


Bonita Peak Mining District

Introducing EPA's Goals

APRIL 24, 2019
SILVERTON TOWN HALL

A solid orange horizontal bar spanning the width of the slide at the bottom.

Minimize Human and Ecological Risks

IMPROVE WATER QUALITY

- Identify achievable actions necessary to meet Table Value Standards at a location downstream of Silverton.
- Improve water quality to meet or exceed State water quality goals in priority areas.

STABILIZE MINE SOURCE AREAS

- Stabilize source areas to minimize unacceptable risk to human, aquatic, and terrestrial receptors.

MINIMIZE UNPLANNED RELEASES

- Prevent unplanned releases that may result in negative impacts to human health, welfare or the environment.

Improve Water Quality

- Focus on mine drainage
 1. Identify achievable actions necessary to meet Table Value Standards at a location downstream of Elk Creek (Site-wide)
 2. Improve water quality to meet or exceed State water quality goals in priority areas. (Focused)



Stabilize Mine Source Areas

- Focus on solid media
- EPA's goal is to stabilize mining-related source areas to minimize unacceptable risk to humans as well as aquatic and terrestrial species.
 - Minimize recreational exposures
 - Reduce erosion into waterbodies
- Interim actions will begin to stabilize source areas



Minimize Unplanned Releases

- Focus on potential fluid hazards
- EPA's goal is to minimize unplanned releases that may result in negative impacts to human health, welfare or the environment.



Natalie/Occidental Mine



Frisco/Bagley Tunnel



Water Quality Goals

What informed the development of the Water Quality Goals?

Risk Assessments – Define unacceptable human and environmental risk

Habitat assessment

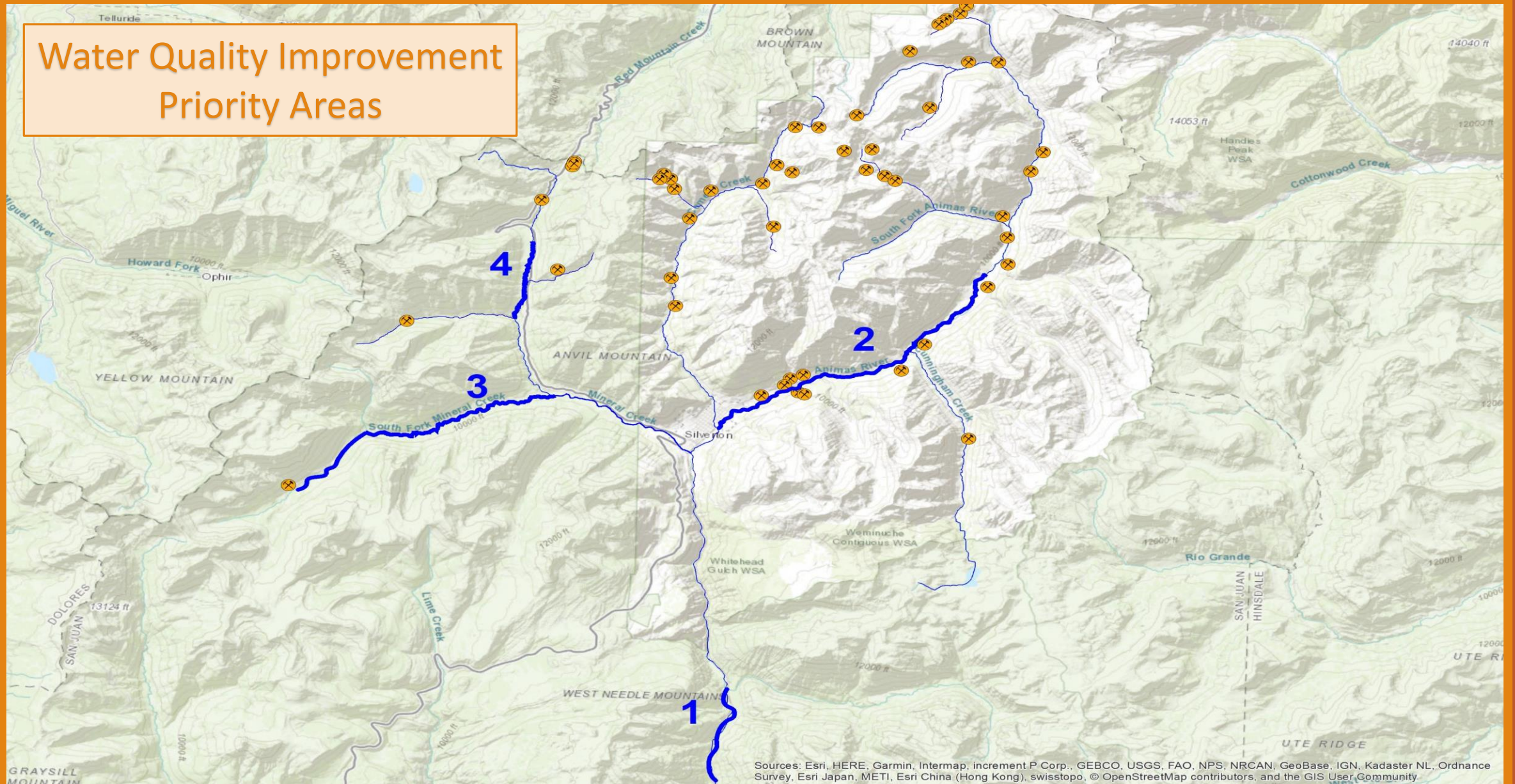
- Determine physical limitations to potential aquatic life improvements in Animas River headwaters.
- Determine where aquatic life exists.

Background contribution – Recognize the influence of background contributions and limit scope of cleanup to actions that result in meaningful improvements in water quality

Ground water investigations – Understand groundwater (including mine workings) and surface water connections to identify those response actions that may be most beneficial to water quality

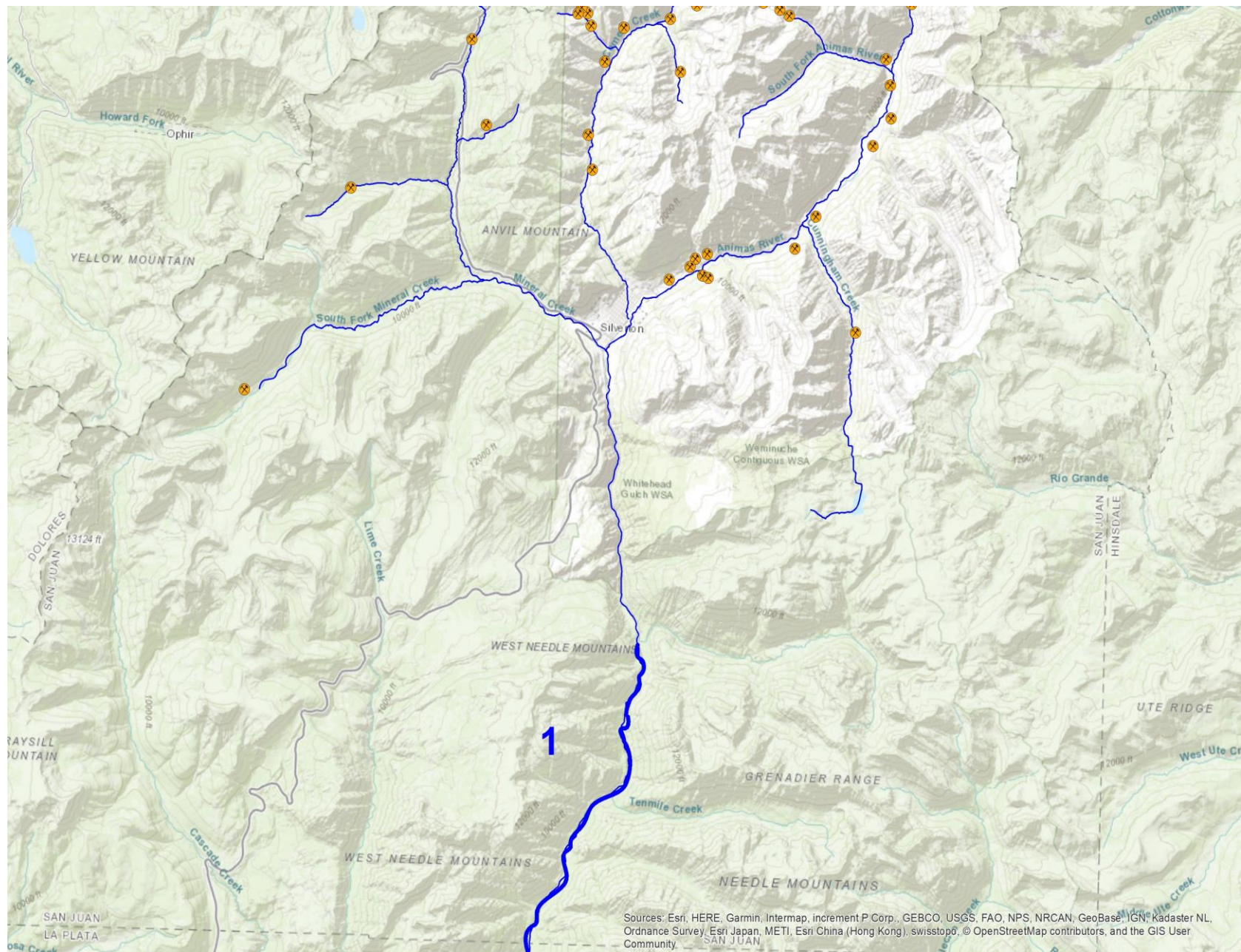
Stakeholders – Consider ideas and opinions from stakeholders in the development of water quality goals, including the Biological Technical Assistance Group (BTAG).

Water Quality Improvement Priority Areas



Sitewide Goal (1)

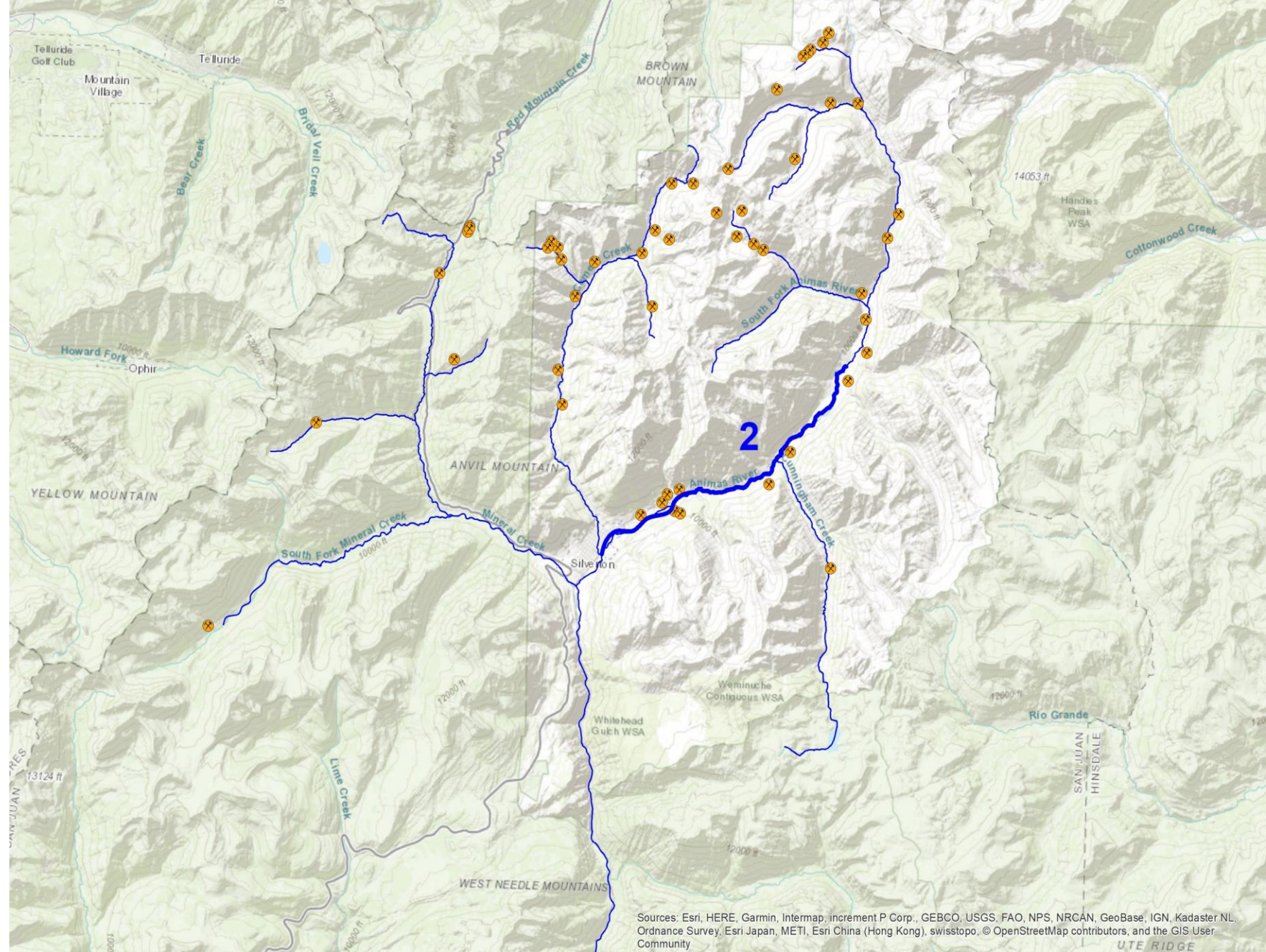
- Animas River downstream of Elk Creek
- Water quality improvements will come from work in all three drainages, including Cement Creek
- Fishery is absent or impaired in this reach
- EPA's Goal: Meet State Table Value Standards in the Animas River below Elk Creek (with possible exception of aluminum due to high background concentrations)



Focus Area

Upper Animas (2)

- Animas from Minnie Gulch to Cement Creek
- Relatively abundant, stable recreational brook trout fishery.
- EPA's Goal: Improve water quality to allow numbers and spatial extent of existing brook trout fishery to improve.

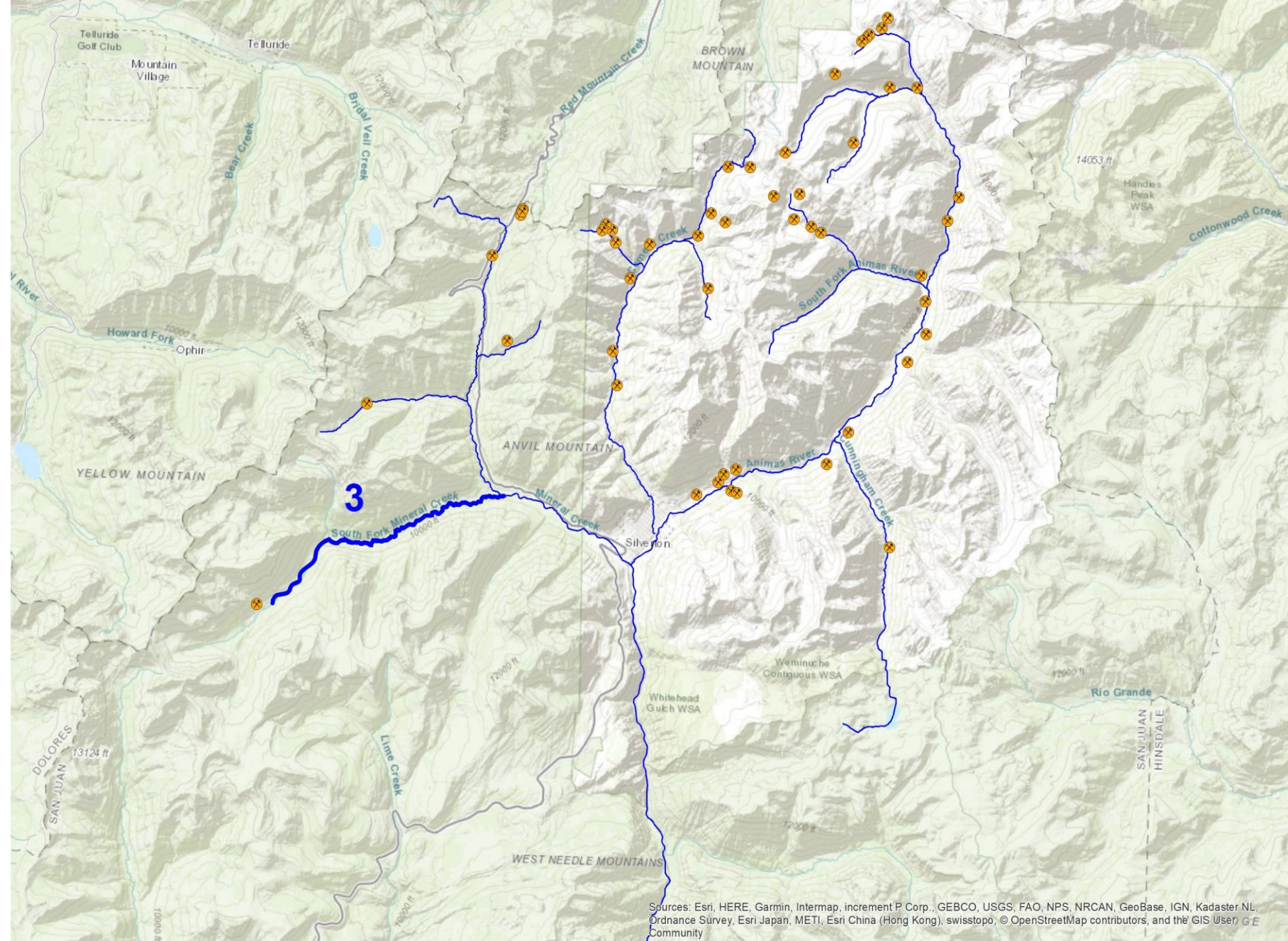


Focus Area

South Fork

Mineral Creek (3)

