– FIGURES –

Final Draft

BASELINE ECOLOGICAL RISK ASSESSMENT

Upper Animas Mining District

San Juan County, COLORADO

April 2015

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Sampling Locations on the Animas River Upstream and Across from Silverton, CO

Sample Locations

Mine Locations

Rivers and Streams

0 1,000 2,000 Feet

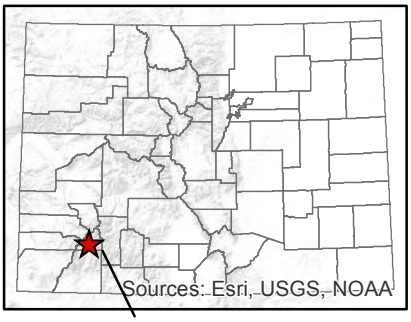
Date: January 30, 2014

Data Sources:
Sample Locations: U.S. EPA Region 8 (2013)
Mine Locations: U.S. EPA and ESAT (2012)
Rivers and Streams: CDOW 1:24k (2004)
Image: Microsoft Bing web service (2014)

Coordinate System/Projection:
UTM Zone 13 North, NAD 83, Meters

N

Colorado



Area Enlarged

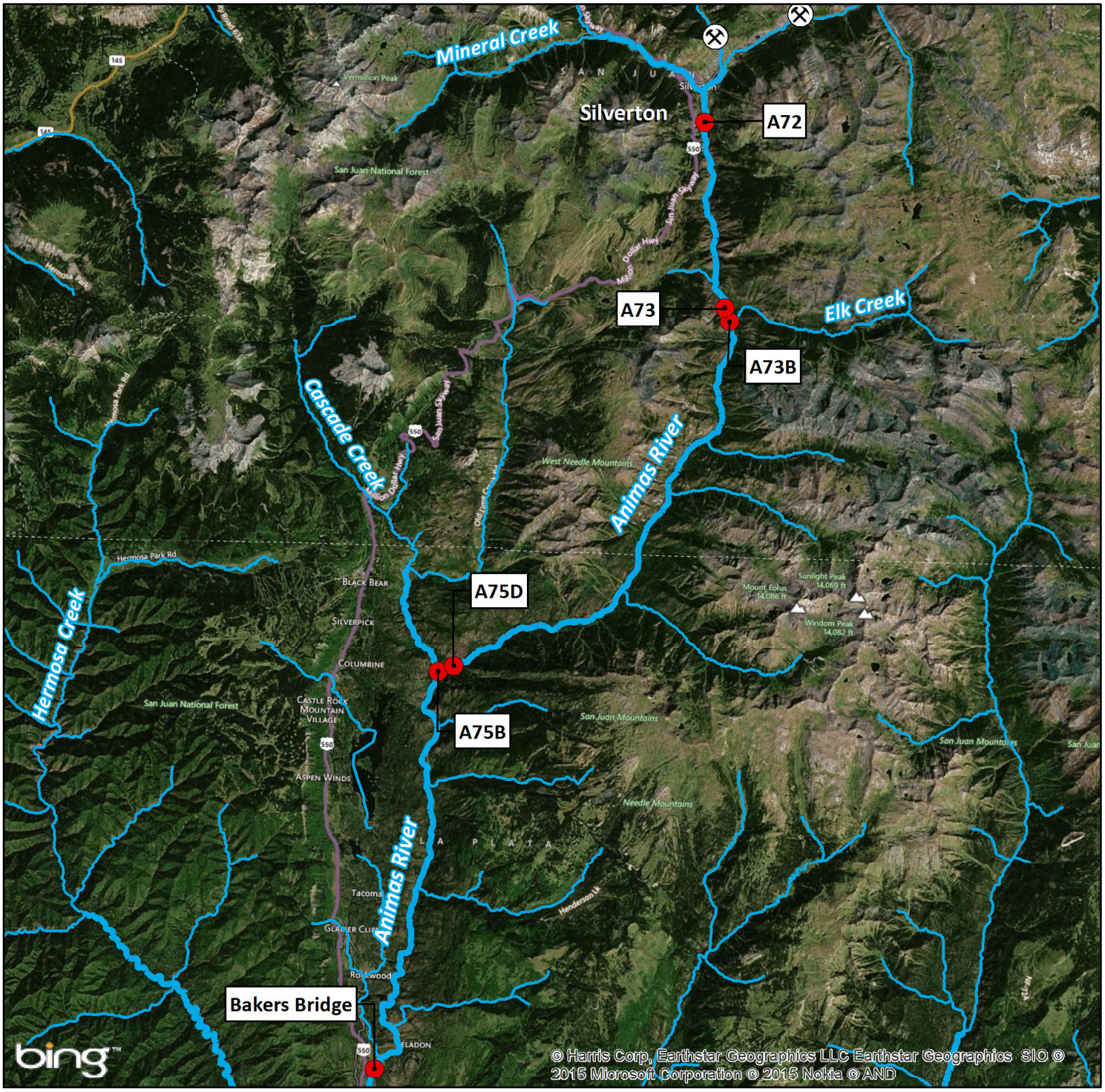


Figure 1.2

Sampling Locations on the Animas River Downstream from Silverton, CO

Sample Locations

Mine Locations

Rivers and Streams

0 1.5 3 Miles

Date: January 30, 2014

Data Sources:

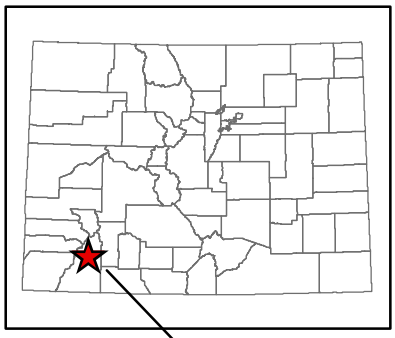
Sample Locations: U.S. EPA Region 8 (2013);
Mine Locations: U.S. EPA and ESAT (2012);
Rivers and Streams: CDOW (2004);
Image: Microsoft Bing web service (2014).

Coordinate System/Projection:

UTM Zone 13 North, NAD 83, Meters

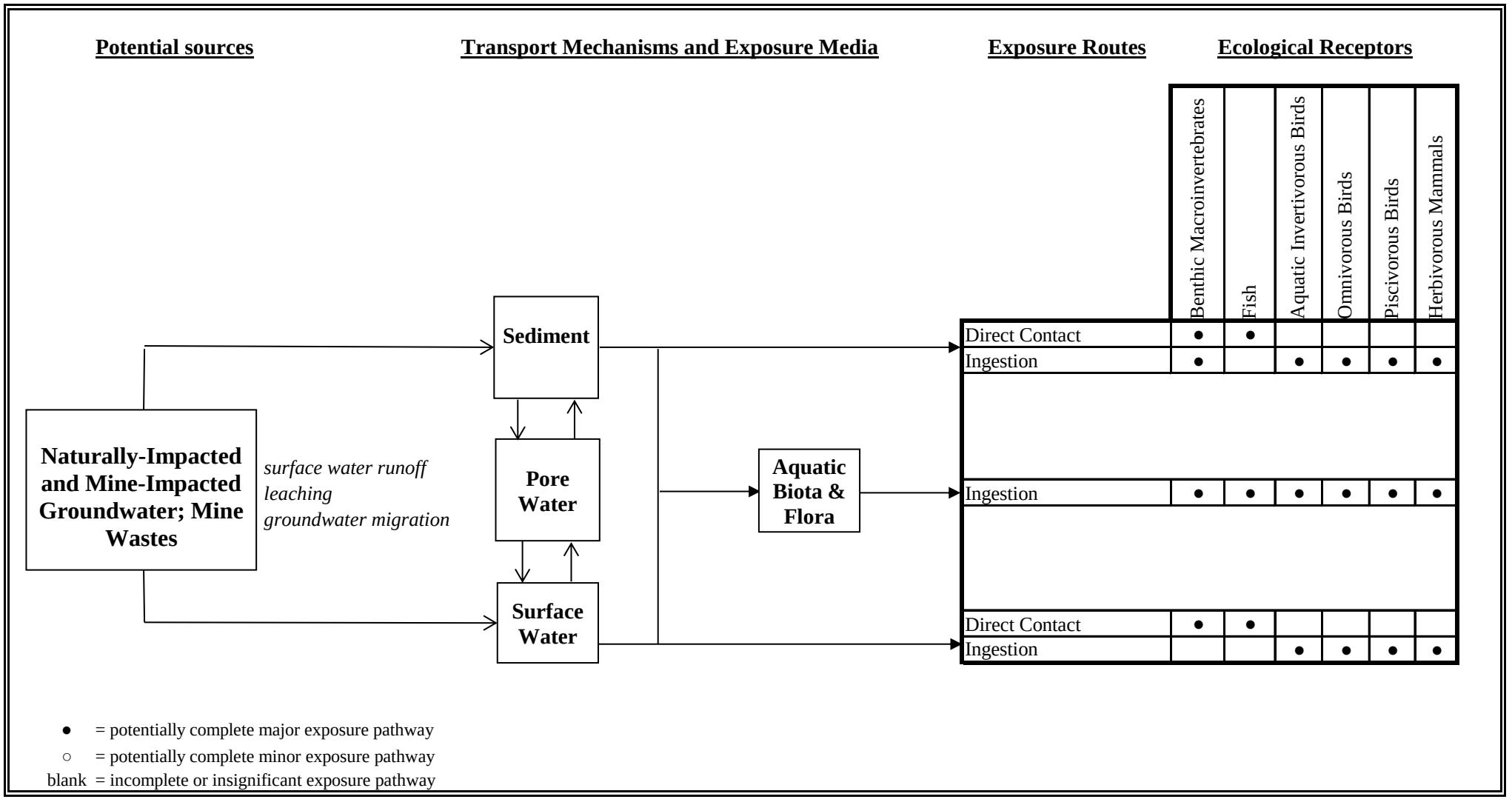
N

Colorado



Area Enlarged

FIGURE 2.1
Site conceptual model for the aquatic habitats and receptors evaluated in the BERA
Baseline Ecological Risk Assessment
