Mountain Studies Institute
SAN JUAN MOUNTAINS, COLORADO

Final Report

416-Fire Aquatic Monitoring
WSRF Grant - POGGI PDAA 201900002894

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Prepared For:
Colorado Water Conservation Board

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1. Introduction

During the summer of 2018, the 416-Fire burned over 54,000 acres in the Hermosa Creek drainage within the Animas River watershed (HUC 14080104), impacting communities during and after the fire, with subsequent runoff and debris flow events. Scientists from Mountain Studies Institute (MSI), Colorado School of Mines (CSM), and USFS Rocky Mountain Research Station (RMRS) formed a partnership called the 416-Fire Aquatic Monitoring Research Group to investigate the water quality and aquatic life impacts from the 416 Fire.

To support these research efforts, Mountain Studies Institute (MSI) was awarded $18,000 by the Colorado Water Conservation Board (CWCB), through the Water Supply Reserve Fund, to conduct a project entitled "416-Fire Aquatic Monitoring" from May 1, 2019 – May 31, 2022. Preliminary studies in 2018 captured the immediate impacts from the fire in Hermosa Creek and the Animas River, and the Research Group's continued sampling and analysis in 2019 allowed resource managers, water providers, and the general public to better understand how these impacts may persist during watershed recovery.

In addition, tracking impacts and recovery from wildfires offers benefits on a regional and state level as well. Both the CWCB and Southwest Basin Roundtable (SWBRT) Basin Implementation Plan (BIP) outline goals for watershed monitoring and recovery. For example, the BIP identified goals to monitor, protect, and improve water quality for all classified uses (F1) and maintain watershed health by protecting and/or restoring watersheds that could affect critical infrastructure and/or environmental and recreational areas (A5). This project's post-fire monitoring and sharing of results contributes to the BIP desired outcomes to monitor and protect water quality as well as support, "watershed/wildfire assessments that identify strategies/treatments necessary to mitigate impacts that occur to hydrology in a post-fire environment."

This CWCB Final Report and future technical reports will enhance understanding of the recovery of river health and wildfire on a local, state and regional level. Currently, the state of Colorado suggests rivers generally recover from wildfire impacts after five years. Sharing the data and results of this study with agencies, research entities, and the public will provide additional evidence to determine if Colorado state's recovery timeline is accurate and reasonable.

2. Project Goals, Objectives, and Tasks

After the 416 Fire ignited on June 1, 2018 the wildfire burned over 54,000 acres for several months at mixed severity levels in the San Juan National Forest, primarily in the Hermosa Creek drainage north of Durango, CO. The fire and smoke negatively impacted livelihoods, homeowners, tourism and the fire restricted access to rural towns and communities. Several subsequent runoff events and debris flows have occurred within the 416-Fire burn area, creating concern in southwest Colorado communities about the resulting impacts to water quality and aquatic life. Ash and sediment delivered from the burn area have been

evident in changes in color, discharge, turbidity, and reports of fish kills in Hermosa Creek and the Animas River (Appendix A). Additionally, irrigators and ditch companies were impacted from sediment and debris flows that inhibited their ability to access their water allocations.

Goals:

As a part of this grant, CWCB generously awarded funds to support investigations by the 416-Fire Aquatic Monitoring Research Group into the impacts and recovery of water quality and aquatic life following the fire. The research group consists of scientists from Mountain Studies Institute (MSI), Colorado School of Mines (CSM), and the US Forest Service Rocky Mountain Research Station (RMRS). Preliminary studies in 2018 captured the immediate impacts of the 416 Fire. The goal of continued monitoring and analysis in 2019 was to provide resource managers, water providers, and the general public with information to better understand how these impacts from wildfire have persisted during watershed recovery.

Objectives:

The primary objectives of this project are:

- Evaluate water quality impacts to Hermosa Creek and the Animas River from the 416-Fire in context of the use of these waters for irrigation, water supply, recreation, and aquatic life.
- Document the recovery of water quality and aquatic life following the 416-Fire to share with concerned public members and more broadly to further our understanding of the recovery of river health after wildfire. For regulatory purposes, the state of Colorado generally considers rivers to recover from wildfire impacts after five years. This study will provide additional evidence as to whether the five-year recovery time period is a reasonable assumption.
- Establish monitoring sites on Hermosa Creek and Junction Creek to serve as watershed comparisons of differing forest health, fire history, and forest health treatments.

Tasks:

We have successfully completed the four tasks CWCB funded for this project, including:

1) Water Quality Sampling
2) Instrumentation
3) Benthic Macroinvertebrate Sampling
4) Data Analysis, Presentations, Reporting

Additional project components were funded through other partners and include additional laboratory analysis of water and benthic macroinvertebrate samples. The Research Group will continue building robust analysis of monitoring results in 2020 for a second year of monitoring results. This report serves to provide a summary of 2019 accomplishments related to the project components funded by CWCB as well as to share preliminary results thus far of the broader effort.

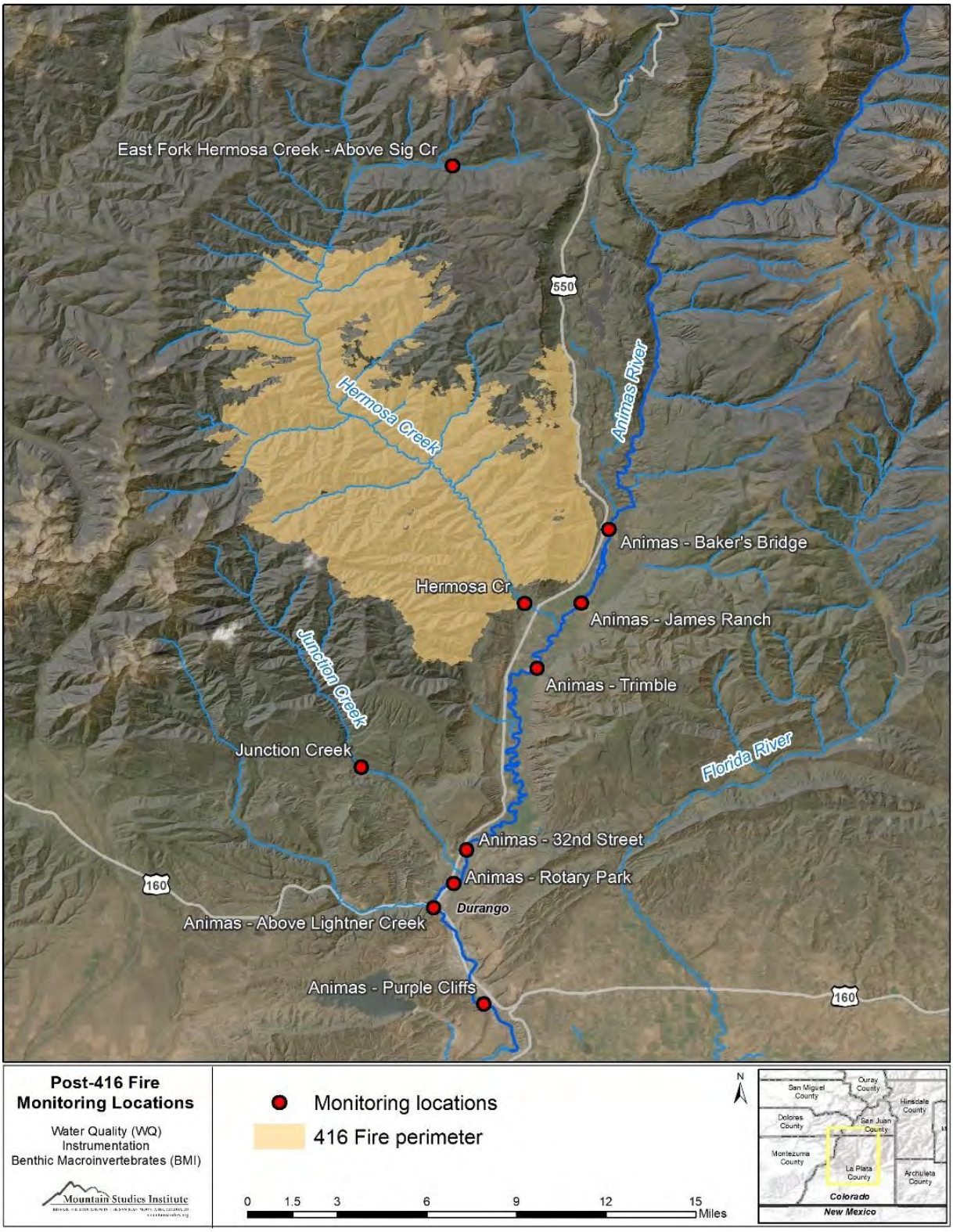
3. Monitoring Methodology and Results

Task 1 - Water Quality Sampling

Methodology: We collected regular and opportunistic water quality samples from five locations; three locations downstream of the burn area and two locations that were unaffected by the fire (Table 1; Map 1; Appendix A). For the broader research effort that the CWCB grant contributed to, in 2019 we collected monthly samples from March through October. We collected opportunistic samples to characterize conditions during key hydrological events, such as the rising limb of spring runoff, and storm events that caused sediment and ash to runoff of the burn area into stream drainages. In sum, we collected a total of 80 regular and opportunistic storm event water quality samples to be analyzed for nutrients, dissolved organic carbon, suspended sediment, and metals. Water quality samples were analyzed by Green Analytical Laboratories, Colorado School of Mines, and Rocky Mountain Research Station.

We compared post-fire results to pre-fire observations and water quality standards to evaluate risks to designated water uses for agriculture, domestic water supply, and aquatic life. This information, along with the continuous water parameter measurements collected through instrumentation (Task 2) generously provided by the Rio Grande Watershed Emergency Action Coordination Team (RWEACT), allowed a comprehensive understanding of the water quality conditions during debris flow and storm events.

Results: Elevated levels of contaminants after the 416 Fire were observed in both 2018 and 2019, with possibly unprecedented levels for some metals (i.e. aluminum, manganese, iron, and mercury) in the Animas River. For most parameters, the highest observed levels occurred in 2018 during storm events immediately after the fire. Fewer water quality standard exceedances occurred in 2019, but many parameters continue to be elevated beyond pre-fire levels. Overall, results from 2019 indicate levels of sediment, metals, and some nutrient forms were lower than levels observed in 2018. These initial findings indicate water quality is recovering in sites impacted downstream of the burn scar (Hermosa Creek and the Animas River at Trimble Lane and Rotary Park). We share results characterizing pre- and post-fire levels of metals and nutrients in Appendix B, C, D, E, and F, and place these results in context of Colorado Department of Public Health and the Environment (CDPHE) water quality standards in Appendix G.



Map 1: Monitoring locations

Table 1: Monitoring locations

Description	Latitude	Longitude	Instrumentation	Water Quality	Benthic macroinvertebrates	Physical habitat surveys
Hermosa Creek – above CR 203	37.4176007	-107.8423549	X	X	X	X
East Fork Hermosa Creek – above Sig Cr	37.63152122	-107.8772825			X	
Junction Creek – Colorado Trail trailhead	37.33762371	-107.9213352	X	X	X	X
Animas River – Baker's Bridge	37.45377427	-107.8014391		X	X	X
Animas River – James Ranch	37.41782203	-107.8148192			X	X
Animas River – Trimble Lane	37.38586261	-107.8362575		X	X	X
Animas River – 32nd Street	37.29727355	-107.8702798			X	
Animas River – Rotary Park	37.28069111	-107.876729		X		
Animas River – above Lightner Creek	37.26892921	-107.8862952			X	X
Animas River – Purple Cliffs	37.22188921	-107.8620385			X	X

Task 2 - Instrumentation

Methodology: Thanks to a cross-watershed partnership with RWEACT, the Research Group deployed HydroLab MS5 multi-probe instruments in Hermosa Creek and Junction Creek in April 2019 to capture peak spring runoff and continued collecting measurements through October 2019. Operation and maintenance of these instruments was managed by Colorado School of Mines scientists due to their experience deploying these instruments in the Rio Grande watershed to assess wildfire impacts.

Higher spring runoff and significant sediment and debris carried downstream from the burn area during storm events made maintaining these instruments difficult. Learning from this experience, the Research Group in 2020 will design more robust anchoring structures and focus deployment in the Hermosa Creek and Junction Creek for sub-watershed comparison.

In addition to the HydroLab instruments, the Research Group also installed radar and tipping bucket precipitation instrumentation on Hermosa Creek to transmit real-time discharge and rainfall levels in 10-minute increments. This information was made available online through the Hydromet Cloud website (http://hydrometcloud.com), providing notification of changing conditions to La Plata County Emergency Management and downstream water users, such as irrigators or water utility managers. Access to real-time data enabled Mountain Studies Institute to collect water quality samples during key storm events to ensure samples captured the sediment and possible contaminants carried in runoff from the 416-Fire burn scar.

Results: Colorado School of Mines conducted analysis of the instrument data indicating substantial differences between burned and unburned sites for total suspended solids (TSS), specific conductivity, and dissolved oxygen (see Appendix C). This information informs interpretation of other water quality parameters and conditions for aquatic life.

Task 3 - Benthic Macroinvertebrate Sampling

Methodology: This research effort also evaluated post-fire impacts to aquatic life via surveys of stream bottom habitat as well as sampling of benthic macroinvertebrate (BMI) community composition and metal tissue concentrations. BMI samples were collected and enumerated from nine locations to compare with pre-fire observations and monitor differences between sites downstream of the burn area and sites unaffected by the fire (see Table 1). Post-fire physical habitat was compared to pre-fire observations to evaluate changes to substrate composition, algae abundance, and chlorophyll-a concentrations.

Results: Results demonstrated substantial changes to the stream bottom habitat of Hermosa Creek, transitioning from cobble-dominated with abundant algae prior to the fire (2016) to higher abundance of sand and fines substrate and decreased algae after the fire (2018-19). We also observed post-fire changes in benthic communities; lower diversity,

increased abundance of Chironomidae midges; and increased benthic tissue concentrations of aluminum, iron, and lead. These impacts dissipate at sites further downstream of the burn area. Results from 2019 demonstrate that recovery is occurring with flushing of sediment and BMI communities trending back toward pre-fire community composition (Appendix H, I, and J).

Task 4 - Data Analysis, Presentations, Reporting:

Analysis of water quality and benthic macroinvertebrate results have been ongoing throughout 2019 and spring of 2020, with statistical analysis and graphic visualizations performed by all three research partners (Appendix K). In 2019 and 2020, Mountain Studies Institute has strived to convey regular updates of preliminary results and findings to the public through reports, presentations, direct contact to water users (e.g. ditch companies and La Plata County Office of Emergency Management), and social media posts.

Several presentations on water quality and benthic macroinvertebrate communities were provided by Project Lead, Scott Roberts, to the following community groups, organizations, and conferences: San Juan Watershed Group, Animas Valley Grange, Animas River Community Forum, Colorado Watershed Assembly, local chapters of Trout Unlimited (Dolores and 5 Rivers), Fort Lewis College guest lectures (departments of Biology, Environmental Studies, and Geosciences), and the public Forest and Fire Learning Series in Durango, CO.

Initial findings have also been shared at community restoration and education events. For example, the Hermosa Resilience Community event had about 100 attendees participate in different activities to learn about fire ecology, impacts to resources, wildfire recovery, and restoration efforts. Demonstrations of how wildfires affect vegetation, soil, and water conditions were presented by MSI and partner organizations, the Durango Nature Studies, San Juan Mountains Association, Trails 2000, and the U.S. Forest Service.

Online updates to the public will continue to be shared through MSI's email newsletter, social media (Facebook), and via Mountain Studies Institute's website at www.mountainstudies.org/animasriver. MSI is also creating an online, interactive Story Map to share both forest and aquatic monitoring on the 416-Fire area to provide comprehensive information on research happening across the landscape. This 416-Fire Story Map will be linked at www.mountainstudies.org/416fire.

Additional partner outreach of post 416-Fire observations from 2018 were included in the collaborative publication, *Our Animas*, developed by the Animas River Community Forum (ARCF). This document is available in print form to ARCF partners, local schools, and online at www.animasrivercommunity.org/our-animas. New editions of this publication will be developed every other year, providing the opportunity to include 2019 416-Fire aquatic monitoring results into updates on the health and recovery of the Animas River.

4. Budget Accounting

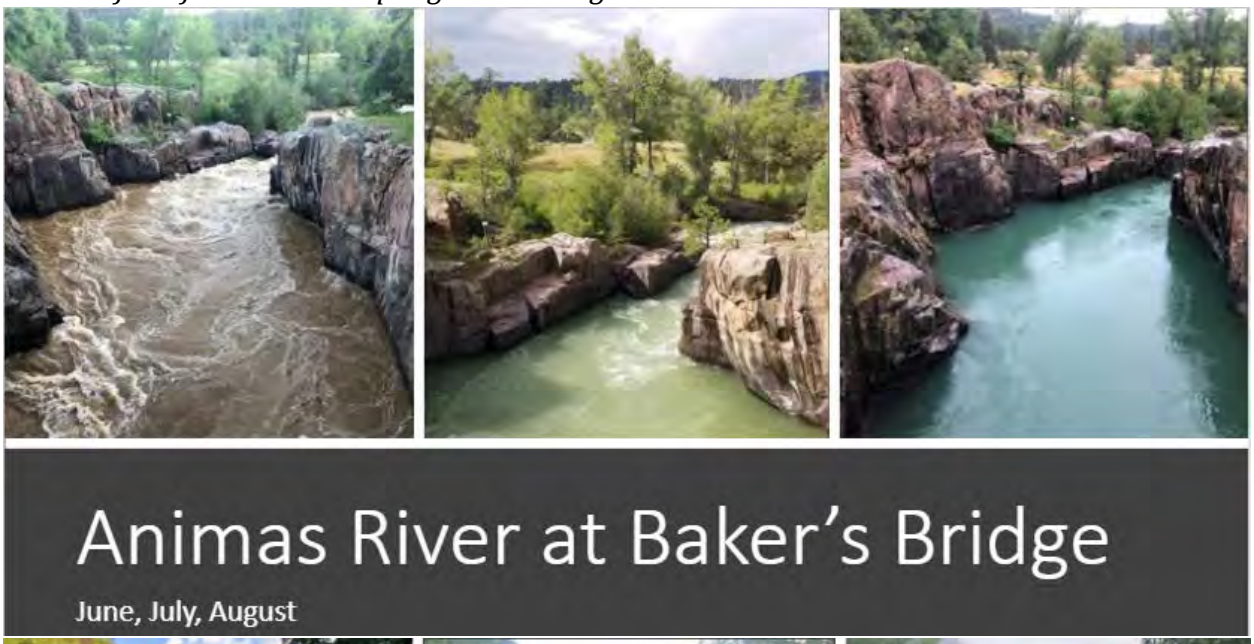
CWCB generously funded four components of our broader research effort: water quality sampling, instrumentation, benthic macroinvertebrate sampling, and data analysis/reporting and public presentations. Our actual use of CWCB funds differed very little from our proposed budget (Table 2). All matching funds were contributed as proposed. All project components were successful. We were able to collect our intended number of water samples as planned, deploy instrumentation, enumerated BMI samples, completed a technical report, and shared results with the public through numerous methods. The 416-Fire Aquatic Monitoring Research Group greatly appreciates the support of CWCB and other partners, allowing the Research Group to conduct these critical steps to understanding the watershed's recovery from wildfire.

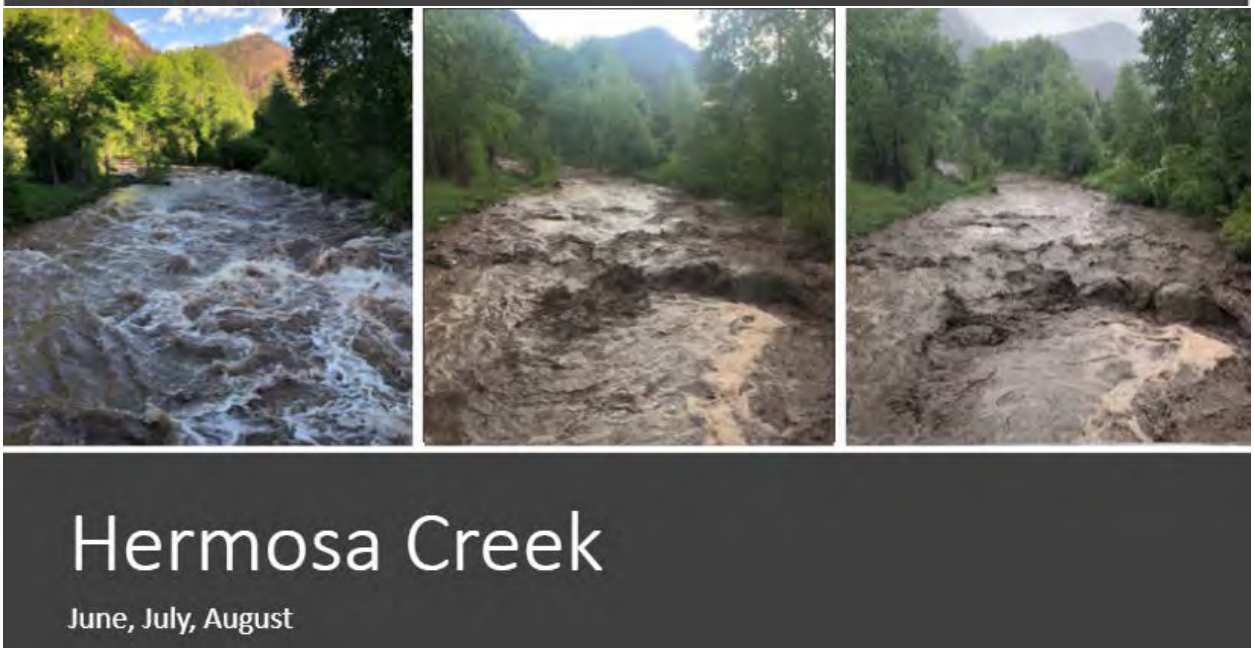
Table 2: Proposed vs. actual use of CWCB project and matching funds.

Task	Description	Proposed use of CWCB funds	Actual use of CWCB funds	Proposed Matching Funds	Actual Matching Funds
1	Water Quality Sampling	$6,000	$5,530.20	$30,243	$30,243
2	Instrumentation	$1,500	$1,646.45	$35,231	$35,231
3	Benthic Macroinvertebrates	$7,000	$6,996.60	$5,601	$5,601
4	Data Analysis, Presentations, and Reporting	$3,500	$3,826.75	$25	$25
	TOTAL	**$18,000**	**$18,000**	**$71,100**	**$71,100**

Appendix A – Site Photos

Photos of the five water sampling sites during stable and storm event conditions in 2019.



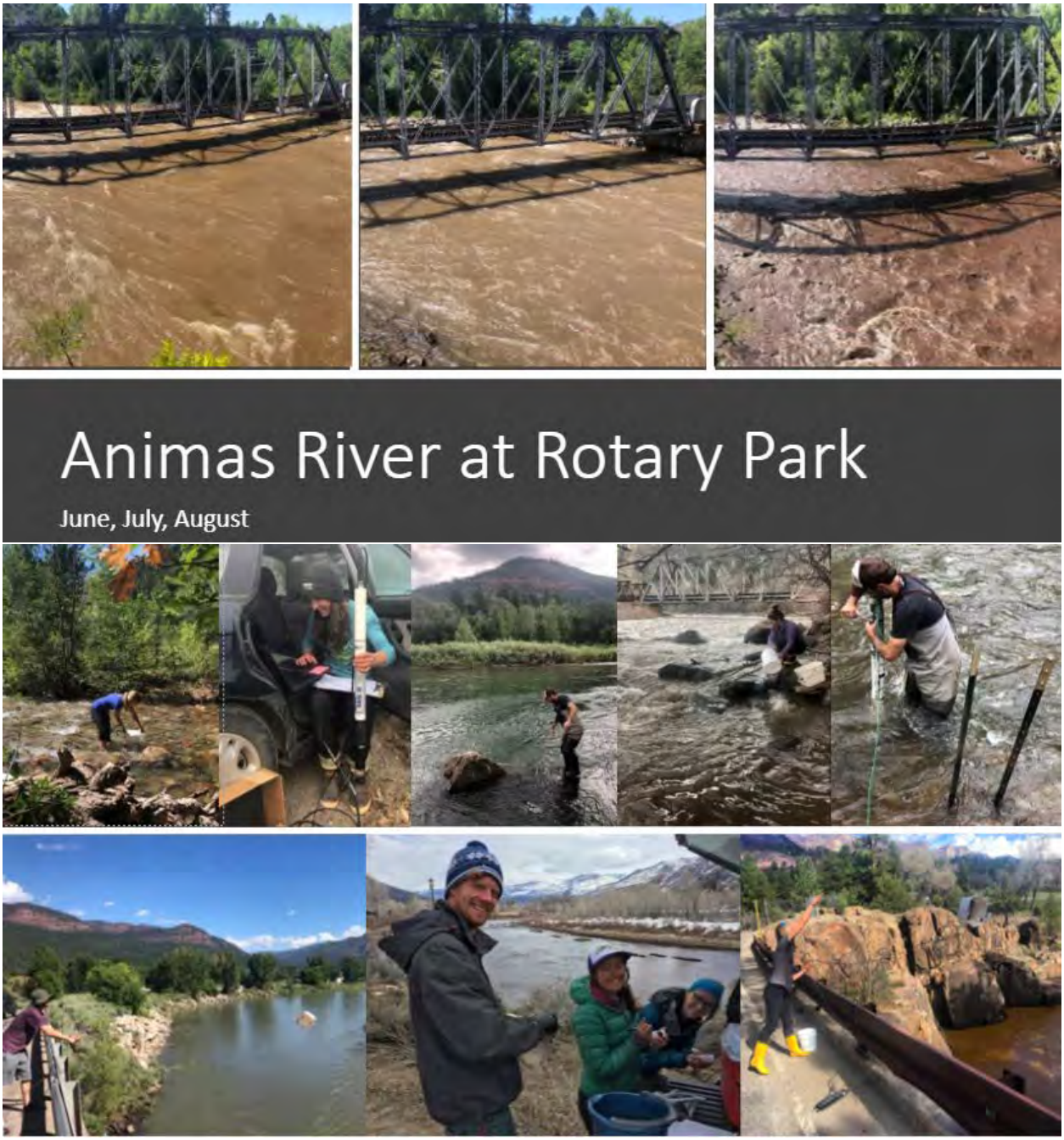


Animas River at Trimble Lane

June, July, August

Junction Creek

June, July, August


Animas River at Rotary Park
June, July, August

Appendix B – Initial Results Presented at the 2019 Colorado Watershed Assembly

Impacts and Recovery:
Animas River water quality and aquatic life following the 416 Fire

Scott Roberts, Mountain Studies Institute, Dr. Ashley Rust & Dr. Terri Hogue, Colorado School of Mines

BACKGROUND

- During the summer of 2018, the 416 Fire burned 54,000 acres in southwest Colorado.