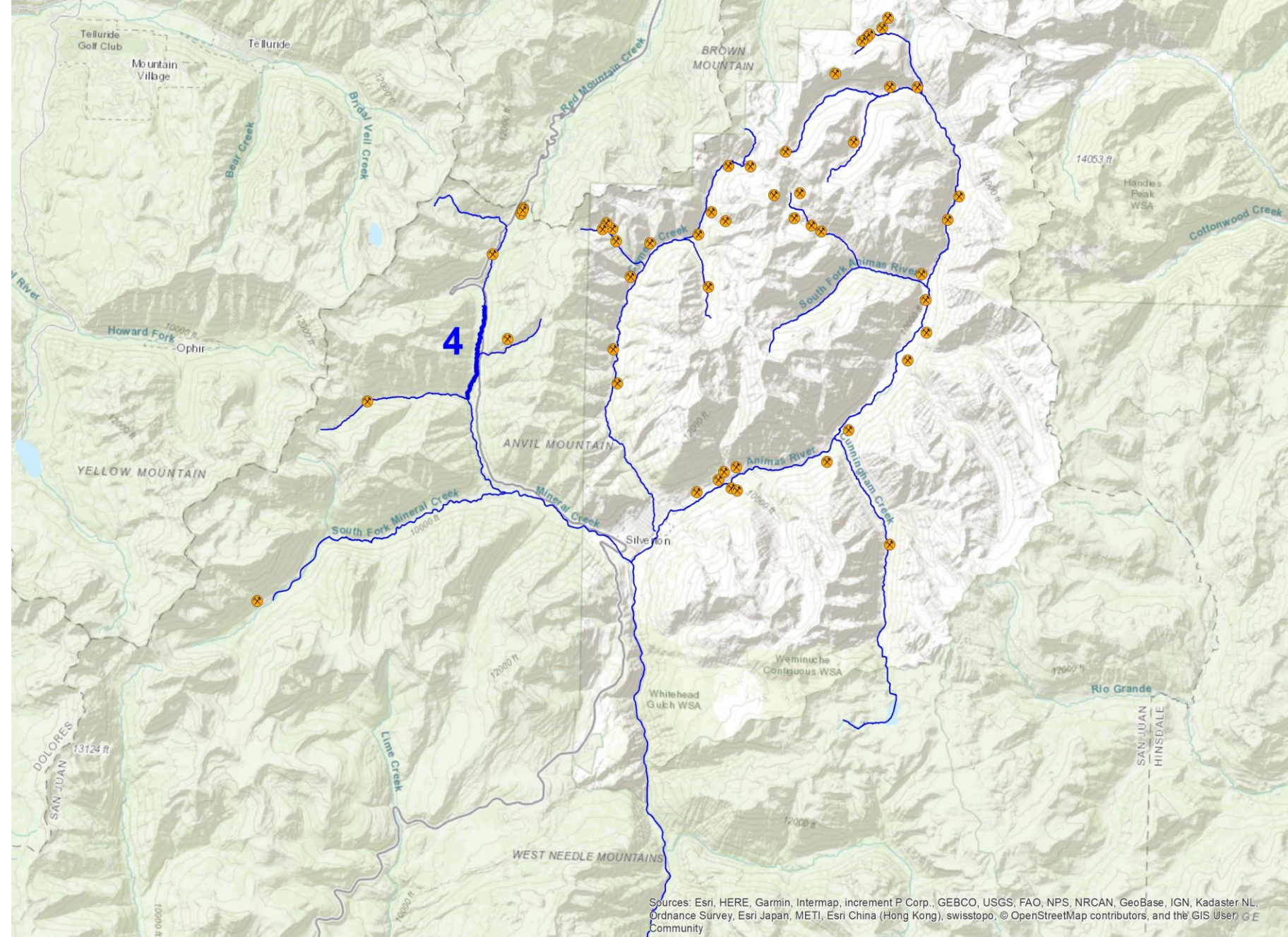
- South Fork of Mineral Creek from headwaters to mouth
- Stable recreational fishery
 - Brook trout- abundant
 - Rainbow trout- stocked
 - Cutthroat trout- present
- EPA's Goal: Improve water to allow numbers and diversity of existing fishery to improve and enhance trout corridor to Animas River.



Focus Area

Mineral Creek (4)

- Mineral Creek between Mill Creek and Middle Fork Mineral Creek
- Brook trout found in this reach in 2016
- Significant improvement in water quality due to actions of stakeholders
- EPA's Goal: Investigate potential for expansion and improvement of Mineral Creek fishery. Improve the benthic macroinvertebrate community.



Paradise Mine

Practical Goals

- Recognize the influence of background contributions
- Limit scope of cleanup to actions that result in meaningful improvements in water quality



Next Steps

- Implement IROD
- Finalize human and terrestrial risk assessments
- Identify data gaps and evaluate loading of priority sources
- Develop cleanup options to achieve goals





Bonita Peak Mining District Aquatic Baseline Ecological Risk Assessment

Andrew Todd, Ph.D.
Aquatic Ecotoxicologist, EPA Region 8
April 23-25, 2019

Aquatic Risk Assessment in the BPMD: Overview of Presentation

- What is a Baseline Ecological Risk Assessment?
- BPMD BERA Process
 - BPMD Biological Technical Assistance Group (“BTAG”)
 - BPMD Aquatic BERA Timeline
- Considering “Background”
- Lines of Evidence / Tools utilized in the BPMD Aquatic Baseline Ecological Risk Assessment process
- Results
- Conclusions and Next Steps

What is a Baseline Ecological Risk Assessment?

The Environmental Protection Agency (EPA) conducts aquatic Baseline Ecological Risk Assessments (aquatic BERAs) to characterize exposure and risks under current conditions within contaminant-influenced waterways to:

- Benthic macroinvertebrates (BMIs) that are exposed to contaminant-influenced sediments and surface water
- Fish and amphibians that are exposed to contaminant-influenced surface water
- Wildlife that eat or drink surface water, sediment and food from contaminant-influenced waterways

Biological Technical Assistance Group (BTAG)

- Bureau of Land Management
- CO Dept. Public Health and the Environment
- CO Parks and Wildlife
- Mountain Studies Institute
- Navajo Nation
- New Mexico Environment Department
- Southern Ute Indian Tribe
- Sunnyside / Kinross
- Trout Unlimited
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- U.S. Geological Survey
- New Mexico Office of Natural Resources Trustee

BPMD Aquatic BERA Timeline

- **7/25/16:** BTAG Meeting in Durango
 - Work Plan discussion, recap of past BERA work in Upper Animas
- **8/2/16:** Phone call with BTAG
 - Established exposure units
- **October 2016-** Aquatic BERA work plan finalized and comments
- **4/18/17:** BTAG Meeting in Ignacio, CO
 - Update on Habitat, BMI, EPA data collection efforts
- **6/27/18:** Draft Aquatic BERA delivered to BTAG for review
- **7/18/18:** BTAG Meeting in Ignacio, CO
 - Presented Draft Aquatic BERA
- **9/10/18:** Written comments received on Draft Aquatic BERA
 - Comments, EPA Responses and Actions are Attachment 2 to BERA
- **2/28/19:** Final BPMD Aquatic BERA sent to BTAG
- **3/12/19:** BTAG Meeting in Ignacio, CO

Natural Conditions (“Background”)

- BPMD BERA Work Plan (2016) explicitly stated that risk characterization would represent total risk and would not attempt to differentiate between man-caused and background
- “Background” risk section: Section 9.8
- Significant spatial variability in geology, alteration, and hydrology documented within the BPMD would necessitate detailed, basin-specific analyses to quantitatively differentiate between natural vs. man-caused metal loading
- Completing this level of analysis within all EUs at the risk assessment stages is not practical or responsible at this spatial scope and stage
- EPA will utilize this type of site-specific analysis later in the RI/FS process

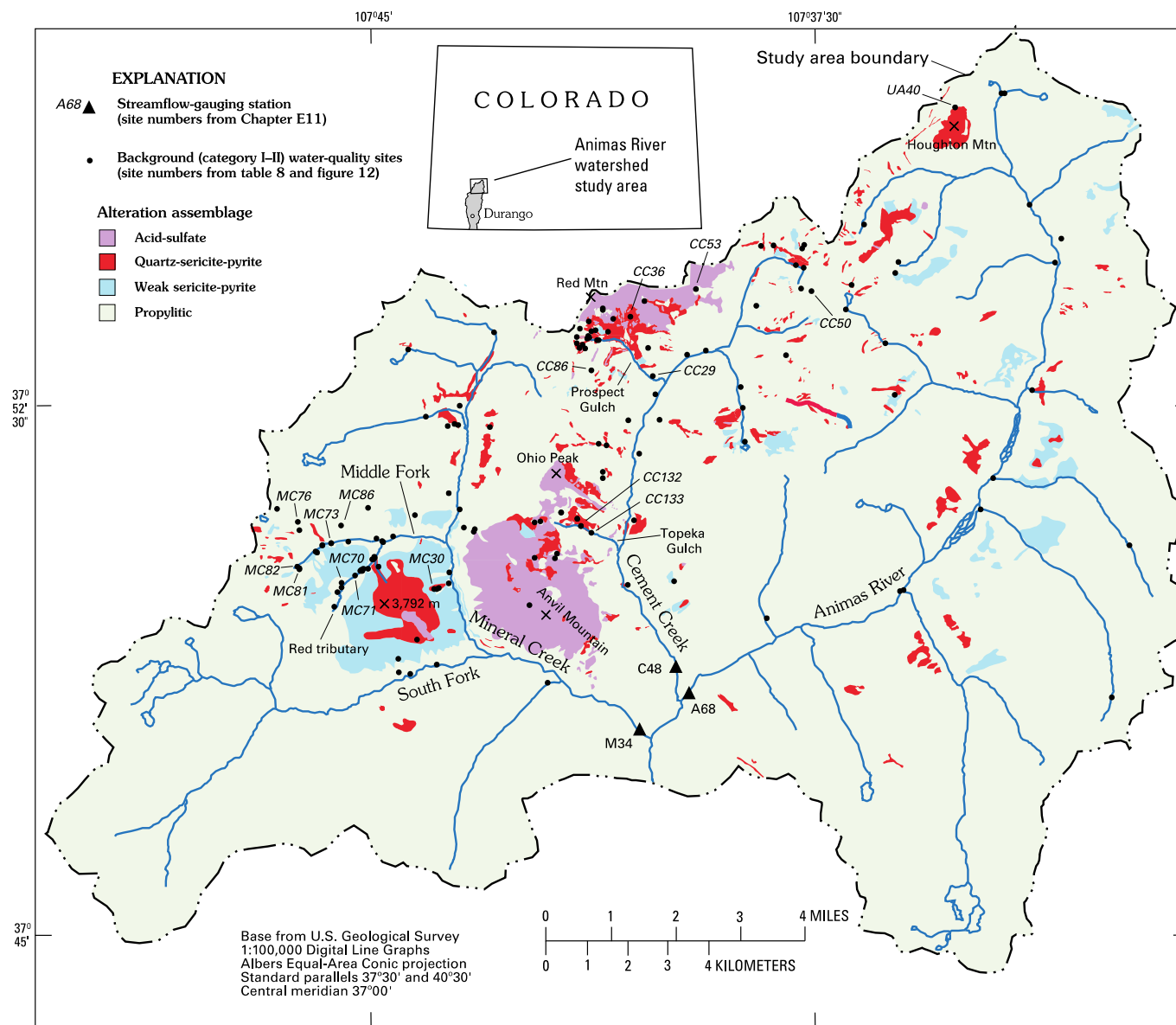


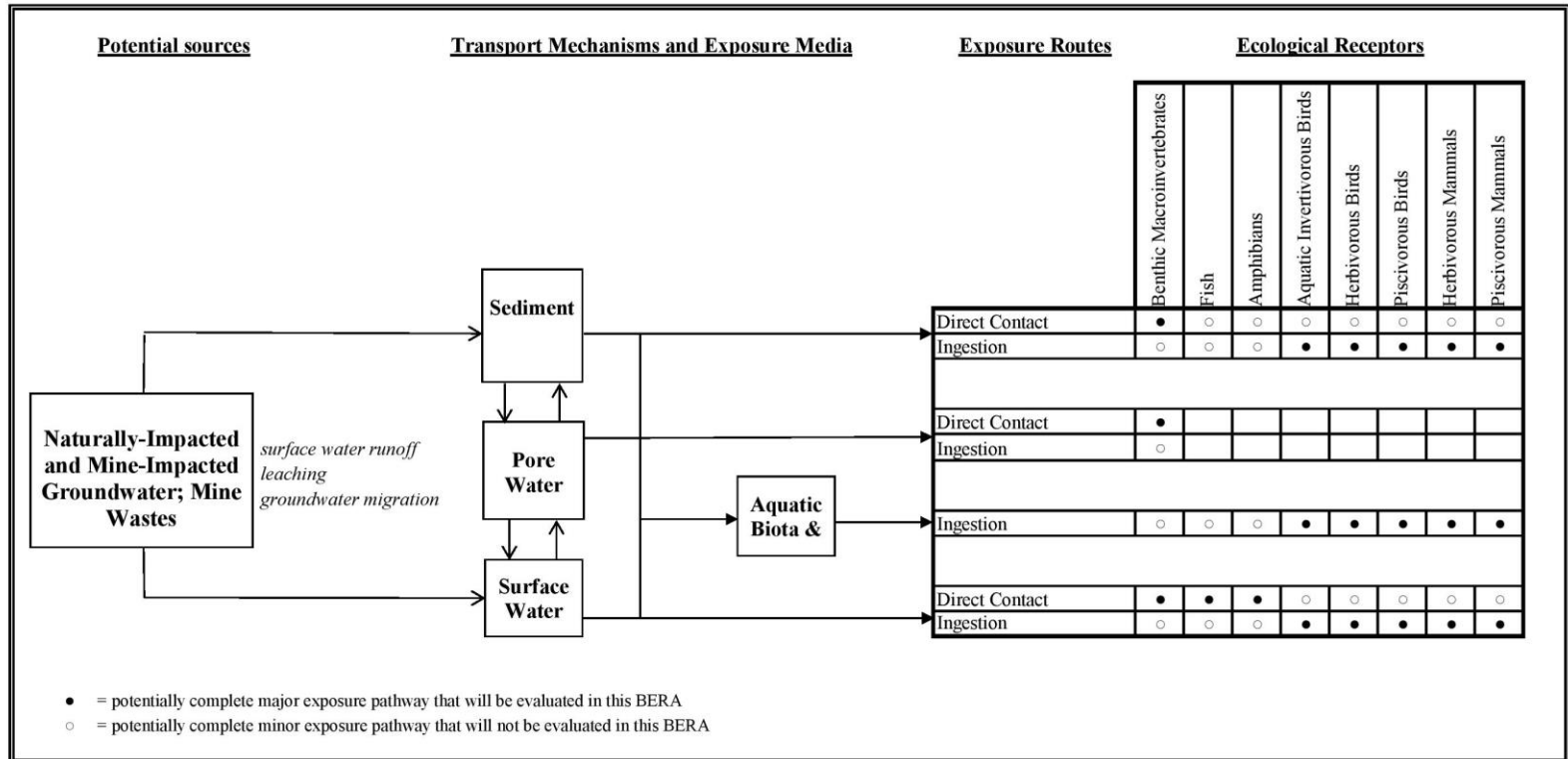
Figure 1. Animas River watershed study area, with distribution of major alteration assemblages.