Upper Animas Mining District



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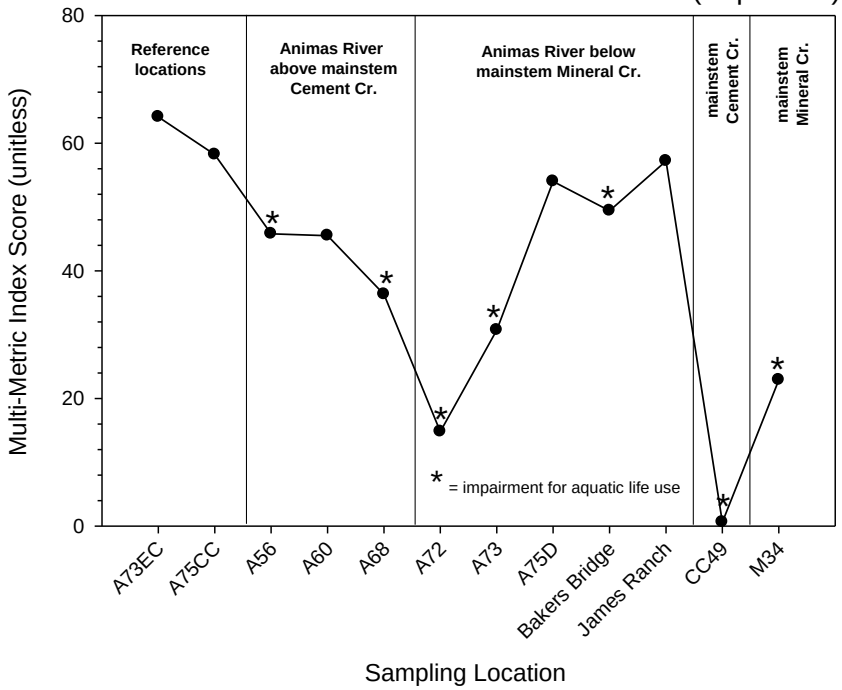

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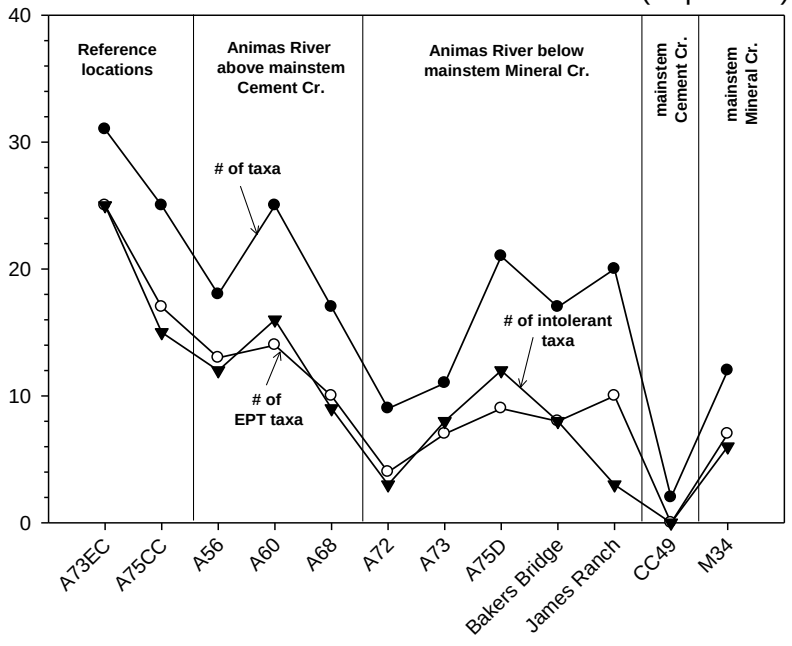

