminnow (0.43 - 1.83 $\mu\text{g/g}$ ww, mean = 1.1 $\mu\text{g/g}$ ww) collected from the White River, we suggest that further investigation is warranted to assess potential adverse impacts to these species, as well as determine the source of mercury contamination. The largest roundtail chubs contained mercury concentrations as high as those found in Colorado pikeminnow. Based on the potential risk associated with mercury exposure in these two sensitive fish species, this information should be used by conservation teams when evaluating threats.

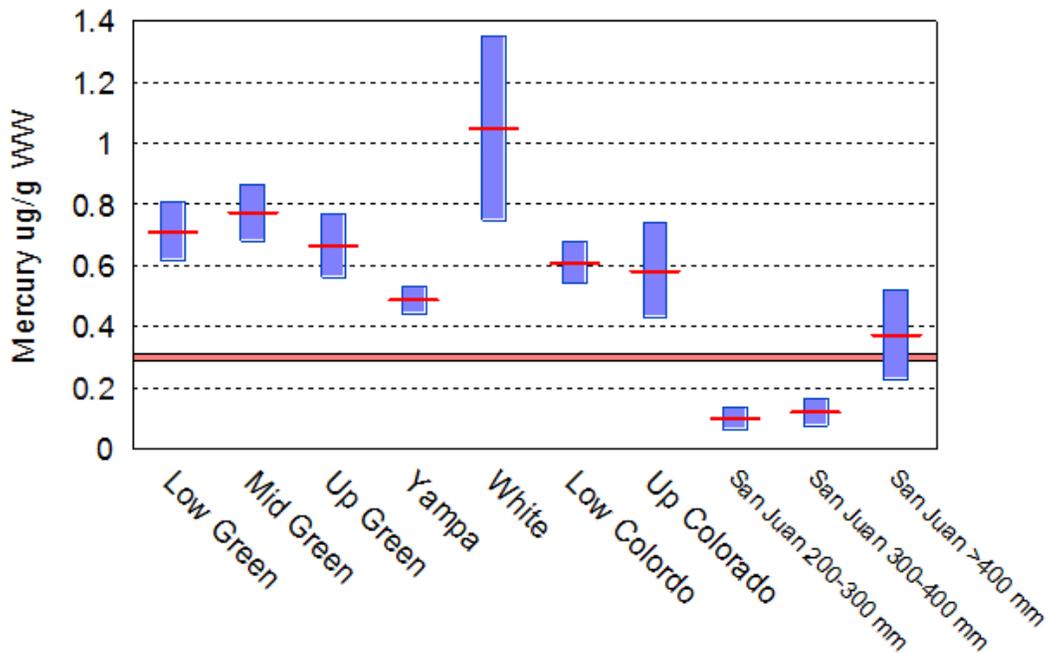


Figure 3. Mean (+/- 95% Confidence Intervals (CI)) of mercury concentrations in Colorado pikeminnow muscle plugs. Red line identifies the USEPA's recommended tissue-based mercury water quality criterion of 0.3 $\mu\text{g/g}$ WW.

From Osmundson and Lusk 2012, based on data described and collected since 2008.

Pariette Draw Selenium and TDS loads to Green River

The Pariette Draw is a tributary of the Green River that is not supporting its warm water fisheries and waterfowl beneficial use classifications due to violations of the criterion for selenium. EPA approved Total Daily Maximum Daily Loads (TMDL) for selenium, total dissolved solids (TDS), and boron, and in the TMDL they included best management practices for mitigating the potential effects of TDS, selenium, and boron to Pariette Draw and Green River aquatic habitats. The Utah Ecological Services (ES) Field Office continues to work with Utah Division of Water Quality to investigate sources and fate of selenium within the Pariette Draw and wetlands. The Utah ES office received funding in 2012 to conduct water quality monitoring and wetland characterization in Pariette Draw Watershed in 2013 with the Utah Division of Water Quality, Utah State University, and other stakeholders. The project was to span over two years and provide selenium exposure data for several biological matrices, including fish.

Due to staffing shortfalls in the Utah ES office, Utah State University agreed to take over the field component of this project in 2013. Graduate student Colleen Jones evaluated selenium concentrations at several sites in the Pariette Draw, in surface water and pore water, soil, and

plants. She also sampled volatile Se to evaluate selenium fate and transport in the system. Avian egg and fish samples were collected in 2014 and 2015. A spatially explicit exposure model (SEEM) is being worked on to evaluate selenium exposure risk to a variety of bird, fish and other important species in the Pariette Wetlands. Besides characterizing current selenium exposure risk, the SEEM model can also be used to support decision-making for future selenium reduction or management actions. Barb Osmundson collected data in muscle plugs in endangered fish from 2014 and will update the Table in Appendix B incorporating data from razorbacks, bonytail and Colorado pikeminnow. A final report on the Pariette Draw research was compiled by Coleen Jones and others (Jones et al. 2015).