Ecological Risk Assessment Documents

- *Upper Animas* Aquatic BERA (Attachment 1)
 - Draft completed in 2015, not finalized due to GK
 - Cement Creek to Bakers Bridge
 - Finalized- March 2019
- *BPMD* Aquatic BERA
 - Remainder of Site above Silverton
 - Upper Animas River and Tributaries
 - Mineral Creek and Tributaries
 - Excludes Cement Creek
 - Durango Reach- Bakers Bridge to Purple Cliffs
 - Finalized- March 2019
- Terrestrial ERA
 - BPMD Site-wide
 - Ongoing

FIGURE 4-1

Conceptual Site Model for Aquatic Habitats and Receptors Evaluated in the Bonita Peak Mining District Aquatic Baseline Ecological Risk Assessment



BPMD Aquatic Conceptual Site Model

Aquatic ERA Lines of Evidence / Tools

- Measurement Endpoints / Tools
 - Hazard Quotient (HQ) Approach- Comparison of chemical concentrations to known benchmarks
 - Site-Specific Toxicity Testing
 - Exposing laboratory organisms to site environmental media
 - Community Surveys
 - Organism surveys
 - Habitat assessments
- All information weighed to develop a conclusion regarding the potential for harmful effects on relevant aquatic populations in the BPMD

BERA Tool: Calculating Hazard Quotients

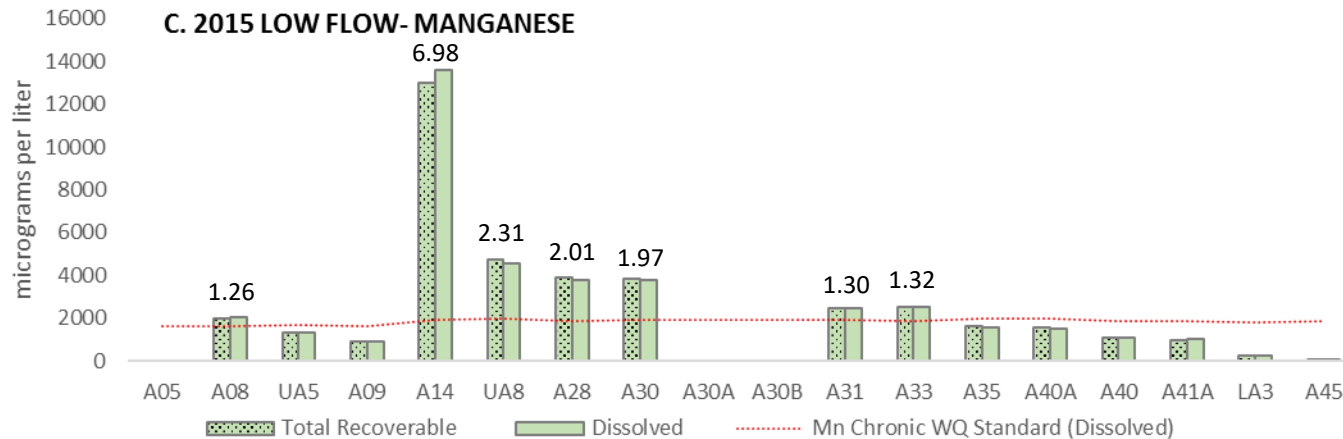
Hazard Quotient (HQ)

$$\text{HQ} = \text{Exposure} / \text{Benchmark}$$

HQ<1 = Acceptable risk

HQ>1 = Further evaluation warranted *or* unacceptable risk

BERA Tool: Calculating Hazard Quotients



- Surface Water HQs

- Comparison of measured water concentrations to applicable Colorado Water Quality Control Commission water quality criteria
- HQ reflect “how many times” the instream concentrations are compared to the applicable WQ criteria

ERA Tool: Site-Specific Toxicity Testing



Sediment Toxicity Testing
(*Hyalomma azteca*)



Surface Water Toxicity Testing
(Rainbow trout)