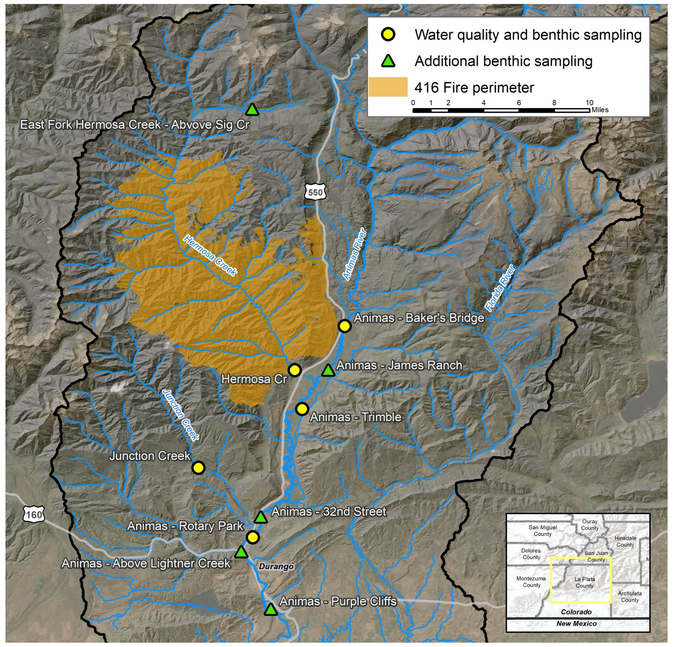
- Ash and sediment delivered from the burn area during storm events and debris flows raised concerns about impacts to water quality and aquatic life in Hermosa Creek and the Animas River.

RESEARCH QUESTIONS

- What impact did the 416-Fire have on Animas River water quality and aquatic life?
- How long will these impacts persist?

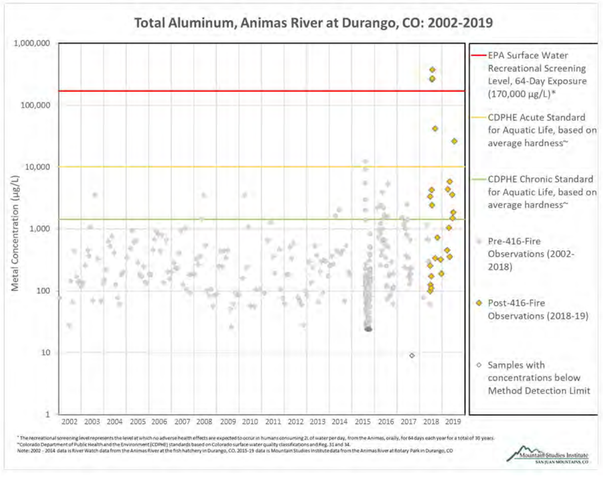
METHODS

- *Water Quality*: We monitored post-fire water quality at five locations using *in-situ* instruments and grab samples during varying hydrological conditions including low-flow, spring runoff and storm events. Samples were analyzed for trace metals, nutrients, sediment, and dissolved organic carbon.
- *Aquatic Insects*: We collected post-fire benthic macroinvertebrate community samples from locations upstream and downstream of the burn area.
- Post-fire data were compared to pre-fire data.

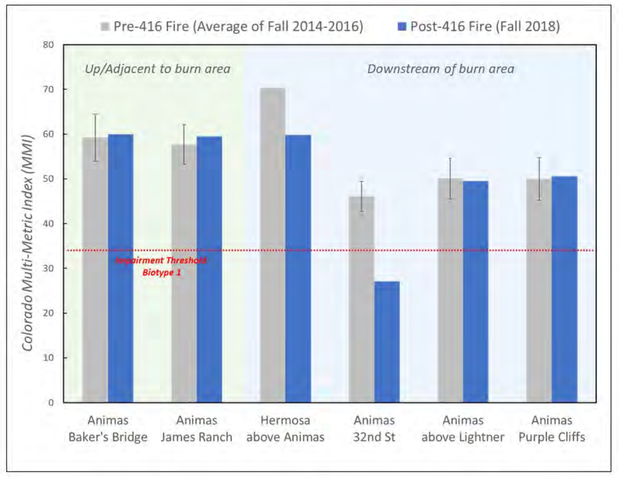


RESULTS

- Results from one year after the fire demonstrate that:
  - Runoff from the 416-burn scar during storm events caused elevated levels of nutrients, sediment, and metal concentrations. Levels of sediment likely were high enough to inhibit fish and insect gill function and smother habitat. Levels of aluminum, iron, and mercury were high enough to be of concern for aquatic life. Average total aluminum, iron, and lead increased by 54, 38, and 11-fold respectively following the fire.
  - Aquatic insect communities in closest downstream proximity to the burn area had reduced diversity and a shift in community composition toward taxa more tolerant of sediment.



Pre- and Post-fire Aluminum



Pre- and Post-fire benthic macroinvertebrates

CONCLUSIONS

- During storm events following the 416 Fire, we detected levels of total aluminum, iron, manganese, and mercury that were unprecedented in the almost twenty year water quality record for the Durango reach of the Animas River, including the 2015 Gold King Mine release.


Gold King Mine Release (2015)

416 Fire and Debris Flows (2018)

- Signs of recovery are evident one year after the fire. Levels of most contaminants were lower in 2019 compared to immediately after the fire in 2018. The wet winter of 2018/19 resulted in a strong prolonged spring runoff period which flushed sediment and re-exposed cobble/pebble habitat that was present before the fire and is favored by aquatic life.
- Our continued research will focus on recovery and assess potential bioaccumulation of metals in aquatic insects.

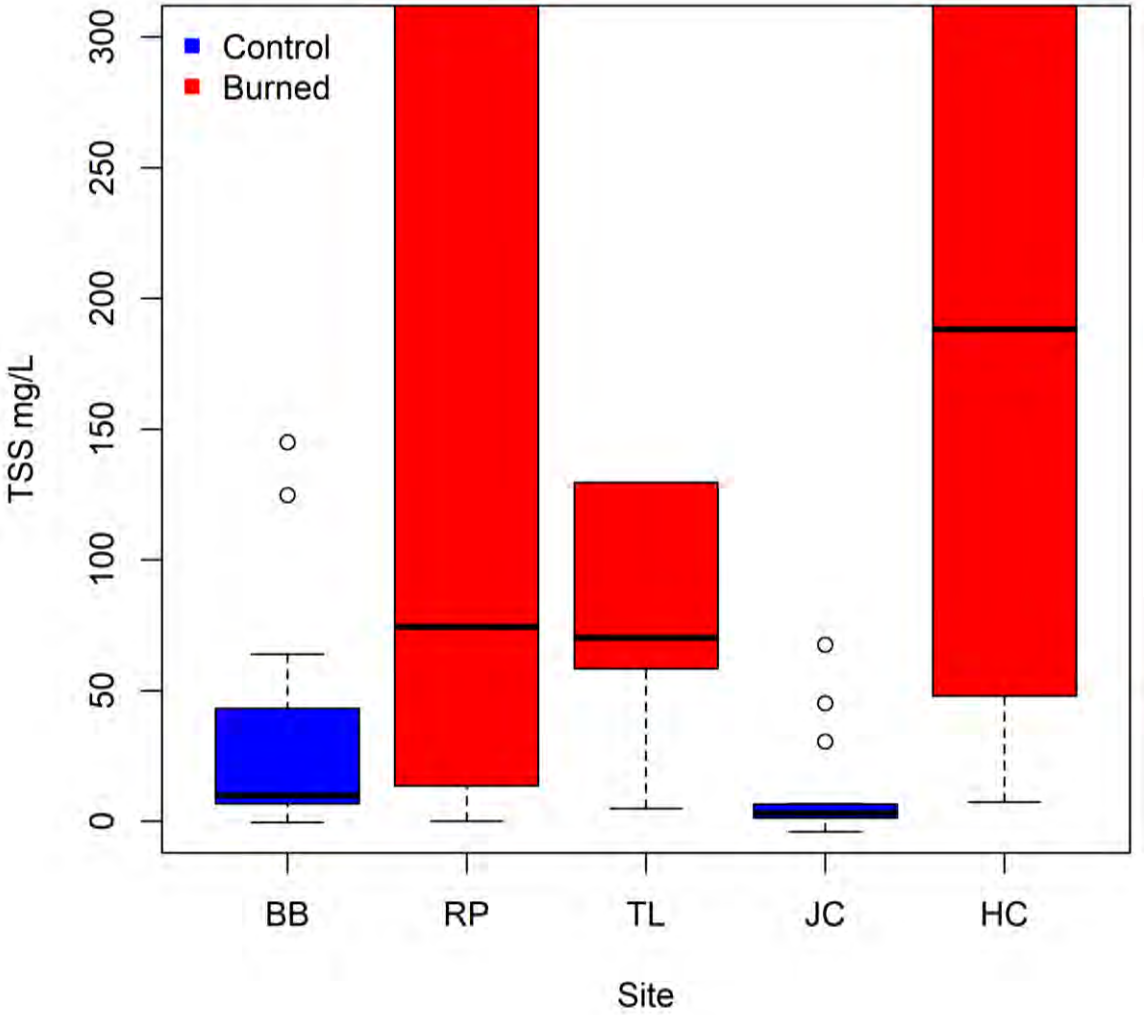
ACKNOWLEDGEMENTS

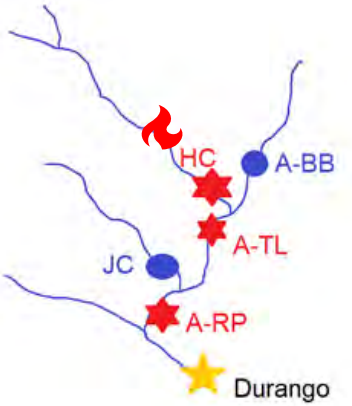
A network of partners provided support for this research including the City of Durango, Colorado Water Conservation Board, Colorado Department of Public Health and the Environment, Colorado School of Mines, Rocky Mountain Research Station, Southwestern Water Conservation District, and Trout Unlimited.

Appendix C – Preliminary water quality results from deployed instrumentation

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

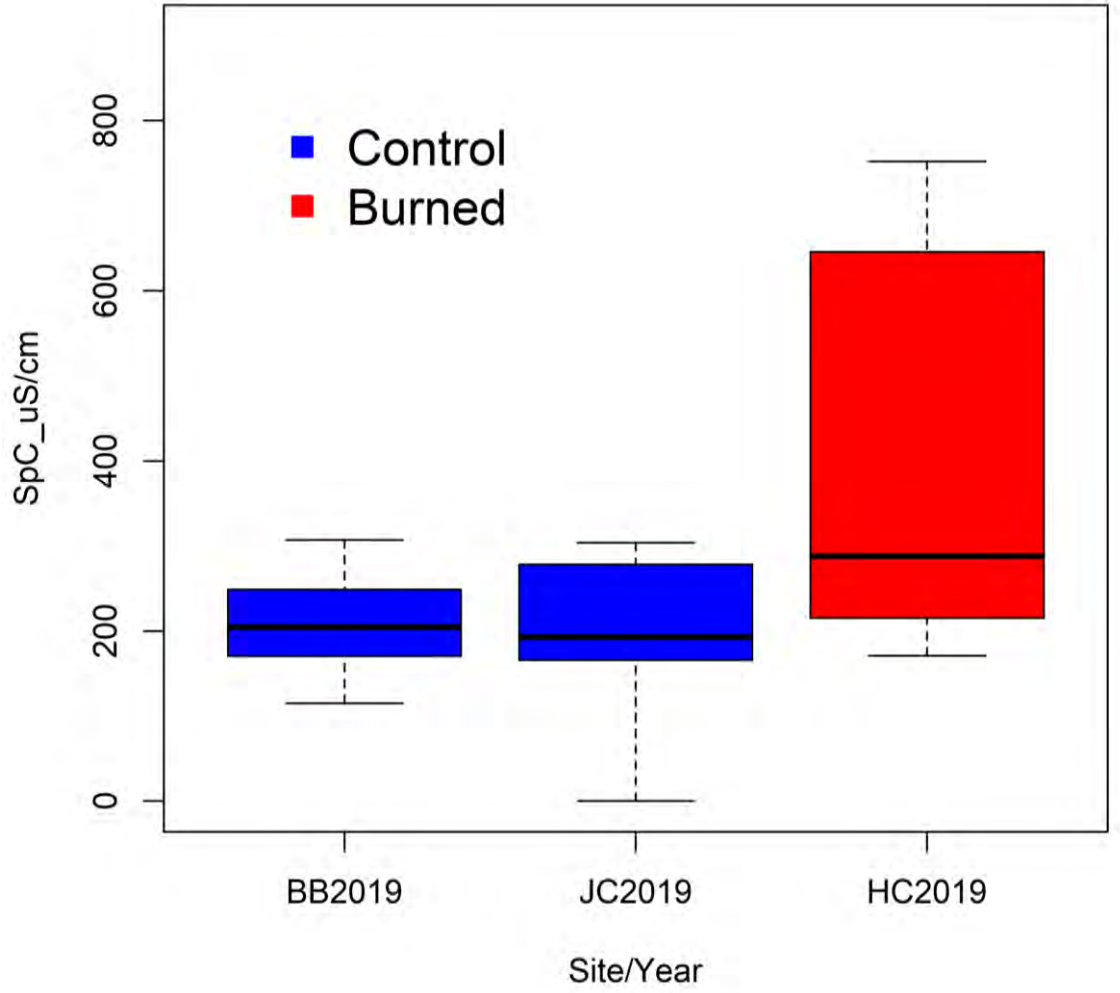
WATER QUALITY RESULTS: TOTAL SUSPENDED SOLIDS (TSS)

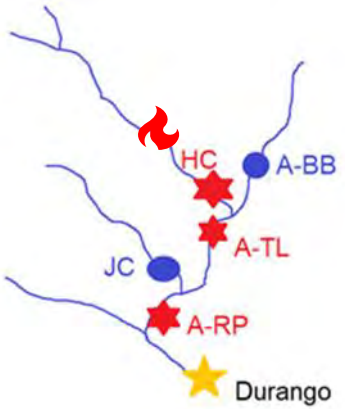




Mann-Whitney U test
$p < 0.05$

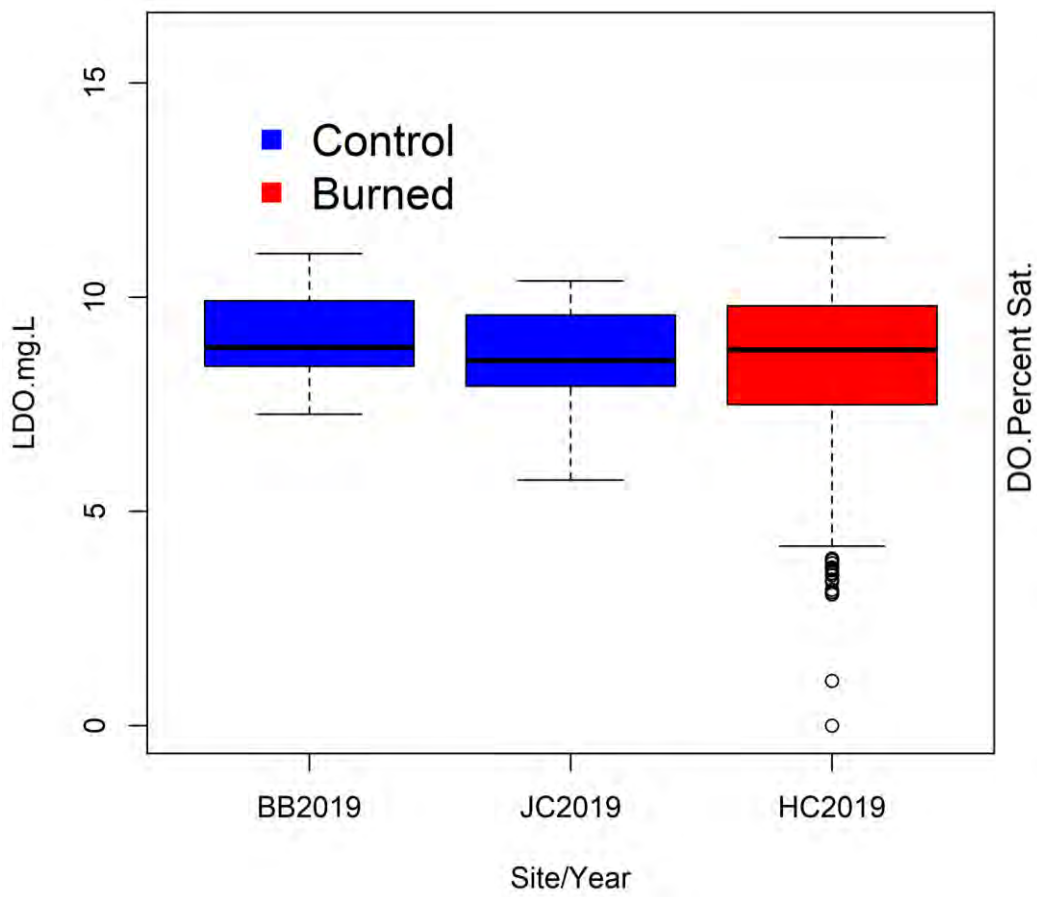
WATER QUALITY RESULTS: SPECIFIC CONDUCTIVITY

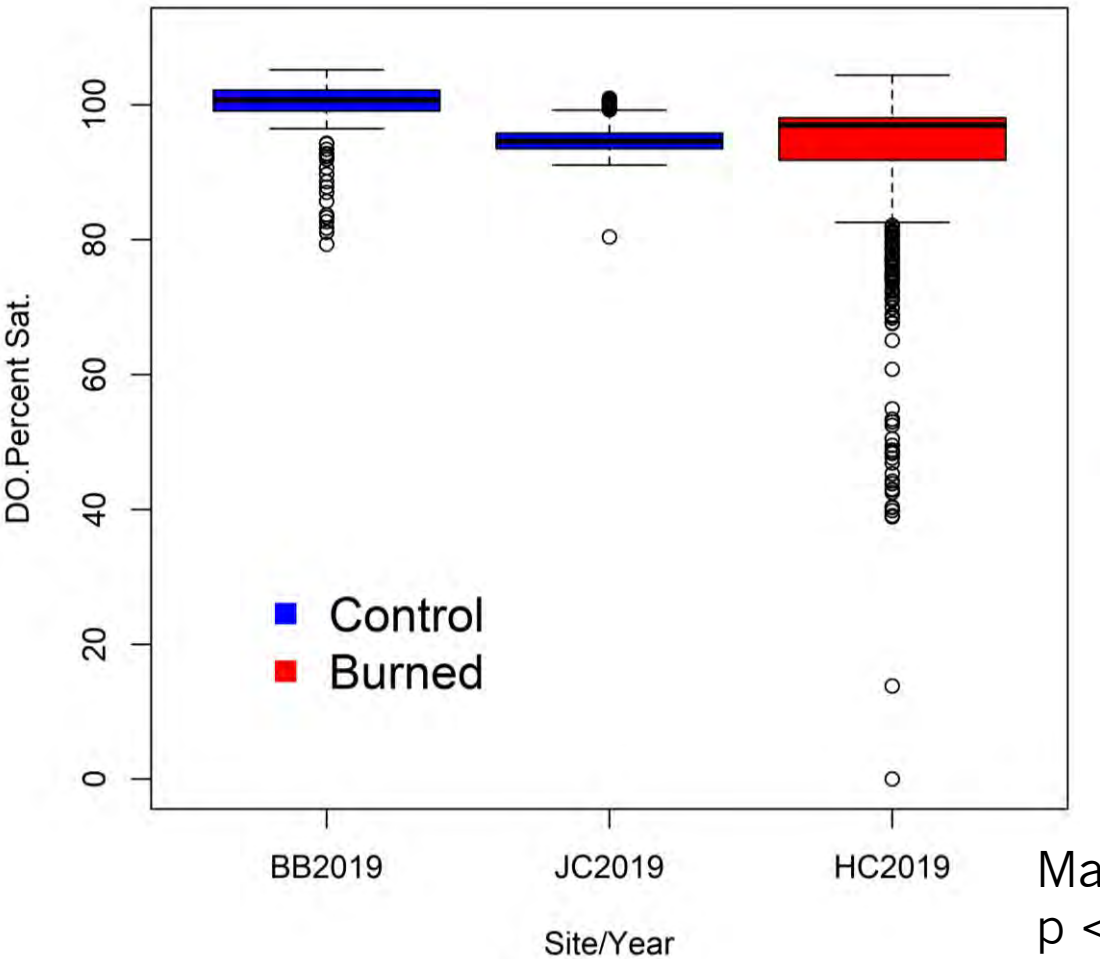


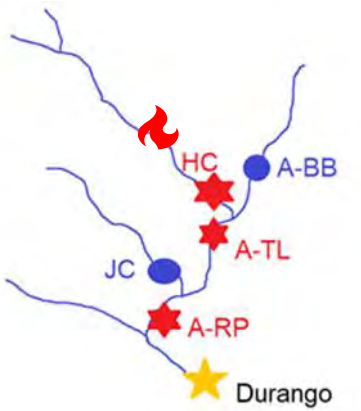


Mann-Whitney U test
$p < 0.05$

WATER QUALITY RESULTS: DISSOLVED OXYGEN







Mann-Whitney U test
$p < 0.05$

Appendix D – Preliminary water quality results: descriptive statistics

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

Animas River at Baker's Bridge															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Aluminum, Filter .45	207	25.00	68.02	1,235	125	8	25.00	60.23	110	34.48	15	25.00	42.83	88.56	16.49
Aluminum, Unfiltered	218	24.00	841	7,453	723	8	158	515	940	286	15	233	755	2,986	745
Ammonia, Unfiltered	139	45.00	48.09	160	12.48	4	45.00	45.00	45.00	0.00	15	45.00	45.00	45.00	0.00
Arsenic, Filter .45	228	10.00	11.04	208	13.24	4	10.00	11.10	14.40	2.20	15	10.00	12.14	27.48	4.45
Arsenic, Unfiltered	227	10.00	13.07	245	19.83	4	10.00	10.00	10.00	0.00	15	10.00	12.38	21.70	3.24
Cadmium, Filter .45	225	0.60	0.65	1.11	0.11	4	0.60	0.60	0.60	0.00	15	0.60	1.12	6.98	1.64
Cadmium, Unfiltered	194	0.60	0.73	2.78	0.23	1	0.60	0.60	0.60		15	0.60	1.01	3.41	0.77
Calcium, Filter .45	194	5,404	40,138	106,548	16,220	4	39,400	53,052	58,000	9,109	15	13,882	30,402	56,045	14,083
Calcium, Unfiltered	177	5,839	42,426	163,182	18,452	6	30,400	41,355	62,122	11,568	15	12,855	22,382	36,305	8,235
Copper, Filter .45	178	5.70	5.92	15.00	1.07	4	5.70	5.70	5.70	0.00	15	5.70	7.27	29.20	6.07
Copper, Unfiltered	183	5.70	11.70	136	11.16	1	5.70	5.70	5.70		15	5.70	9.62	33.74	8.11
Dissolved Organic Carbon						9	568	673	827	87.67	15	850	2,033	3,966	998
Iron, Filter .45	215	28.00	71.80	1,617	183	8	28.00	31.07	52.58	8.69	15	28.00	38.28	87.12	19.23
Iron, Unfiltered	225	17.00	1,271	6,410	1,094	8	152	617	1,448	437	15	266	2,009	11,359	3,094
Lead, Filter .45	228	5.03	5.09	18.00	0.86	8	5.03	5.03	5.03	0.00	15	5.03	6.00	13.08	2.27
Lead, Unfiltered	219	5.03	9.20	350	24.53	8	5.03	5.03	5.03	0.00	15	5.03	14.11	73.68	19.38
Magnesium, Filter .45	194	363	4,829	50,925	3,767	4	4,560	5,450	5,940	628	15	1,774	4,060	7,510	1,964
Magnesium, Unfiltered	177	404	5,231	65,976	4,946	6	3,290	4,633	7,700	1,765	15	2,160	4,910	8,670	2,003
Manganese, Filter .45	228	7.50	374	986	199	8	245	350	550	102	15	70.25	221	389	99.95
Manganese, Unfiltered	219	46.60	470	7,313	522	8	254	377	658	135	15	164	402	1,440	322
Mercury, Unfiltered	2	0.08	0.08	0.08	0.00	4	0.08	0.08	0.08	0.00	15	0.08	0.08	0.08	0.00
Molybdenum, Filter .45	12	1.24	6.23	10.60	3.98	3	1.24	1.65	2.23	0.51	15	1.24	3.12	22.87	5.50
Molybdenum, Unfiltered	11	1.24	5.64	10.20	3.63	3	1.24	1.37	1.64	0.23	15	1.24	1.51	3.09	0.59
Nitrate/Nitrite as N, Unfiltered	144	20.00	185	6,000	505	8	58.00	82.44	149	36.75	15	54.00	88.60	174	29.18
Phosphate (PO4), Unfiltered	6	10.00	19.67	42.00	12.47	1	10.00	10.00	10.00		15	10.00	10.00	10.00	0.00