Backwater Habitats Near Atlas Tailings Site

In 2014 Paul Abate and Chris Cline visited the Atlas Tailings site near Moab, Utah, to discuss proposed modifications to the backwater habitats near the uranium mining tailings pile that are needed because the removal is beginning to encroach into parts of the tailings where shallow groundwater pumping is occurring to keep ammonia out of the backwaters (they have removed a lot of tailings). They discussed several approaches and options, and they were going to get back to FWS with some proposed modifications. Atlas's remediation team started sending out year-end reports; the current status of this site and associated mitigation plans is uncertain.

II.B.1.a. Identify actions to reduce selenium contamination to levels that will not impede recovery (Ongoing)

Selenium Task Force, Selenium Management Program, and Salinity Control Program

The Aspinall Programmatic Biological Opinion (BO) was finalized in 2010. A Selenium Reduction Program was formed in conjunction with the BO, to implement remediation projects associated with selenium exceedances in the Uncompahgre Project area and downstream (Gunnison River basin).

The Gunnison Basin **Selenium Management Program** (SMP) is a private/public partnership of concerned parties working together to identify and implement solutions to reduce selenium concentration in the Gunnison and Colorado rivers. The goal of the SMP is to reduce adverse effects of selenium on endangered fish species in the Gunnison and Colorado rivers. A work group was established in December 2009 charged with developing a program outline and implementation plan aimed at meeting state water quality standards for selenium and protecting endangered fish. The Grand Junction EC staff has been an active member in the Selenium Management Program since 2012, attending all work group meetings.

The **Selenium Task Force** is a local grassroots organization, established in the Uncompahgre basin to explore options for reducing selenium loads into the Uncompahgre River to meet state water quality standards. On-going Task Force projects include: an effort to determine other source areas for selenium contamination, a phytoremediation project using poplar trees, and monitoring the effects of land use conversion on selenium loading (i.e. conversion of irrigated and non-irrigated lands to subdivisions). The Grand Junction office continues to participate with the Selenium Task Force.

The Grand Junction EC staff (currently, Creed Clayton) continues in their role as the Salinity Coordinator for the Service on the Colorado River Basin **Salinity Control Program**. This position is responsive to the request by various Federal and state and local programs to reduce salinity concentrations within the upper Colorado River Basin to meet salinity compact requirements with Mexico at the US/Mexican Border. Direct results of the Salinity Control Program are reductions in canal leakage, improved delivery systems, more efficient irrigation practices, and protecting wildlife habitat values. Salinity control actions also reduce selenium mobilization into ground water and surface streams.

The USGS five-year selenium report assessing dissolved selenium concentrations and loads in the lower Gunnison River basin was published in 2018 (Henneberg, 2018). According to that report, Se concentrations in the Gunnison River at Whitewater finally decreased to the state standard in 2016. While this is encouraging, additional monitoring, data and analysis are needed. More work is still required to continue reducing Se within critical habitat; hot spots remain in habitats preferred by endangered fish (back waters, side channels, tributary confluences, etc.). Ultimately, tissue Se concentrations in resident fish will be the best indicator of water quality and whether Se concentrations have been adequately reduced in the system. The USGS is expected to publish a report in 2019 (authors N.K. Day et al.) documenting Se concentrations in fish tissue in the Gunnison River and elsewhere within endangered fish critical habitat (Green, White, and Yampa Rivers).

Technical Assistance

Grand Junction EC staff submitted an off-refuge proposal in 2010, which was accepted for 2011 funding, to determine selenium concentrations in endangered fish in the Gunnison River, as well as surrogate fish species in the Gunnison River. While Colorado Parks & Wildlife (CPW) and Colorado River Fisheries Program (CRFP) staff conducted endangered fish population surveys, muscle plug samples were collected for selenium analysis. Results from this selenium study have been used by the SMP to determine baseline selenium concentrations and evaluate effectiveness of selenium remediation efforts. (See Appendix B for details regarding the selenium studies since undertaken by CPW and CRFP) Selenium concentrations in surrogate fish species (roundtail chub, carp, and speckled dace) collected in 2010, 2011, and 2012 will be compared to the same species collected in 1992, to investigate any changes over the last 20 years

and remediation efforts taken thus far by the selenium task force.

Selenium concentrations will be compared to toxicity reference values associated with adverse effects, in particular to those values associated with reproductive impairment. These tissue selenium concentrations will also be divided by water concentrations to determine bioaccumulation factors. The bioaccumulation factors will in turn be used to help assess load reductions needed by the Selenium Management Program in remediation efforts to minimize risk of reproductive impairment for the endangered Colorado River fish.

II.B.2.a. Ensure that all new petroleum product pipelines have emergency shutoff valves (Ongoing)

USFWS Ecological Services addresses this through Section 7 consultation, although not all pipeline approvals have a federal nexus that results in consultation. USFWS will be addressing this concern in the form of an FWS Spill Response Plan.