Figure 3.1 (cont'd): Summary of select benthic invertebrate community data collected in September-October 2014 from the Animas River, main stem Cement Creek, and main stem Mineral Creek

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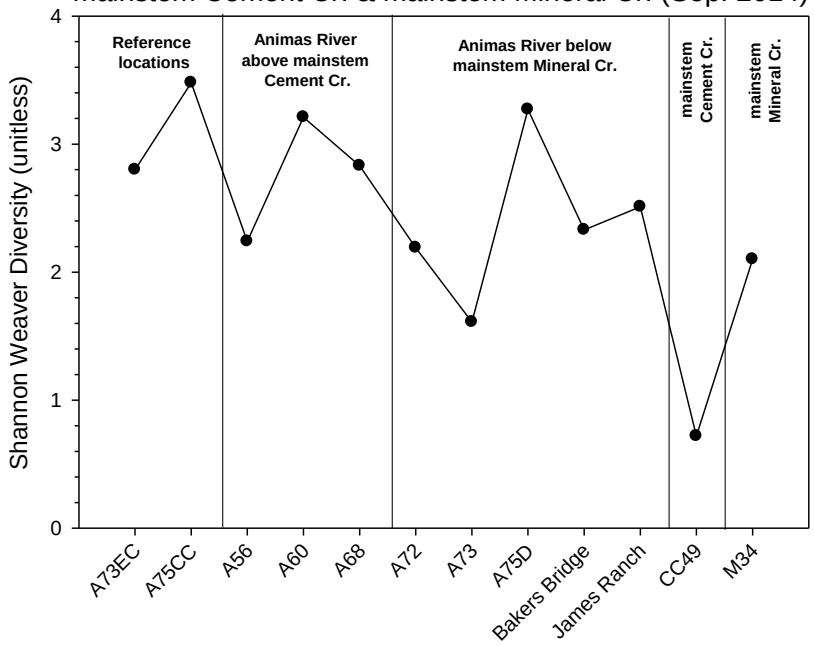
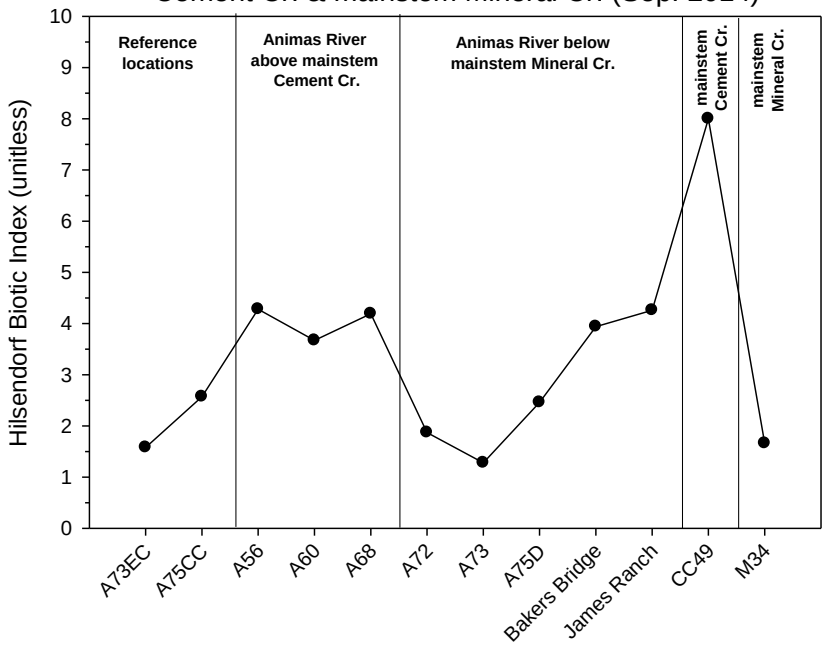