Animas River at Baker's Bridge															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Phosphorus, Unfiltered	101	11.00	34.51	912	90.78	7	11.00	11.86	15.00	1.57	15	11.00	115	954	252
Potassium, Filter .45	123	200	739	2,628	294	4	713	936	1,056	155	15	412	683	1,727	336
Potassium, Unfiltered	119	200	996	25,063	2,240	2	900	986	1,073	123	15	400	691	930	144
Selenium, Filter .45	228	8.23	8.52	48.70	3.08	4	8.23	8.63	9.80	0.78	15	8.23	8.97	18.66	2.68
Selenium, Unfiltered	219	8.23	9.28	158	10.56	1	9.30	9.30	9.30		15	8.23	8.50	10.96	0.74
Sulfate, Unfiltered	165	5,800	98,221	1,020,000	96,909	5	130,000	149,223	170,000	16,506	15	20,540	55,780	107,569	31,295
Total Kjeldahl nitrogen, Unfiltered						4	133	133	133	0.00	15	67.40	148	744	203
Total Nitrogen (calc), Unfiltered						8	72.70	154	212	53.96	15	121	236	810	201
Total Suspended Solids, Unfiltered	163	0.00	14,199	724,100	57,351	1	9,400	9,400	9,400		14	0.00	26,629	145,000	39,236
Zinc, Filter .45	228	5.00	136	373	72.66	4	131	220	464	163	15	8.68	98.55	404	93.04
Zinc, Unfiltered	219	5.40	211	619	87.20	1	583	583	583		15	87.03	177	438	99.11

Hermosa Creek above CR 203															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Aluminum, Filter .45	65	25.00	26.98	147	15.14	12	25.00	113	321	92.61	15	25.00	46.78	210	54.59
Aluminum, Unfiltered	65	24.00	99.45	1,009	200	13	144	418,053	2,560,000	866,942	15	24.00	120,633	1,520,000	390,025
Ammonia, Unfiltered	61	45.00	47.70	90.00	8.74	4	45.00	309	1,100	528	15	45.00	234	1,100	367
Arsenic, Filter .45	65	10.00	10.00	10.00	0.00	4	10.00	10.61	12.43	1.21	15	10.00	16.33	27.27	6.55
Arsenic, Unfiltered	65	10.00	10.00	10.00	0.00	4	10.00	18.21	31.00	10.19	15	10.00	32.30	110	35.14
Cadmium, Filter .45	65	0.60	0.60	0.60	0.00	4	0.60	0.60	0.60	0.00	15	0.60	0.60	0.60	0.00
Cadmium, Unfiltered	65	0.60	0.60	0.60	0.00	1	0.60	0.60	0.60		15	0.60	2.49	24.09	6.02
Calcium, Filter .45	64	10,992	79,330	140,831	30,447	4	45,800	93,935	129,942	36,190	15	28,552	63,950	127,484	31,885
Calcium, Unfiltered	65	11,257	82,929	143,456	30,424	11	51,000	1,116,303	5,750,000	2,056,542	15	29,570	68,150	159,100	34,314
Copper, Filter .45	65	5.70	5.70	5.70	0.00	5	5.70	5.70	5.70	0.00	15	5.70	5.70	5.70	0.00
Copper, Unfiltered	65	5.70	5.70	5.70	0.00	2	5.70	92.85	180	123	15	5.70	27.85	182	55.04
Dissolved Organic Carbon						13	641	28,580	165,000	50,334	15	936	6,142	23,290	5,958
Iron, Filter .45	65	28.00	28.38	48.00	2.55	12	28.00	65.12	204	63.20	15	28.00	46.91	187	50.30
Iron, Unfiltered	65	17.00	75.06	1,205	178	13	17.00	365,385	2,510,000	796,632	15	25.66	127,698	1,620,000	415,701
Lead, Filter .45	65	5.03	5.03	5.03	0.00	13	5.03	5.03	5.03	0.00	15	5.03	5.98	9.41	1.48
Lead, Unfiltered	65	5.03	5.03	5.03	0.00	13	5.03	934	6,060	1,971	15	5.03	311	4,170	1,070
Magnesium, Filter .45	64	971	11,009	21,921	4,952	4	6,210	12,299	17,187	4,719	15	3,378	8,602	19,292	5,302
Magnesium, Unfiltered	65	1,039	11,349	22,051	5,111	11	5,040	294,729	1,570,000	574,089	15	2,260	8,645	20,760	6,053
Manganese, Filter .45	65	5.00	5.00	5.00	0.00	13	11.60	475	3,720	1,016	15	5.00	23.31	97.32	26.46
Manganese, Unfiltered	65	5.00	7.19	51.90	7.88	13	29.40	22,672	141,000	46,567	15	14.42	5,348	68,200	17,472
Mercury, Unfiltered						12	0.08	1.08	6.20	2.19	11	0.08	0.08	0.08	0.00
Molybdenum, Filter .45						4	3.43	4.31	6.20	1.28	15	1.24	2.36	4.11	0.86
Molybdenum, Unfiltered						1	6.05	6.05	6.05		15	1.24	2.03	4.23	0.90
Nitrate/Nitrite as N, Unfiltered	41	20.00	238	6,670	1,037	12	20.00	155	1,000	296	15	20.00	544	2,280	722
Phosphate (PO4), Unfiltered						9	10.00	36,248	208,000	68,385	15	10.00	149	1,830	470

Hermosa Creek above CR 203															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Phosphorus, Unfiltered	30	11.00	12.74	29.80	4.55	11	11.00	12,475	67,900	21,048	15	11.00	8,019	56,500	18,401
Potassium, Filter .45	65	200	818	1,497	283	4	1,319	3,607	9,450	3,907	15	501	1,935	7,201	2,214
Potassium, Unfiltered	65	200	880	2,607	335	2	1,400	1,507	1,614	151	15	464	1,916	7,764	2,076
Selenium, Filter .45	65	8.23	8.23	8.23	0.00	4	8.23	8.23	8.23	0.00	15	8.23	9.21	16.58	2.57
Selenium, Unfiltered	65	8.23	8.23	8.23	0.00	1	22.84	22.84	22.84		15	8.23	8.94	14.22	1.83
Sulfate, Unfiltered	65	5,400	117,100	235,000	63,291	5	59,000	171,861	290,000	85,583	15	3,843	69,392	226,270	71,678
Total Kjeldahl nitrogen, Unfiltered						9	133	73,331	537,000	175,392	15	67.40	15,263	154,000	41,138
Total Nitrogen (calc), Unfiltered						13	88.70	51,216	537,485	147,463	15	73.40	15,806	156,280	41,567
Total Suspended Solids, Unfiltered	65	0.00	4,435	51,700	9,397	1	25,600	25,600	25,600		14	7,400	5,888,176	45,402,000	13,903,879
Zinc, Filter .45	65	5.00	6.00	17.20	2.61	5	5.00	73.31	305	130	15	5.00	37.11	407	102
Zinc, Unfiltered	65	3.00	9.21	60.00	9.90	2	285	848	1,410	795	15	4.11	180	1,064	346

Animas River at Trimble															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Aluminum, Filter .45	183	25.00	66.84	6,333	466	4	25.00	53.75	78.00	21.93	14	25.00	28.84	41.22	6.04
Aluminum, Unfiltered	183	24.00	492	6,391	646	4	147	2,343	8,260	3,954	15	64.21	3,494	24,584	6,361
Ammonia, Unfiltered	144	45.00	60.59	1,590	130						15	45.00	768	10,700	2,748
Arsenic, Filter .45	182	10.00	12.62	306	23.40						14	10.00	13.50	31.74	6.54
Arsenic, Unfiltered	182	10.00	14.38	299	28.18						14	10.00	16.31	32.40	5.97
Cadmium, Filter .45	183	0.60	0.61	1.96	0.10						14	0.60	0.63	1.05	0.12
Cadmium, Unfiltered	183	0.60	0.63	2.30	0.17						14	0.60	0.94	2.30	0.57
Calcium, Filter .45	182	7,953	59,105	144,620	23,342						14	17,177	45,467	81,445	21,917
Calcium, Unfiltered	183	7,907	63,263	256,334	28,249	4	50,400	62,250	74,000	9,693	15	20,930	43,479	85,580	16,632
Copper, Filter .45	183	5.70	6.32	95.80	6.73						14	5.70	5.70	5.70	0.00
Copper, Unfiltered	183	5.70	8.19	96.10	7.93						14	5.70	10.21	28.66	7.53
Dissolved Organic Carbon						4	675	1,525	3,830	1,541	15	253	2,319	3,993	1,225
Iron, Filter .45	183	28.00	57.97	220	35.12	4	28.00	28.00	28.00	0.00	14	28.00	32.80	64.32	10.36
Iron, Unfiltered	183	20.00	757	5,755	887	4	213	2,346	7,810	3,656	15	161	4,022	17,766	4,696
Lead, Filter .45	182	5.03	6.49	265	19.23	4	5.03	5.03	5.03	0.00	14	5.03	6.33	12.40	2.34
Lead, Unfiltered	182	5.03	8.28	265	20.60	4	5.03	9.05	21.10	8.04	15	5.03	18.93	68.20	17.33
Magnesium, Filter .45	182	460	8,389	74,679	5,928						14	2,250	6,088	11,454	3,105
Magnesium, Unfiltered	183	504	9,444	82,847	8,582	4	6,360	8,275	11,000	1,956	15	2,976	6,581	13,190	3,263
Manganese, Filter .45	183	5.00	225	1,302	117	4	43.90	151	200	72.04	14	50.86	156	263	57.45
Manganese, Unfiltered	183	26.50	261	1,302	123	4	201	255	378	82.80	15	157	423	830	238
Mercury, Unfiltered											14	0.08	0.08	0.08	0.00
Molybdenum, Filter .45											14	1.24	2.00	4.46	1.05
Molybdenum, Unfiltered											14	1.24	1.59	3.22	0.65
Nitrate/Nitrite as N, Unfiltered	150	20.00	156	5,020	414	4	50.00	70.00	100	21.35	15	55.00	198	709	205
Phosphate (PO4), Unfiltered						2	230	1,185	2,140	1,351	15	10.00	10.00	10.00	0.00

Animas River at Trimble															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Phosphorus, Unfiltered	101	11.00	23.60	111	20.68	4	11.00	199	697	334	15	11.00	409	3,040	843
Potassium, Filter .45	124	200	2,241	5,509	1,199						14	522	1,430	3,518	945
Potassium, Unfiltered	125	200	2,391	5,648	1,211						15	584	1,418	3,355	831
Selenium, Filter .45	182	8.23	8.82	52.30	4.26						14	8.23	8.36	9.97	0.47
Selenium, Unfiltered	182	8.23	9.47	89.80	7.81						14	8.23	9.04	13.48	1.80
Sulfate, Unfiltered	167	4,310	101,637	231,000	48,887						15	20,537	63,732	140,892	39,964
Total Kjeldahl nitrogen, Unfiltered						4	133	585	1,940	904	15	67.40	1,369	13,500	3,402
Total Nitrogen (calc), Unfiltered						4	183	655	2,040	924	15	122	1,567	13,659	3,419
Total Suspended Solids, Unfiltered	171	0.00	11,277	490,000	39,786						14	4,800	270,086	1,870,000	489,970
Zinc, Filter .45	183	5.00	94.43	459	44.84						14	5.00	75.13	485	121
Zinc, Unfiltered	183	5.00	124	458	52.75						14	31.40	130	259	67.12

Animas River at Rotary Park															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Aluminum, Filter .45	362	25.00	42.02	3,306	174	13	25.00	174	1,400	391	14	25.00	270	3,410	904
Aluminum, Unfiltered	407	24.00	527	26,210	1,639	15	99.00	63,937	374,000	125,754	15	30.34	12,935	95,233	26,807
Ammonia, Unfiltered	34	45.00	73.11	490	81.06	4	45.00	4,537	18,000	8,975	15	45.00	121	451	116
Arsenic, Filter .45	348	10.00	11.34	270	14.81	4	10.00	10.86	13.42	1.71	15	10.00	12.79	20.55	3.99
Arsenic, Unfiltered	382	10.00	13.47	305	24.62	4	10.00	12.18	16.14	2.91	15	10.01	23.88	70.36	16.78
Cadmium, Filter .45	313	0.60	0.60	1.84	0.08	4	0.60	0.60	0.60	0.00	15	0.60	0.64	1.15	0.14
Cadmium, Unfiltered	346	0.60	0.64	5.10	0.30	1	0.60	0.60	0.60		15	0.60	1.13	3.29	0.80
Calcium, Filter .45	315	7,717	65,192	181,929	21,772	4	79,092	93,298	107,000	13,763	15	18,163	47,514	90,315	22,890
Calcium, Unfiltered	401	8,022	63,881	183,415	21,067	14	46,805	220,052	981,000	289,257	15	23,407	47,213	63,312	12,549
Copper, Filter .45	368	5.70	6.20	83.50	4.71	4	5.70	5.70	5.70	0.00	15	5.70	5.70	5.70	0.00
Copper, Unfiltered	401	5.70	11.72	652	41.52	1	5.70	5.70	5.70		15	5.70	23.41	104	29.09
Dissolved Organic Carbon						17	676	8,756	41,000	13,709	15	889	2,878	4,832	1,071
Iron, Filter .45	356	28.00	60.37	7,929	421	14	28.00	140	977	287	15	28.00	282	3,809	976
Iron, Unfiltered	409	17.00	1,935	182,000	12,072	16	152	67,541	471,000	144,341	15	127	13,650	80,969	24,686
Lead, Filter .45	376	5.03	5.33	108	5.32	15	5.03	5.47	11.70	1.72	15	5.03	5.81	9.43	1.40
Lead, Unfiltered	409	5.03	28.25	2,620	190	16	5.03	156	885	306	15	5.03	38.71	114	34.07
Magnesium, Filter .45	315	472	9,593	115,625	6,808	4	10,419	12,705	15,800	2,419	15	2,302	6,570	12,855	3,553
Magnesium, Unfiltered	401	520	9,308	116,422	6,205	14	8,380	53,105	262,000	83,645	15	3,025	7,081	14,620	4,076
Manganese, Filter .45	349	5.00	88.95	972	98.18	15	10.80	268	928	271	15	5.00	122	345	87.03
Manganese, Unfiltered	382	5.00	142	1,910	166	15	98.20	2,972	14,800	5,368	15	136	859	3,697	966
Mercury, Unfiltered	142	0.08	0.08	0.26	0.02	12	0.08	0.19	0.70	0.22	11	0.08	0.08	0.08	0.00
Molybdenum, Filter .45	112	1.24	1.90	12.40	2.35	3	2.23	3.64	5.50	1.68	15	1.24	1.93	4.14	0.92
Molybdenum, Unfiltered	142	1.24	1.99	25.80	3.12	1	1.87	1.87	1.87		15	1.24	1.66	3.37	0.75
Nitrate/Nitrite as N, Unfiltered	44	20.00	159	1,370	201	15	20.00	107	551	149	15	43.00	200	728	210
Phosphate (PO4), Unfiltered	14	21.00	98.57	192	46.52	8	10.00	26,058	106,000	39,422	15	10.00	10.00	10.00	0.00

Animas River at Rotary Park															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Phosphorus, Unfiltered	23	11.00	35.55	100	26.30	13	11.00	5,597	34,600	10,606	15	11.00	841	6,350	1,700
Potassium, Filter .45	248	200	2,870	10,000	1,367	4	3,404	5,636	10,100	3,144	15	526	1,891	4,365	1,272
Potassium, Unfiltered	278	200	2,912	9,900	1,292	2	3,550	3,565	3,581	21.75	15	590	2,245	6,700	1,780
Selenium, Filter .45	348	8.23	8.56	79.70	4.39	4	8.23	8.28	8.42	0.09	15	8.23	9.54	13.53	2.05
Selenium, Unfiltered	381	8.23	8.62	89.50	4.69	1	9.26	9.26	9.26		15	8.23	8.37	9.79	0.41
Sulfate, Unfiltered	26	15,300	92,512	210,000	62,314	5	150,000	168,563	182,815	16,985	15	22,611	77,821	153,154	50,913
Total Kjeldahl nitrogen, Unfiltered	33	50.00	532	1,340	209	11	133	19,169	79,200	31,666	15	67.40	2,927	22,300	6,020
Total Nitrogen (calc), Unfiltered	22	100	620	1,203	203	15	142	14,259	79,209	28,146	15	110	3,127	22,462	6,025
Total Suspended Solids, Unfiltered	38	0.00	56,522	816,000	161,048	1	9,000	9,000	9,000		14	6,400	524,000	2,816,000	807,385
Zinc, Filter .45	368	5.00	42.10	276	28.82	4	17.60	127	376	167	15	5.00	62.83	621	155
Zinc, Unfiltered	409	2.80	78.39	1,240	97.13	1	324	324	324		15	4.11	197	495	160

Junction Creek at Coloardo Trailhead															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Aluminum, Filter .45	31	25.00	26.42	50.00	5.18						15	25.00	31.04	73.81	16.00
Aluminum, Unfiltered	31	24.00	113	1,737	308						15	24.00	99.27	689	174
Ammonia, Unfiltered	2	45.00	45.00	45.00	0.00						15	45.00	45.00	45.00	0.00
Arsenic, Filter .45	31	10.00	10.00	10.00	0.00						15	10.00	12.09	17.51	2.56
Arsenic, Unfiltered	31	10.00	10.00	10.00	0.00						15	10.00	12.29	20.41	3.85
Cadmium, Filter .45	31	0.60	0.60	0.60	0.00						15	0.60	0.63	0.98	0.10
Cadmium, Unfiltered	31	0.60	0.60	0.60	0.00						15	0.60	0.61	0.74	0.04
Calcium, Filter .45	31	252	41,968	56,603	14,063						15	20,326	35,243	50,543	9,382
Calcium, Unfiltered	31	27,115	46,462	60,033	9,361						15	20,316	43,446	61,750	11,147
Copper, Filter .45	31	5.70	5.70	5.70	0.00						15	5.70	5.70	5.70	0.00
Copper, Unfiltered	31	5.70	5.98	14.50	1.58						15	5.70	5.70	5.70	0.00
Dissolved Organic Carbon											15	869	2,502	4,917	1,448
Iron, Filter .45	31	28.00	34.13	131	20.03						15	28.00	28.00	28.00	0.00
Iron, Unfiltered	31	17.00	125	1,527	281						15	17.00	98.88	717	181
Lead, Filter .45	31	5.03	5.03	5.03	0.00						15	5.03	5.76	8.90	1.25
Lead, Unfiltered	31	5.03	5.07	6.20	0.21						15	5.03	5.40	7.27	0.78
Magnesium, Filter .45	29	3,832	6,997	8,880	1,494						15	2,893	5,533	8,521	1,782
Magnesium, Unfiltered	31	3,825	7,229	9,483	1,503						15	2,292	6,391	10,980	2,562
Manganese, Filter .45	31	5.00	5.47	10.10	1.34						15	5.00	5.00	5.00	0.00
Manganese, Unfiltered	31	5.00	12.04	90.50	21.01						15	5.00	15.79	110	27.32
Mercury, Unfiltered											15	0.08	0.08	0.08	0.00
Molybdenum, Filter .45											15	1.24	1.70	3.15	0.66
Molybdenum, Unfiltered											15	1.24	1.81	3.25	0.75
Nitrate/Nitrite as N, Unfiltered											15	20.00	25.40	50.00	10.03
Phosphate (PO4), Unfiltered											15	10.00	10.00	10.00	0.00

Junction Creek at Coloardo Trailhead															
Analyte	**Pre-Fire**					**Post-Fire 2018**					**Post-Fire 2019**				
	N	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*	*N*	*Min*	*Avg*	*Max*	*SD*
Phosphorus, Unfiltered	2	11.00	11.00	11.00	0.00						15	11.00	42.37	326	81.45
Potassium, Filter .45	31	200	791	1,209	248						15	499	721	944	120
Potassium, Unfiltered	31	563	880	1,506	247						15	300	748	995	185
Selenium, Filter .45	31	8.23	8.23	8.23	0.00						15	8.23	8.92	12.63	1.54
Selenium, Unfiltered	31	8.23	8.23	8.23	0.00						15	8.23	9.65	22.41	3.76
Sulfate, Unfiltered	2	2,880	9,140	15,400	8,853						15	2,928	8,986	22,293	5,634
Total Kjeldahl nitrogen, Unfiltered											15	67.40	195	734	255
Total Nitrogen (calc), Unfiltered											15	73.40	210	773	266
Total Suspended Solids, Unfiltered	2	0.00	2,900	5,800	4,101						14	0.00	12,443	67,600	20,618
Zinc, Filter .45	31	5.00	5.35	9.80	1.09						15	5.00	52.52	651	166
Zinc, Unfiltered	31	5.00	8.01	29.70	6.02						15	4.11	8.64	15.09	4.74

Appendix E – Preliminary water quality results: percent change in average concentration from pre-fire to post-fire periods.

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

Animas River at Baker's Bridge				
Analyte	***Percent change in average from…***			
	Pre-Fire to Post-Fire	**Pre-Fire to 2018 Post-Fire**	**Pre-Fire to 2019 Post-Fire**	**2018 Post-Fire to 2019 Post-Fire**
	%	*%*	*%*	*%*
Aluminum, Filter .45	-28.14	-11.47	-37.03	-23.07
Aluminum, Unfiltered	-20.16	-38.83	-10.20	34.66
Ammonia, Unfiltered	-6.42		-6.42	
Arsenic, Filter .45	7.91		9.88	
Arsenic, Unfiltered	-9.08		-5.25	
Cadmium, Filter .45	55.86		72.74	
Cadmium, Unfiltered	34.98		38.51	
Calcium, Filter .45	-12.38		-24.26	
Calcium, Unfiltered	-34.47	-2.53	-47.25	-51.99
Copper, Filter .45	17.17		22.74	
Copper, Unfiltered	-19.85		-17.75	
Dissolved Organic Carbon				135
Iron, Filter .45	-50.18	-56.72	-46.68	3.79
Iron, Unfiltered	19.99	-51.46	58.10	187
Lead, Filter .45	11.17	-1.28	17.81	21.62
Lead, Unfiltered	19.01	-45.37	53.35	224
Magnesium, Filter .45	-9.86		-15.92	
Magnesium, Unfiltered	-7.65	-11.43	-6.14	-7.97
Manganese, Filter .45	-29.01	-6.43	-41.05	-50.30
Manganese, Unfiltered	-16.26	-19.77	-14.39	0.19
Mercury, Unfiltered	0.00		0.00	
Molybdenum, Filter .45	-53.89		-49.99	
Molybdenum, Unfiltered	-73.70		-73.30	
Nitrate/Nitrite as N, Unfiltered	-53.37	-55.53	-52.21	4.93
Phosphate (PO4), Unfiltered	-49.15		-49.15	
Phosphorus, Unfiltered	137	-65.65	232	507
Potassium, Filter .45	-0.30		-7.52	
Potassium, Unfiltered	-27.11		-30.59	
Selenium, Filter .45	4.51		5.36	
Selenium, Unfiltered	-7.90		-8.44	
Sulfate, Unfiltered	-19.43	51.93	-43.21	-68.89
Total Kjeldahl nitrogen, Unfiltered				
Total Nitrogen (calc), Unfiltered				48.72
Total Suspended Solids, Unfiltered	79.44		87.53	
Zinc, Filter .45	-8.98		-27.73	
Zinc, Unfiltered	-4.09		-16.08	

Red font indicates increase; green font indicates decrease;
blanks indicate insufficeint data preventing assessment

Hermosa Creek above CR 203				
Analyte	***Percent change in average from…***			
	Pre-Fire to Post-Fire	**Pre-Fire to 2018 Post-Fire**	**Pre-Fire to 2019 Post-Fire**	**2018 Post-Fire to 2019 Post-Fire**
	%	*%*	*%*	*%*
Aluminum, Filter .45	183	320	73.36	-49.12
Aluminum, Unfiltered	260,062	420,282	121,205	-57.01
Ammonia, Unfiltered	423		390	
Arsenic, Filter .45	51.27		63.32	
Arsenic, Unfiltered	193		223	
Cadmium, Filter .45	0.00		0.00	
Cadmium, Unfiltered	297		317	
Calcium, Filter .45	-11.43		-19.39	
Calcium, Unfiltered	517	1,246	-17.82	-93.48
Copper, Filter .45	0.00	0.00	0.00	0.00
Copper, Unfiltered	523		389	
Dissolved Organic Carbon				-75.45
Iron, Filter .45	93.77	129	65.26	-13.45
Iron, Unfiltered	317,043	486,680	170,025	-48.02
Lead, Filter .45	10.18	0.00	19.01	12.06
Lead, Unfiltered	11,836	18,469	6,088	-50.84
Magnesium, Filter .45	-14.79		-21.87	
Magnesium, Unfiltered	1,043	2,497	-23.82	-96.98
Manganese, Filter .45	4,560	9,400	366	-94.62
Manganese, Unfiltered	186,130	315,190	74,278	-65.43
Mercury, Unfiltered				-92.58
Molybdenum, Filter .45				
Molybdenum, Unfiltered				
Nitrate/Nitrite as N, Unfiltered	55.58	-35.04	128	86.92
Phosphate (PO4), Unfiltered				-99.47
Phosphorus, Unfiltered	77,623	97,796	62,829	-4.54
Potassium, Filter .45	180		137	
Potassium, Unfiltered	112		118	
Selenium, Filter .45	9.36		11.86	
Selenium, Unfiltered	19.09		8.54	
Sulfate, Unfiltered	-18.86	46.76	-40.74	-54.97
Total Kjeldahl nitrogen, Unfiltered				-69.57
Total Nitrogen (calc), Unfiltered				-55.87
Total Suspended Solids, Unfiltered	123,843		132,655	
Zinc, Filter .45	669	1,122	518	-33.90
Zinc, Unfiltered	2,712		1,859	