II.B.2.b. Identify locations of existing petroleum-product pipelines potentially affecting critical habitat and determine if they have emergency shutoff valves. (Pending)

The Pipeline and Hazardous Materials Safety Administration has developed the Pipeline Integrity Management Mapping Application (PIMMA) for use by pipeline operators and Federal, state, and local government officials. This should be a valuable tool in assessing threats to endangered fish. USFWS should investigate use of PIMMA to address existing pipelines that may need shutoff valves.

II.B.3. Review and recommend modifications to State and Federal Hazardous materials spills emergency response programs (Ongoing)

Spill Contingency Response

EC staff from Colorado and Salt Lake City maintain an ongoing presence within State and Federal hazardous materials spills emergency response programs. Through routine participation in response programs we review and recommend modifications to various response actions, contingency plans, and spill drills affecting the CO River and tributaries. EC staff met with EPA in November and December of 2012 to discuss improvements to the Green River Spill Contingency Plan. EPA met with federal and state agencies, which act as natural resource trustees, and industry to develop a watershed protection plan that would be more effective than the Green River Spill Contingency Plan, which was primarily meant to facilitate coordination among federal and state response agencies. As part of the watershed protection plan for the Green River Basin, EPA is updating its information concerning FWS trust resources and best coordination and communication procedures in the event of an oil spill or release of hazardous substance. Meetings with EPA, Chevron, and EC and Fisheries staff were conducted during

2013 in Rangely, CO and Vernal Utah to address pipeline locations and spill planning for the Green River watershed, including tributaries White and Yampa Rivers. In 2015, EPA initiated planning efforts for the development of a Colorado River Spill Contingency Plan. Colorado EC staff (most recently, Chris Cline) has participated in these planning meetings and activities since February 2015. As of 2017, one result of these planning efforts has been the development of “high water” vs. “low water” strategies for spill response that will respect corresponding habitat preferences of endangered fish. In addition, field reconnaissance led to the identification and mapping of best locations to place spill-control booms should a spill occur. Pre-set anchors for such booms were established at those sites, and maps and instructions developed to facilitate their use for quick spill response, should that become necessary.

II.C.1. Support actions to reduce or eliminate contaminant impacts of selenium in the Grand Valley (Ongoing)

Participation in the Selenium Task Force and the Selenium Management Program

As described under II.B.1.A., the Grand Junction EC staff continues to be involved with the Grand Valley Selenium Task Forces and Selenium Management Program.

Lower Colorado River (Segment 3.) Mixing Zone Sampling with EPA

During 2011, the Colorado Water Quality Control Commission (Commission) revised its list of Water-Quality-Limited Segments Requiring Total Maximum Daily Loads (TMDLs) (Regulation #93), including delisting of the lower Colorado River main stem between the Gunnison River confluence and Colorado-Utah Stateline (segment 3) for impairment by selenium. This segment is included in designated critical habitat for the endangered Colorado River fish. The standard for impaired waterways, developed in 2002, is 4.6 parts per billion (ppb) selenium. The Commission proposed the delisting due to the 85th percentile selenium concentration of 4.3 ppb for 37 water samples collected from the Lower Colorado River segment between 2002 and 2006.

Barb Osmundson, who worked for many years on selenium issues and recovery of the endangered fishes prior to her retirement in 2018, reviewed the proposed regulation change, and expressed concern related to the proposal, including:

1. Use of the 85th percentile selenium concentrations is not accurate enough to support delisting the segment. The difference between the 85th percentile value of the samples and the standard is not enough to disallow the possibility of analytical error.
2. Geographical areas and timing of data collections biased the samples towards lower selenium concentrations by avoiding collection below smaller tributaries that contribute higher loads to the Colorado River system, and lack of sampling during low flow seasons and drought years when selenium values would be more concentrated.

Barb provided written testimony to the Commission regarding these concerns on October 27,

2011 and testified at the public hearing before the Commission on December 12. Despite concerns, the Commission ended up delisting Segment 3.

EPA understood Service concerns and was able to secure funding starting in 2012 to collect water samples for selenium analysis below the confluence of high selenium tributaries that empty into this segment (3) of the lower Colorado River. Samples were collected in 2012 by Grand Junction EC staff during August and again during September (accompanied by EPA staff Karl Herman). During 2013, samples were collected during August, but the government shutdown prevented the scheduled sampling during October. Sampling by Fish and Wildlife Service EC staff and EPA occurred in August and October of 2014 and continued in August and October, 2015.

The State of Colorado is currently revisiting their NPDES permit discharge conditions for gravel pit mining operations along the 18-Mile Reach of the Colorado River. Grand Junction Office staff are involved in discussions to address associated selenium concerns.