Figure 3.1d: The Hilsendorf Biotic Index for the benthic invertebrate community in the Animas River, mainstem Cement Cr. & mainstem Mineral Cr. (Sep. 2014)



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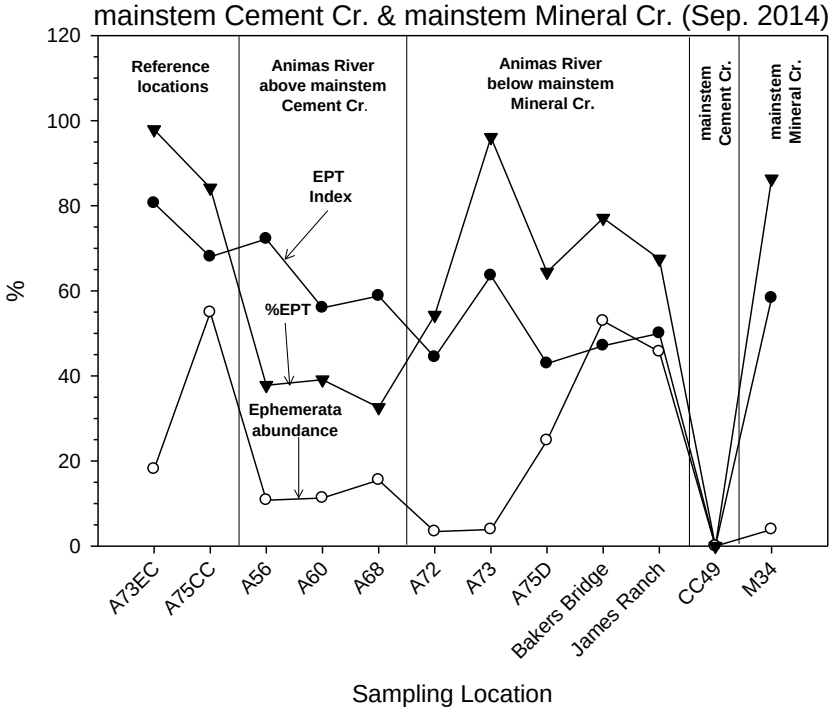