Red font indicates increase; green font indicates decrease;
blanks indicate insufficeint data preventing assessment

Animas River at Trimble				
Analyte	***Percent change in average from…***			
	Pre-Fire to Post-Fire	**Pre-Fire to 2018 Post-Fire**	**Pre-Fire to 2019 Post-Fire**	**2018 Post-Fire to 2019 Post-Fire**
	%	*%*	*%*	*%*
Aluminum, Filter .45	-48.57		-56.85	
Aluminum, Unfiltered	561		610	
Ammonia, Unfiltered	1,167		1,167	
Arsenic, Filter .45	6.99		6.99	
Arsenic, Unfiltered	13.44		13.44	
Cadmium, Filter .45	3.77		3.77	
Cadmium, Unfiltered	48.79		48.79	
Calcium, Filter .45	-23.07		-23.07	
Calcium, Unfiltered	-25.03		-31.27	
Copper, Filter .45	-9.84		-9.84	
Copper, Unfiltered	24.70		24.70	
Dissolved Organic Carbon				
Iron, Filter .45	-45.26		-43.42	
Iron, Unfiltered	385		431	
Lead, Filter .45	-6.84		-2.37	
Lead, Unfiltered	104		129	
Magnesium, Filter .45	-27.43		-27.43	
Magnesium, Unfiltered	-26.54		-30.31	
Manganese, Filter .45	-31.10		-30.60	
Manganese, Unfiltered	48.42		62.03	
Mercury, Unfiltered				
Molybdenum, Filter .45				
Molybdenum, Unfiltered				
Nitrate/Nitrite as N, Unfiltered	9.29		26.50	
Phosphate (PO4), Unfiltered				
Phosphorus, Unfiltered	1,446		1,634	
Potassium, Filter .45	-36.21		-36.21	
Potassium, Unfiltered	-40.72		-40.72	
Selenium, Filter .45	-5.28		-5.28	
Selenium, Unfiltered	-4.58		-4.58	
Sulfate, Unfiltered	-37.29		-37.29	
Total Kjeldahl nitrogen, Unfiltered				
Total Nitrogen (calc), Unfiltered				
Total Suspended Solids, Unfiltered	2,295		2,295	
Zinc, Filter .45	-20.44		-20.44	
Zinc, Unfiltered	5.38		5.38	

Red font indicates increase; green font indicates decrease;
blanks indicate insufficeint data preventing assessment

Animas River at Rotary Park				
Analyte	*Percent change in average from…*			
	Pre-Fire to Post-Fire	Pre-Fire to 2018 Post-Fire	Pre-Fire to 2019 Post-Fire	2018 Post-Fire to 2019 Post-Fire
	%	%	%	%
Aluminum, Filter .45	432	314	542	133
Aluminum, Unfiltered	7,198	12,041	2,356	-71.54
Ammonia, Unfiltered	1,337		65.79	
Arsenic, Filter .45	9.16		12.75	
Arsenic, Unfiltered	59.01		77.30	
Cadmium, Filter .45	4.09		5.45	
Cadmium, Unfiltered	72.32		77.53	
Calcium, Filter .45	-12.33		-27.12	
Calcium, Unfiltered	105	244	-26.09	-79.94
Copper, Filter .45	-8.10		-8.10	
Copper, Unfiltered	90.21		99.65	
Dissolved Organic Carbon				-70.52
Iron, Filter .45	254	132	368	192
Iron, Unfiltered	2,043	3,391	605	-72.29
Lead, Filter .45	5.78	2.61	8.95	0.43
Lead, Unfiltered	251	451	37.01	-68.73
Magnesium, Filter .45	-18.06		-31.52	
Magnesium, Unfiltered	215	471	-23.92	-87.59
Manganese, Filter .45	119	202	36.82	-68.81
Manganese, Unfiltered	1,247	1,989	504	-65.86
Mercury, Unfiltered	70.11	136	-2.19	-58.62
Molybdenum, Filter .45	16.70		1.62	
Molybdenum, Unfiltered	-16.25	-6.14	-16.92	
Nitrate/Nitrite as N, Unfiltered	-3.80	-32.90	25.30	-16.24
Phosphate (PO4), Unfiltered	9,102	26,336	-89.86	-99.96
Phosphorus, Unfiltered	8,477	15,644	2,266	-80.17
Potassium, Filter .45	-6.65		-34.12	
Potassium, Unfiltered	-17.59		-22.92	
Selenium, Filter .45	8.44		11.54	
Selenium, Unfiltered	-2.21		-2.85	
Sulfate, Unfiltered	8.64	82.21	-15.88	-51.77
Total Kjeldahl nitrogen, Unfiltered	1,742	3,504	450	-80.45
Total Nitrogen (calc), Unfiltered	1,301	2,198	404	-73.09
Total Suspended Solids, Unfiltered	766		827	
Zinc, Filter .45	81.57		49.24	
Zinc, Unfiltered	162		152	

Red font indicates increase; green font indicates decrease;
blanks indicate insufficeint data preventing assessment

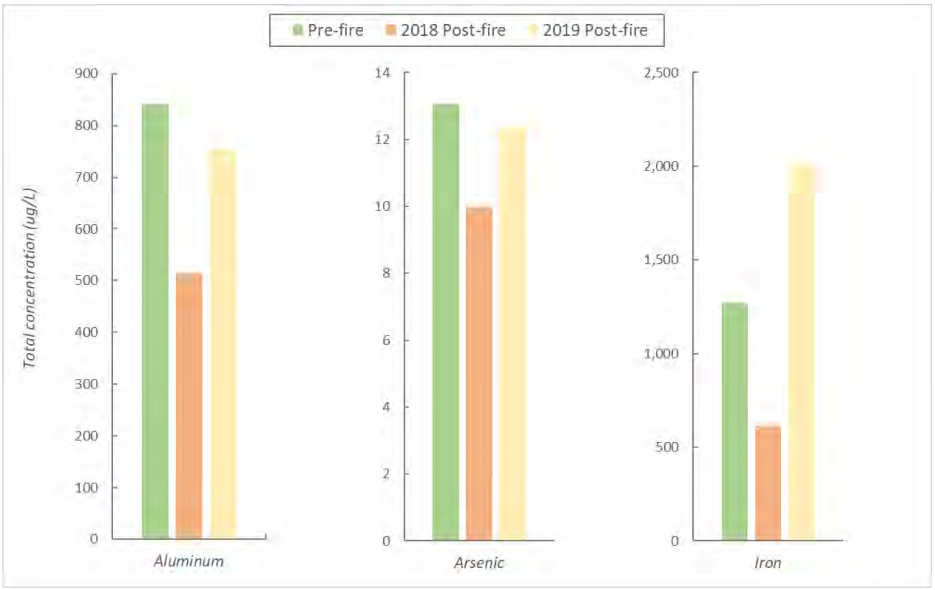
Junction Creek at Coloardo Trailhead				
Analyte	***Percent change in average from…***			
	Pre-Fire to Post-Fire	**Pre-Fire to 2018 Post-Fire**	**Pre-Fire to 2019 Post-Fire**	**2018 Post-Fire to 2019 Post-Fire**
	%	*%*	*%*	*%*
Aluminum, Filter .45	17.49		17.49	
Aluminum, Unfiltered	-11.80		-11.80	
Ammonia, Unfiltered	0.00		0.00	
Arsenic, Filter .45	20.89		20.89	
Arsenic, Unfiltered	22.88		22.88	
Cadmium, Filter .45	5.53		5.53	
Cadmium, Unfiltered	1.60		1.60	
Calcium, Filter .45	-16.02		-16.02	
Calcium, Unfiltered	-6.49		-6.49	
Copper, Filter .45	0.00		0.00	
Copper, Unfiltered	-4.74		-4.74	
Dissolved Organic Carbon				
Iron, Filter .45	-17.96		-17.96	
Iron, Unfiltered	-20.86		-20.86	
Lead, Filter .45	14.57		14.57	
Lead, Unfiltered	6.52		6.52	
Magnesium, Filter .45	-20.92		-20.92	
Magnesium, Unfiltered	-11.60		-11.60	
Manganese, Filter .45	-8.61		-8.61	
Manganese, Unfiltered	31.16		31.16	
Mercury, Unfiltered				
Molybdenum, Filter .45				
Molybdenum, Unfiltered				
Nitrate/Nitrite as N, Unfiltered				
Phosphate (PO4), Unfiltered				
Phosphorus, Unfiltered	285		285	
Potassium, Filter .45	-8.79		-8.79	
Potassium, Unfiltered	-15.05		-15.05	
Selenium, Filter .45	8.32		8.32	
Selenium, Unfiltered	17.23		17.23	
Sulfate, Unfiltered	-1.69		-1.69	
Total Kjeldahl nitrogen, Unfiltered				
Total Nitrogen (calc), Unfiltered				
Total Suspended Solids, Unfiltered	329		329	
Zinc, Filter .45	882		882	
Zinc, Unfiltered	7.78		7.78	

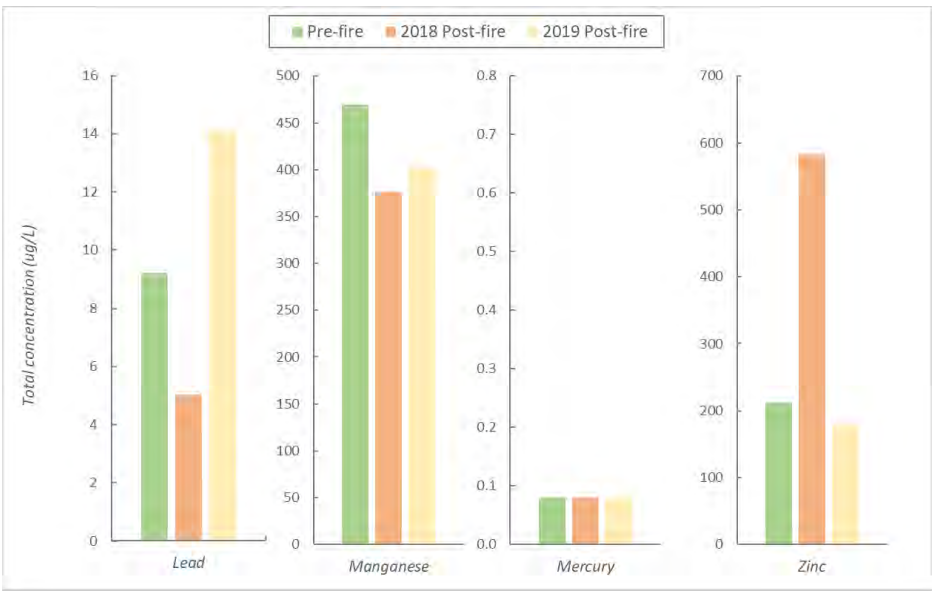
Red font indicates increase; green font indicates decrease;
blanks indicate insufficeint data preventing assessment

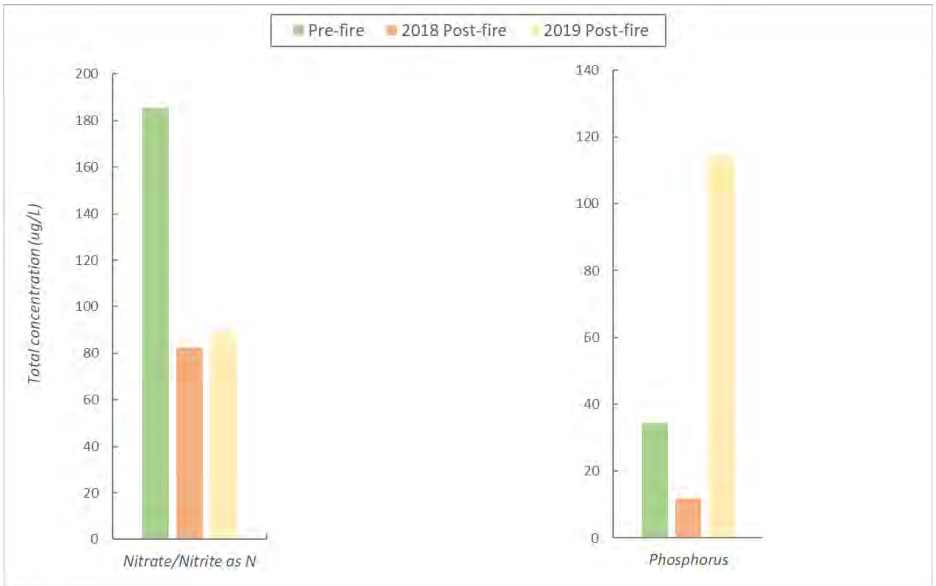
Appendix F – Preliminary water quality results: plots of select analytes depicting average concentration during pre-fire, post-fire 2018, and post-fire 2019.