II.D. Support actions to reduce or eliminate selenium impacts at Ashley Creek and Stewart Drain (Ongoing)

The Recovery Program, UDWR, FWS, and Texas A&M University are currently researching Selenium uptake in razorback sucker at Stewart Lake and Johnson Bottom wetlands. Field samples of age-0 razorback sucker (incidental mortalities), larval razorback, and other surrogate species have been collected opportunistically since 2013. Selenium results are currently being analyzed and were provided in a draft report in 2017, in support of a revised Stewart Lake management plan and biological opinion.

Contacts:

Creed Clayton
U.S. Fish and Wildlife Service
Grand Junction Ecological Services Field Office
445 West Gunnison Ave, Suite 240
Grand Junction, CO 81501
ph 970-628-7187
creed_clayton@fws.gov

Chris Cline
U.S. Fish and Wildlife Service
Environmental Contaminants Division
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119
ph. 801.975.3330
fx. 801.975.3331
Chris_Cline@fws.gov

Laura Archuleta
U.S. Fish and Wildlife Service
Environmental Contaminants Specialist
Ecological Services
46525 Hwy 114,
Saguache, CO 81149
Ph 719.655.6121
Laura_Archuleta@fws.gov

Citations:

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APPENDIX A

Biological Opinions Incorporating Contaminants Considerations

2015 Colowyo Coal Mine Biological Opinions (2 total)

The Colowyo coal mine area in Moffat and Rio Blanco Counties has been active for more than 100 years. The mine recently proposed a modification of its mining plan and an expansion of its operations. The Grand Junction Environmental Contaminants staff provided technical assistance for the 2015 Colowyo Biological Opinion (BO) issued by the Grand Junction, CO Ecological Services Office. Mercury concentrations discovered during the research project previously described helped to influence the adoption of conservation measures described in this BO.

As a result of a legal challenge (*WildEarth Guardians v. U.S. Office of Surface Mining et al.*, Case 1:13-cv-00518-RBJ (D. Colo. 2015)), the District Court of Colorado required OSMRE to review their action (including any effects from that action) and complete additional analysis under the National Environmental Policy Act (NEPA). The Proposed Action includes future mining at the South Taylor/Lower Wilson Permit Area, and the interrelated activity of burning the mined coal at the Craig Generating Station. Much of the coal produced at the Colowyo Mine (South Taylor and West pits) since 2008 has been sent to the Craig Generating Station in Craig, Colorado. It was determined that coal combustion at the Craig Generating Station was a reasonably foreseeable indirect effect under NEPA of the South Taylor/Lower Wilson mine plan authorization. The Colowyo BO addresses the effects to the four endangered fish and their critical habitats from contaminants released from coal combustion and mine discharge. Combustion of coal releases the following pollutants: sulfur dioxide, particulate matter, nitrogen oxides (NO_x), mercury (Hg), selenium, and carbon dioxide. The Craig Generating Station, along with all coal fired power plants, has measures in place that reduce mercury and other emissions. Despite emission reduction measures, and for the purposes of the consultation, it was estimated that 7.8 kg of mercury (3.13 x 2.5) would be emitted annually from the Craig Generating Station from the combustion of the Colowyo coal. The Service's BO included an evaluation of the proposed action's effects to the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail and their critical habitat. Conservation measures are actions that will be taken by the Federal agency or applicant, and serve to minimize or compensate for, project effects on the species under review. As part of the proposed action, Colowyo has committed to the conservation measures below that are intended to advance the scientific information on the potential effects of coal combustion to the affected species. Also included are measures intended to improve the status of the four endangered fish by supporting the recovery program.

The following conservation measures will be implemented for the direct benefit and ultimate conservation of the endangered Colorado River fish in the Yampa and White River basins. By being included in the proposed action these conservation measures are now mandatory commitments of the project proponent. As described in the BA, the applicant has committed to the following conservation measures:

- 1) **Species Preservation and Recovery Actions Funding.** Colowyo will contribute \$50,000 to the National Fish & Wildlife Foundation (NFWF) to implement recovery actions overseen by the Recovery Program. This measure would directly benefit the endangered

Colorado River fish species in the two rivers impacted by mining and combustion of coal mined at the Colowyo Mine. Funding will be provided within 30 days of receipt of the South Taylor/Lower Wilson mining plan approval from OSMRE. The funds are to be directed toward the control of nonnative fish species in both the Yampa and White River's designated critical habitat for the Colorado Pike Minnow, or to support other recovery activities that directly benefit the endangered fish in the action area such as habitat improvement.

- 2) Mercury Deposition Modeling. Due to the uncertainty of understanding the origins of the mercury that is being deposited into the Yampa and White River Basins, Colowyo and their parent organization Tri-State have committed to funding a study to further develop the knowledge of mercury source attribution for future decision making. The overall goal of this effort is to improve the amount of information available to researchers and policy makers regarding mercury in the Yampa and White River basins.