ERA Tool: Community Surveys



Benthic Macroinvertebrate Collection

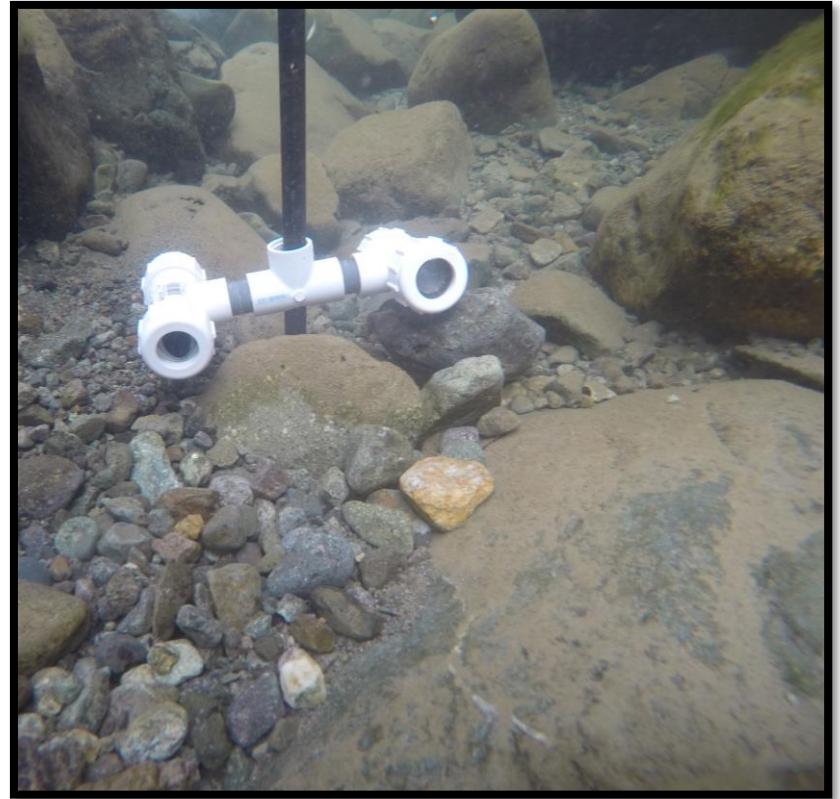


Electrofishing

ERA Tool: Habitat Surveys



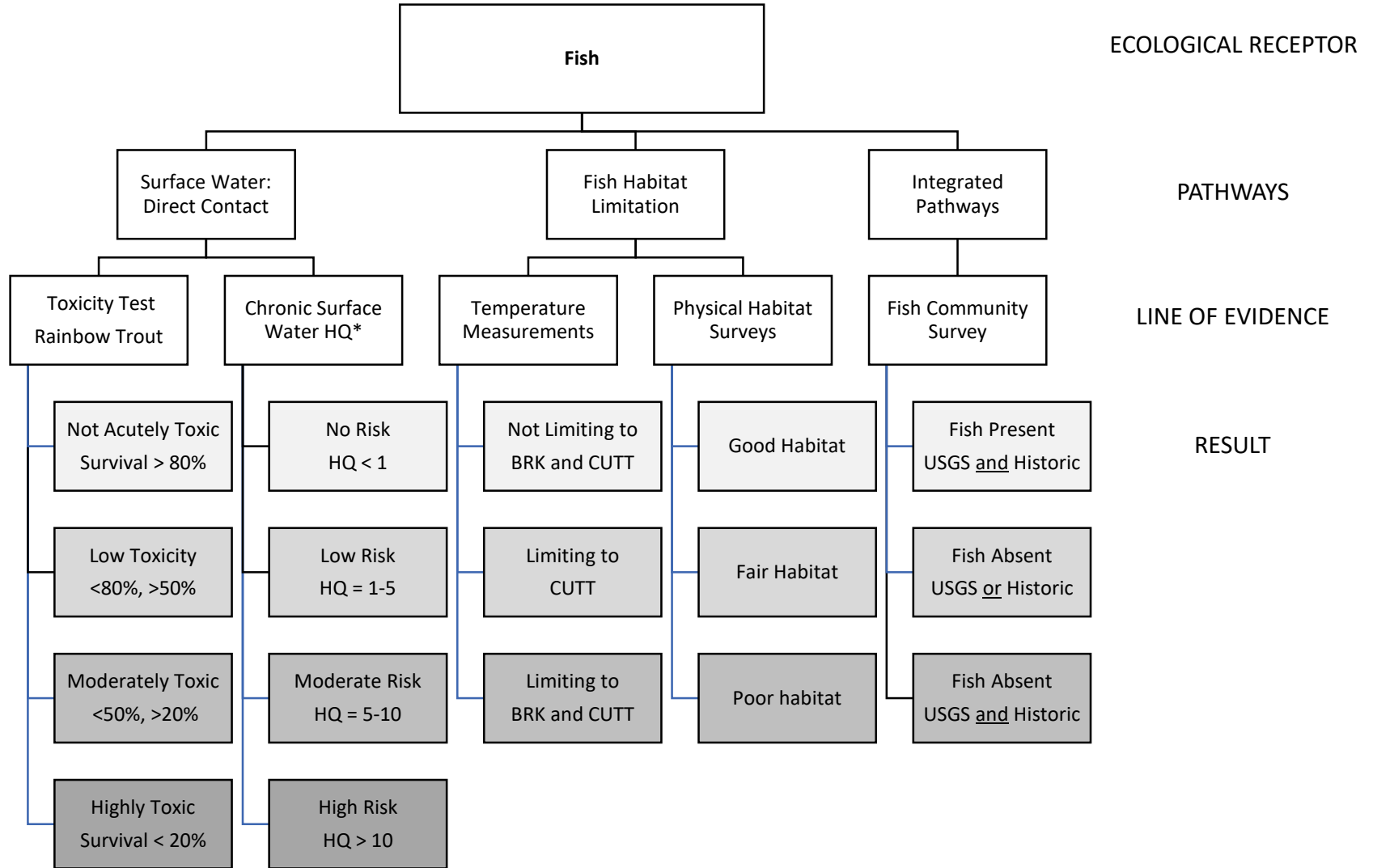
Physical Habitat Characterization



Thermal Regime

Risk Characterization Matrix- Fish

ECOLOGICAL GOAL: Maintain a stable and healthy fish community

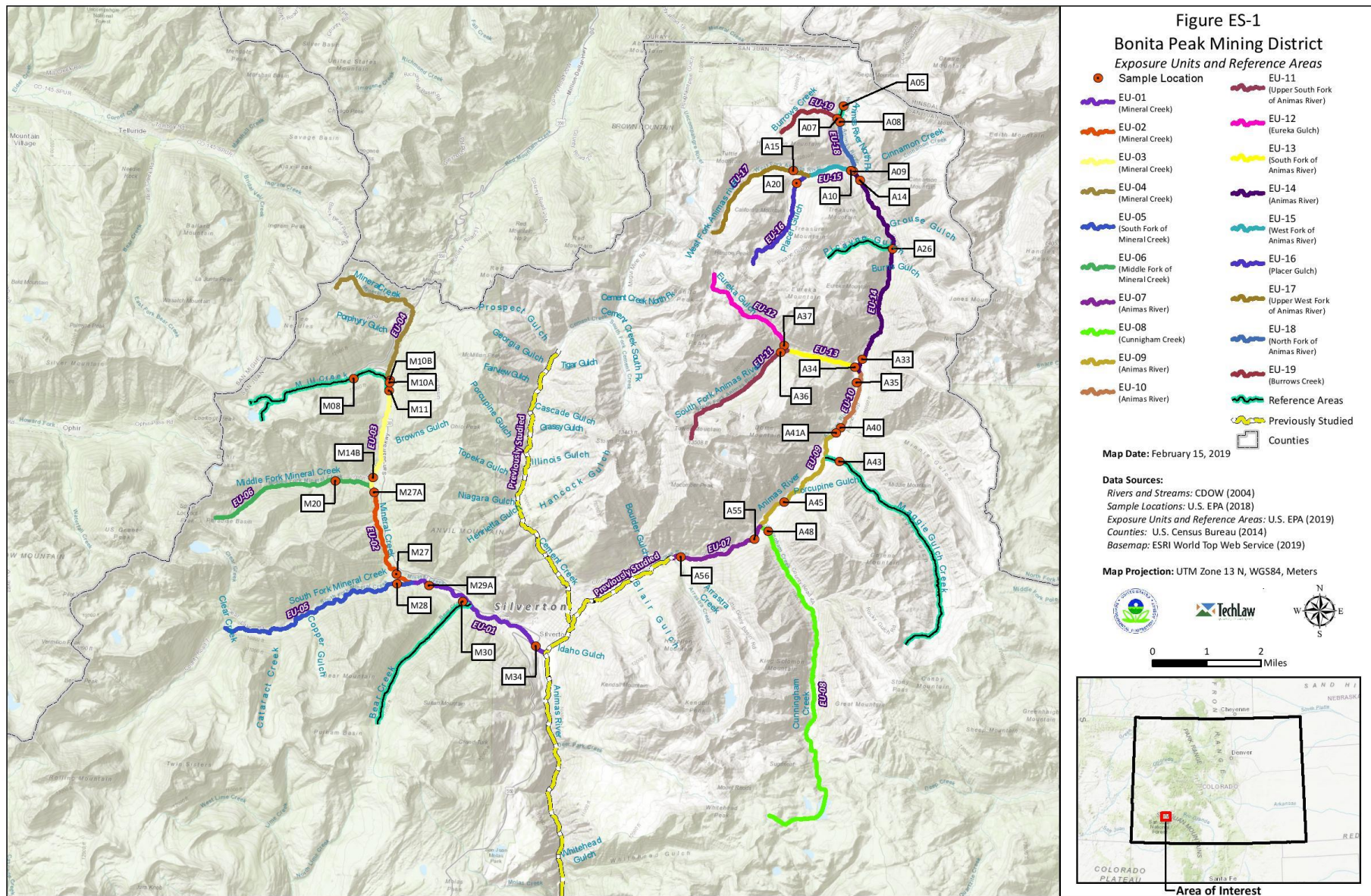


* Calculated for each COPEC

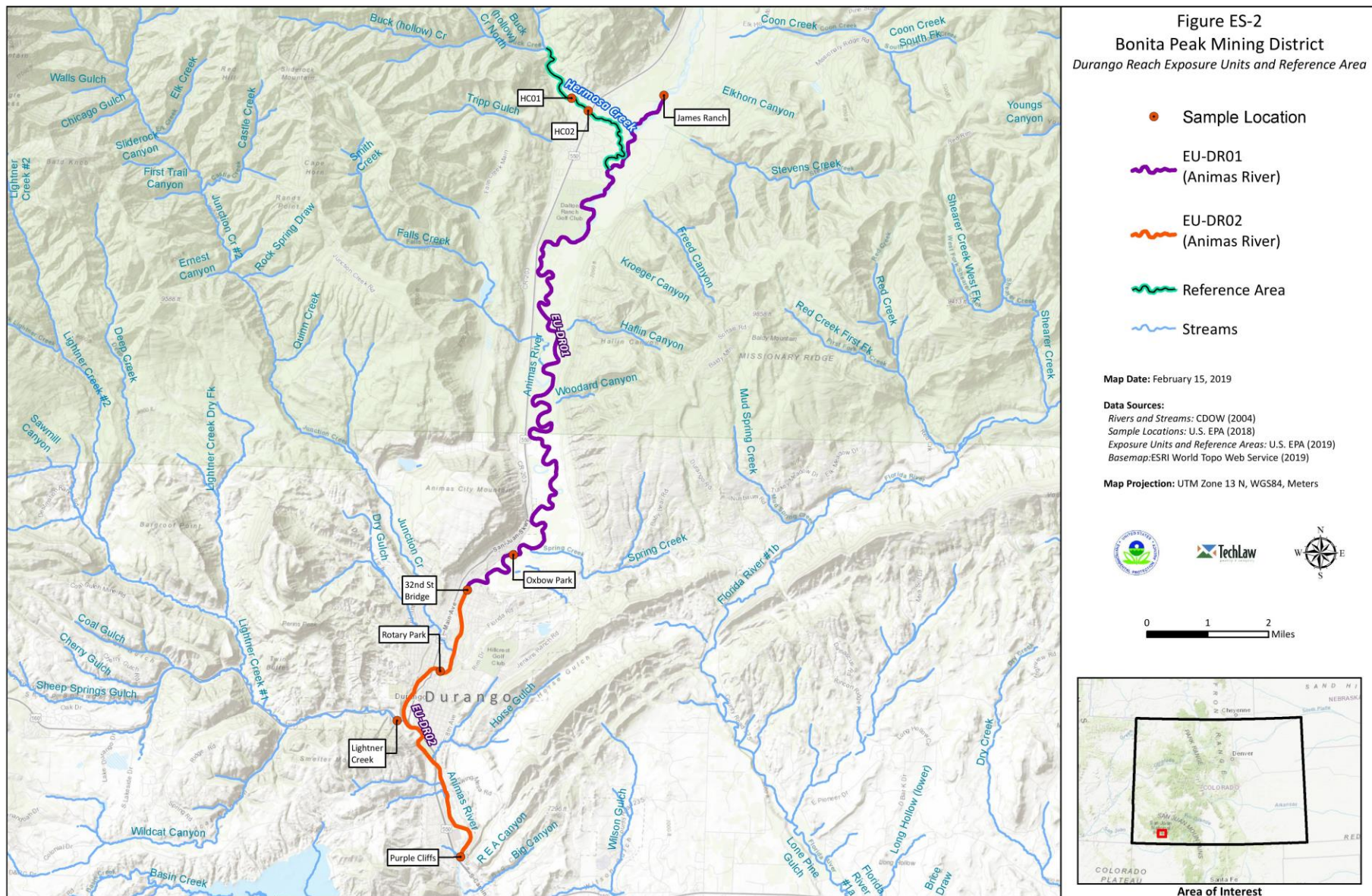
Spatial Scope of BPMD Aquatic BERA



Photo Credit: Sherry Skipper



BPMD Aquatic BERA Exposure Units (EUs)- Upper Watershed



BPMD Aquatic BERA Exposure Units (EUs)- Durango Reach

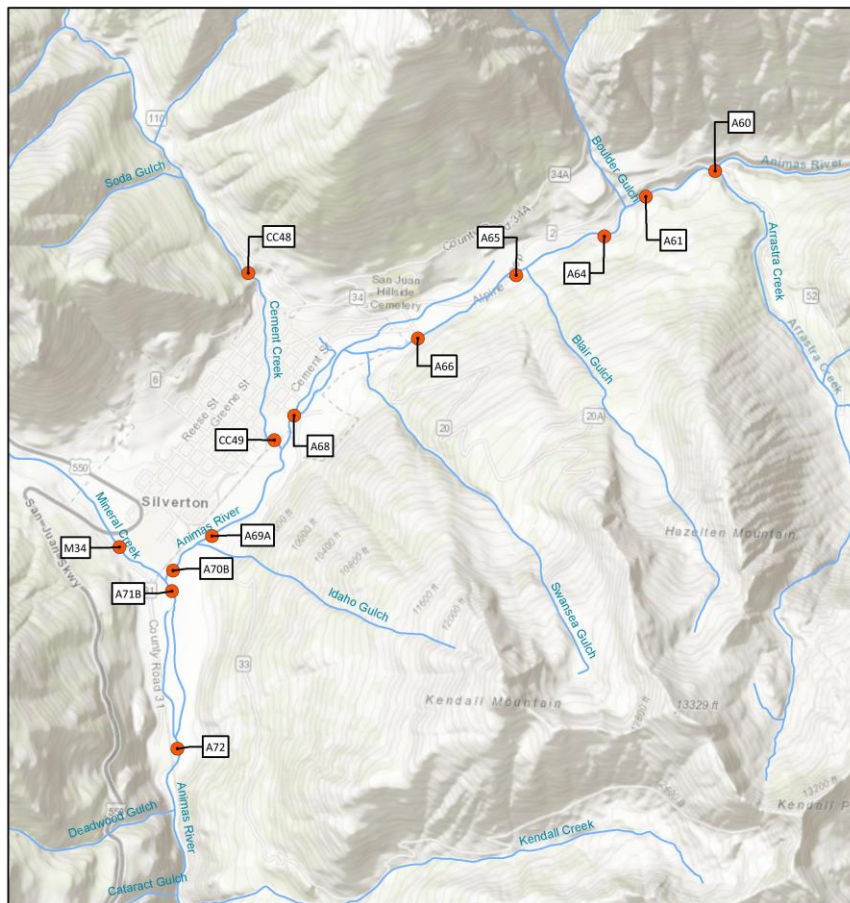


Figure 3-1
Sampling Locations on the Animas River
Upstream and Across from Silverton, CO

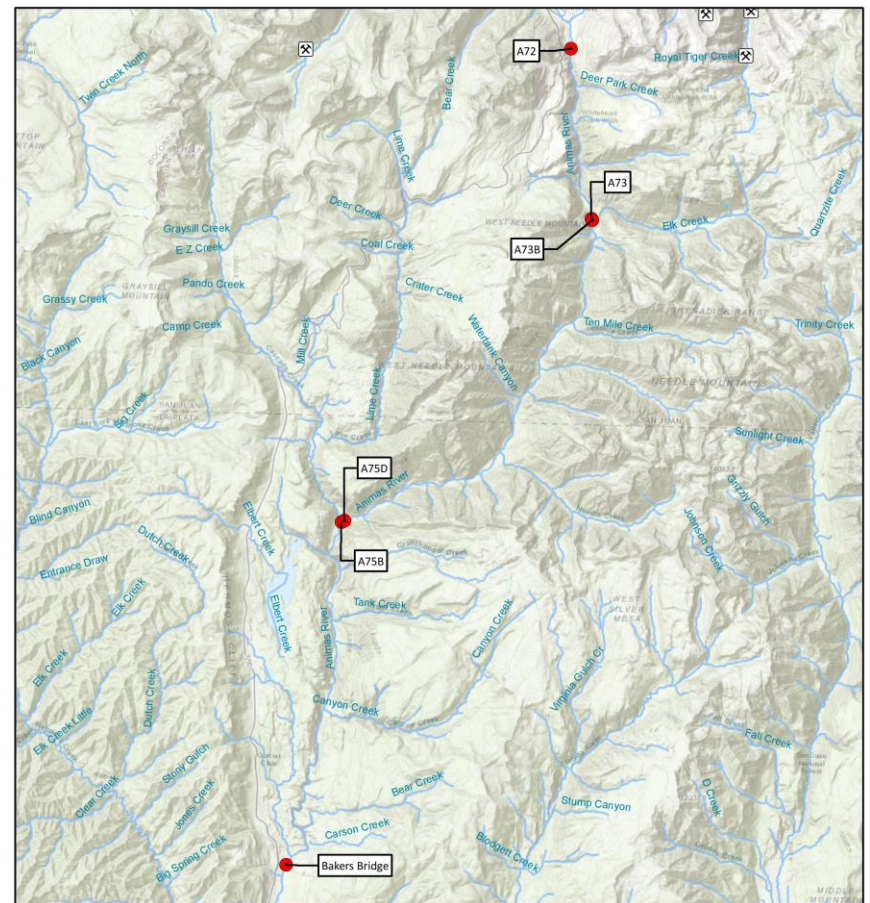
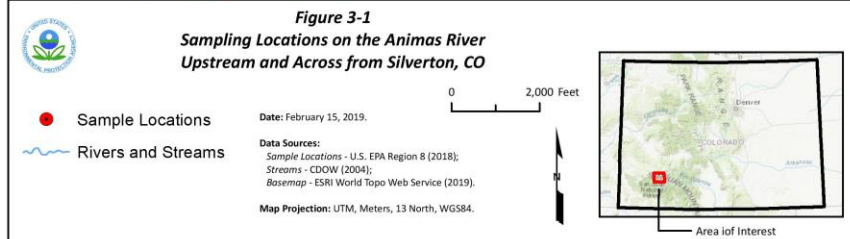
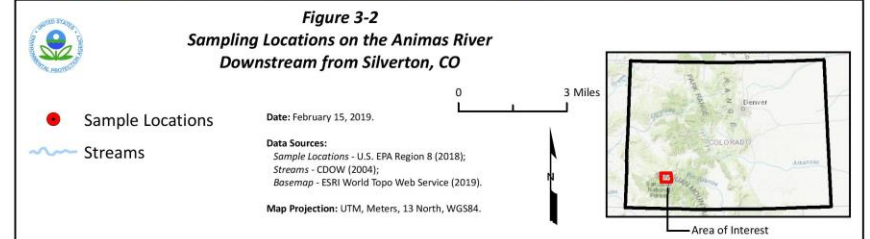


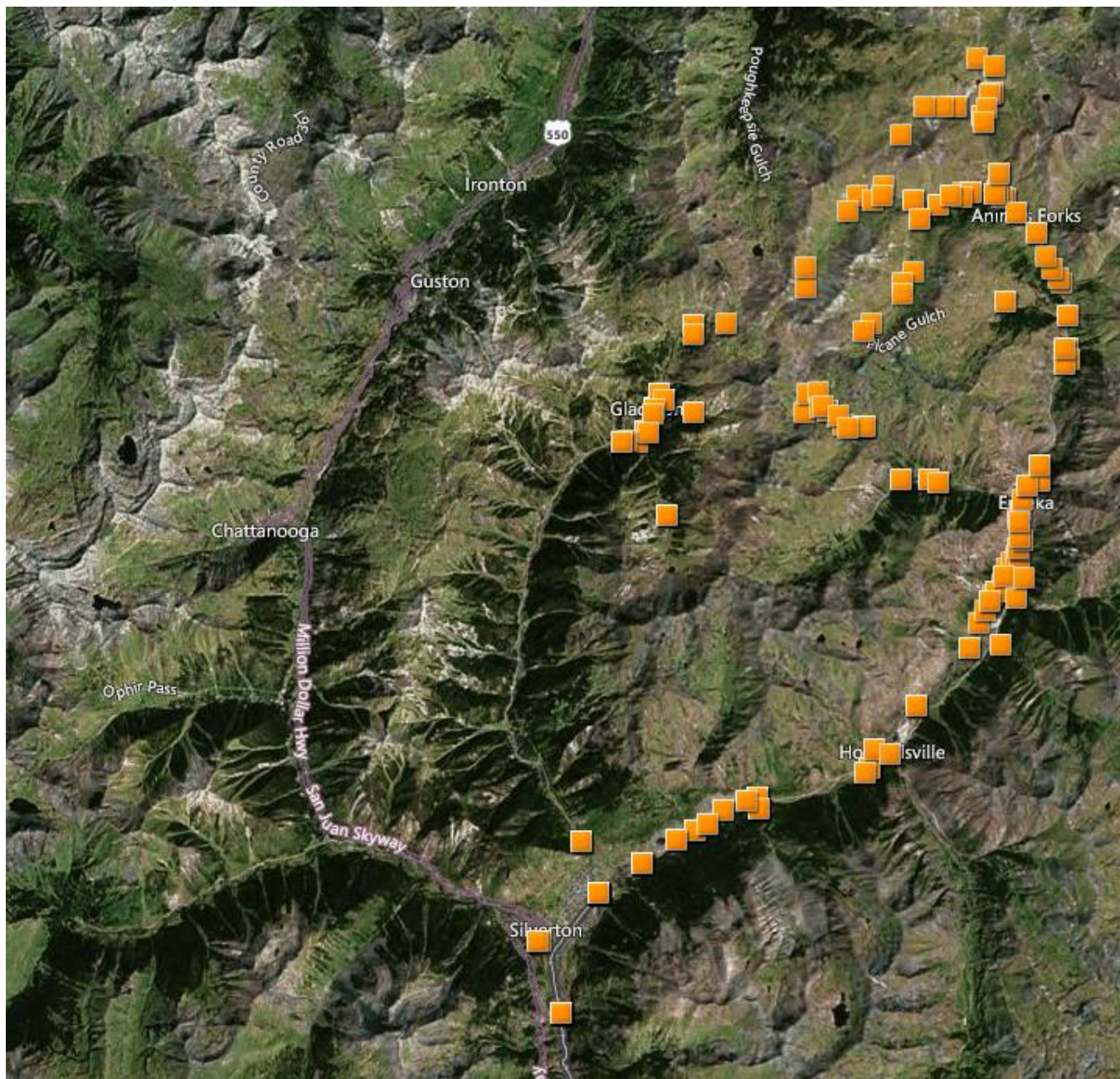
Figure 3-2
Sampling Locations on the Animas River
Downstream from Silverton, CO



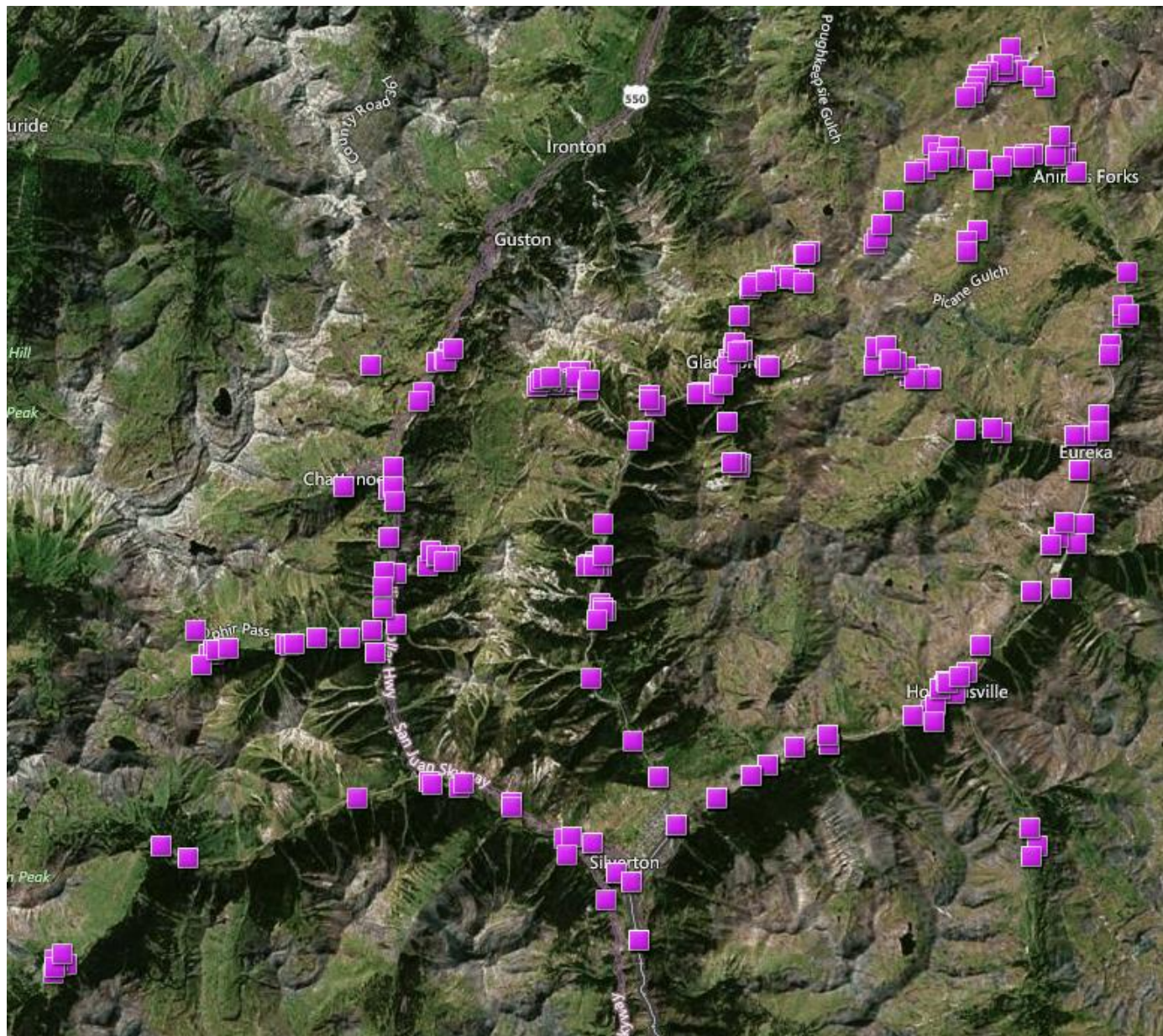
Upper Animas Aquatic BERA Exposure Units (EUs)

EPA Sampling Efforts: 2015-2017

- Multi-media
 - Surface Water
 - Sediment
 - Porewater- Interstitial water in the sediments
 - Fishery Information (presence/absence and tissue concentrations)
 - Benthic Macroinvertebrates (community composition and tissue concentrations)
 - Toxicology (acute surface water toxicity and sediment toxicity)
 - Habitat Suitability Information (thermal suitability, habitat suitability)
- Spatially comprehensive
 - Locations selected to characterizing spatially variability of environmental impacts and importance of different sources
- Temporally comprehensive
 - Intra-annual variability- High flow and low flow sampling events
 - Inter-annual variability- 2015, 2016, and 2017



Surface Water Sampling Locations (2015)



Surface Water Sampling Locations (2016)

Results



Line Of Evidence- Hazard Quotients



09/14/2016

BPMD Hazard Quotients- Chronic

Table 9.8 Summary of Surface Water Central Tendency Exposure (CTE) Minimum Hardness Chronic Ecological Screening Value Hazard Quotients (HQs) for Aquatic Community-Level Receptors. Note that only contaminants that had at least one CTE low-effect HQ>1 (acute or chronic) in at least one exposure unit are summarized.