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

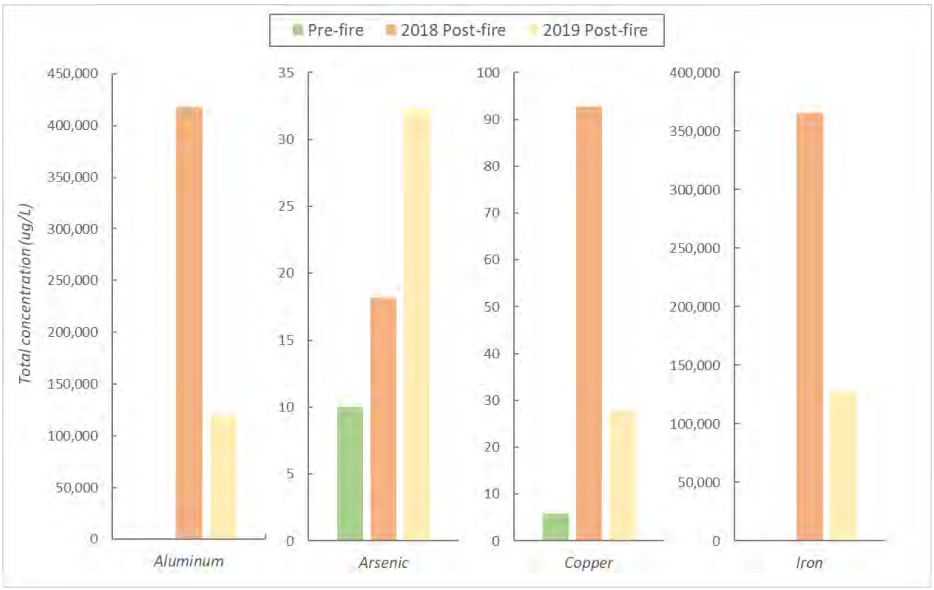
Animas River at Bakers Bridge

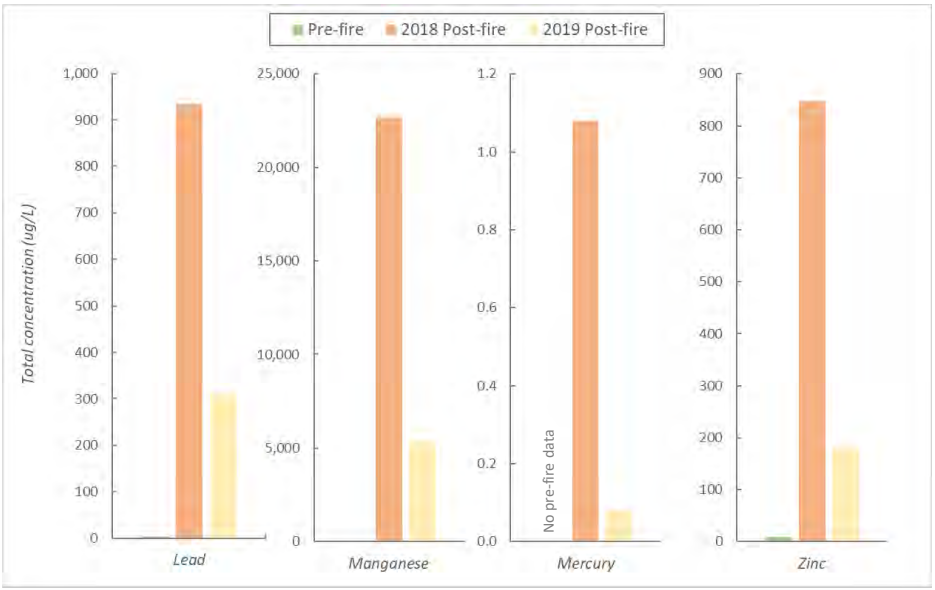


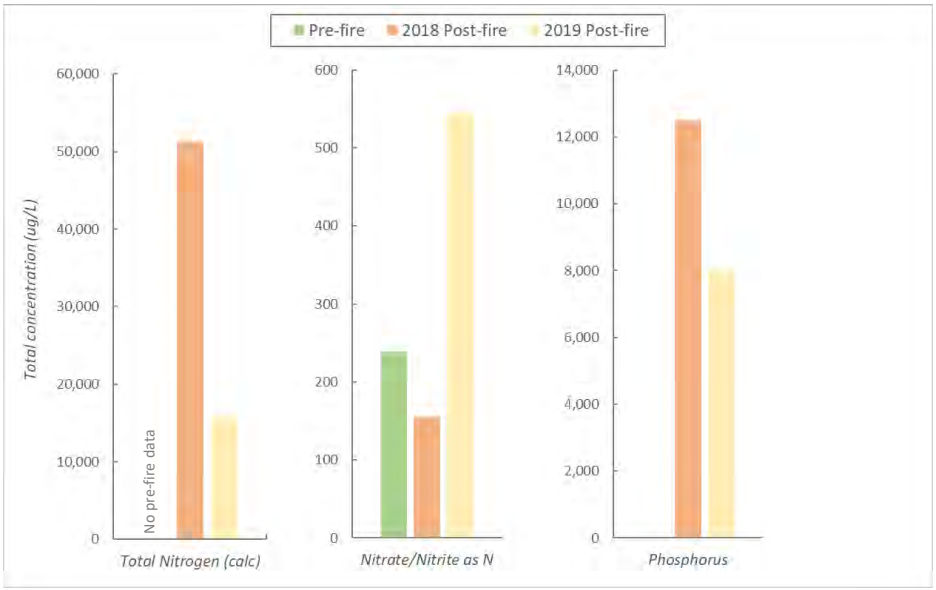




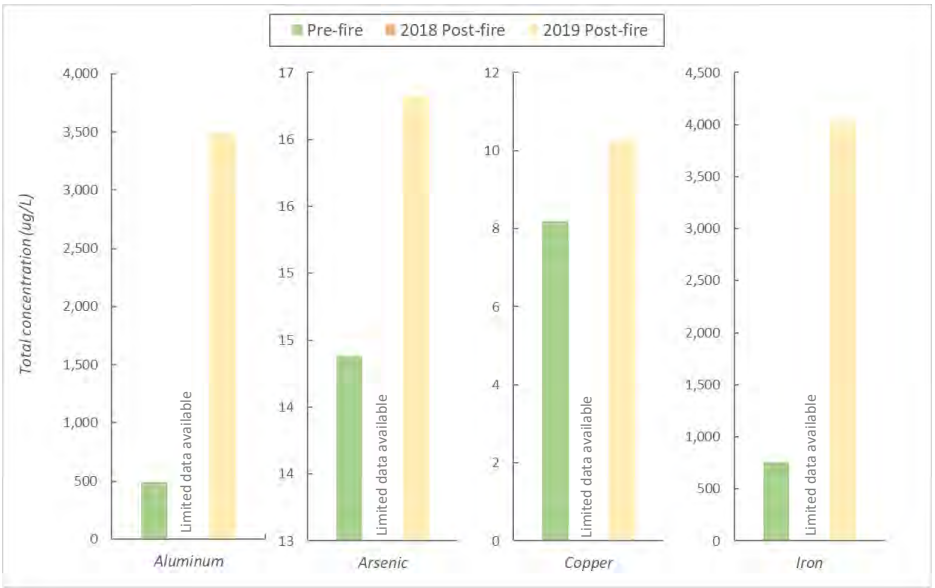
Hermosa Creek at CR 203

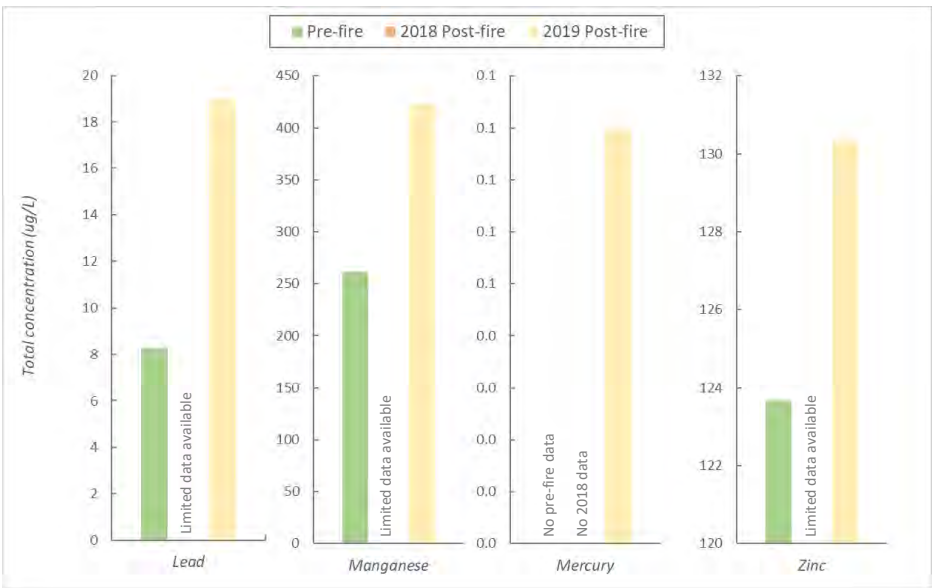


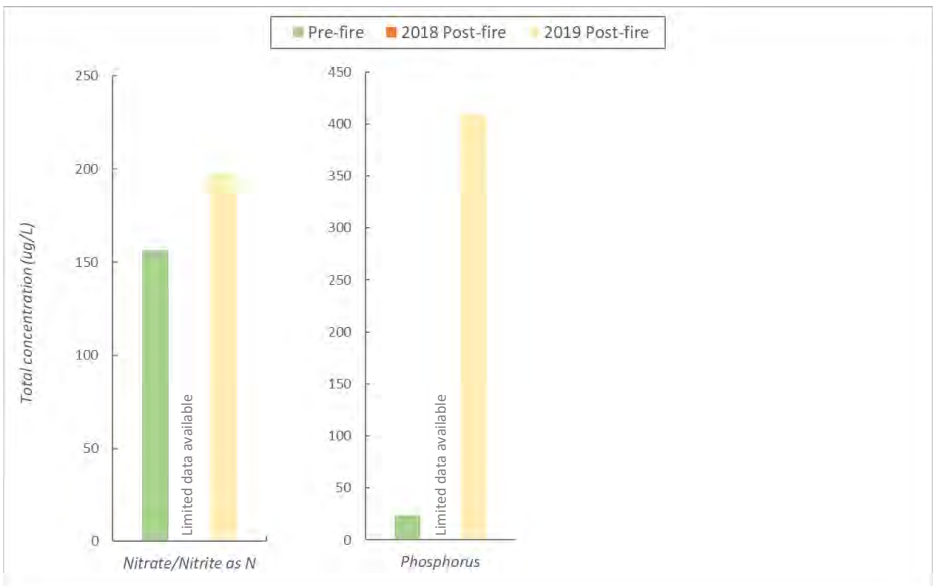




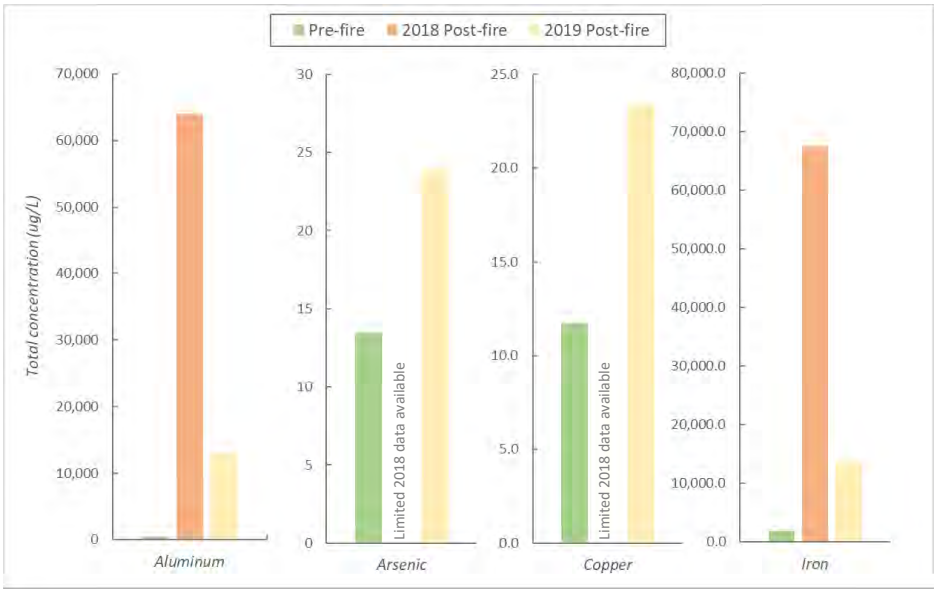
Animas River at Trimble Lane

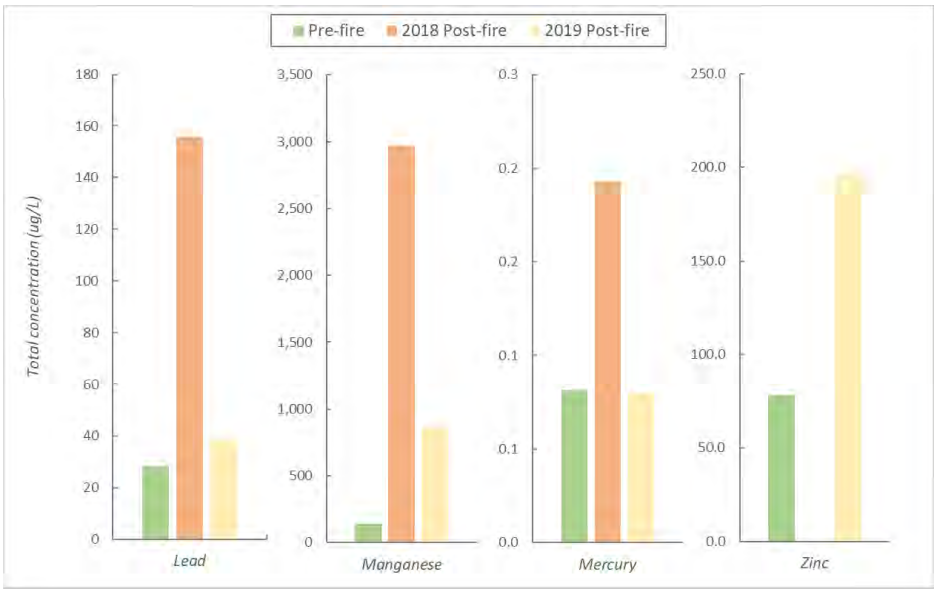


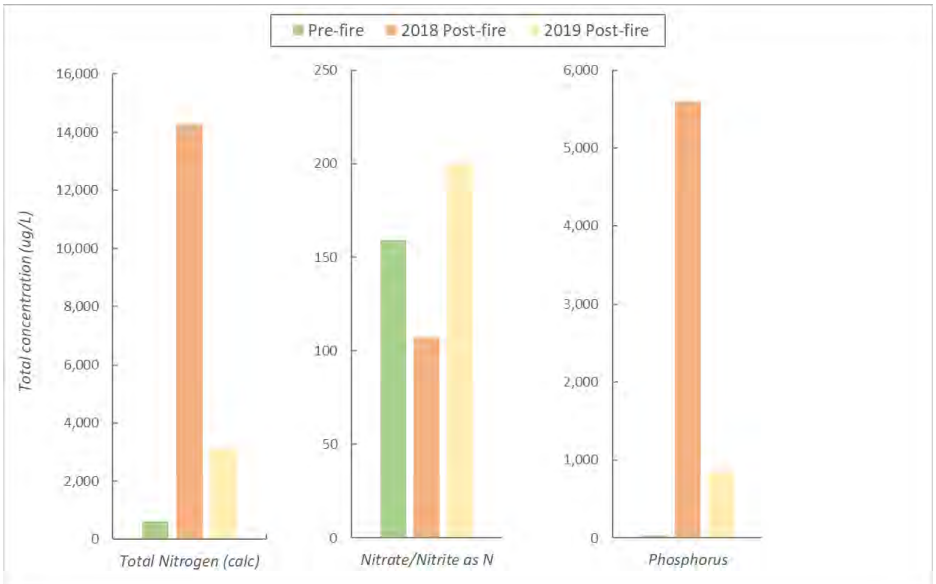




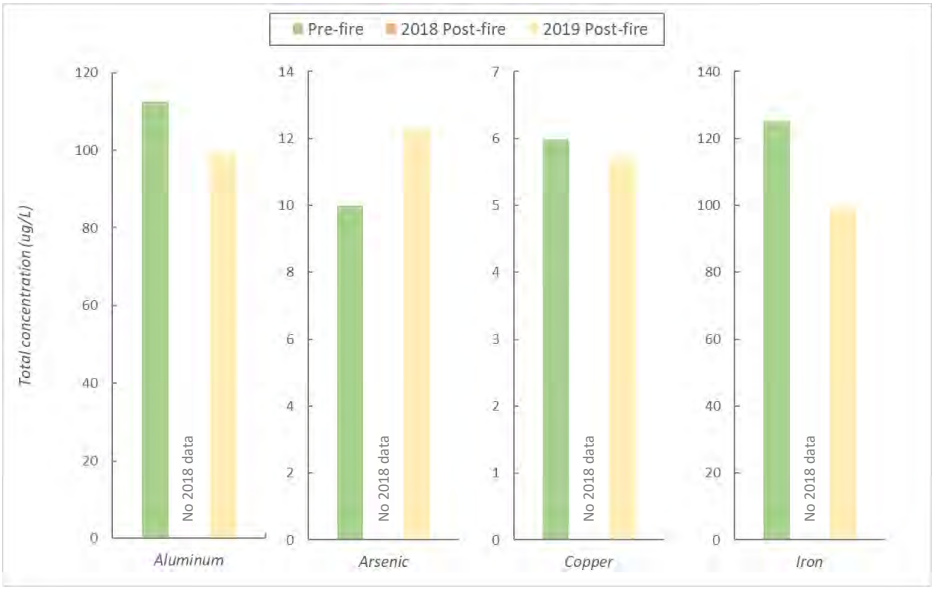
Animas River at 32nd Street, Durango

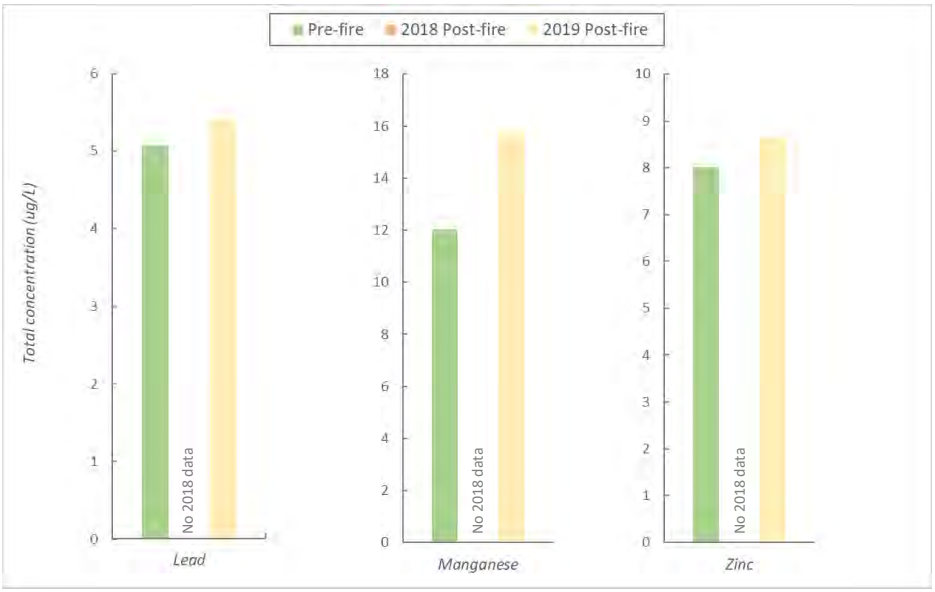






Junction Creek at Colorado Trailhead



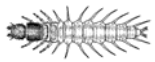


Appendix G – Preliminary water quality results: in context of water quality standards

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

Animas River at Bakers Bridge

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Metals						
Aluminum	Pre-fire Post-fire 2018 Post-fire 2019	-	-	6/178=3%; HQ=0.23 0/8=0%; HQ=0.10 1/15=7%; HQ=0.44	93/178=52%; HQ=1.77 2/8=25%; HQ=0.70 10/15=67%; HQ=3.06	-
Antimony	Pre-fire Post-fire 2018 Post-fire 2019	0/12=0%; HQ=0.11 0/1=0%; HQ=0.61 0/15=0%; HQ=0.61	-	-	-	-
Arsenic	Pre-fire Post-fire 2018 Post-fire 2019	14/14=100%; HQ=5.97 - 9 surpassed*	2/228=1%; HQ=0.11 0/4=0%; HQ=0.02 0/15=0%; HQ=0.12	0/228=0%; HQ=0.03 0/4=0%; HQ=0.01 0/15=0%; HQ=0.03	1/228=0%; HQ=0.06 0/4=0%; HQ=0.02 0/15=0%; HQ=0.07	-
Barium	Pre-fire Post-fire 2018 Post-fire 2019	0/12=0%; HQ=0.07 0/1=0%; HQ=0.07 0/15=0%; HQ=0.07	-	-	-	-
Berryllium	Pre-fire Post-fire 2018 Post-fire 2019	0/12=0%; HQ=0.07 0/1=0%; HQ=0.04 0/15=0%; HQ=0.04	0/15=0%; HQ=0.01 0/1=0%; HQ=0.00 0/15=0%; HQ=0.00	-	-	-
Cadmium	Pre-fire Post-fire 2018 Post-fire 2019	0/220=0%; HQ=0.15 0/1=0%; HQ=0.12 0/15=0%; HQ=0.20	0/220=0%; HQ=0.08 0/1=0%; HQ=0.06 0/15=0%; HQ=0.10	0/186=0%; HQ=0.17 0/4=0%; HQ=0.11 2/15=13%; HQ=0.52	73 surpassed* 0 surpassed* 4 surpassed*	0/186=0%; HQ=0.28 0/4=0%; HQ=0.17 2/15=13%; HQ=0.84
Copper	Pre-fire Post-fire 2018 Post-fire 2019	0/220=0%; HQ=0.02 0/1=0%; HQ=0.01 0/15=0%; HQ=0.01	0/220=0%; HQ=0.08 0/1=0%; HQ=0.03 0/15=0%; HQ=0.05	2/185=1%; HQ=0.22 0/4=0%; HQ=0.18 1/15=7%; HQ=0.73	3/183=2%; HQ=0.32 0/4=0%; HQ=0.29 1/9=11%; HQ=0.99	-
Iron	Pre-fire Post-fire 2018 Post-fire 2019	4/225=2%; HQ=0.21 0/8=0%; HQ=0.07 0/15=0%; HQ=0.10	-	-	100/225=44%; HQ=1.27 2/8=25%; HQ=0.62 7/15=47%; HQ=2.01	-

Animas River at Bakers Bridge

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Lead	Pre-fire	4/220=2%; HQ=0.16	1/220=0%; HQ=0.08	0/186=0%; HQ=0.04	10 surpassed*	-
	Post-fire 2018	0/8=0%; HQ=0.04	0/8=0%; HQ=0.02	0/8=0%; HQ=0.01	0 surpassed*	
	Post-fire 2019	1/15=7%; HQ=0.28	0/15=0%; HQ=0.14	0/15=0%; HQ=0.14	3 surpassed*	
Manganese	Pre-fire	**227/228=100%; HQ=7.49	-	0/186=0%; HQ=0.12	0/186=0%; HQ=0.22	-
	Post-fire 2018	**8/8=100%; HQ=7.00		0/8=0%; HQ=0.11	0/8=0%; HQ=0.19	
	Post-fire 2019	**15/15=100%; HQ=4.41		0/15=0%; HQ=0.08	0/15=0%; HQ=0.14	
Mercury	Pre-fire	0/2=0%; HQ=0.34	-	-	0 surpassed*	-
	Post-fire 2018	0/4=0%; HQ=0.02			-	
	Post-fire 2019	0/15=0%; HQ=0.02			-	
Molybdenum	Pre-fire	0/16=0%; HQ=0.04	0/16=0%; HQ=0.03	-	-	-
	Post-fire 2018	0/4=0%; HQ=0.01	0/4=0%; HQ=0.01			
	Post-fire 2019	0/15=0%; HQ=0.01	0/15=0%; HQ=0.01			
Nickel	Pre-fire	0/46=0%; HQ=0.17	0/46=0%; HQ=0.08	0/12=0%; HQ=0.01	0/12=0%; HQ=0.06	-
	Post-fire 2018	0/1=0%; HQ=0.02	0/1=0%; HQ=0.01	0/4=0%; HQ=0.00	0/4=0%; HQ=0.02	
	Post-fire 2019	0/15=0%; HQ=0.02	0/15=0%; HQ=0.01	0/15=0%; HQ=0.01	0/15=0%; HQ=0.05	
Selenium	Pre-fire	1/220=0%; HQ=0.11	3/220=1%; HQ=0.27	2/228=1%; HQ=0.23	5 surpassed*	-
	Post-fire 2018	0/1=0%; HQ=0.19	0/1=0%; HQ=0.46	0/4=0%; HQ=0.14	1 surpassed*	
	Post-fire 2019	0/15=0%; HQ=0.17	0/15=0%; HQ=0.42	1/15=7%; HQ=0.49	2 surpassed*	
Thallium	Pre-fire	0/4=0%; HQ=0.43	-	-	0/12=0%; HQ=0.03	-
	Post-fire 2018	-			0/1=0%; HQ=0.70	
	Post-fire 2019	-			1/15=7%; HQ=0.76	
Uranium	Pre-fire	-	-	-	-	-
	Post-fire 2018			0/4=0%; HQ=0.00	0/4=0%; HQ=0.00	
	Post-fire 2019			-	-	

Animas River at Bakers Bridge						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Zinc	Pre-fire	0/220=0%; HQ=0.04	0/220=0%; HQ=0.11	25/186=13%; HQ=0.73	90/186=48%; HQ=0.97	39/51=76%; HQ=1.61
	Post-fire 2018	0/1=0%; HQ=0.12	0/1=0%; HQ=0.29	1/4=25%; HQ=0.82	1/4=25%; HQ=1.08	-
	Post-fire 2019	0/15=0%; HQ=0.04	0/15=0%; HQ=0.09	2/15=13%; HQ=0.74	6/15=40%; HQ=0.97	10/11=91%; HQ=1.70
Nutrients						
Ammonia	Pre-fire	-	-	0/142=0%; HQ=0.00	0/142=0%; HQ=0.01	-
	Post-fire 2018			0/4=0%; HQ=0.00	0/4=0%; HQ=0.00	
	Post-fire 2019			0/15=0%; HQ=0.00	0/15=0%; HQ=0.01	
Nitrite	Pre-fire	-	-	-	-	-
	Post-fire 2018					
	Post-fire 2019					
Nitrate		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	0/1=0%; HQ=0.03	0/1=0%; HQ=0.00			
	Post-fire 2018	0/1=0%; HQ=0.07	0/1=0%; HQ=0.01			
	Post-fire 2019	0/15=0%; HQ=0.04	0/15=0%; HQ=0.00			
Nitrate/ Nitrite		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	0/147=0%; HQ=0.02	0/147=0%; HQ=0.00			
	Post-fire 2018	0/8=0%; HQ=0.01	0/8=0%; HQ=0.00			
	Post-fire 2019	0/15=0%; HQ=0.01	0/15=0%; HQ=0.00			
Chloride	Pre-fire	0/158=0%; HQ=0.01	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.01				
	Post-fire 2019	0/15=0%; HQ=0.01				

Animas River at Bakers Bridge

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

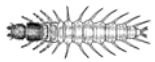
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Boron	Pre-fire	-	0/8=0%; HQ=0.13	-	-	-
	Post-fire 2018		0/1=0%; HQ=0.13			
	Post-fire 2019		0/15=0%; HQ=0.02			
Sulfate	Pre-fire	2/165=1%; HQ=0.39	-	-	-	-
	Post-fire 2018	0/5=0%; HQ=0.60				
	Post-fire 2019	0/15=0%; HQ=0.22				
Interim CDPHE Standard						
Total Nitrogen	Pre-fire	-				
	Post-fire 2018	0/8=0%; HQ=0.12				
	Post-fire 2019	0/15=0%; HQ=0.19				
Total Phosphorus	Pre-fire	2/101=2%; HQ=0.30				
	Post-fire 2018	0/7=0%; HQ=0.10				
	Post-fire 2019	3/15=20%; HQ=1.03				

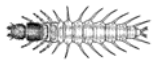
- = no water quality benchmark available or assessment was not possible due to data availability or laboratory detection limits

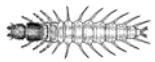
**in cases where lab detection limits were higher than the water quality standard, it is not possilbe to calculate a Hazard Quotient or assess % of samples that surpassed standard; Instead, we report the # of exceedances among those samples with detection limits sufficiently low enough to be able to compare to the standard*

***Manganese at this level is not of concern for human health. The concern is associated with aesthetic effects such as staining of appliances.*

****Fish-specific standards: Cadmium (acute standard for trout); Zinc (chronic standard for sculpin)*

Hermosa Creek						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Metals						
Aluminum	Pre-fire	-	-	0/65=0%; HQ=0.02	3/65=5%; HQ=0.11	-
	Post-fire 2018			7/13=54%; HQ=41.73	10/13=77%; HQ=292.29	
	Post-fire 2019			3/15=20%; HQ=23.60	8/15=53%; HQ=165.32	
Antimony	Pre-fire	-	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.61				
	Post-fire 2019	0/15=0%; HQ=0.61				
Arsenic	Pre-fire	-	0/65=0%; HQ=0.10	0/65=0%; HQ=0.03	0/65=0%; HQ=0.07	-
	Post-fire 2018	2 surpassed*	0/4=0%; HQ=0.14	0/4=0%; HQ=0.01	0/4=0%; HQ=0.03	
	Post-fire 2019	12 surpassed*	2/15=13%; HQ=0.32	0/15=0%; HQ=0.05	0/15=0%; HQ=0.11	
Barium	Pre-fire	-	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.27				
	Post-fire 2019	3/15=20%; HQ=1.67				
Berryllium	Pre-fire	-	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.04	0/1=0%; HQ=0.00			
	Post-fire 2019	3/15=20%; HQ=0.72	0/15=0%; HQ=0.03			
Cadmium	Pre-fire	0/65=0%; HQ=0.10	0/65=0%; HQ=0.05	0/65=0%; HQ=0.09	0 surpassed*	0/65=0%; HQ=0.14
	Post-fire 2018	0/1=0%; HQ=0.12	0/1=0%; HQ=0.06	0/4=0%; HQ=0.02	0 surpassed*	0/4=0%; HQ=0.04
	Post-fire 2019	1/15=7%; HQ=0.50	1/15=7%; HQ=0.25	0/15=0%; HQ=0.14	0 surpassed*	0/15=0%; HQ=0.22
Copper	Pre-fire	0/65=0%; HQ=0.00	0/65=0%; HQ=0.01	0/65=0%; HQ=0.04	0/65=0%; HQ=0.06	-
	Post-fire 2018	0/2=0%; HQ=0.09	0/2=0%; HQ=0.46	0/5=0%; HQ=0.12	0/5=0%; HQ=0.19	
	Post-fire 2019	0/15=0%; HQ=0.03	0/15=0%; HQ=0.14	0/15=0%; HQ=0.26	0/15=0%; HQ=0.41	
Iron	Pre-fire	0/65=0%; HQ=0.04	-	-	1/65=2%; HQ=0.07	-
	Post-fire 2018	0/13=0%; HQ=0.26			9/13=69%; HQ=365.38	
	Post-fire 2019	0/15=0%; HQ=0.10			9/15=60%; HQ=127.70	

Hermosa Creek						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Lead	Pre-fire	0/65=0%; HQ=0.06	0/65=0%; HQ=0.03	0/65=0%; HQ=0.02	0 surpassed*	-
	Post-fire 2018	5/13=38%; HQ=18.66	5/13=38%; HQ=9.33	0/13=0%; HQ=0.00	0 surpassed*	
	Post-fire 2019	3/15=20%; HQ=6.22	3/15=20%; HQ=3.11	0/15=0%; HQ=0.05	5 surpassed*	
Manganese	Pre-fire	**0/65=0%; HQ=0.10	-	0/65=0%; HQ=0.00	0/65=0%; HQ=0.00	-
	Post-fire 2018	**9/13=69%; HQ=9.50		0/13=0%; HQ=0.10	1/13=8%; HQ=0.18	
	Post-fire 2019	**2/15=13%; HQ=0.46		0/15=0%; HQ=0.01	0/15=0%; HQ=0.01	
Mercury	Pre-fire	-	-	-	-	-
	Post-fire 2018	2/12=17%; HQ=0.52			4 surpassed*	
	Post-fire 2019	0/15=0%; HQ=0.11			-	
Molybdenum	Pre-fire	-	-	-	-	-
	Post-fire 2018	0/4=0%; HQ=0.03	0/4=0%; HQ=0.02			
	Post-fire 2019	0/15=0%; HQ=0.01	0/15=0%; HQ=0.01			
Nickel	Pre-fire	-	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.01	0/1=0%; HQ=0.01	0/4=0%; HQ=0.00	0/4=0%; HQ=0.01	
	Post-fire 2019	3/15=20%; HQ=0.35	0/15=0%; HQ=0.17	0/15=0%; HQ=0.00	0/15=0%; HQ=0.02	
Selenium	Pre-fire	0/65=0%; HQ=0.10	0/65=0%; HQ=0.25	0/65=0%; HQ=0.27	-	-
	Post-fire 2018	0/1=0%; HQ=0.46	1/1=100%; HQ=1.14	0/4=0%; HQ=0.15	0 surpassed*	
	Post-fire 2019	0/15=0%; HQ=0.18	0/15=0%; HQ=0.45	0/15=0%; HQ=0.50	3 surpassed*	
Thallium	Pre-fire	-	-	-	-	-
	Post-fire 2018				0/1=0%; HQ=0.70	
	Post-fire 2019				0/15=0%; HQ=0.70	
Uranium	Pre-fire	-	-	-	-	-
	Post-fire 2018			0/4=0%; HQ=0.00	0/4=0%; HQ=0.00	
	Post-fire 2019			-	-	

Hermosa Creek						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Zinc	Pre-fire	0/65=0%; HQ=0.00	0/65=0%; HQ=0.00	0/65=0%; HQ=0.02	0/65=0%; HQ=0.02	-
	Post-fire 2018	0/2=0%; HQ=0.17	0/2=0%; HQ=0.42	0/5=0%; HQ=0.15	0/5=0%; HQ=0.20	0/1=0%; HQ=0.33
	Post-fire 2019	0/15=0%; HQ=0.04	0/15=0%; HQ=0.09	1/15=7%; HQ=0.11	1/15=7%; HQ=0.14	0/1=0%; HQ=0.04
Nutrients						
Ammonia	Pre-fire	-	-	0/61=0%; HQ=0.01	0/61=0%; HQ=0.02	-
	Post-fire 2018			0/4=0%; HQ=0.01	0/4=0%; HQ=0.04	
	Post-fire 2019			0/15=0%; HQ=0.04	0/15=0%; HQ=0.09	
Nitrite	Pre-fire	-	-	-	-	-
	Post-fire 2018					
	Post-fire 2019					
Nitrate		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	-	-			
	Post-fire 2018	0/1=0%; HQ=0.02	0/1=0%; HQ=0.00			
	Post-fire 2019	1/15=7%; HQ=0.21	0/15=0%; HQ=0.02			
Nitrate/ Nitrite		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	0/41=0%; HQ=0.02	0/41=0%; HQ=0.00			
	Post-fire 2018	0/13=0%; HQ=0.01	0/13=0%; HQ=0.00			
	Post-fire 2019	0/15=0%; HQ=0.05	0/15=0%; HQ=0.01			
Chloride	Pre-fire	0/65=0%; HQ=0.00	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.00				
	Post-fire 2019	0/15=0%; HQ=0.01				

Hermosa Creek

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Boron	Pre-fire	-	-	-	-	-
	Post-fire 2018		0/1=0%; HQ=0.23			
	Post-fire 2019		0/15=0%; HQ=0.03			
Sulfate	Pre-fire	0/65=0%; HQ=0.47	-	-	-	-
	Post-fire 2018	1/5=20%; HQ=0.69				
	Post-fire 2019	0/15=0%; HQ=0.28				
Interim CDPHE Standard						
Total Nitrogen	Pre-fire	-				
	Post-fire 2018	6/13=46%; HQ=40.97				
	Post-fire 2019	8/15=53%; HQ=12.64				
Total Phosphorus	Pre-fire	0/30=0%; HQ=0.08				
	Post-fire 2018	10/12=83%; HQ=104.00				
	Post-fire 2019	8/15=53%; HQ=72.90				

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**in cases where lab detection limits were higher than the water quality standard, it is not possilbe to calculate a Hazard Quotient or assess % of samples that surpassed standard; Instead, we report the # of exceedances among those samples with detection limits sufficiently low enough to be able to compare to the standard*

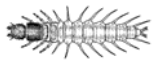
***Manganese at this level is not of concern for human health. The concern is associated with aesthetic effects such as staining of appliances.*

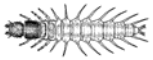
****Fish-specific standards: Cadmium (acute standard for trout); Zinc (chronic standard for sculpin)*