The Electric Power Research Institute (EPRI) will conduct an air quality deposition modeling analysis to determine the sources of mercury being deposited in the Yampa and White River basins in northwest Colorado. Mercury is a global pollutant and may undergo atmospheric transport over both short and very long (intercontinental) distances depending on its chemical form. The attribution of sources contributing to mercury deposition in the Yampa and White River Basins will be determined from modeling conducted at multiple geographic scales: global, regional and local. As done by EPRI in the San Juan River Basin (EPRI 2014), a global mercury model, GEOS-Chem (Goddard Earth Observing System Chemistry), will be applied to provide concentrations of mercury in the United States due to distant sources. The CMAQ model (Congestion Mitigation and Air Quality) and CMAQ-APT (CMAQ with Advanced Plume Treatment) model will be used by EPRI to simulate emissions and deposition at a finer scale. At the local level individual sources will be modeled to determine their contribution to loading in the analysis area. The atmospheric models keep track of which sources or source categories contribute to eventual deposition by "tagging" or labeling each unit of mercury by where it originated. Tags are carried along with the calculations for deposition so that the analysis of deposited mercury into the local analysis area can show how much and from which sources. Deposition receptors will be identified in the local scale modeling.

The deposition modeling and source attribution analysis for the Yampa and White River basins will be conducted similar to the deposition modeling and source attribution analysis performed for the San Juan River Basin Project in the Four Corners region. The analysis will consider anthropogenic and natural sources of mercury deposition and will model the transport, chemical transformation and deposition of mercury under both wet and dry conditions. Colowyo will fund the deposition modeling analysis to an amount not to exceed \$224,000.00. The modeling effort will be initiated within 30 days of the approval of the mining permit and will be completed within 24 months. Information gathered from this modeling effort will fill an obvious gap in the information available for the protection of the endangered Colorado River fish species from contaminants. Results of the study will aid in planning for the recovery of endangered fish and other listed species potentially affected by mercury contamination in the Yampa and White River Basins.

Other Biological Opinions

Other biological opinions that have incorporated contaminant considerations include opinions for the [Trapper Mine](#) and for [Foidel Creek Mine](#). These are similar to the Colowyo opinions in that they address mercury and selenium effects to endangered fish from coal combustion. All three mines (including ColoWyo) are in the Yampa River Basin.

In addition, FWS's 2003 Mixing Zone Biological Opinion addresses contaminants as they relate to endangered fish in Colorado.

APPENDIX B

Selenium Evaluations in the Gunnison River Since 1992

During 2010 fish population surveys conducted by the CPW, muscle plug samples were taken from 15 roundtail chubs and 15 carp in the Gunnison River basin for selenium analysis. Fifteen whole body speckled dace were also collected for selenium analysis. These samples were collected from the upper portion of designated critical habitat from the Uncompahgre River confluence in Delta, CO (RM 56.3) to Escalante at RM 44.1. No endangered fish were encountered during this survey, so no endangered fish muscle plugs were collected. Muscle plug collections continued during 2011 summer on the lower stretch of critical habitat in the Gunnison River between Escalante (RM 44.1) and the Colorado River confluence (RM 0.7). During 2011 fish population surveys conducted by Colorado River Fisheries Project, muscle plugs were taken from 15 roundtail chub, 15 common carp, and four bonytail for selenium analysis. Also, 15 whole body speckled dace were collected, and egg samples were taken from 7 white suckers for selenium analysis. Nine composite samples of invertebrates were collected from Delta to Grand Junction to examine selenium concentrations in dietary items. During 2012 fish population surveys conducted by Colorado River Fisheries Project, muscle plugs were taken from 15 carp, 5 razorback suckers, and 4 Colorado pikeminnow for selenium analysis. Whole body samples of 16 speckled dace, and 6 composite invertebrate samples were also collected. Results of all data sets are displayed in Appendix B.

Selenium concentrations exceeded the 8 ug/g DW toxicity guideline (Lemly 1996) for selenium in fish muscle tissue in muscle plugs from 14 out of 30 total roundtail chub, 42 out of 44 carp, and 2/4 bonytail. The range in selenium concentrations found in bonytail from 0.8 to 8.6 ug/g DW is most likely a function of how long they had been at large in the Gunnison River or in Butch Craig pond (adjacent to the Gunnison River) after release from the hatchery. Selenium concentrations in 1 of the 3 captured Colorado pikeminnow exceeded the toxicity guideline of 8 ug/g DW. One Colorado pikeminnow captured in Redlands fish ladder July 31, 2012 was recaptured in the Gunnison River at river mile 15.2 on October 4, 2012. While in the Gunnison River, the selenium concentration in muscle increased from 2.9 to 5.1 ug./g DW. Selenium concentrations in razorback suckers were <2 ug/g DW in recently released hatchery raised fish, but one razorback sucker at large in the Gunnison River contained 7.3 ug/g DW, approaching the 8 ug/g DW toxicity guideline. Selenium concentrations in all whole body speckled dace samples exceeded the 4 ug/g DW selenium toxicity guideline for whole body fish (Lemly 1996).