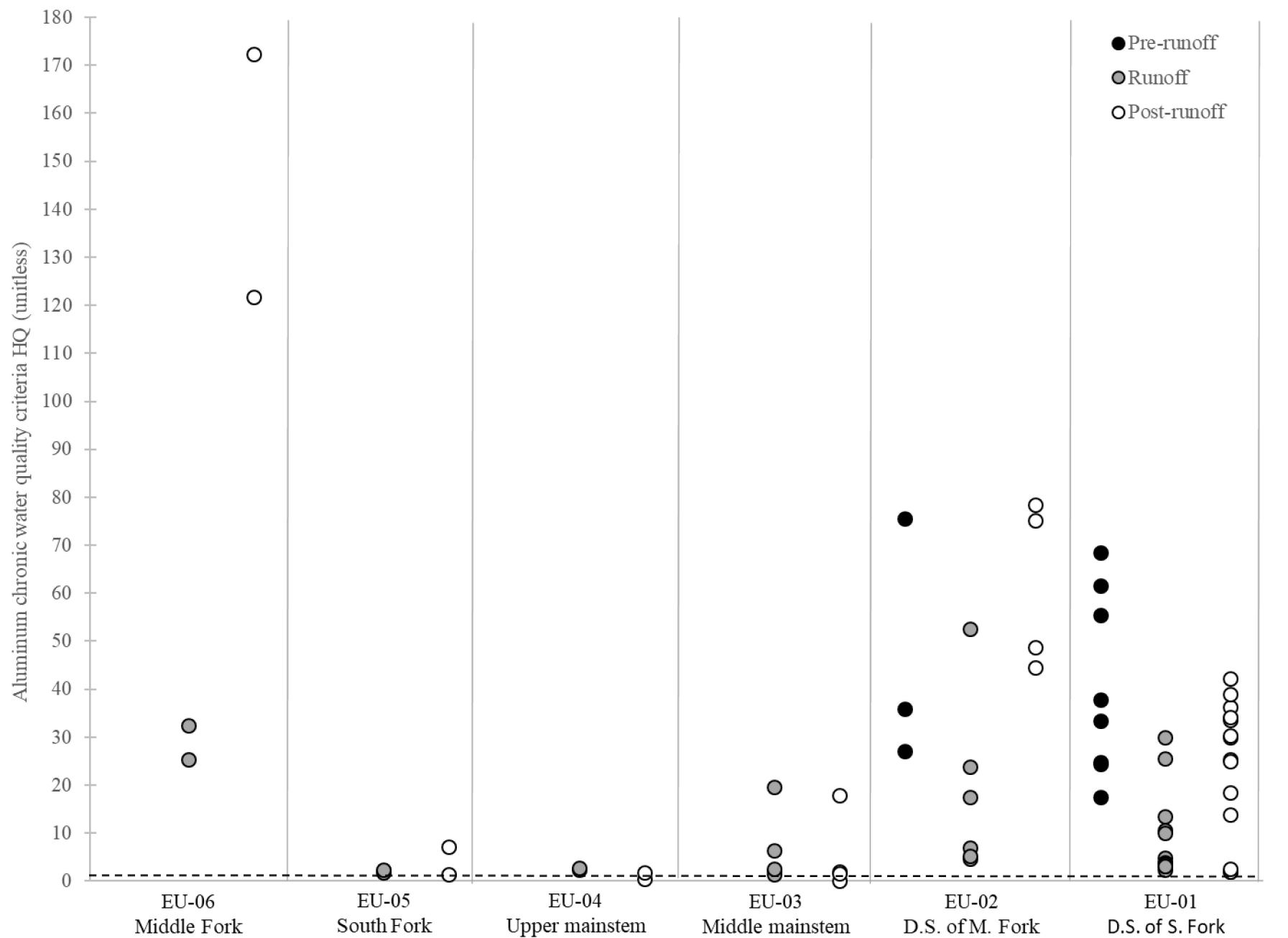
Exposure unit	Location	pH ^a	Aluminum ^b	Beryllium	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Zinc
EU-01	Lower Mineral Creek	5.42	40.4/6.65		1.79		4.81			4.00	1.58
EU-02	Lower Mineral Creek	4.66	61.8/11.2		2.87	1.62	6.90	2.54			2.61
EU-03	Middle Mineral Creek	6.53	8.22/5.23		2.53	2.80	1.03	6.31			2.83
EU-04	Upper Mineral Creek		3.24/2.62	0.96	4.88	4.45		11.8			6.40
EU-05	South Fork Mineral Creek		7.05/2.36				0.86				
EU-06	Middle Fork Mineral Creek	4.34	147/8.9		1.10		18.8				
EU-07	Mainstem Animas River		3.87/0.85		2.35	0.98	0.33				2.90
EU-08	Cunningham Creek		1.63/0.90		-	-					
EU-09	Mainstem Animas River	6.43	4.10/2.10		4.48	2.00					5.68
EU-10	Mainstem Animas River		5.81/3.16		6.92	3.18		0.99	0.70		8.15
EU-11	Upper South Fork Animas River		5.88/1.55								
EU-12	Eureka Gulch		2.92/1.32		9.46	2.51					12.8
EU-13	Lower South Fork Animas River		10.9/2.77		4.88	1.92	0.58	1.01			6.39
EU-14	Mainstem Animas River	4.31	28.8/9.95	1.11	12.9	4.61		2.25	3.70		14.6
EU-15	Lower West Fork Animas River	5.37	75.6/12.9	1.10	18.7	4.32		4.48	8.67		23.0
EU-16	Placer Gulch	6.04	10.6/6.31		12.5	5.24		7.43	1.38		20.4
EU-17	Upper West Fork Animas River	5.29	114/24.3	2.79	26.5	2.81		1.84	13.7		29.0
EU-18	North Fork Animas River	5.02	40.4/18.0	1.92	23.5	3.18		5.02	1.08		17.1
EU-19	Burrows Gulch	4.57	110/94.9	3.82	91.0	16.8		10.2	3.99		61.3
EU-DR01	Animas River - upper Durango Reach		31.0/11.1				4.70			4.00	
EU-DR02	Animas River - lower Durango Reach	6.79	16.9/5.40		0.44		6.92			4.00	
EU-R1	Mineral Creek trib. - Bear Creek										
EU-R2	Mineral Creek trib. - Mill Creek		3.05/1.62	1.57				1.55			
EU-R3	Animas River trib - Maggie Gulch		3.44/1.98								
EU-R4	Animas River trib - Picayne Gulch		2.30/1.45								
EU-R5	Animas River trib - upper N. Fork Animas R.		4.77/6.35	1.78	11.2			1.26			7.24
EU-R6	Durango Reach trib. - Hermosa Creek										

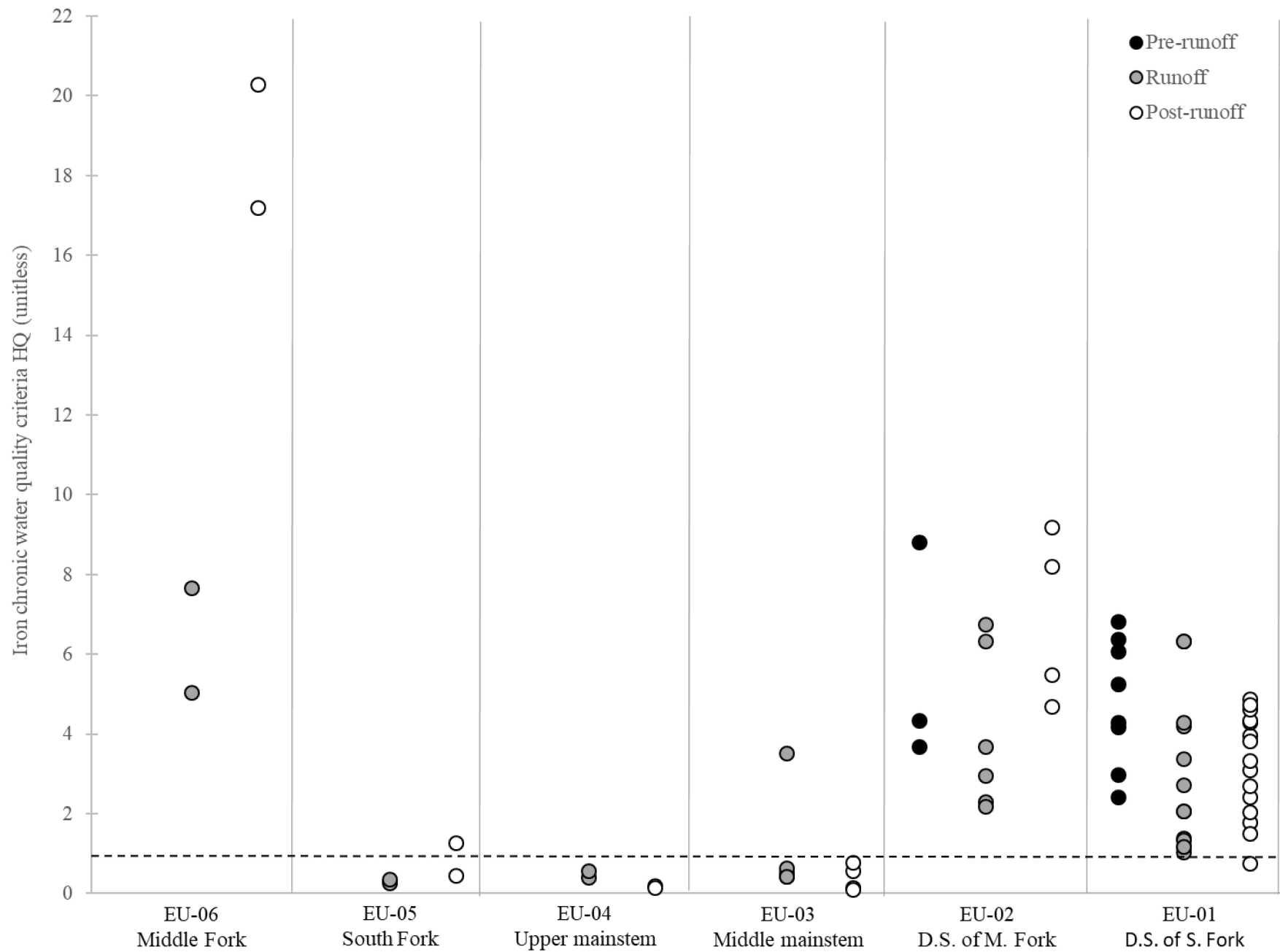
^a Reported pH values are lowest CTEs of all pH measurements collected from each EU and hydroperiod; not HQs

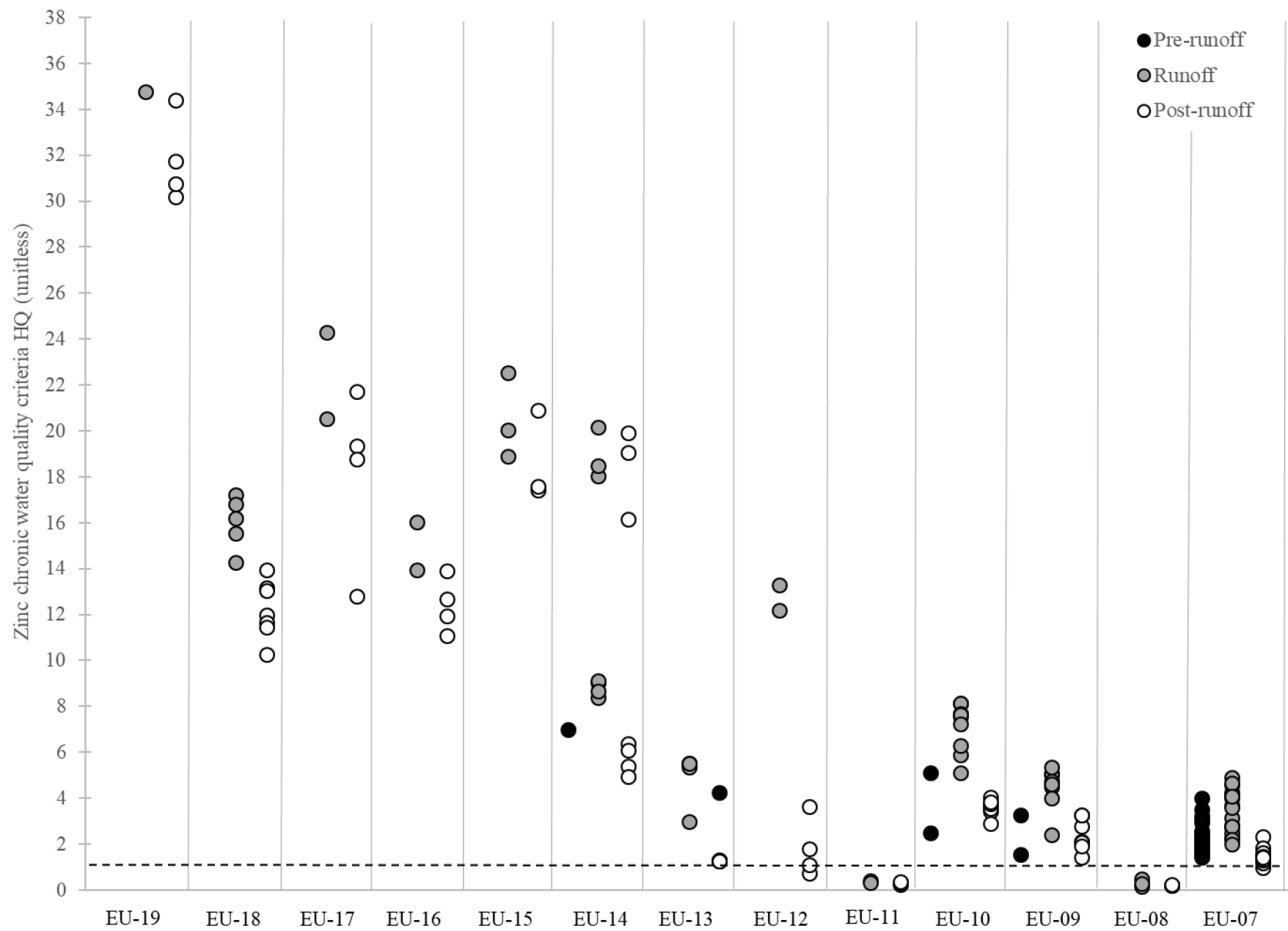
^b Two aluminum HQs were derived; one using the 87 µg/L default criteria and the other using the hardness-dependent criteria, respectively. Color coding refers to the hardness-dependent criteria

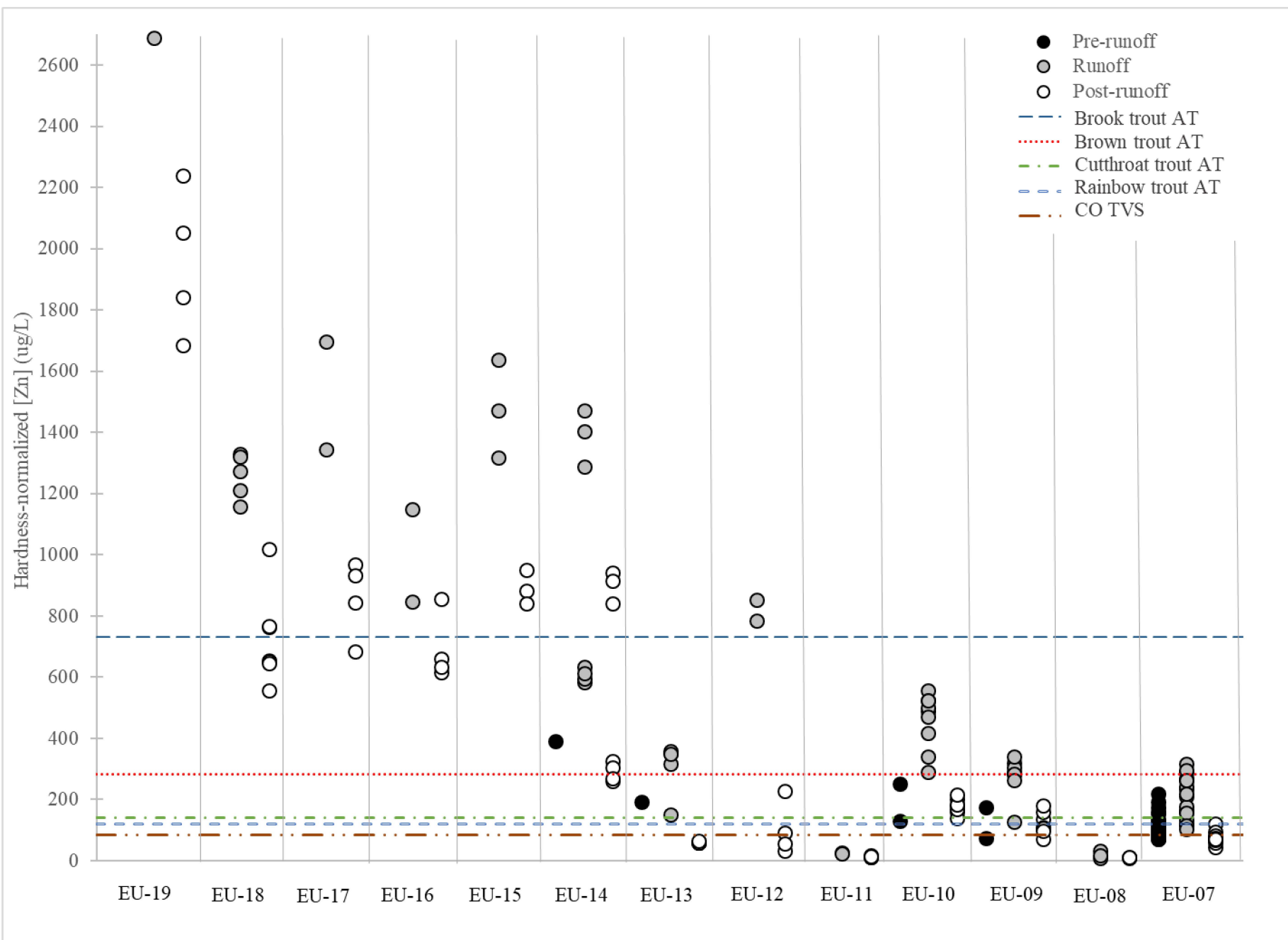
Color code definitions:

WHITE (no value)	Not a contaminant of potential ecological concern
Lightest	HQ <1.0 or pH >6.5
	HQ >1.0 but <5.0 or pH <6.5 but >5.5
	HQ >5.0 but <10.0 or pH <5.5 but >4.4
Darkest	HQ >10.0 or pH <4.4







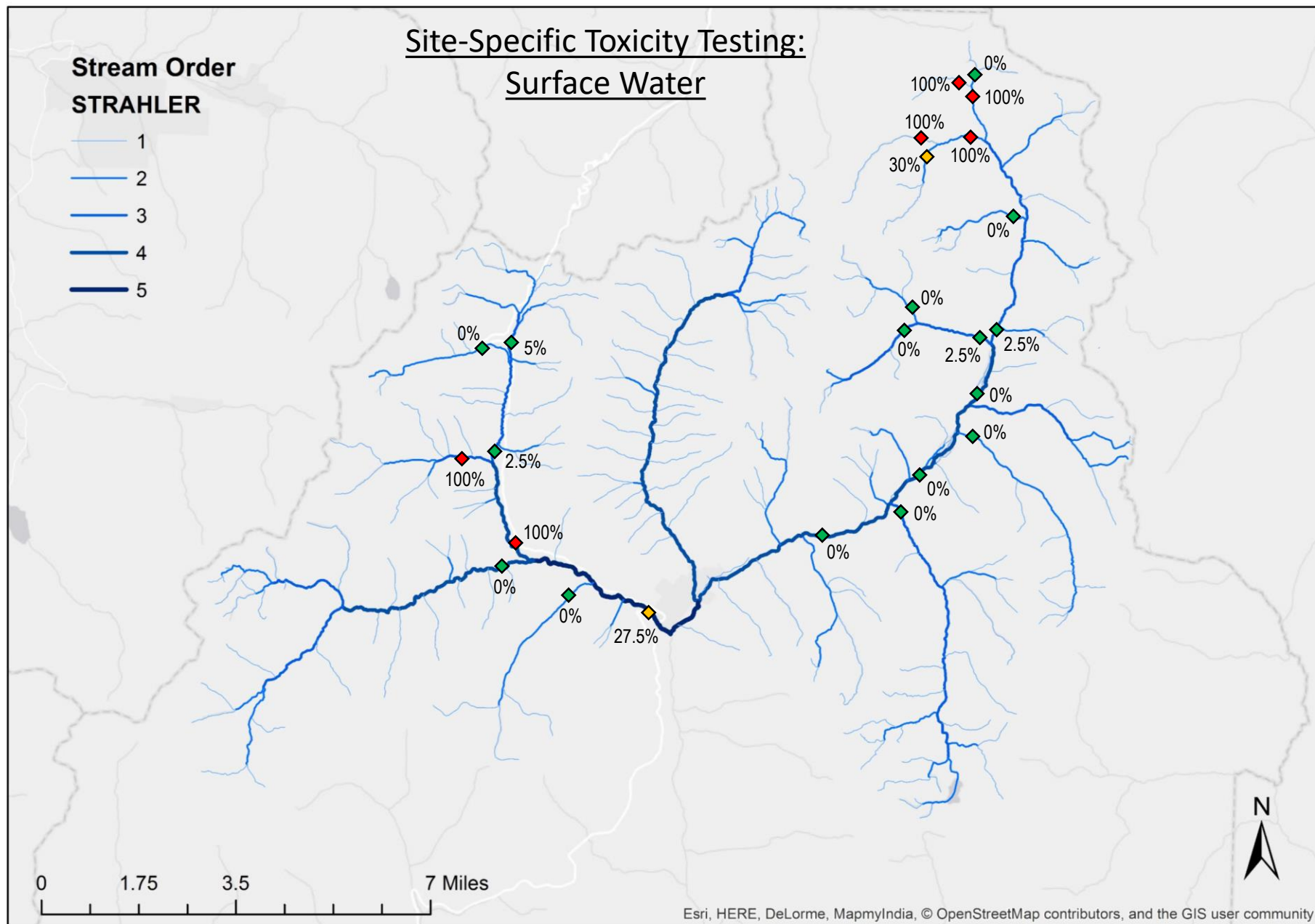


Site-Specific Toxicity Testing

- Surface Water Toxicity Test
 - October 2016 test with juvenile rainbow trout
 - 96-hour static renewal acute toxicity test
 - Waters collected from Upper Animas locations
 - Site Locations: A07, A08, A10, A15, A20, A33, A34, A36, A37, A40, A45, A48, and A56
 - Reference Locations: A05 (North Fork Animas above Burrows Gulch), A26 (Picayne Gulch), and A43 (Maggie Gulch)
 - Waters collected from Mineral Creek locations
 - Site Locations: M10A, M14B, M20, M27, M28, M34
 - Reference Locations: M30 (Bear Creek) and M08 (Mill Creek)

Site-Specific Toxicity Testing: Surface Water

Stream Order STRAHLER



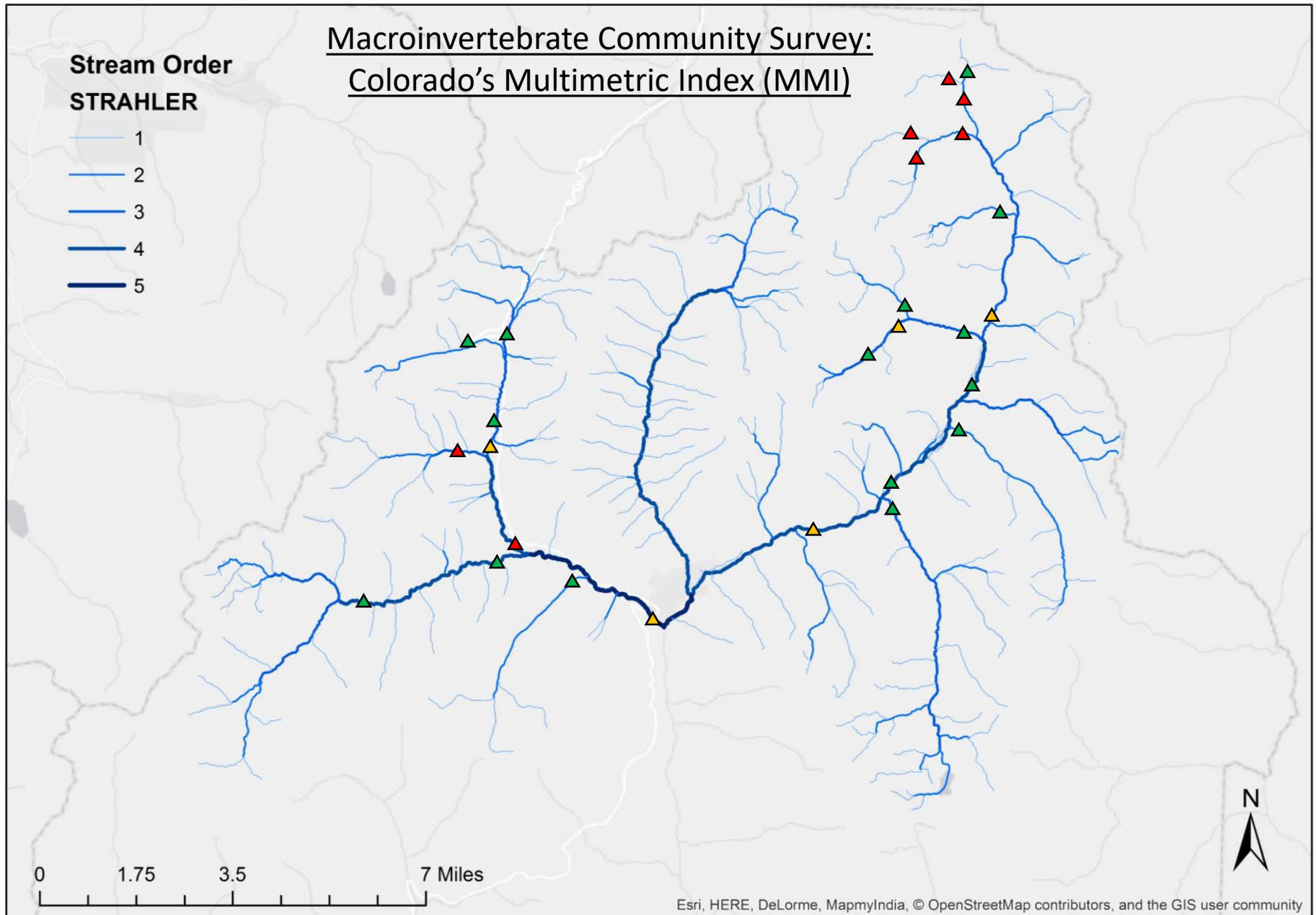
- ◆ Limited mortality observed during 96-hr test
- ◆ Partial mortality observed during 96-hr test
- ◆ Complete mortality observed during 96-hr test

Community Surveys (Bugs)

- Mountain Studies Institute
 - October 2016 sampling (Roberts 2017)
 - Replicated sampling method used previously within the Animas River Watershed (Anderson 2007)
 - Numerous benthic macroinvertebrate (BMI) metrics calculated
 - **MMI Score- State of Colorado bioassessment tool**
 - Biotype 2 (Mountains) Impairment Threshold = 40
 - EPT Taxa
 - EPT species (mayflies, stoneflies, caddisflies) are considered sensitive to pollution
 - EPT Richness
 - Taxa Richness
 - Taxa richness has been found to be reduced in streams with elevated metal concentrations

Macroinvertebrate Community Survey: Colorado's Multimetric Index (MMI)

Stream Order STRAHLER



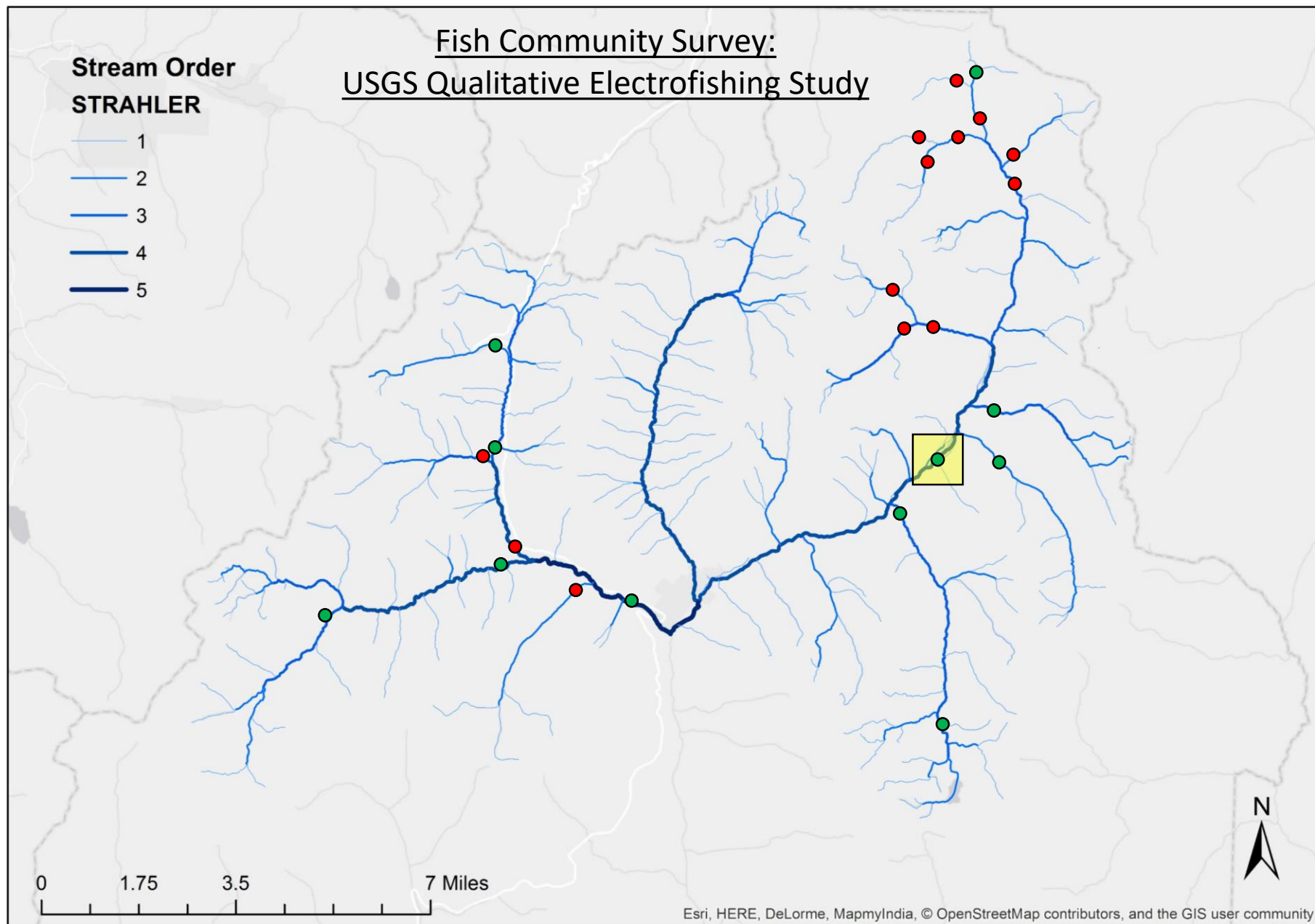
- ▲ MMI score exceeds attainment threshold (48) for Mountains biotype.
- ▲ MMI score falls below the impairment threshold (40) for the Mountains biotype.
- ▲ MMI score falls between the impairment and attainment thresholds for the Mountains biotype (i.e. the “Gray Zone”)

Community Surveys (Fish)

- USGS- Electrofishing and Other Fishery Observations
 - October 2016 sampling
 - Occurred during fish collection for human health risk assessment and downloading of water temperature loggers
 - Qualitative Assessments
 - Only serve as documentation of the presence / absence of fish at the time of sampling
 - More quantitative studies would be necessary to measure fish abundance and biomass (two-pass removal studies) or persistence of fishery at a given location (multiple years of fish presence, tagged fish studies)
 - Quantitative Assessments
 - Colorado Parks and Wildlife has a routine electrofishing location at Howardsville

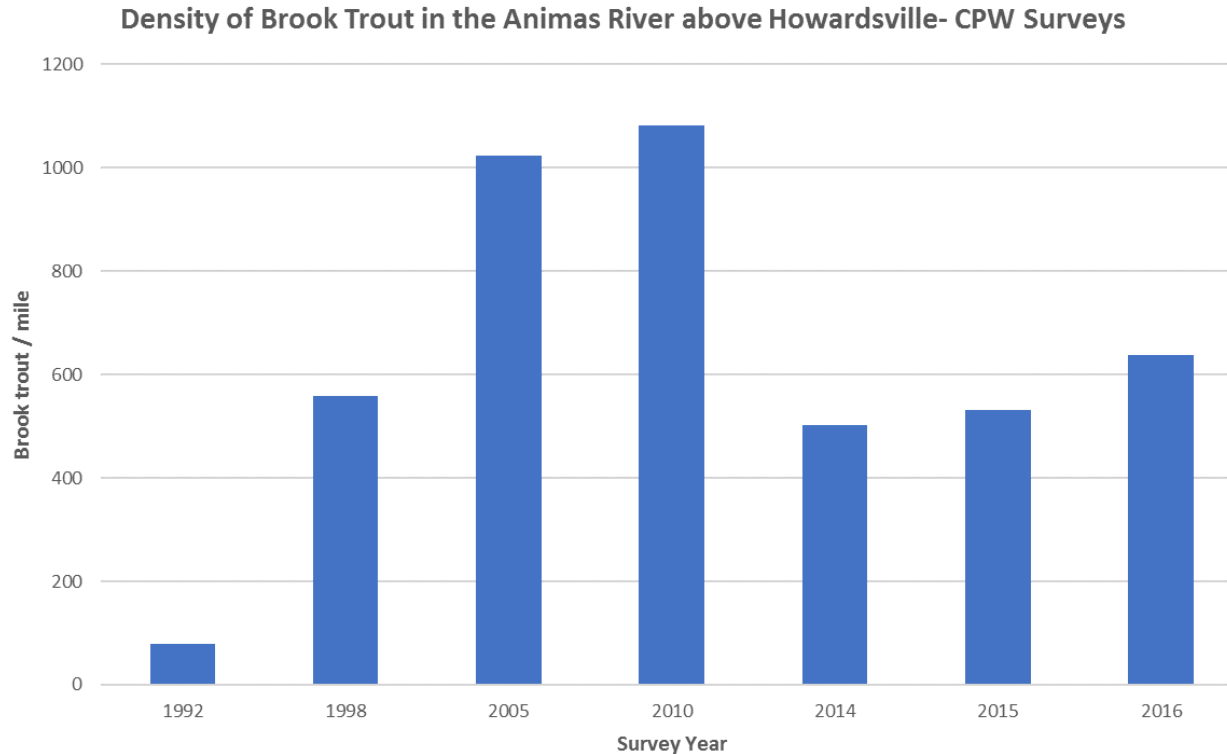
Fish Community Survey: USGS Qualitative Electrofishing Study