Animas River at Trimble Lane

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

Parameter	Time period	 CDPHE Domestic Water Supply Standard	 CDPHE Agriculture Chronic Standard	 CDPHE Aquatic Life Acute Standard	 CDPHE Aquatic Life Chronic Standard	 CDPHE Fish-specific Standard***
Metals						
Aluminum	Pre-fire			3/183=2%; HQ=0.10	33/183=18%; HQ=0.88	
	Post-fire 2018	-	-	0/4=0%; HQ=0.25	1/4=25%; HQ=1.73	-
	Post-fire 2019			3/15=20%; HQ=0.86	10/15=67%; HQ=6.00	
Antimony	Pre-fire	-				
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.61				
Arsenic	Pre-fire	10/10=100%; HQ=8.97	2/182=1%; HQ=0.14	0/182=0%; HQ=0.04	1/182=1%; HQ=0.08	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	11 surpassed*	0/14=0%; HQ=0.16	0/14=0%; HQ=0.04	0/14=0%; HQ=0.08	
Barium	Pre-fire	-				
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.20				
Berryllium	Pre-fire	-	-			
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.05	0/14=0%; HQ=0.00			
Cadmium	Pre-fire	0/183=0%; HQ=0.10	0/183=0%; HQ=0.05	0/183=0%; HQ=0.11	8 surpassed*	0/183=0%; HQ=0.17
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.19	0/14=0%; HQ=0.09	0/14=0%; HQ=0.20	2 surpassed*	0/14=0%; HQ=0.32
Copper	Pre-fire	0/183=0%; HQ=0.01	0/183=0%; HQ=0.03	2/183=1%; HQ=0.14	2/183=1%; HQ=0.22	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.01	0/14=0%; HQ=0.05	0/14=0%; HQ=0.35	0/14=0%; HQ=0.53	
Iron	Pre-fire	0/183=0%; HQ=0.19			27/183=15%; HQ=0.76	
	Post-fire 2018	0/4=0%; HQ=0.09	-	-	1/4=25%; HQ=2.35	-
	Post-fire 2019	0/14=0%; HQ=0.09			11/15=73%; HQ=4.02	

Animas River at Trimble Lane						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Lead	Pre-fire	3/182=2%; HQ=0.14	1/182=1%; HQ=0.07	1/182=1%; HQ=0.04	7 surpassed*	
	Post-fire 2018	0/4=0%; HQ=0.13	0/4=0%; HQ=0.07	0/4=0%; HQ=0.00	0 surpassed*	-
	Post-fire 2019	1/15=7%; HQ=0.38	0/15=0%; HQ=0.19	0/14=0%; HQ=0.07	5 surpassed*	
Manganese	Pre-fire	**182/183=99%; HQ=4.50		0/183=0%; HQ=0.06	0/183=0%; HQ=0.11	
	Post-fire 2018	**3/4=75%; HQ=3.02	-	0/4=0%; HQ=0.04	0/4=0%; HQ=0.08	-
	Post-fire 2019	**14/14=100%; HQ=3.12		0/14=0%; HQ=0.05	0/14=0%; HQ=0.09	
Mercury	Pre-fire	-			-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.02			-	
Molybdenum	Pre-fire	-	-			
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.01	0/14=0%; HQ=0.01			
Nickel	Pre-fire	-	-	-	-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.03	0/14=0%; HQ=0.02	0/14=0%; HQ=0.00	0/14=0%; HQ=0.03	
Selenium	Pre-fire	2/182=1%; HQ=0.13	4/182=2%; HQ=0.32	4/182=2%; HQ=0.31	10 surpassed*	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.18	0/14=0%; HQ=0.45	0/14=0%; HQ=0.45	1 surpassed*	
Thallium	Pre-fire	-			-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	-			0/14=0%; HQ=0.70	
Uranium	Pre-fire			-	-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019			-	-	

Animas River at Trimble Lane						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Zinc	Pre-fire	0/183=0%; HQ=0.02	0/183=0%; HQ=0.06	2/183=1%; HQ=0.36	4/183=2%; HQ=0.47	10/22=45%; HQ=1.05
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/14=0%; HQ=0.03	0/14=0%; HQ=0.07	1/14=7%; HQ=0.33	1/14=7%; HQ=0.43	1/4=25%; HQ=0.50
Nutrients						
Ammonia	Pre-fire	-	-	0/144=0%; HQ=0.00	0/144=0%; HQ=0.01	-
	Post-fire 2018			-	-	
	Post-fire 2019			0/15=0%; HQ=0.02	1/15=7%; HQ=0.11	
Nitrite	Pre-fire	-	-	-	-	-
	Post-fire 2018					
	Post-fire 2019					
Nitrate		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	-	-			
	Post-fire 2018	-	-			
	Post-fire 2019	0/15=0%; HQ=0.11	0/15=0%; HQ=0.01			
Nitrate/ Nitrite		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	0/150=0%; HQ=0.02	0/150=0%; HQ=0.00			
	Post-fire 2018	0/4=0%; HQ=0.01	0/4=0%; HQ=0.00			
	Post-fire 2019	0/15=0%; HQ=0.02	0/15=0%; HQ=0.00			
Chloride	Pre-fire	0/167=0%; HQ=0.06	-	-	-	-
	Post-fire 2018	-				
	Post-fire 2019	0/15=0%; HQ=0.03				

Animas River at Trimble Lane

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Boron	Pre-fire	-	-	-	-	-
	Post-fire 2018		-			
	Post-fire 2019		0/14=0%; HQ=0.03			
Sulfate	Pre-fire	0/167=0%; HQ=0.41	-	-	-	-
	Post-fire 2018	-				
	Post-fire 2019	0/15=0%; HQ=0.25				
Interim CDPHE Standard						
Total Nitrogen	Pre-fire	-				
	Post-fire 2018	1/4=25%; HQ=0.52				
	Post-fire 2019	6/15=40%; HQ=1.25				
Total Phosphorus	Pre-fire	1/101=1%; HQ=0.19				
	Post-fire 2018	1/4=25%; HQ=1.80				
	Post-fire 2019	7/15=47%; HQ=3.71				

- = no water quality benchmark available or assessment was not possible due to data availability or laboratory detection limits

**in cases where lab detection limits were higher than the water quality standard, it is not possilbe to calculate a Hazard Quotient or assess % of samples that surpassed standard; Instead, we report the # of exceedances among those samples with detection limits sufficiently low enough to be able to compare to the standard*

***Manganese at this level is not of concern for human health. The concern is associated with aesthetic effects such as staining of appliances.*

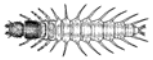
****Fish-specific standards: Cadmium (acute standard for trout); Zinc (chronic standard for sculpin)*

Animas River at Rotary Park						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Metals						
Aluminum	Pre-fire	-	-	8/399=2%; HQ=0.10	60/399=15%; HQ=1.36	-
	Post-fire 2018			4/15=27%; HQ=6.35	7/15=47%; HQ=44.51	
	Post-fire 2019			4/15=27%; HQ=1.97	10/15=67%; HQ=13.78	
Antimony	Pre-fire	2/146=1%; HQ=0.11	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.61				
	Post-fire 2019	0/15=0%; HQ=0.61				
Arsenic	Pre-fire	17 surpassed*	6/382=2%; HQ=0.09	0/348=0%; HQ=0.02	1/348=0%; HQ=0.05	-
	Post-fire 2018	2 surpassed*	0/4=0%; HQ=0.08	0/4=0%; HQ=0.01	0/4=0%; HQ=0.03	
	Post-fire 2019	15 surpassed*	0/15=0%; HQ=0.24	0/15=0%; HQ=0.03	0/15=0%; HQ=0.08	
Barium	Pre-fire	0/147=0%; HQ=0.11	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.11				
	Post-fire 2019	2/15=13%; HQ=0.53				
Berryllium	Pre-fire	0/147=0%; HQ=0.11	0/146=0%; HQ=0.00	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.04	0/1=0%; HQ=0.00			
	Post-fire 2019	1/15=7%; HQ=0.17	0/15=0%; HQ=0.01			
Cadmium	Pre-fire	1/346=0%; HQ=0.07	0/346=0%; HQ=0.04	0/304=0%; HQ=0.07	3 surpassed*	0/304=0%; HQ=0.12
	Post-fire 2018	0/1=0%; HQ=0.12	0/1=0%; HQ=0.06	0/4=0%; HQ=0.03	0 surpassed*	0/4=0%; HQ=0.05
	Post-fire 2019	0/15=0%; HQ=0.23	0/15=0%; HQ=0.11	0/15=0%; HQ=0.18	2 surpassed*	0/15=0%; HQ=0.30
Copper	Pre-fire	0/409=0%; HQ=0.01	3/409=1%; HQ=0.05	2/368=1%; HQ=0.10	6/368=2%; HQ=0.16	-
	Post-fire 2018	0/1=0%; HQ=0.01	0/1=0%; HQ=0.03	0/4=0%; HQ=0.10	0/4=0%; HQ=0.17	
	Post-fire 2019	0/15=0%; HQ=0.02	0/15=0%; HQ=0.12	0/15=0%; HQ=0.33	0/15=0%; HQ=0.50	
Iron	Pre-fire	3/376=1%; HQ=0.17	-	-	69/409=17%; HQ=1.93	-
	Post-fire 2018	2/16=13%; HQ=0.52			7/16=44%; HQ=67.54	
	Post-fire 2019	1/15=7%; HQ=0.91			10/15=67%; HQ=13.65	

Animas River at Rotary Park

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Lead	Pre-fire	16/409=4%; HQ=0.53	10/409=2%; HQ=0.26	0/368=0%; HQ=0.02	9 surpassed*	
	Post-fire 2018	4/16=25%; HQ=3.08	4/16=25%; HQ=1.54	0/15=0%; HQ=0.00	1 surpassed*	-
	Post-fire 2019	5/15=33%; HQ=0.77	1/15=7%; HQ=0.39	0/15=0%; HQ=0.07	7 surpassed*	
Manganese	Pre-fire	**219/349=63%; HQ=1.76		0/341=0%; HQ=0.02	0/341=0%; HQ=0.04	
	Post-fire 2018	**10/15=67%; HQ=5.37	-	0/15=0%; HQ=0.06	0/15=0%; HQ=0.11	-
	Post-fire 2019	**13/15=87%; HQ=2.43		0/15=0%; HQ=0.04	0/15=0%; HQ=0.06	
Mercury	Pre-fire	4/8=50%; HQ=7.29			4 surpassed*	
	Post-fire 2018	0/12=0%; HQ=0.08	-	-	3 surpassed*	-
	Post-fire 2019	0/15=0%; HQ=0.04			-	
Molybdenum	Pre-fire	0/147=0%; HQ=0.01	0/147=0%; HQ=0.01			
	Post-fire 2018	0/4=0%; HQ=0.02	0/4=0%; HQ=0.01	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.01	0/15=0%; HQ=0.01			
Nickel	Pre-fire	0/147=0%; HQ=0.02	0/147=0%; HQ=0.01	0/104=0%; HQ=0.00	0/104=0%; HQ=0.01	
	Post-fire 2018	0/1=0%; HQ=0.01	0/1=0%; HQ=0.01	0/4=0%; HQ=0.00	0/4=0%; HQ=0.01	-
	Post-fire 2019	1/15=7%; HQ=0.15	0/15=0%; HQ=0.07	0/15=0%; HQ=0.00	0/15=0%; HQ=0.02	
Selenium	Pre-fire	1/381=0%; HQ=0.07	2/381=1%; HQ=0.17	2/348=1%; HQ=0.19	8 surpassed*	
	Post-fire 2018	0/1=0%; HQ=0.19	0/1=0%; HQ=0.46	0/4=0%; HQ=0.14	1 surpassed*	-
	Post-fire 2019	0/15=0%; HQ=0.17	0/15=0%; HQ=0.42	0/15=0%; HQ=0.52	5 surpassed*	
Thallium	Pre-fire	1/132=1%; HQ=0.38			0/112=0%; HQ=0.01	
	Post-fire 2018	-	-	-	0/1=0%; HQ=0.70	-
	Post-fire 2019	-			0/15=0%; HQ=0.70	
Uranium	Pre-fire			-	-	
	Post-fire 2018	-	-	0/4=0%; HQ=0.00	0/4=0%; HQ=0.00	-
	Post-fire 2019			-	-	

Animas River at Rotary Park						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Zinc	Pre-fire	0/409=0%; HQ=0.02	0/409=0%; HQ=0.04	0/368=0%; HQ=0.16	2/368=1%; HQ=0.21	0/33=0%; HQ=0.56
	Post-fire 2018	0/1=0%; HQ=0.06	0/1=0%; HQ=0.16	0/4=0%; HQ=0.29	1/4=25%; HQ=0.38	-
	Post-fire 2019	0/15=0%; HQ=0.04	0/15=0%; HQ=0.10	1/15=7%; HQ=0.24	1/15=7%; HQ=0.32	0/3=0%; HQ=0.24
Nutrients						
Ammonia	Pre-fire	-	-	0/69=0%; HQ=0.00	0/69=0%; HQ=0.02	-
	Post-fire 2018			0/4=0%; HQ=0.12	1/4=25%; HQ=0.64	
	Post-fire 2019			0/15=0%; HQ=0.00	0/15=0%; HQ=0.02	
Nitrite	Pre-fire	-	-	-	-	-
	Post-fire 2018					
	Post-fire 2019					
Nitrate		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	0/9=0%; HQ=0.00	0/9=0%; HQ=0.00			
	Post-fire 2018	0/1=0%; HQ=0.08	0/1=0%; HQ=0.01			
	Post-fire 2019	0/15=0%; HQ=0.12	0/15=0%; HQ=0.01			
Nitrate/ Nitrite		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	0/44=0%; HQ=0.02	0/44=0%; HQ=0.00			
	Post-fire 2018	0/15=0%; HQ=0.01	0/15=0%; HQ=0.00			
	Post-fire 2019	0/15=0%; HQ=0.02	0/15=0%; HQ=0.00			
Chloride	Pre-fire	0/26=0%; HQ=0.05	-	-	-	-
	Post-fire 2018	0/1=0%; HQ=0.10				
	Post-fire 2019	0/15=0%; HQ=0.03				

Animas River at Rotary Park

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Boron	Pre-fire	-	0/8=0%; HQ=0.13	-	-	-
	Post-fire 2018		0/1=0%; HQ=0.23			
	Post-fire 2019		0/15=0%; HQ=0.05			
Sulfate	Pre-fire	0/26=0%; HQ=0.37	-	-	-	-
	Post-fire 2018	0/5=0%; HQ=0.67				
	Post-fire 2019	0/15=0%; HQ=0.31				
Interim CDPHE Standard						
Total Nitrogen	Pre-fire	0/22=0%; HQ=0.50				
	Post-fire 2018	6/15=40%; HQ=11.41				
	Post-fire 2019	6/15=40%; HQ=2.50				
Total Phosphorus	Pre-fire	11/45=24%; HQ=1.38				
	Post-fire 2018	7/14=50%; HQ=47.28				
	Post-fire 2019	8/15=53%; HQ=7.64				

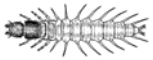
- = no water quality benchmark available or assessment was not possible due to data availability or laboratory detection limits

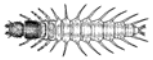
**in cases where lab detection limits were higher than the water quality standard, it is not possilbe to calculate a Hazard Quotient or assess % of samples that surpassed standard; Instead, we report the # of exceedances among those samples with detection limits sufficiently low enough to be able to compare to the standard*

***Manganese at this level is not of concern for human health. The concern is associated with aesthetic effects such as staining of appliances.*

****Fish-specific standards: Cadmium (acute standard for trout); Zinc (chronic standard for sculpin)*

Junction Creek						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Metals						
Aluminum	Pre-fire			0/31=0%; HQ=0.03	1/31=3%; HQ=0.18	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019			0/15=0%; HQ=0.02	1/15=7%; HQ=0.14	
Antimony	Pre-fire	-				
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.61				
Arsenic	Pre-fire	-	0/31=0%; HQ=0.10	0/31=0%; HQ=0.03	0/31=0%; HQ=0.07	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	8 surpassed*	0/15=0%; HQ=0.11	0/15=0%; HQ=0.03	0/15=0%; HQ=0.07	
Barium	Pre-fire	-				
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.23				
Berryllium	Pre-fire	-	-			
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.04	0/15=0%; HQ=0.00			
Cadmium	Pre-fire	0/31=0%; HQ=0.10	0/31=0%; HQ=0.05	0/31=0%; HQ=0.14	0 surpassed*	0/31=0%; HQ=0.22
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.12	0/15=0%; HQ=0.06	0/15=0%; HQ=0.19	2 surpassed*	0/15=0%; HQ=0.31
Copper	Pre-fire	0/31=0%; HQ=0.00	0/31=0%; HQ=0.01	0/31=0%; HQ=0.06	0/31=0%; HQ=0.09	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.01	0/15=0%; HQ=0.03	0/15=0%; HQ=0.35	0/15=0%; HQ=0.53	
Iron	Pre-fire	0/31=0%; HQ=0.06			1/31=3%; HQ=0.12	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.01			0/15=0%; HQ=0.10	

Junction Creek						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Lead	Pre-fire	0/31=0%; HQ=0.06	0/31=0%; HQ=0.03	0/31=0%; HQ=0.03	0 surpassed*	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.10	0/15=0%; HQ=0.05	0/15=0%; HQ=0.07	6 surpassed*	
Manganese	Pre-fire	**0/31=0%; HQ=0.11		0/31=0%; HQ=0.00	0/31=0%; HQ=0.00	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	**0/15=0%; HQ=0.02		0/15=0%; HQ=0.00	0/15=0%; HQ=0.00	
Mercury	Pre-fire	-			-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.02			-	
Molybdenum	Pre-fire	-	-			
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.01	0/15=0%; HQ=0.01			
Nickel	Pre-fire	-	-	-	-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.01	0/15=0%; HQ=0.01	0/15=0%; HQ=0.00	0/15=0%; HQ=0.02	
Selenium	Pre-fire	0/31=0%; HQ=0.10	0/31=0%; HQ=0.25	0/31=0%; HQ=0.27	-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.19	1/15=7%; HQ=0.48	0/15=0%; HQ=0.48	4 surpassed*	
Thallium	Pre-fire	-			-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	-			0/15=0%; HQ=0.70	
Uranium	Pre-fire			-	-	
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019			-	-	

Junction Creek						
% of samples that surpassed water quality standards; average Hazard Quotients (HQ)						
						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Zinc	Pre-fire	0/31=0%; HQ=0.00	0/31=0%; HQ=0.00	0/31=0%; HQ=0.02	0/31=0%; HQ=0.03	0/4=0%; HQ=0.05
	Post-fire 2018	-	-	-	-	-
	Post-fire 2019	0/15=0%; HQ=0.00	0/15=0%; HQ=0.00	1/15=7%; HQ=0.19	1/15=7%; HQ=0.26	0/3=0%; HQ=0.06
Nutrients						
Ammonia	Pre-fire	-	-	0/2=0%; HQ=0.00	0/2=0%; HQ=0.01	-
	Post-fire 2018			-	-	
	Post-fire 2019			0/15=0%; HQ=0.01	0/15=0%; HQ=0.03	
Nitrite	Pre-fire	-	-	-	-	-
	Post-fire 2018					
	Post-fire 2019					
Nitrate		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	-	-			
	Post-fire 2018	-	-			
	Post-fire 2019	0/15=0%; HQ=0.02	0/15=0%; HQ=0.00			
Nitrate/ Nitrite		*Acute standard*	*Acute standard*	-	-	-
	Pre-fire	-	-			
	Post-fire 2018	-	-			
	Post-fire 2019	0/15=0%; HQ=0.00	0/15=0%; HQ=0.00			
Chloride	Pre-fire	0/2=0%; HQ=0.00	-	-	-	-
	Post-fire 2018	-				
	Post-fire 2019	0/15=0%; HQ=0.00				

Junction Creek

% of samples that surpassed water quality standards; average Hazard Quotients (HQ)

						
Parameter	**Time period**	**CDPHE Domestic Water Supply Standard**	**CDPHE Agriculture Chronic Standard**	**CDPHE Aquatic Life Acute Standard**	**CDPHE Aquatic Life Chronic Standard**	**CDPHE Fish-specific Standard*** **
Boron	Pre-fire	-	-	-	-	-
	Post-fire 2018		-			
	Post-fire 2019		0/15=0%; HQ=0.03			
Sulfate	Pre-fire	0/2=0%; HQ=0.04	-	-	-	-
	Post-fire 2018	-				
	Post-fire 2019	0/15=0%; HQ=0.04				
Interim CDPHE Standard						
Total Nitrogen	Pre-fire	-				
	Post-fire 2018	-				
	Post-fire 2019	0/15=0%; HQ=0.17				
Total Phosphorus	Pre-fire	0/2=0%; HQ=0.05				
	Post-fire 2018	-				
	Post-fire 2019	1/15=7%; HQ=0.37				

- = no water quality benchmark available or assessment was not possible due to data availability or laboratory detection limits

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****Fish-specific standards: Cadmium (acute standard for trout); Zinc (chronic standard for sculpin)*

Appendix H – Preliminary physical habitat results: descriptive statistics

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

Position in relation to burn area	StreamName	SiteName	Survey Date	Embeddedness average	Substrate size average (mm)	Substrate size standard deviation	Percent composition						
							fines	sand	gravel	pebble	cobble	boulder	algae
Within	Big Bend Creek	Above Fish Barrier	7/16/2019	15	72	76	6	14	10	30	34	6	20
Within	Big Bend Creek	Above Hermosa	10/2/2019	54	40	63	4	28	18	28	20	2	0
Within	Big Bend Creek	Fire Affected	7/16/2019	n/a	3	3	0	80	20	0	0	0	0
Within	Big Lick Creek	above Hermosa	10/2/2019	35	36	37	8	6	16	42	14	14	2
Within	Clear Creek	above Hermosa	9/18/2019	26	118	127	6	8	4	18	56	8	46
Within	Dutch Creek	above Hermosa Trail	8/9/2019	n/a	26	29	0	12	32	24	12	20	0
Within	Hermosa Cr	above Salt Creek	10/2/2019	61	43	71	10	54	2	6	26	2	0
Within	South Fork Hermosa Creek	above Hermosa	9/18/2019	60	40	66	0	18	32	34	12	4	0
Downstream	Hermosa Cr	Above CR 203	9/30/2016	22	165	106	5	1	0	5	77	12	48
			9/27/2018	28	164	191	32	3	0	1	41	23	25
			3/19/2019	33	182	186	8	30	1	0	27	35	1
			9/27/2019	36	215	208	0	16	0	5	50	29	7
Downstream	Animas River	Abv Trimble Lane	9/25/2019	45	25	30	2	36	18	31	12	0	55
Downstream	Animas River	Abv Lightner Creek	9/20/2015	6	153	126	10	0	4	8	62	16	6
			9/25/2018	18	179	161	12	0	0	2	60	26	84
			9/26/2019	2	107	60	0	0	2	12	83	3	95
Downstream	Animas River	Purple Cliffs	9/22/2015	16	148	54	0	0	0	4	96	0	48
Upstream	Hermosa Cr	Above Corral Draw	10/2/2019	0	151	107	0	0	3	13	73	13	0
Upstream	Animas River	Below Bakers Bridge	10/1/2019	0	139	77	0	0	0	14	77	9	4
Upstream	Animas River	James Ranch	3/20/2019	13	126	44	0	0	0	0	98	2	100
Upstream	Animas River	James Ranch	9/27/2019	14	102	94	2	0	4	22	70	3	5
Upstream	Junction Creek	at Colorado Trailhead	9/24/2019	0	94	49	1	0	0	31	67	1	32

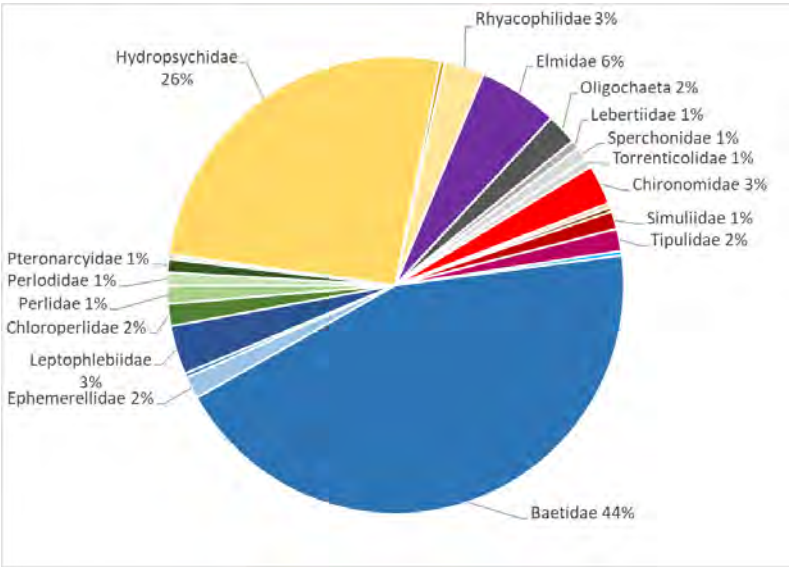
Appendix I – Preliminary benthic macroinvertebrate community composition comparing pre-fire, post-fire 2018, and post-fire 2019 samples.