Selenium concentrations in Gunnison River water samples measured at Whitewater demonstrated a statistically significant downward trend from 1986-2008 (Mayo and Leib, 2012). Compared to those collected in 1992, speckled dace selenium concentrations in 2010-2012 also showed a decreasing trend. There was, however, no significant decrease in muscle plug selenium in roundtail chubs when comparing recent samples to those collected in 1992. Decreasing selenium trends in the Gunnison River are in part due to efforts of the salinity control program and selenium task force to reduce deep percolation of irrigation water into Mancos shale soils. Future efforts of these two groups, plus the selenium management program established pursuant to the 2009 Aspinall/Gunnison PBO, will aim at meeting the selenium state water quality standard, and benefiting the recovery of the endangered Colorado River fish.

APPENDIX C
Selenium concentrations in biota collected from the lower Gunnison River

Table 1. Selenium concentrations in biota collected from the lower Gunnison River.

Species	Collection Date	River Mile	% Moisture	Selenium (ug/g DW)	Length (mm)	Matrix ¹	Notes
Roundtail Chub	07/21/10	51.7	79.3	12.8	380	MP	
Roundtail Chub	07/21/10	51.7	78.9	5.3	275	MP	
Roundtail Chub	07/21/10	51.7	78.9	7.8	264	MP	
Roundtail Chub	07/21/10	51.7	78.1	7.0	280	MP	
Roundtail Chub	07/21/10	51.7	78.2	5.8	300	MP	
Roundtail Chub	07/21/10	51.7	79.7	10.8	264	MP	
Roundtail Chub	07/21/10	53.0	79.2	8.0	264	MP	
Roundtail Chub	07/21/10	53.8	78.1	9.5	383	MP	
Roundtail Chub	07/21/10	53.8	77.9	6.5	330	MP	
Roundtail Chub	07/21/10	54.6	77.6	8.3	252	MP	
Roundtail Chub	07/21/10	54.6	78.5	8.0	242	MP	
Roundtail Chub	07/21/10	54.6	78.2	8.8	245	MP	
Roundtail Chub	07/21/10	54.6	77.5	32.3	293	MP	
Roundtail Chub	07/21/10	54.6	78.4	8.7	391	MP	
Roundtail Chub	07/21/10	54.6	78.4	6.4	403	MP	
Roundtail Chub	08/17/11	39.1	79.4	6.5	337	MP	
Roundtail Chub	08/18/11	21.3	80.0	6.2	297	MP	
Roundtail Chub	08/17/11	39.1	80.4	7.1	315	MP	
Roundtail Chub	08/19/11	12.9	80.7	8.5	291	MP	
Roundtail Chub	08/17/11	39.1	79.3	5.6	339	MP	
Roundtail Chub	08/19/11	12.9	80.0	8.9	293	MP	
Roundtail Chub	08/19/11	4.4	79.8	7.9	347	MP	
Roundtail Chub	08/19/11	4.4	80.0	8.8	275	MP	
Roundtail Chub	08/19/11	12.9	79.9	7.8	267	MP	
Roundtail Chub	08/19/11	12.9	79.5	7.8	245	MP	
Roundtail Chub	08/18/11	21.3	80.7	5.5	332	MP	
Roundtail Chub	08/19/11	12.9	80.7	11.2	264	MP	
Roundtail Chub	08/18/11	21.3	80.7	6.9	308	MP	
Roundtail Chub	08/17/11	39.1	79.7	5.5	340	MP	
Roundtail Chub	08/18/11	21.3	81.5	7.0	390	MP	

Species	Collection Date	River Mile	% Moisture	Selenium (ug/g DW)	Length (mm)	Matrix ¹	Notes
Common Carp	07/21/10	53.0	77.2	13.5	545	MP	
(duplicate)			77.3	13.7		MP	
Common Carp	07/21/10	53.0	76.8	8.4	440	MP	
Common Carp	07/21/10	53.0	75.6	20.4	535	MP	
Common Carp	07/21/10	53.0	74.9	9.9	547	MP	
(duplicate)			76	10		MP	
Common Carp	07/21/10	53.0	74.4	8.5	500	MP	
Common Carp	07/21/10	53.0	77.3	12.8	470	MP	
Common Carp	07/21/10	53.8	74.3	8.8	550	MP	
Common Carp	07/21/10	53.8	74.4	9.4	560	MP	
Common Carp	07/21/10	53.8	75.3	11	455	MP	
(duplicate)			72.5	10.1		MP	
Common Carp	07/21/10	53.8	76.4	11.2	615	MP	
Common Carp	07/21/10	54.6	74.6	16.5	610	MP	
Common Carp	07/21/10	54.6	73.8	19.3	552	MP	
Common Carp	07/21/10	54.6	76	15.4	448	MP	
Common Carp	07/21/10	54.6	73.4	12.5	453	MP	
Common Carp	07/21/10	54.6	75.2	11.7	505	MP	
Common Carp	08/19/11	4.4	72.5	10.2	573	MP	
Common Carp	08/18/11	21.3	79.3	12.2	595	MP	
Common Carp	08/18/11	23.1	78.5	8.50	604	MP	
Common Carp	08/18/11	12.9	79.4	10.2	685	MP	
Common Carp	08/17/11	39.1	77.9	10.6	476	MP	
Common Carp	08/19/11	4.4	77.5	10.0	598	MP	
Common Carp	08/19/11	12.9	79.0	10.9	547	MP	
Common Carp	08/19/11	14.4	70.7	8.5	580	MP	
Common Carp	08/17/11	39.1	78.0	9.7	525	MP	
Common Carp	08/17/11	39.1	82.3	32.2	360	MP	
(duplicate)			81.8	35.1		MP	
Common Carp	08/18/11	21.3	76.4	10.5	493	MP	
Common Carp	08/19/11	12.9	76.7	10.9	545	MP	
Common Carp	08/19/11	21.3	77.4	11.6	591	MP	
(duplicate)			77.7	11.1		MP	
Common Carp	08/19/11	4.4	72.0	9.7	540	MP	