Stream Order STRAHLER

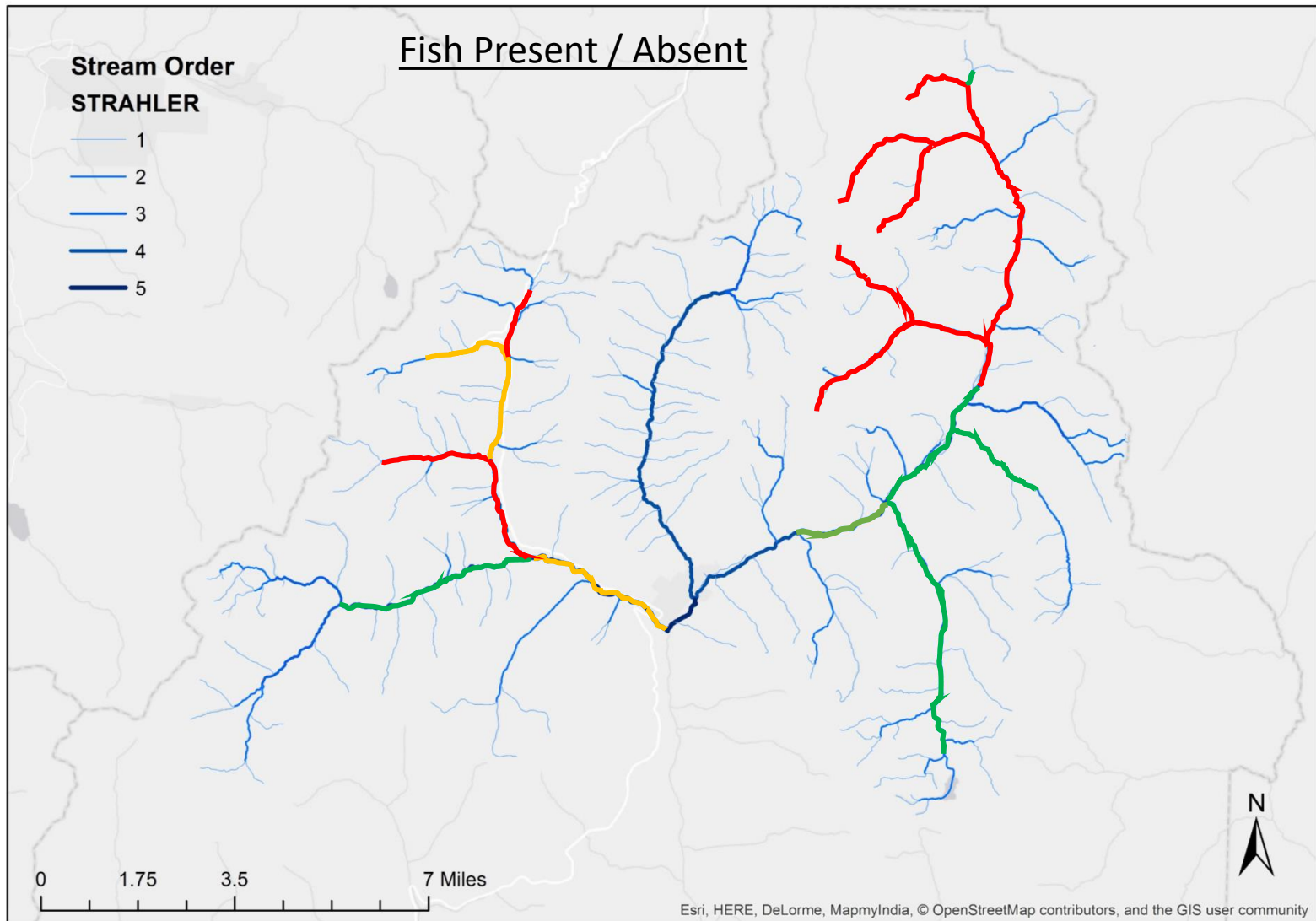


- Fish determined to be absent in Fall 2016 via qualitative electrofishing survey
- Fish determined to be present in Fall 2016 via qualitative electrofishing survey and/or observation

Community Surveys (Fish)- Quantitative



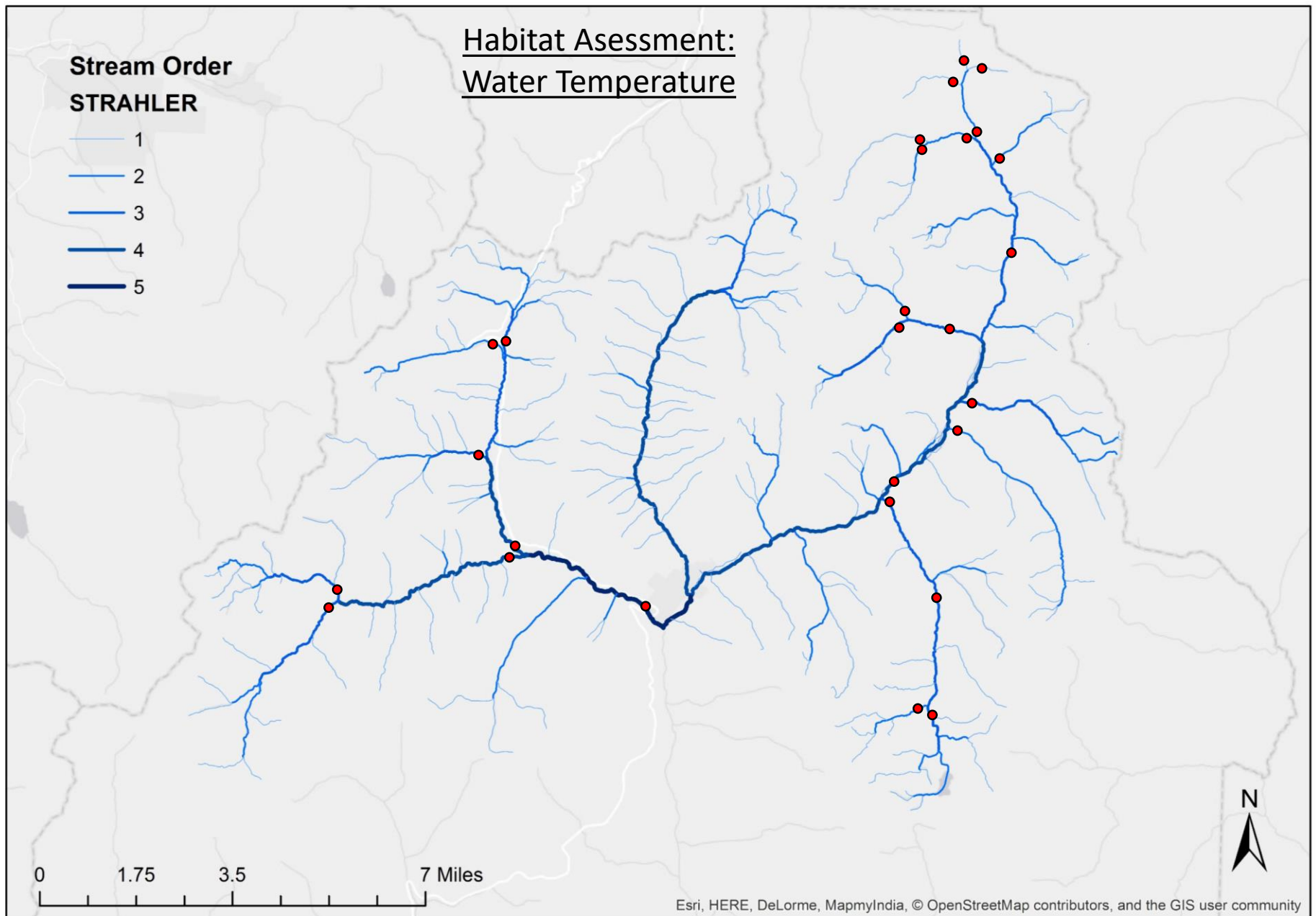
- Population of brook trout has remained relatively stable over the last several decades
- Drop in density between 2010 and 2015 attributed to angling pressure and not to metal toxicity (biomass has not changed much)



- Fish absent
- Fish determined to be present in Fall 2016 but residence duration unknown
- Fish determined to be present in Fall 2016 and believed to be resident year-round

Habitat Information

- USGS Upper Animas Habitat Suitability Assessment
 - Measurement of suitability of thermal regime in upper Animas and Mineral Creek for trout (2016 – 2017)
 - Measurement of stream intermittency / freezing in upper Animas and Mineral Creek (2016 – 2017)
 - Qualitative assessment of instream macrohabitat quality in 12 sites in the *Upper Animas River* only



- 2016 / 2017 Stream Temperature Intermittency Conductivity Sensor Locations

Table 9.11 Summary of United State Geological Survey (USGS) (2018) Fish Thermal Suitability and Habitat Assessment Results.
Shaded rows designate EUs where fish were observed during USGS (2018) and/or historic fish surveys.

Exposure unit	Location	Intermittency or freezing?	Thermal suitability	Physical habitat potential ³
EU-01	Lower Mineral Creek	No	CTT ²	NA
EU-02	Lower Mineral Creek	No	CTT ²	NA
EU-03	Middle Mineral Creek	No	NA	NA
EU-04	Upper Mineral Creek	No	CTT ²	NA
EU-05	South Fork Mineral Creek	No	Below CTT temp. range ²	NA
EU-06	Middle Fork Mineral Creek	No	Below CTT temp. range ²	NA
EU-07	Mainstem Animas River	No	NA	NA
EU-08	Cunningham Creek	No	BRK ¹ ; CTT ^{1,2}	Good
EU-09	Mainstem Animas River	No	BRK ¹ ; CTT ^{1,2}	Good
EU-10	Mainstem Animas River	No	NA	NA
EU-11	Upper South Fork Animas River	No	Below CTT temp. range ²	NA
EU-12	Eureka Gulch	No	BRK ¹ ; Below CTT temp. range ²	Fair
EU-13	Lower South Fork Animas River	No	BRK ¹ ; Below CTT temp. range ²	Poor
EU-14	Mainstem Animas River	No	BRK ¹ ; CTT ¹	Good
EU-15	Lower West Fork Animas River	No	BRK ¹ ; Below CTT temp. range ²	Good
EU-16	Placer Gulch	No	BRK ¹ ; Below CTT temp. range ²	Fair
EU-17	Upper West Fork Animas River	No	BRK ¹ ; Below CTT temp. range ²	Fair
EU-18	North Fork Animas River	NA	BRK ¹	Fair
EU-19	Burrows Gulch	No	BRK ¹ ; Below CTT temp. range ²	Poor
EU-DR01	Animas River - upper Durango Reach	No	NA	NA
EU-DR02	Animas River - lower Durango Reach	No	NA	NA
EU-R1	Mineral Creek trib. - Bear Creek	No	NA	NA
EU-R2	Mineral Creek trib. - Mill Creek	No	Below CTT temp. range ²	NA
EU-R3	Animas River trib - Maggie Gulch	No	BRK ¹ ; CTT ¹	Good
EU-R4	Animas River trib - Picayne Gulch	NA	NA	NA
EU-R5	Animas River trib - upper N. Fork Animas R	No	BRK ¹ ; Below CTT temp. range ²	Fair
EU-R6	Durango Reach trib. - Hermosa Creek	No	NA	NA

BRK = Brook trout

CTT = Cutthroat trout

NA = Not assessed or stream temperature, intermittency, relative conductivity logger was lost

¹ Thermal suitability determined using Harig and Fausch (2002) realized thermal niche rankings

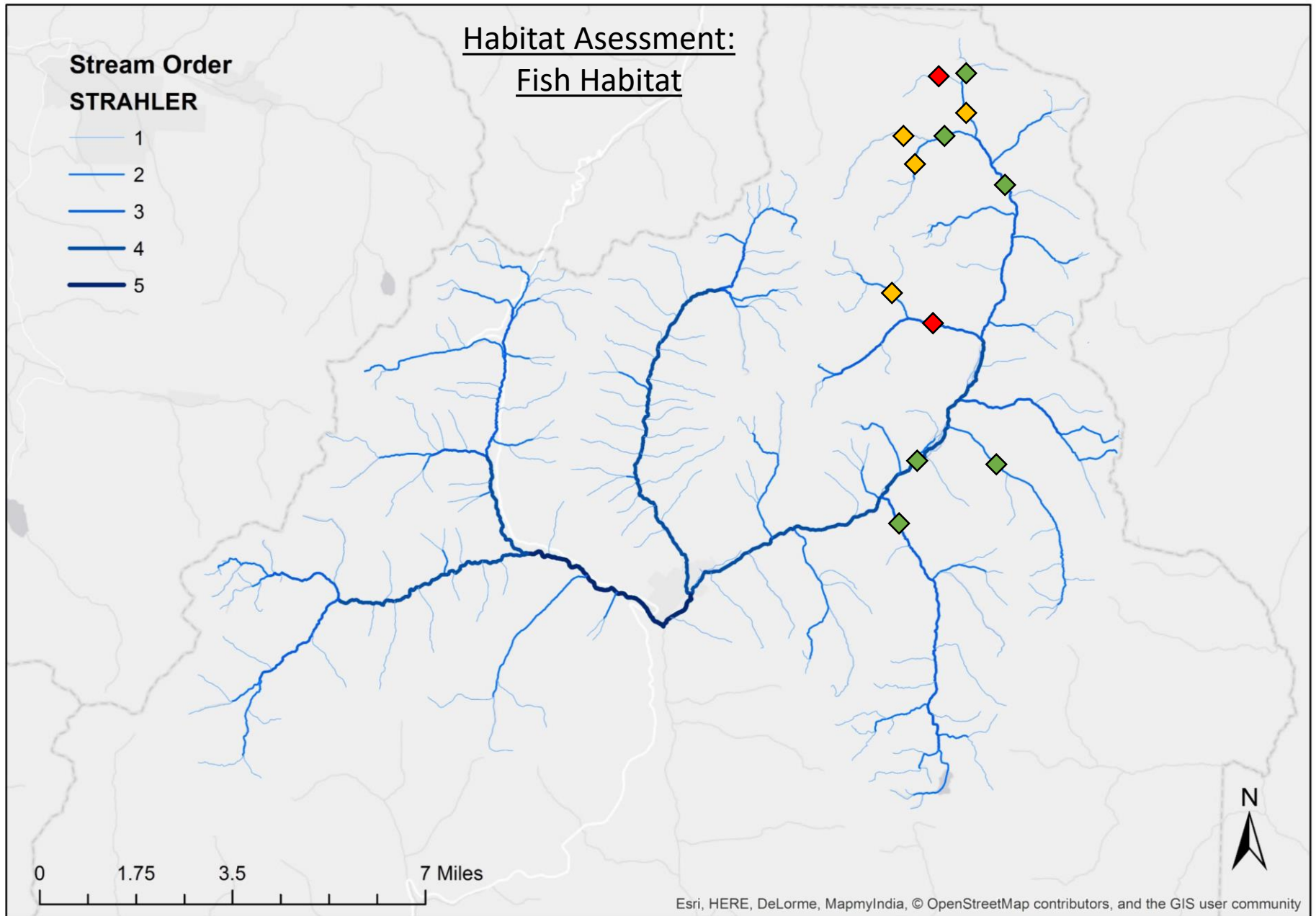
² Thermal suitability determined by USGS (2018) using temperature data obtained from Rocky Mountain rivers and streams

³ Fish habitat ratings were obtained from Table 15 in the USGS (2018) Fish Habitat and Community Survey Data Report; fish habitat ratings were based on physical habitat parameters (gradient/slope, depth, substrate composition, bank stability, riparian composition, and presence of pools and large woody debris) measured and observed in each survey reach.