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

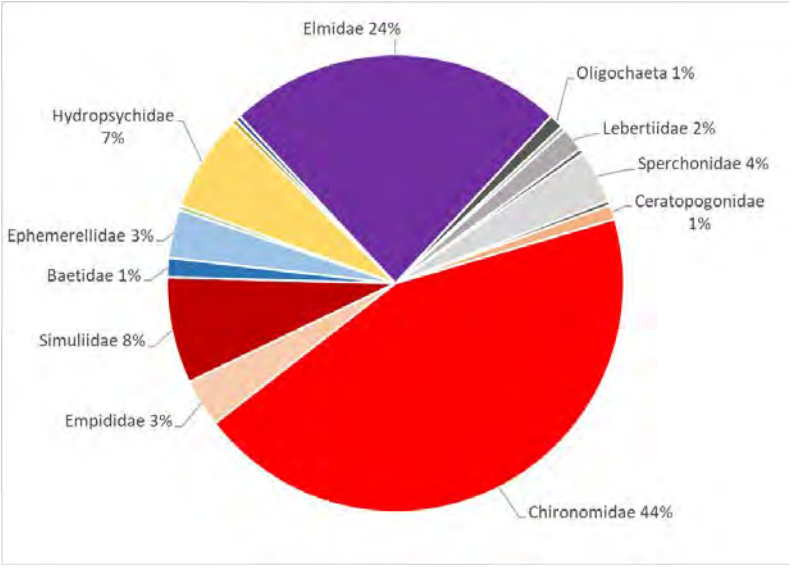
Locations downstream of 416 Fire:

Hermosa Creek above CR 203

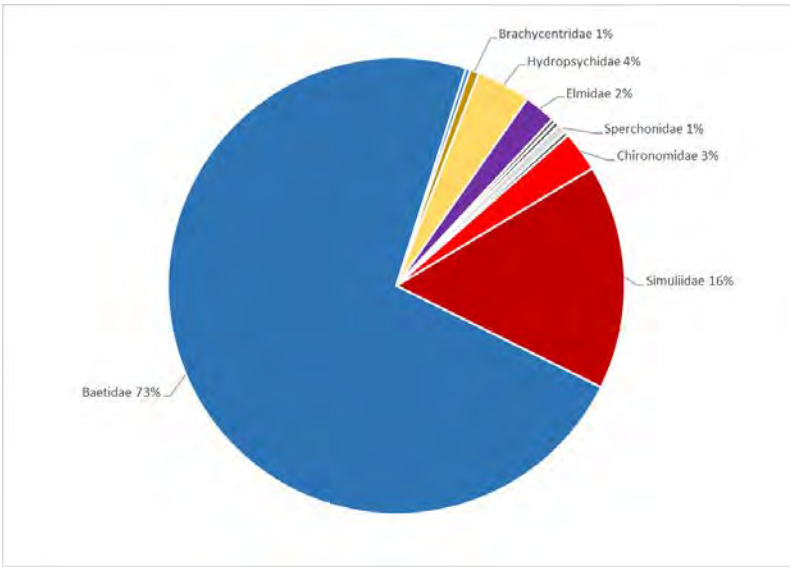
Pre-fire



2018 Post-fire



2019 Post-fire



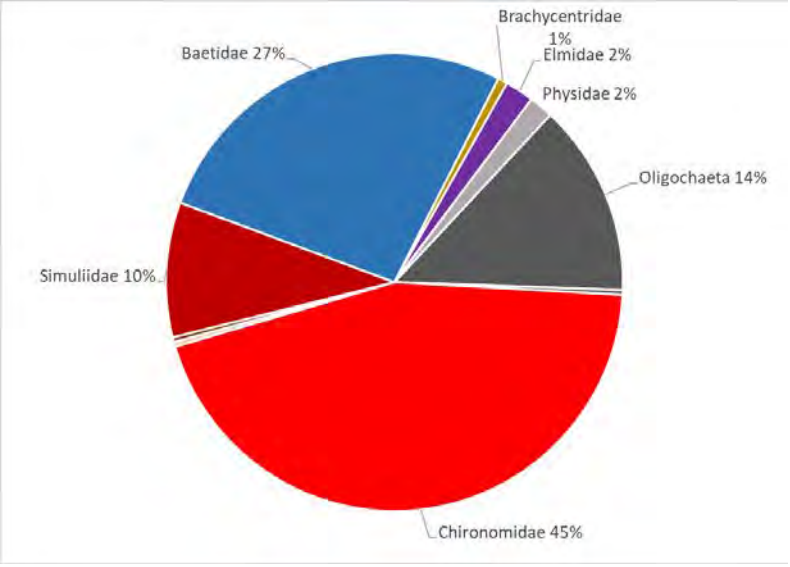
Hermosa Creek above CR 203 benthic community composition pre- and post-fire

Animas River at Trimble Lane

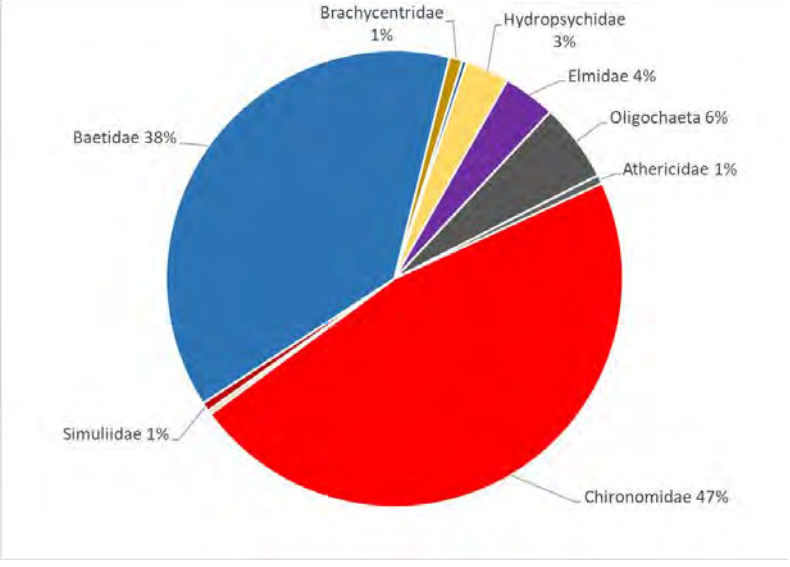
Pre-fire

Sample was not collected

2018 Post-fire



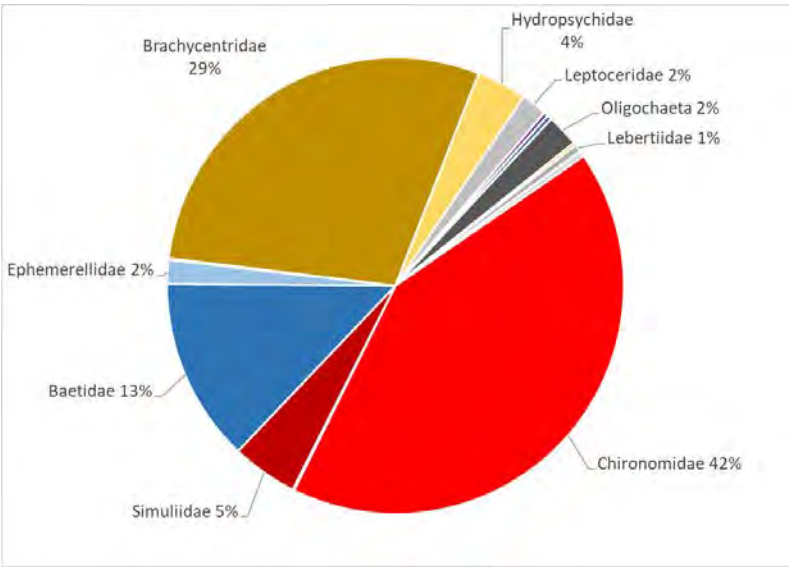
2019 Post-fire



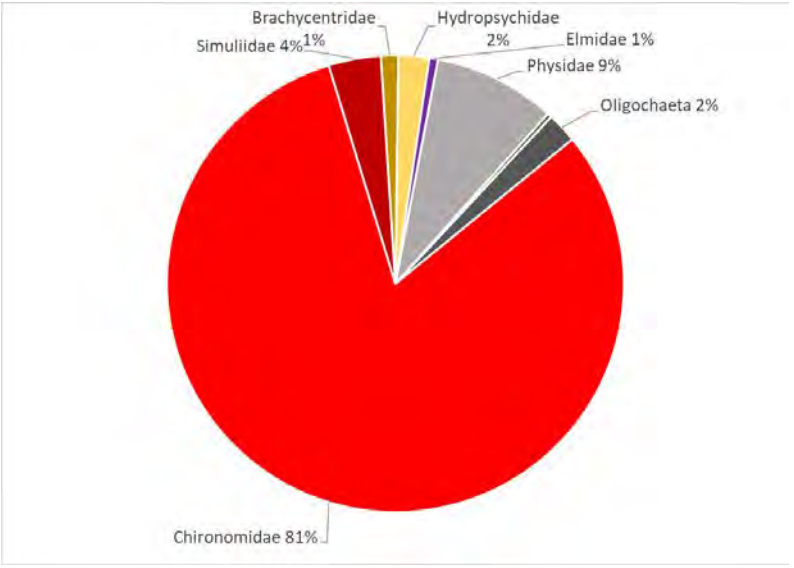
Animas River at Trimble Lane benthic community composition pre- and post-fire

Animas River at 32nd St, Durango

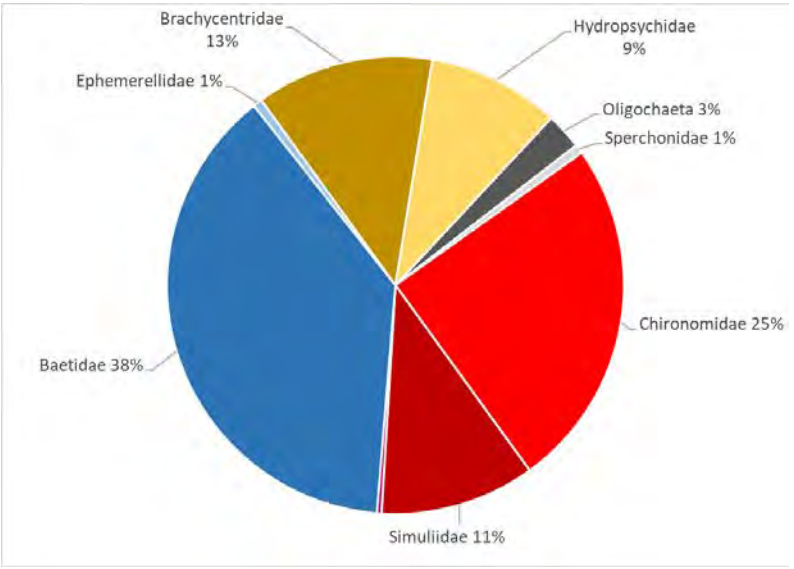
Pre-fire



2018 Post-fire



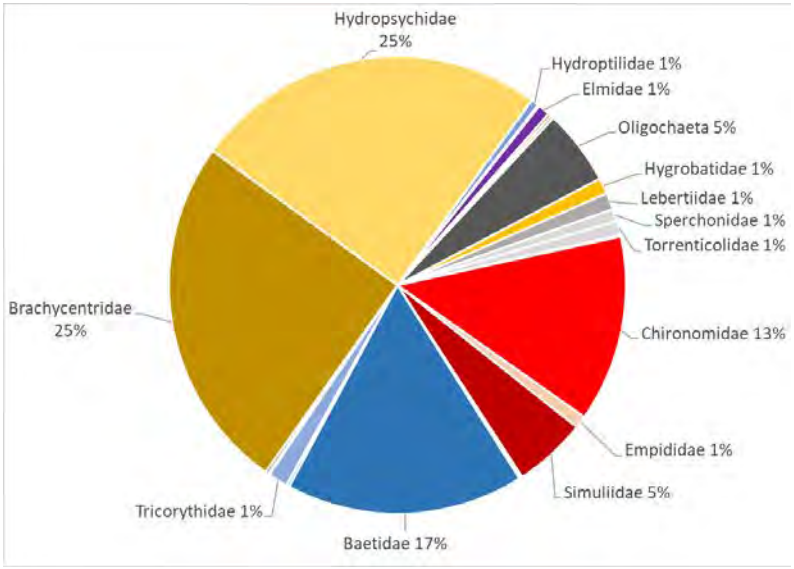
2019 Post-fire



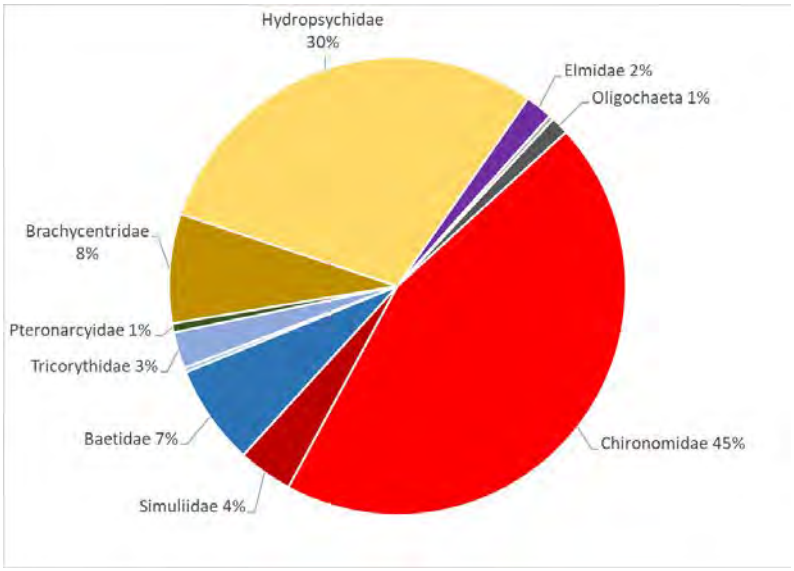
Animas River at 32nd St benthic community composition pre- and post-fire

Animas River above Lightner Creek

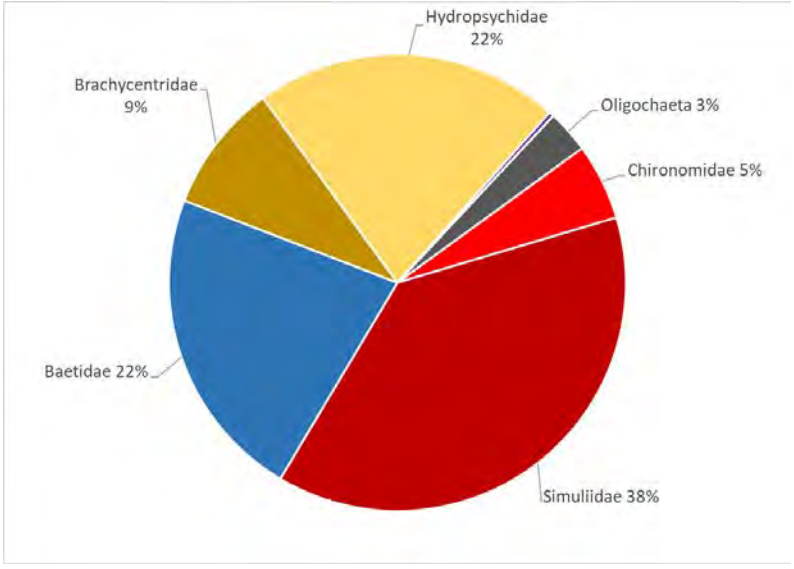
Pre-fire



2018 Post-fire



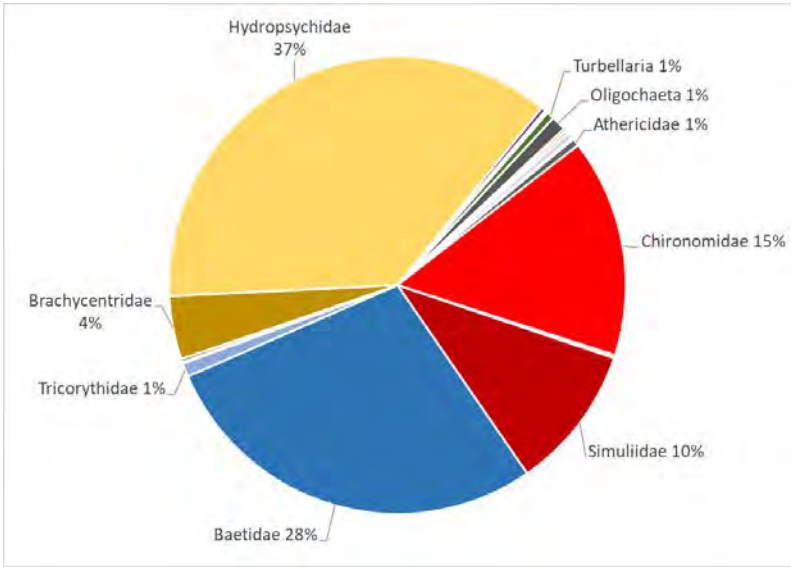
2019 Post-fire



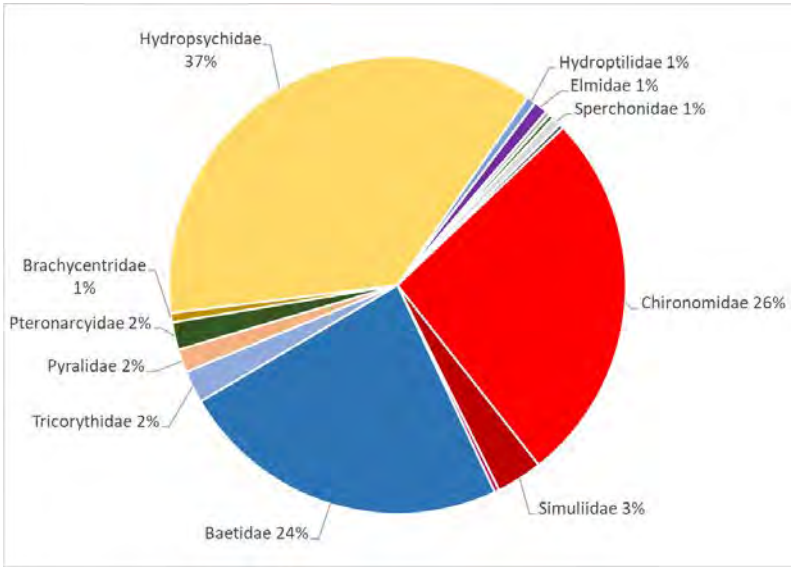
Animas River above Lightner Creek benthic community composition pre- and post-fire

Animas River at Purple Cliffs

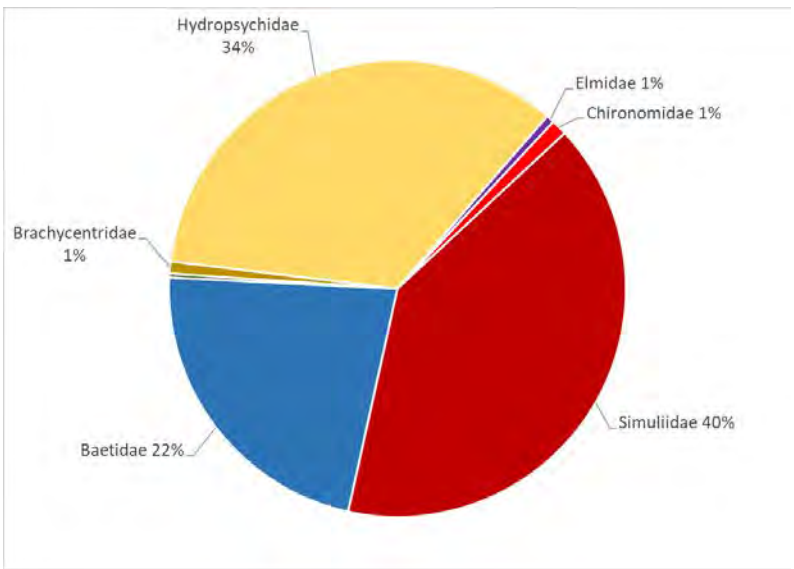
Pre-fire



2018 Post-fire



2019 Post-fire

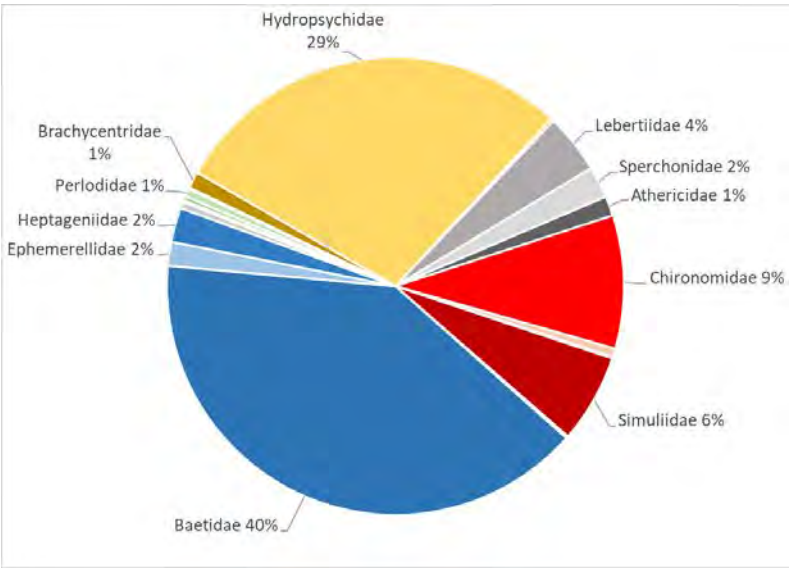


Animas River at Purple Cliffs benthic community composition pre- and post-fire

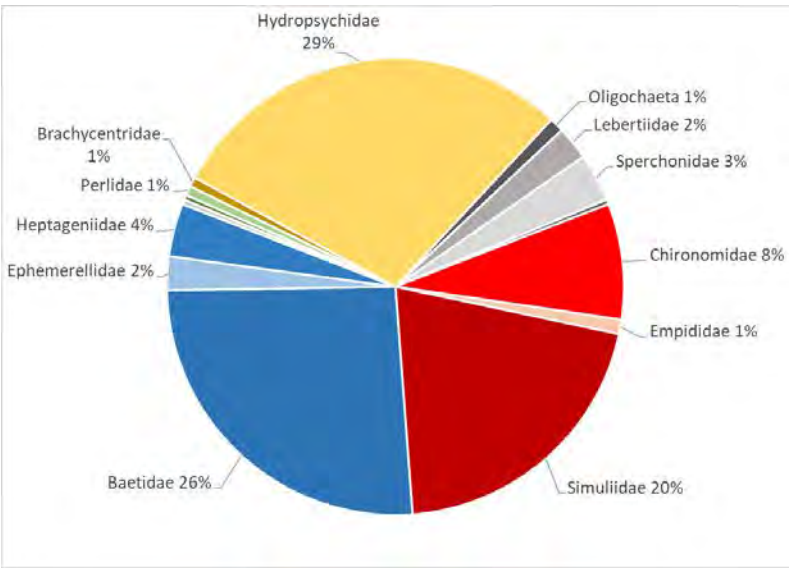
Locations not downstream of 416 Fire:

Animas River at Bakers Bridge

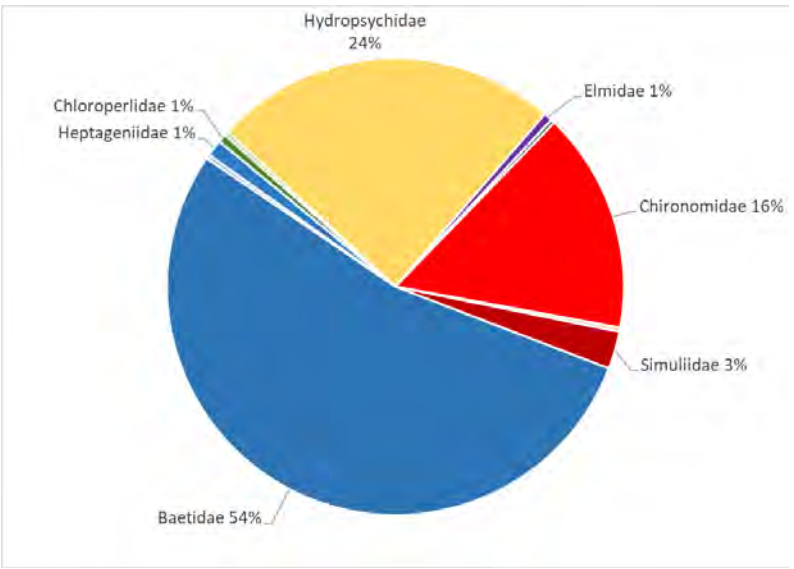
Pre-fire



2018 Post-fire



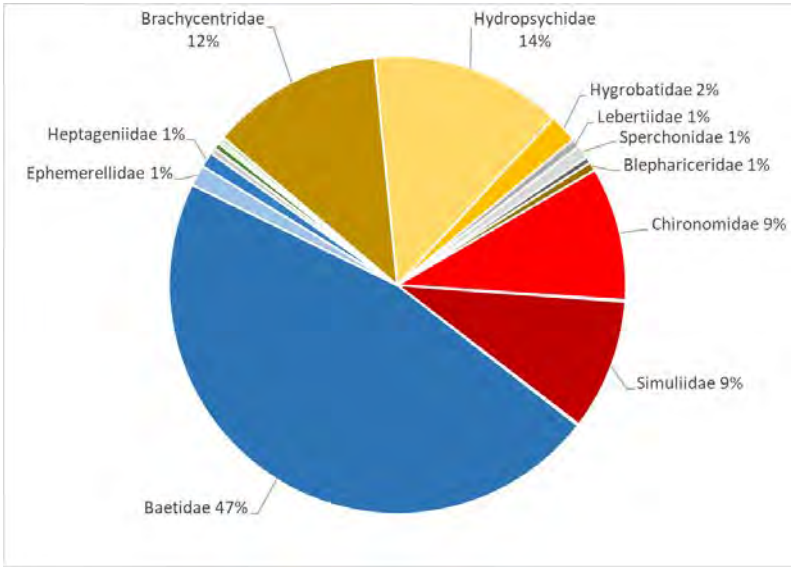
2019 Post-fire



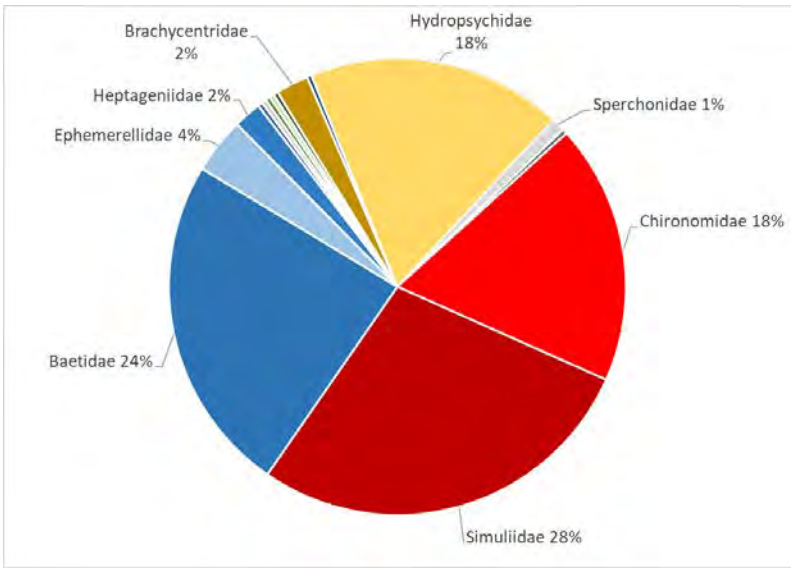
Animas River at Bakers Bridge benthic community composition pre- and post-fire