Species	Collection Date	River Mile	% Moisture	Selenium (ug/g DW)	Length (mm)	Matrix ¹	Notes
Common Carp	08/18/11	21.3	79.7	11.0	564	MP	
Common Carp	08/27/12	52.7	76.2	8.49	565	MP	
Common Carp	08/27/12	54.4	76.6	9.76	643	MP	
Common Carp	08/28/12	47.6	79.8	8.04	546	MP	
(duplicate)			76.4	7.40		MP	
Common Carp	08/29/12	21.8	72.2	8.47		MP	
Common Carp	08/29/12	21.8	75.7	6.03		MP	
Common Carp	08/29/12	35.4	75.9	9.49		MP	
Common Carp	08/30/12	18.2	71.9	9.39	614	MP	
(duplicate)			85.3	8.66		MP	
Common Carp	08/30/12	14.5	77.9	10.45		MP	
Common Carp	08/30/12	13.5	78.9	6.87	716	MP	
Common Carp	08/30/12	12.4	78.6	9.15	676	MP	
Common Carp	08/31/12	8.3	74.3	7.64		MP	
Common Carp	10/05/12	12.1	75.6	10.1	559	MP	
Common Carp	10/03/12	35	77.7	10.7	555	MP	
Common Carp	10/03/12	35	78.2	9.67	658	MP	
		Butch					
Bonytail	06/09/11	Craig pond	80.5	8.43	336	MP	
Bonytail	08/23/11	---	74.4	0.89	352	MP	
Bonytail	08/19/11	12.9	72.4	0.81	308	MP	
(duplicate)		12.9	74.4	0.89		MP	
Bonytail	08/29/11	RFL	79.0	8.58	366	MP	
Razorback sucker	10/01/12	54	80.8	1.53	380	MP	
Razorback sucker	10/01/12	54	77.3	1.35	382	MP	
Razorback sucker	10/05/12	---	78.2	7.28	456	MP	
Razorback sucker	10/05/12	4.3	72.8	5.2	448	MP	
Razorback sucker	10/04/12	21.4	78.7	1.4	356	MP	
Colorado pikeminnow	10/04/12	15.2	78.2	5.08	645	MP	
Colorado pikeminnow	07/31/12	RFL	66.2	2.93	640	MP	
Colorado pikeminnow	07/18/12	RFL	83.7	8.68	518	MP	
Colorado pikeminnow	07/18/12	RFL	76.4	5.68	398	MP	
Speckled dace	07/21/10	53.8	67.2	8.29	91	WB	
Speckled dace	07/21/10	53.0	63.9	7.13	106	WB	
Speckled dace	07/21/10	53.0	63.3	7.44	94	WB	