Habitat Assessment: Fish Habitat

Stream Order STRAHLER

- 1
- 2
- 3
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◆ 2016 Habitat Assessment Locations

SITE ID	EXPOSURE UNIT (EU)	Average Wetted Width (ft)	Measured Average Reach Slope	Measured Discharge (cfs)	Fast Water Habitat (%)	Average Wetted Depth (ft)	Pocket Pools Density (#/mile)	Average Pocket Pool Maximum Depth (ft)
Sites with Fish Presence Confirmed								
NFA3	Reference	5.2	5.8%	0.4	97%	0.3	606	0.6
MAG1	Reference	8.7	6.4%	3.7	85%	0.5	630	0.9
ANI3	EU-09	31.5	0.6%	34.5	88%	0.7	156	1.7
CUN1	EU-08	15.2	2.4%	7.7	96%	0.5	602	0.9
Observed Range		5.2 - 15.2	0.6 - 6.4%	0.4 - 34.5	85-97%	0.3 - 0.7	156 - 630	0.6 - 1.7
Literature Value			1-7%^A					0.6^B
Sites with Fish Absence Confirmed								
BUR2	EU-19	6.3	0.7%	0.3	73%	0.4	151	0.7
NFA2	EU-18	7.8	4.0%	0.7	95%	0.3	518	0.6
CAL1	EU-17	6.3	4.7%	2.0	91%	0.4	630	0.6
PLC1	EU-16	8.1	4.4%	1.5	93%	0.3	683	0.6
WFA1	EU-15	10.7	4.3%	2.6	83%	0.5	779	0.9
ANI10	EU-14	18.2	2.8%	10.7	94%	0.6	764	0.9
SFA3	EU-13	8.1	3.0%	3.6	99%	0.5	409	0.9
EUR2	EU-12	6	7.7%	1.1	79%	0.3	623	0.6

^A Speas 2009

^B Harig and Fausch 2002

FAST WATER HABITAT

- Most impacted sites have key habitat metrics that fall within observed ranges for sites with fish presence confirmed and/or within habitable ranges documented in the literature
- Burrows Gulch (BUR2) has low density of pocket pools, low measured baseflow discharge, low average reach slope



09/16/2016

Burrows Gulch

SITE ID	EXPOSURE UNIT (EU)	Average Wetted Width (ft)	Measured Average Reach Slope	Measured Discharge (cfs)	Slow Water Habitat (%)	Pool Average Maximum Depth (ft)	Pool Average Residual Depth (ft)
Sites with Fish Presence Confirmed							
NFA3	Reference	5.2	5.8%	0.4	3%	1.2	0.7
MAG1	Reference	8.7	6.4%	3.7	15%	1.7	1.1
ANI3	EU-09	31.5	0.6%	34.5	12%	4.5	3.3
CUN1	EU-08	15.2	2.4%	7.7	4%	1.2	0.4
Observed Range		5.2 - 15.2	0.6 - 6.4%	0.4 - 34.5	3 - 15%	1.2 - 4.5	0.4 - 3.3
Literature Value			1-7%^A				1.0^B
Sites with Fish Absence Confirmed							
BUR2	EU-19	6.3	0.7%	0.3	27%	1.9	1.4
NFA2	EU-18	7.8	4.0%	0.7	5%	1.3	1.0
CAL1	EU-17	6.3	4.7%	2.0	9%	2.0	1.7
PLC1	EU-16	8.1	4.4%	1.5	7%	1.2	0.7
WFA1	EU-15	10.7	4.3%	2.6	17%	1.8	1.1
ANI10	EU-14	18.2	2.8%	10.7	6%	2.4	1.3
SFA3	EU-13	8.1	3.0%	3.6	1%	1.1	0.4
EUR2	EU-12	6	7.7%	1.1	21%	1.5	1.0

^A Speas 2009

^B Harig and Fausch 2002

SLOW WATER HABITAT

- Most impacted sites have key habitat metrics that fall within observed ranges for sites with fish presence confirmed
- The South Fork of the Animas (SFA3) has a small % of slow water habitat, lack of deep pools



09/15/2016

South Fork Animas

Conclusions



Aquatic BERA Results / Conclusions

- Aquatic organisms in many portions of the BPMD are at high risk from low pH and elevated metals concentrations
- The greatest risks to aquatic organisms occurred in reaches that were below mine features and/or highly-mineralized areas
- Other portions of the site have fewer limiting factors, including lower concentrations of metals
- Several of these areas were identified as priority focus areas for future site activity (Goals)
- BPMD BERA is just one tool that will help decision-makers in evaluating path forward during the RI/FS process

Table ES-1 Final Risk Characterization Summary For Each Assessment Endpoint and Exposure Unit (EU). Hazard quotient (HQ)-based risk characterization focused on Central Tendency Exposure (CTE) low-effect or chronic results since these HQs represent the highest levels of risk.

Exposure unit	Exposure unit description	BENTHIC MACROINVERTEBRATES				HABITAT ¹	WATER-COLUMN INVERTEBRATES AND FISH			WILDLIFE SPECIES ²				
		Low-effect sediment HQs ³	Chronic pore water HQs ⁴	Sed. tox. test ⁵	BMI comm. Survey ⁶		Chronic surface water HQs ⁴	Acute tox. test	Fish pres./abs. ⁷	Am. Dipper	Mallard	Kingfisher	Muskrat	Raccoon
MINERAL CREEK WATERSHED														
EU-01	Lower mainstem Mineral Creek	Low risk	Mod. risk	Highly toxic	Impaired	Suboptimal / NA	Mod. risk	Low toxicity	Trout present	Low risk	Acceptable risk	Low risk	Low risk	Low risk
EU-02	Lower mainstem Mineral Creek	Low risk	High risk	Highly toxic	Impaired	Suboptimal / NA	High risk	Highly toxic	No fish	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-03	Mid. mainstem Mineral Creek	Low risk	Mod. risk	Moderately toxic	Impaired	Optimal / NA	Mod. risk	Not acutely toxic	Trout present	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
EU-04	Upper mainstem Mineral Creek	High risk	Low risk	Moderately toxic	Not impaired	Suboptimal / NA	High risk	Not acutely toxic	No fish	High risk	Low risk	Mod. risk	Low risk	Acceptable risk
EU-05	South Fork Mineral Creek	Acceptable risk	High risk	Low toxicity	Not impaired	Optimal / NA	Low risk	Not acutely toxic	Trout present	Acceptable risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-06	Middle Fork Mineral Creek	Low risk	High risk	Highly toxic	Impaired	Optimal / NA	High risk	Highly toxic	No fish	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
UPPER ANIMAS BERA EU ⁸														
NA	Cement Creek	Low risk	NA	High risk	Impaired	NA / NA	High risk	Highly toxic	No fish	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
NA	Animas R. above Cement Cr. to Arrastra Cr.	High risk	High risk	Low toxicity	Impaired	NA / NA	Mod. risk	Not acutely toxic	Trout present	High risk	Acceptable risk	Low risk	Low risk	Low risk
NA	Animas R. between Cement Cr. and Mineral Cr.	NA	NA	NA	NA	NA / NA	High risk	NA	NA	NA	NA	NA	NA	NA
NA	Animas R. 300 ft. below Mineral Cr.	NA	NA	NA	NA	NA / NA	High risk	NA	NA	NA	NA	NA	NA	NA
NA	Animas R. 3,500 feet below Mineral Cr.	Low risk	Mod. risk	Low toxicity	Impaired	NA / NA	High risk	Highly toxic	Trout present	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
NA	Animas R. at Elk Cr. confluence	Low risk	High risk	Moderately toxic	Impaired	NA / NA	High risk	Not acutely toxic	Trout present	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
NA	Animas R. at Cascade Cr. confluence	Low risk	Low risk	Low toxicity	Not impaired	NA / NA	High risk	Not acutely toxic	Trout present	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
NA	Animas R. at Bakers Bridge	High risk	Low risk	Not toxic	Not impaired	NA / NA	Mod. risk	Not acutely toxic	Trout present	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
ANIMAS RIVER - UPPER REACHES AND TRIBUTARIES														
EU-07	Mainstem - Arrastra Cr. to Cunningham Cr.	Mod. risk	Low risk	Moderately toxic	Impaired	Optimal / NA	Low risk	Not acutely toxic	Trout present	High risk	Low risk	Low risk	Low risk	Acceptable risk
EU-08	Cunningham Creek	Low risk	Mod. risk	Low toxicity	Not impaired	Suboptimal / Good	Acceptable risk	Not acutely toxic	Trout present	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-09	Mainstem - Cunningham Cr. to Minnie G.	High risk	Low risk	Low toxicity	Not impaired	Suboptimal / Good	Mod. risk	Not acutely toxic	Trout present	Mod. risk	Acceptable risk	Acceptable risk	Low risk	Acceptable risk
EU-10	Mainstem - Minnie G. to South Fork Animas R.	High risk	Low risk	Low toxicity	Not impaired	Suboptimal / NA	Mod. risk	Not acutely toxic	No fish	Mod. risk	Acceptable risk	Mod. risk	Low risk	Acceptable risk
EU-11	Upper South Fork Animas River	Low risk	Low risk	Moderately toxic	Impaired	Optimal / NA	Low risk	Not acutely toxic	No fish	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-12	Eureka Gulch	Mod. risk	Low risk	Moderately toxic	Not impaired	Suboptimal / Fair	High risk	Not acutely toxic	No fish	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-13	Lower South Fork Animas River	Mod. risk	Acceptable risk	Low toxicity	Not impaired	Optimal / Poor	Mod. risk	Not acutely toxic	No fish	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-14	Mainstem - S. Fork to W. Fork Animas River	Mod. risk	High risk	Low toxicity	Impaired	Optimal / Good	High risk	Not acutely toxic	No fish	Mod. risk	Acceptable risk	Low risk	Low risk	Acceptable risk
EU-15	Lower West Fork Animas River	High risk	High risk	Highly toxic	Impaired	Optimal / Good	High risk	Highly toxic	No fish	High risk	Acceptable risk	Mod. risk	Low risk	Low risk
EU-16	Pine Gulch	High risk	High risk	Low toxicity	Impaired	Optimal / Fair	High risk	Low toxicity	No fish	High risk	Low risk	High risk	Mod. risk	Low risk
EU-17	Upper West Fork Animas River	Mod. risk	High risk	Highly toxic	Impaired	Optimal / Fair	High risk	Highly toxic	No fish	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
EU-18	N. Fork Animas River to Burrows Cr.	Low risk	High risk	Moderately toxic	Impaired	Suboptimal / Fair	High risk	Highly toxic	No fish	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-19	Burrows Gulch	High risk	High risk	Moderately toxic	Impaired	Optimal / Poor	High risk	Highly toxic	No fish	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
ANIMAS RIVER - DURANGO REACH														
EU-DR01	James Ranch to 32nd St. Bridge	Low risk	Low risk	Low toxicity	Impaired	NA / NA	High risk	NA	Trout present ⁸	Low risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk
EU-DR02	32nd St. Bridge to Purple Cliffs	Low risk	Low risk	Low toxicity	Impaired	NA / NA	Mod. risk	NA	Trout present ⁸	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
REFERENCE EXPOSURE UNITS														
EU-R1	Mineral Creek trib. - Bear Creek	Low risk	Low risk	Low toxicity	Not impaired	Optimal / NA	Acceptable risk	Not acutely toxic	No fish	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
EU-R2	Mineral Creek trib. - Mill Creek	Low risk	Low risk	Low toxicity	Not impaired	Optimal / NA	Low risk	Not acutely toxic	Trout present	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
EU-R3	Animas River trib. - Maggie Gulch	Low risk	Acceptable risk	Low toxicity	Not impaired	Optimal / Good	Low risk	Not acutely toxic	Trout present	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
EU-R4	Animas River trib. - Picaeys Gulch	Low risk	Acceptable risk	Low toxicity	Not impaired	Optimal / NA	Low risk	Not acutely toxic	No fish	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
EU-R5	Animas River trib. - Upper N. Fork Animas River	Low risk	Low risk	Low toxicity	Not impaired	Optimal / Fair	High risk	Not acutely toxic	Trout present	Low risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
EU-R6	Durango Reach trib. - Hermosa Creek	Acceptable risk	Acceptable risk	Low toxicity	Not impaired	Suboptimal / NA	Acceptable risk	Not acutely toxic	Trout present	Acceptable risk	Acceptable risk	Low risk	Acceptable risk	Acceptable risk

BMI = Benthic Macroinvertebrate, COPEC = Contaminant of Potential Ecological Concern, NA = Not Assessed, BERA = Baseline Ecological Risk Assessment

¹ BMI habitat ratings were based on average Barbour et al. (1999) habitat evaluation parameter scores obtained from respective Mountain Studies Institute BMI assessment reports. Fish habitat ratings were obtained from Table 15 in the USGS (2018) Fish Habitat and Community Survey Data Report, fish habitat ratings were based on physical habitat parameters (gradient/slope, depth, substrate composition, bank stability, riparian composition, and presence of pools and large woody debris) measured and observed in each survey reach.

² All wildlife risks based on CTE low-effect, toxicity reference value HQs

³ Risk based on CTE low-effect, ecological screening value HQs

⁴ Risk based on CTE chronic, ecological screening value HQs

⁵ Only summarizes the most recent, December 2017 sediment test results when less recent tests were also conducted

⁶ Impairment status based on Colorado Multi-Metric Index scores being above or below respective sampling location impairment threshold

⁷ Summarizes 2016 and historic fish survey results

⁸ Based on multiple historic and recent Colorado Parks and Wildlife fish surveys conducted throughout the Durango Reach

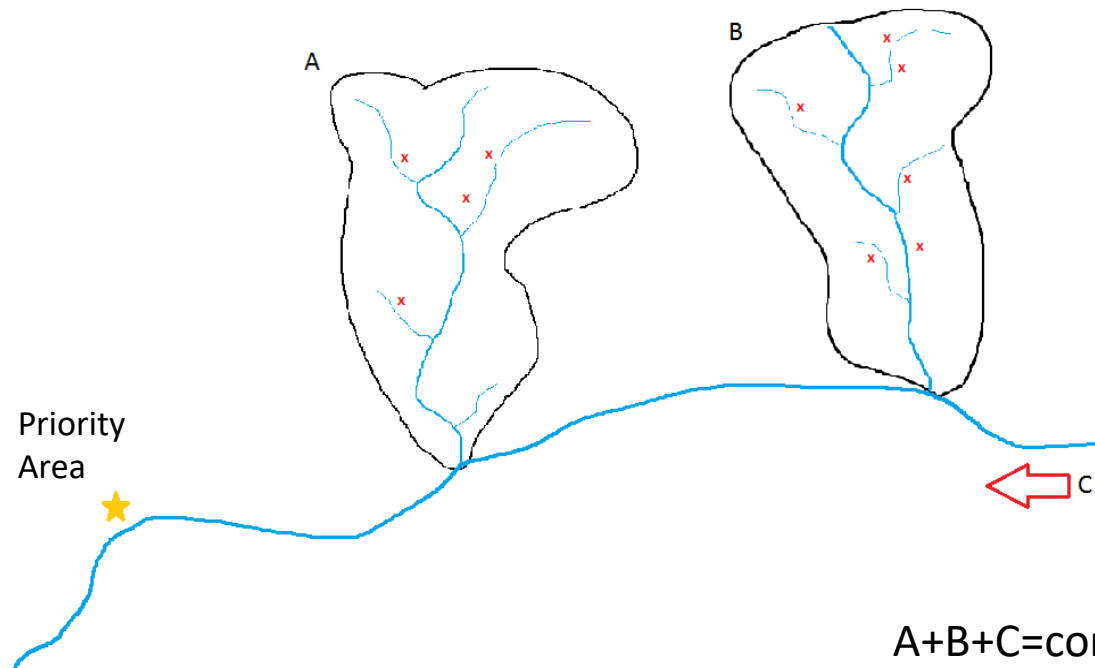
Color code definitions*:

Lightest	All CTE HQs <1.0 or tox. test survival >80% or not impaired (BMIs) or trout present in historic and 2016 fish surveys
	At least one COPEC CTE HQ >1.0 but <5.0 or tox. test survival <80% but >50% or trout present in either historic or 2016 fish surveys but not during both
	At least one COPEC CTE HQ >5.0 but <10.0 or tox. test survival <50% but >20% or BMI community impaired or fish absent
Darkest	At least one COPEC CTE HQ >10.0 or tox. test survival <20%

* Note that it is understood that risk does not increase in a linear fashion with increasing HQs. As such, relative risk terminology was only used to qualitatively highlight differences in risk and should not be interpreted beyond this intended use.

Loading Assessment Strategy

- Determine loading contribution from individual mines/reaches.
- Run remediation scenarios



Mine	Reach	% Contribution Within Reach
1	A	10
2	A	50
3	A	5
4	A	35
5	B	5
6	B	30
7	B	30
8	B	5
9	B	5
10	B	25

$A+B+C = \text{concentration@}$





Questions?