Animas River at James Ranch

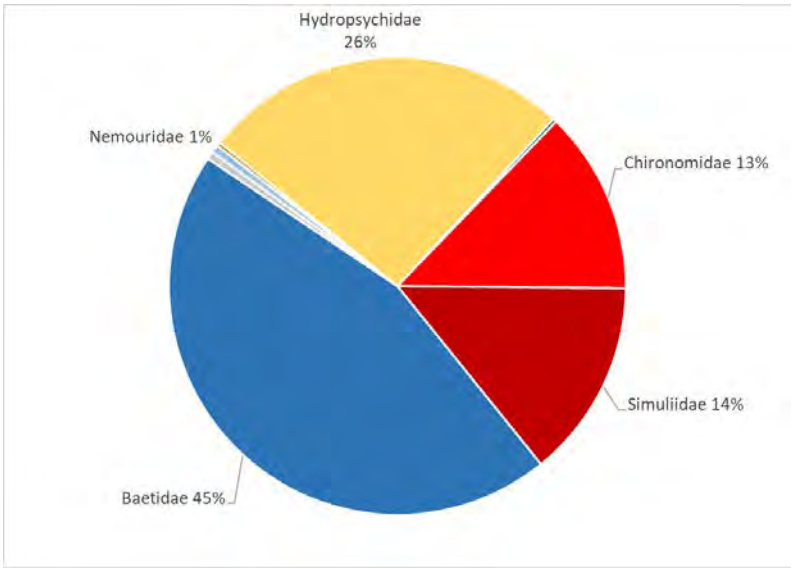
Pre-fire



2018 Post-fire



2019 Post-fire



Animas River at James Ranch benthic community composition pre- and post-fire

Junction Creek at Colorado Trailhead

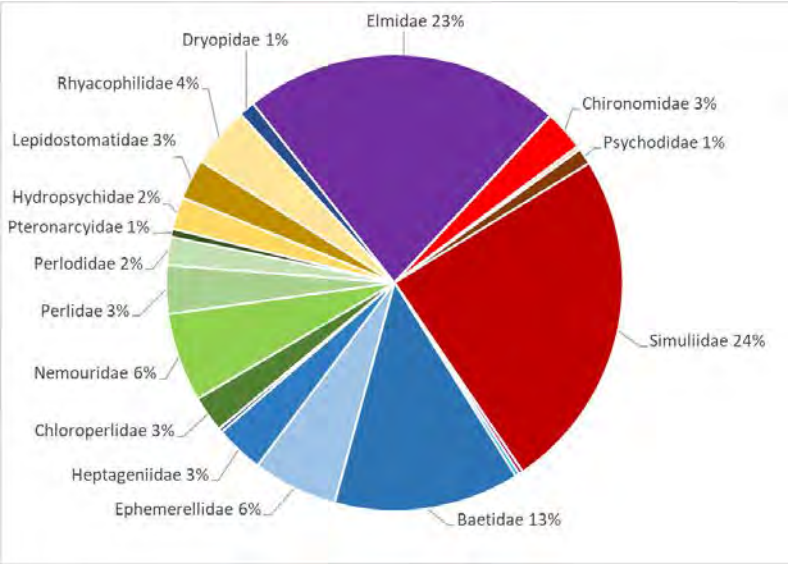
Pre-fire

Sample was not collected

2018
Post-fire

Sample was not collected

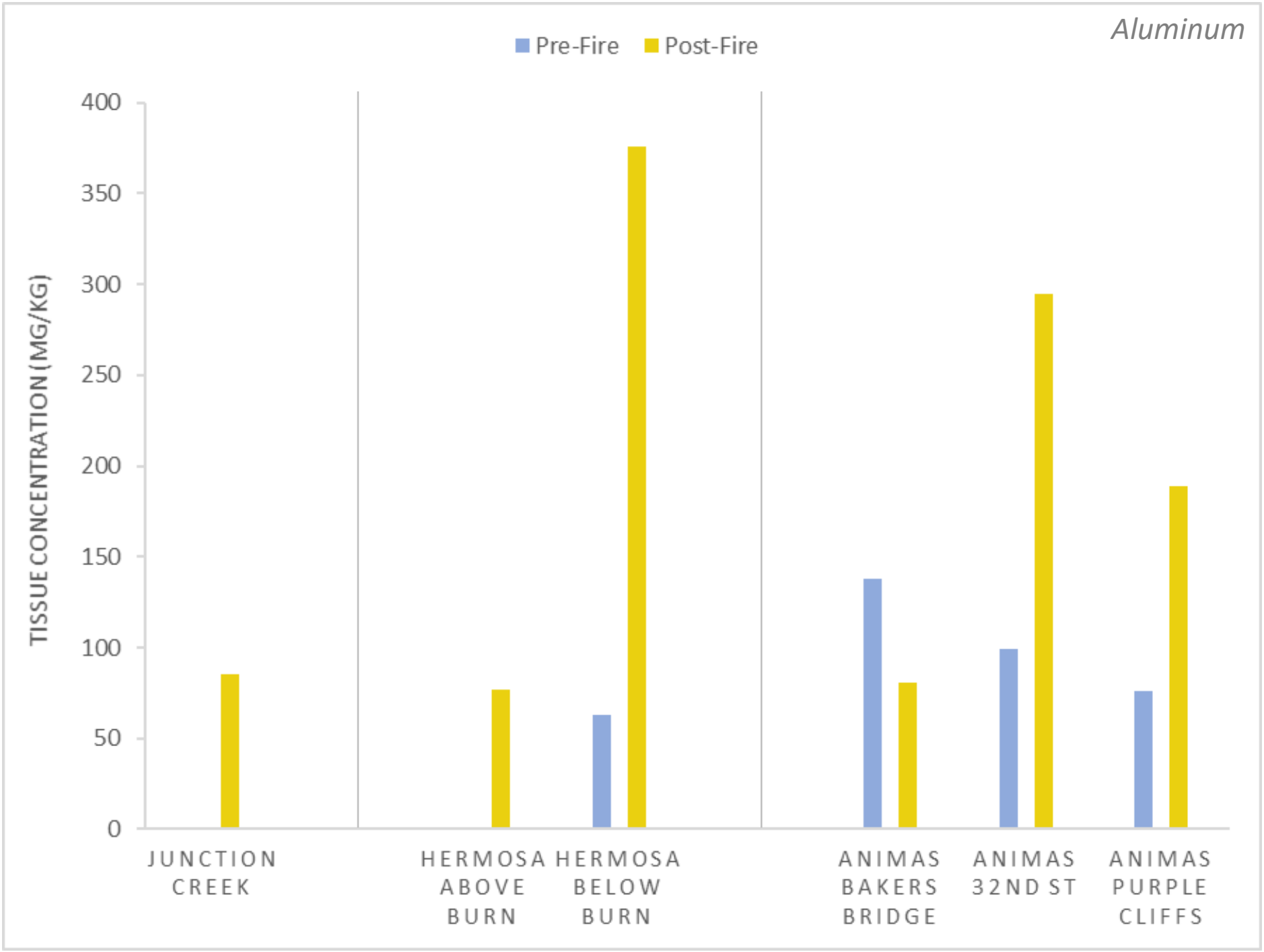
2019
Post-fire

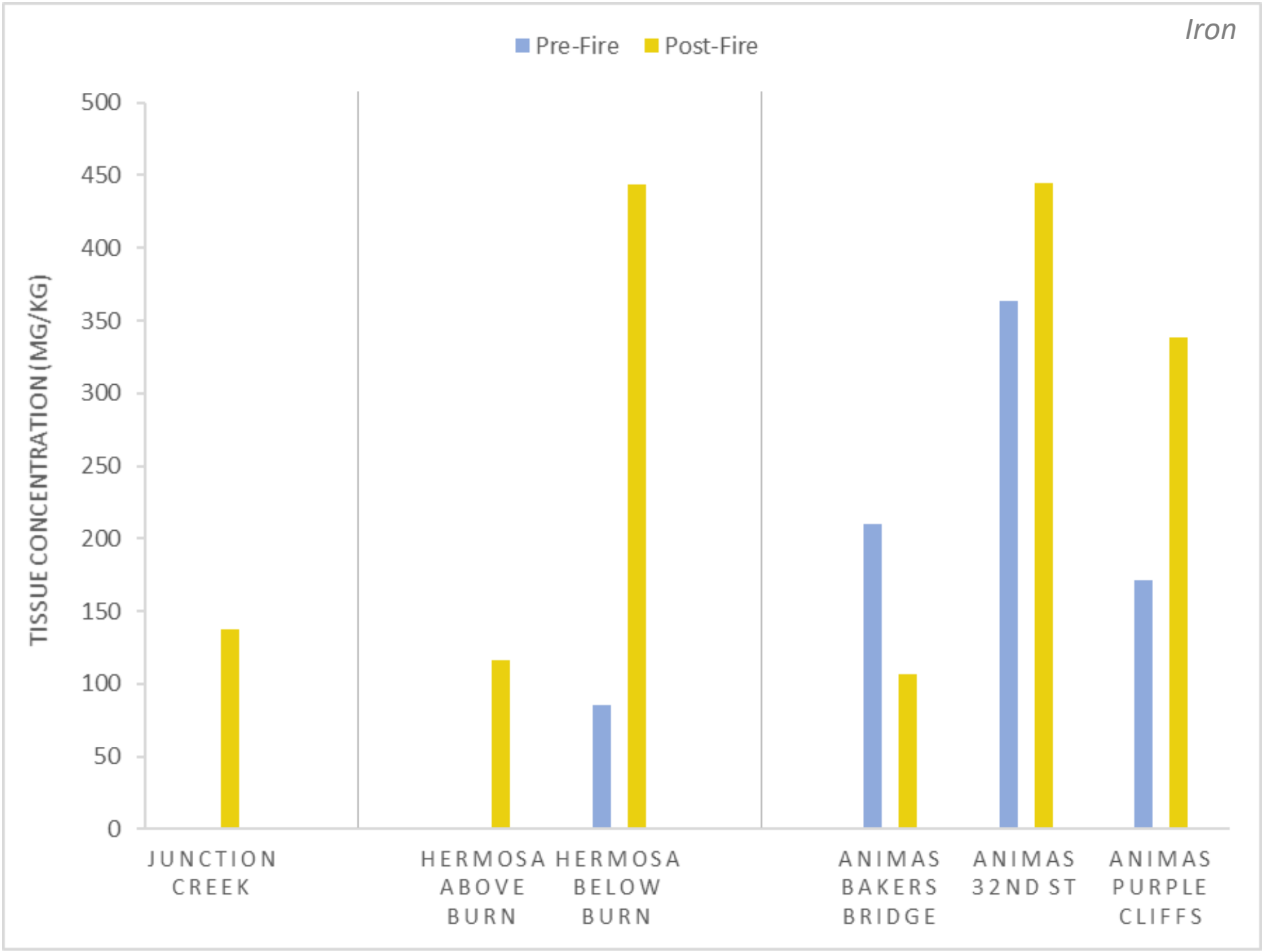


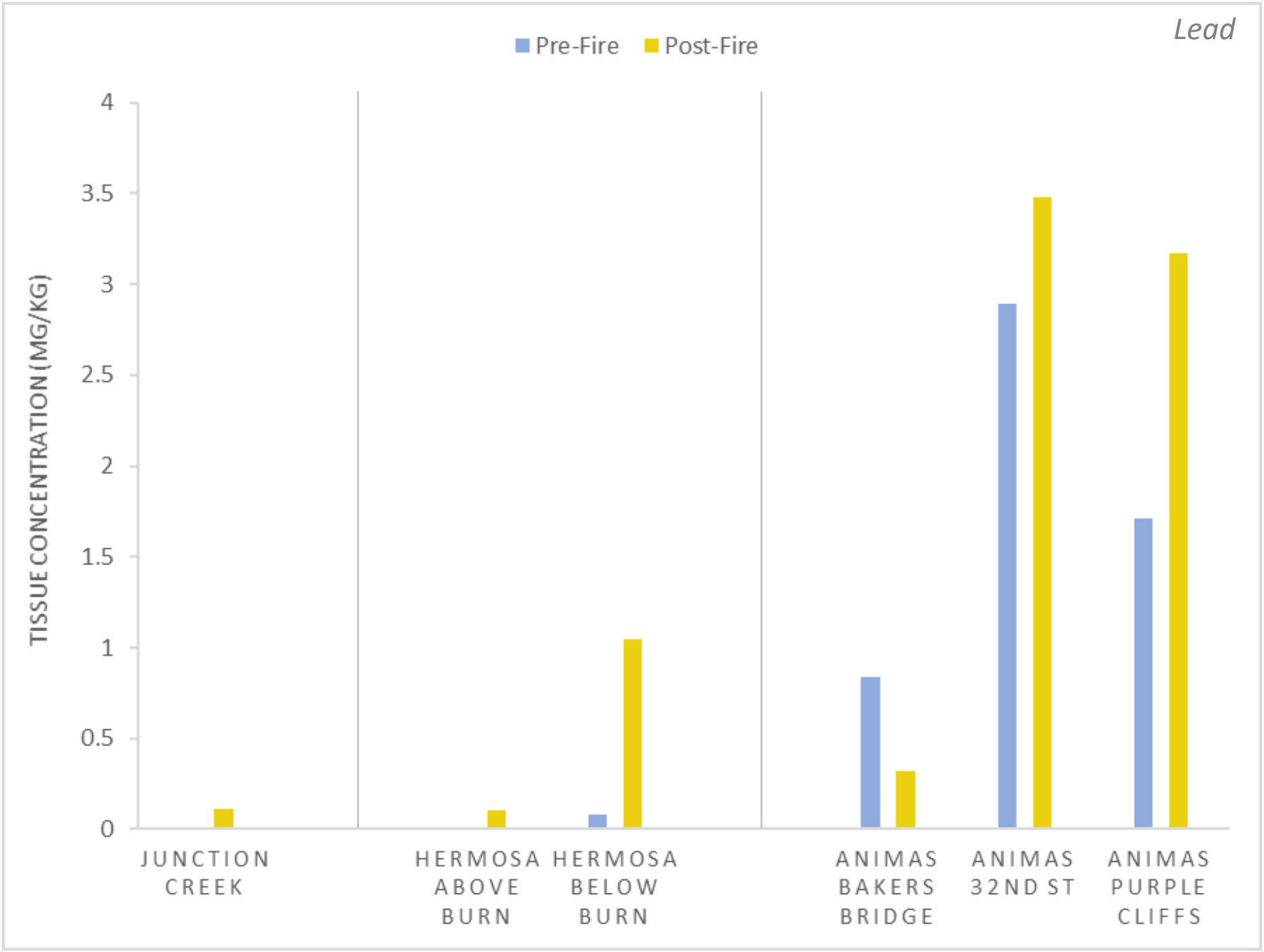
Junction Creek at Colorado Trailhead benthic community composition pre- and post-fire

Appendix J – Preliminary benthic macroinvertebrate tissue metal concentrations.

Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.


Aluminum
Pre-Fire
Post-Fire
TISSUE CONCENTRATION (MG/KG)
400
350
300
250
200
150
100
50
0
JUNCTION CREEK
HERMOSA ABOVE BURN
HERMOSA BELOW BURN
ANIMAS BAKERS BRIDGE
ANIMAS 32ND ST
ANIMAS PURPLE CLIFFS

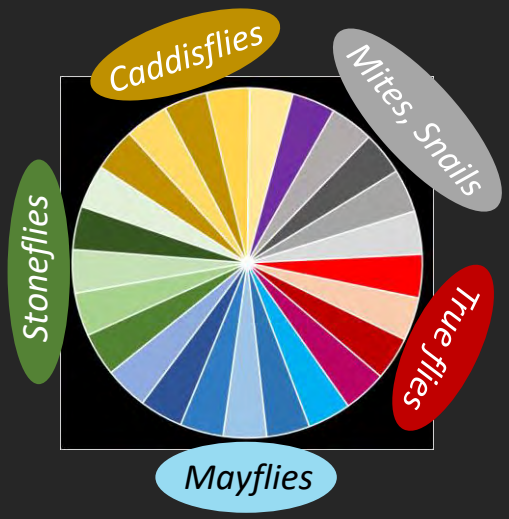

Iron
Pre-Fire
Post-Fire
TISSUE CONCENTRATION (MG/KG)
500
450
400
350
300
250
200
150
100
50
0
JUNCTION CREEK
HERMOSA ABOVE BURN
HERMOSA BELOW BURN
ANIMAS BAKERS BRIDGE
ANIMAS 32ND ST
ANIMAS PURPLE CLIFFS

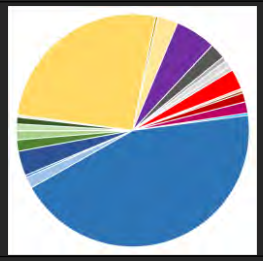
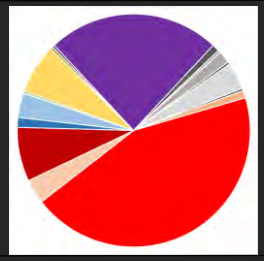
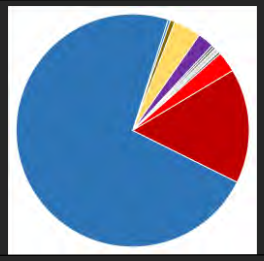
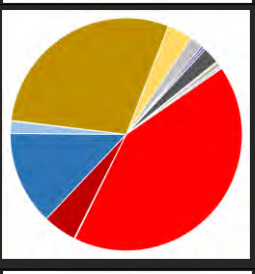
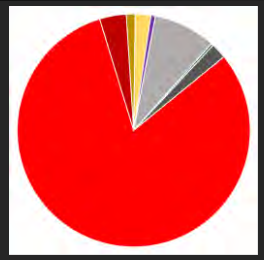
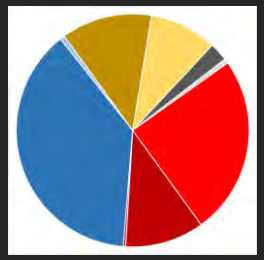
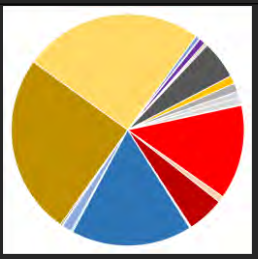
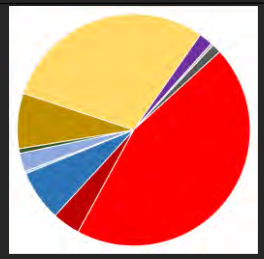
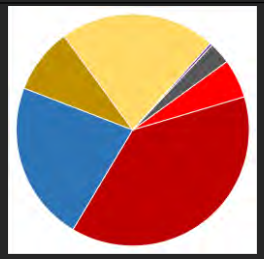
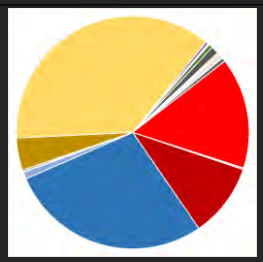
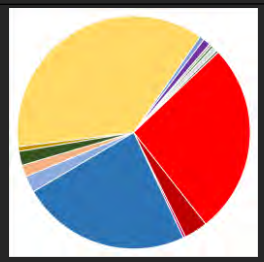
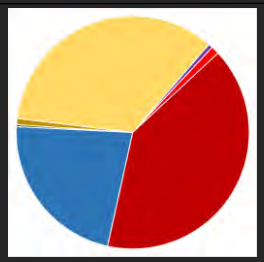

Lead
Pre-Fire
Post-Fire
TISSUE CONCENTRATION (MG/KG)
4
3.5
3
2.5
2
1.5
1
0.5
0
JUNCTION CREEK
HERMOSA ABOVE BURN
HERMOSA BELOW BURN
ANIMAS BAKERS BRIDGE
ANIMAS 32ND ST
ANIMAS PURPLE CLIFFS

Appendix K – Examples of interpretation outreach materials prepared to convey findings to the public.

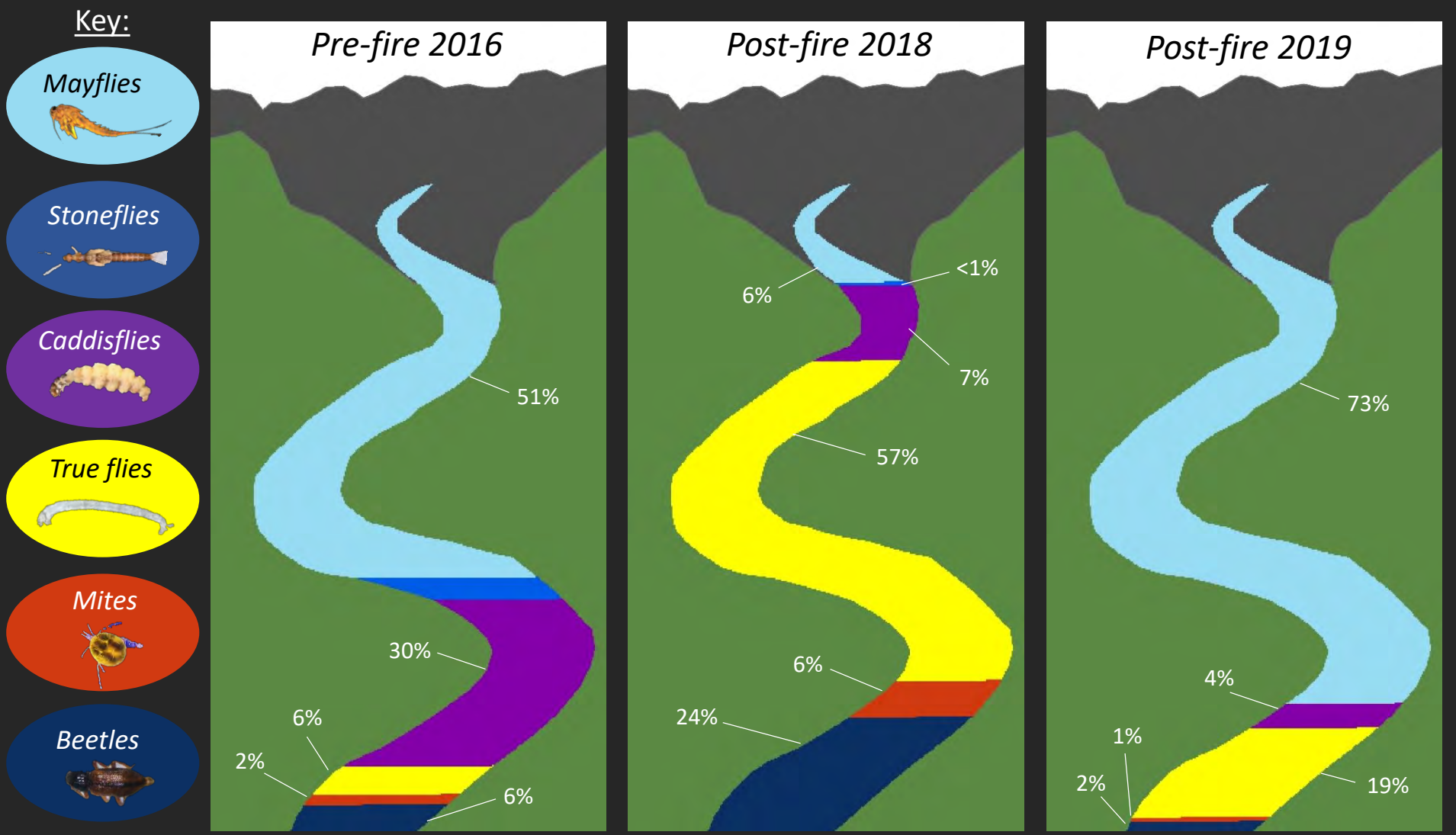
Analysis and interpretation of our broader post-fire research is ongoing and will continue with new data being collected in 2020. These results are preliminary.

Key:



	Pre-Fire	Post-Fire '18	Post-Fire '19
	↑ May, Caddis, Stone ↓ Midges ↑ Diversity	↓ May, Caddis, Stone ↑ Midges ↓ Diversity	↑ Baetis ↑ Blackfly ↓ Diversity
Hermosa *Above 203*			
Animas *32nd*			
Animas *Above Lightner*			
Animas *Above Purple Cliffs*			

Hermosa Creek
Aquatic insect community composition



Hermosa Creek
Stream Bottom Habitat