Species	Collection Date	River Mile	% Moisture	Selenium (ug/g DW)	Length (mm)	Matrix ¹	Notes
Speckled dace	07/21/10	53.0	66.2	6.11	108	WB	
Speckled dace	07/21/10	53.0	67.0	6.09	95	WB	
Speckled dace	07/21/10	53.8	58.7	7.07	95	WB	
Speckled dace	07/21/10	53.8	66.6	7.49	74	WB	
Speckled dace	07/21/10	53.8	66.0	8.38	95	WB	
Speckled dace	07/21/10	53.8	63.9	8.5	91	WB	
Speckled dace	07/21/10	53.8	65.1	6.55	91	WB	
Speckled dace	07/21/10	54.6	66.9	5.74	113	WB	
Speckled dace	07/21/10	53.8	61.2	6.21	115	WB	
Speckled dace	07/21/10	54.6	64.2	8.82	84	WB	
Speckled dace	07/21/10	54.6	70.3	8.45	83	WB	
Speckled dace	07/21/10	54.6	69.5	9.68	101	WB	
Speckled dace	08/17/11	37.8	73.5	10.5	100	WB	
Speckled dace	08/17/11	39.1	72.9	9.12	57	WB	
Speckled dace	08/17/11	39.1	73.2	6.93	53	WB	
Speckled dace	08/19/11	11.4	74.8	7.85	89	WB	
Speckled dace	08/19/11	12.9	74.3	7.97	60	WB	
Speckled dace	08/18/11	22.3	73.2	9.06	92	WB	
Speckled dace	08/18/11	22.3	74.4	7.27	100	WB	
Speckled dace	08/18/11	22.3	75.2	8.04	101	WB	
Speckled dace	08/19/11	12.9	77.0	10.0	79	WB	
Speckled dace	08/18/11	22.3	74.1	7.29	120	WB	
Speckled dace	08/19/11	11.4	70.8	6.9	96	WB	
Speckled dace	08/19/11	9.8	73.9	11.0	100	WB	
Speckled dace	08/17/11	39.1	75.0	9.85	71	WB	
Speckled dace	08/19/11	11.4	76.8	8.41	75	WB	
Speckled dace	08/19/11	12.9	77.3	11.2	78	WB	
Speckled dace	08/27/12	50.9	68.6	8.14	118	WB	
Speckled dace	08/27/12	52.7	66.3	9.48	92	WB	
Speckled dace	08/27/12	54.4	67.7	9.02	70	WB	
Speckled dace	08/28/12	38	65.3	6.06	82	WB	
Speckled dace	08/28/12	48.1	64.8	6.64	86	WB	
Speckled dace	08/29/12	24.1	68.2	5.54	85	WB	
Speckled dace	08/29/12	35.1	65.9	7.53	102	WB	

Species	Collection Date	River Mile	% Moisture	Selenium (ug/g DW)	Length (mm)	Matrix ¹	Notes
Speckled dace	08/29/12	21.8	68.9	9.69	47	WB	
Speckled dace	08/30/12	18.2	62.4	7.37	91	WB	
Speckled dace	08/30/12	14.4	65.4	8.58	72	WB	
Speckled dace	08/30/12	13.3	65.5	8.38	70	WB	
Speckled dace	08/30/12	12.4	69.5	8.54	47	WB	
Speckled dace	08/31/12	8.2	64.6	7.11	90	WB	
Speckled dace	10/05/12	10.5	67.5	9.13	74	WB	
Speckled dace	10/02/12	47.7	68.8	7.97	63	WB	
Speckled dace	10/01/12	54.5	72.1	12.1	70	WB	
White sucker	05/19/11	51.4	75.5	8.80		Fish eggs	Formed eggs with a little fluid
White sucker	05/19/11	51.4	75.5	8.80		Fish eggs	Formed eggs with a little fluid
White sucker	05/19/11	51.4	75.2	8.71		Fish eggs	Most eggs not fully formed
White sucker	05/26/11	27.3	76.0	6.85		Fish eggs	Eggs fully formed with lots of fluid
White sucker	06/02/11	27.3	80.9	8.15		Fish eggs	Eggs with lots of fluid
White sucker	06/02/11	38.4	73.3	8.52		Fish eggs	Well formed eggs
White sucker	05/18/11	30.4	67.5	6.53		Fish eggs	Very formed eggs
Invertebrates	08/12/11	50.3	96.9	7.52		Composite	Mostly Hydropsychidae
Invertebrates	08/12/11	56.3	77.0	8.24		Composite	Mostly Hydropsychidae-BUC
Invertebrates	08/12/11	57.0	77.6	5.46		Composite	Mostly Hydropsychidae-AUC
Invertebrates	08/12/11	57.0	68.4	5.67		Composite	Perlolidae-AUC
Invertebrates	08/12/11	56.3	66.7	11.3		Single	Perlolidae-BUC
Invertebrates	07/29/11	4.8	72.3	7.31		Single	Odonata-1 nymph
Invertebrates	07/29/11	4.8	97.2	7.98		Composite	Mostly Hydropsychidae
Invertebrates	07/29/11	9.9-15.4	97.5	8.74		Composite	Mostly Hydropsychidae, few mayflies
Invertebrates	07/28/11	33.0	76.3	8.39		Composite	Mostly Hydropsychidae
Invertebrates	06/25/12	8.5	73.8	9.19		Composite	Mostly Hydropsychidae
Invertebrates	06/26/12	22	89.3	5.33		Composite	Mostly Hydropsychidae
Invertebrates	06/28/12	57	90	6.39		Composite	Hydropsychidae-AUC
Invertebrates	06/28/12	56	87.4	6.45		Composite	Hydropsychidae-BUC
Invertebrates	06/28/12	48	91	5.91		Composite	Hydropsychidae
Invertebrates	07/03/12	3	88.3	5.99		Composite	RFL, Mostly Hydropsychidae-RFL

¹MP=Muscle plug, WB=Whole body, Composite=Multiple specimens: ²BUC=Below Uncompahgre confluence, AUC=Above Uncompahgre confluence, RFL=Redlands fish ladder