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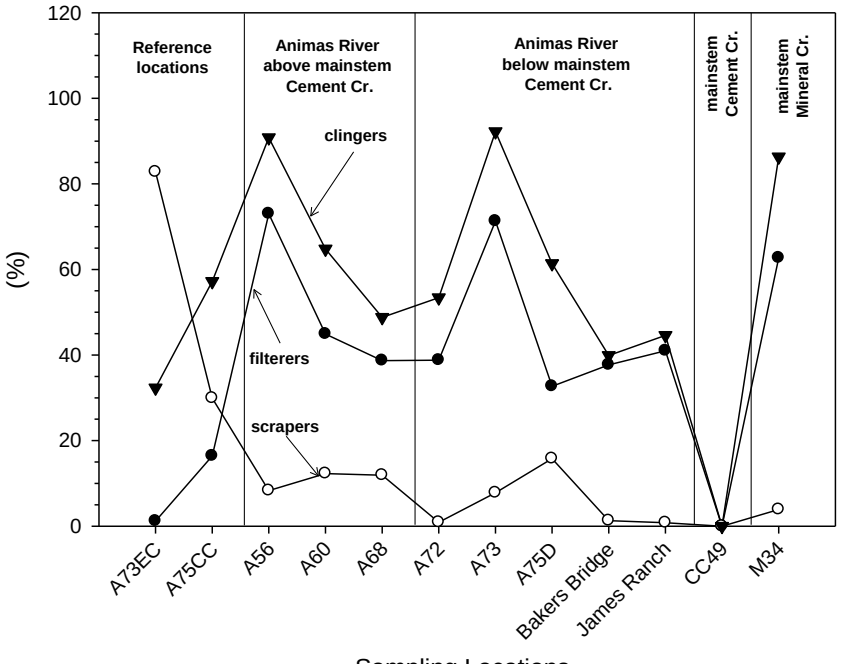
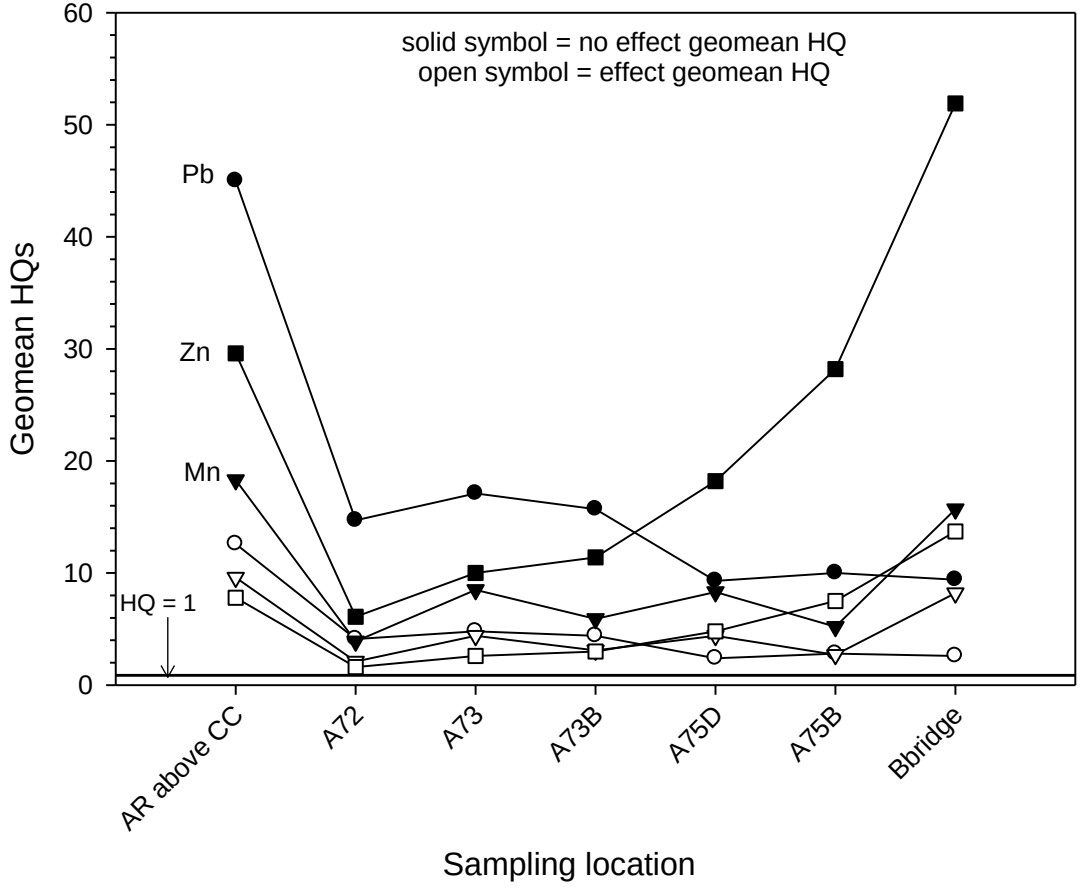


Figure 5.1: Geometric mean no effect and effect HQs for the benthic invertebrate community exposed to sediment in the Animas River above Cement Creek and below Mineral Creek



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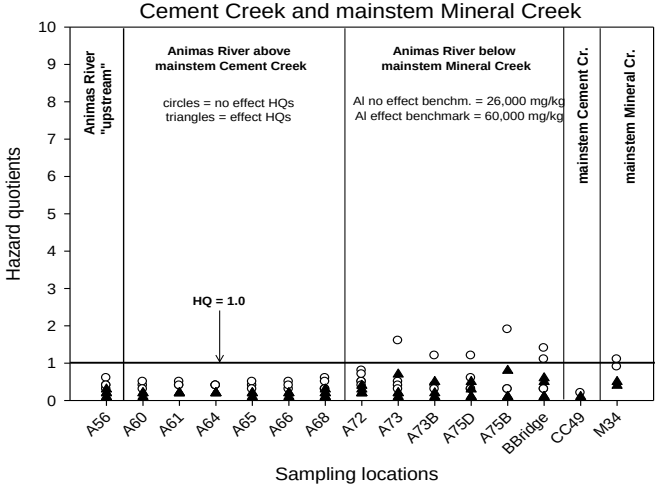

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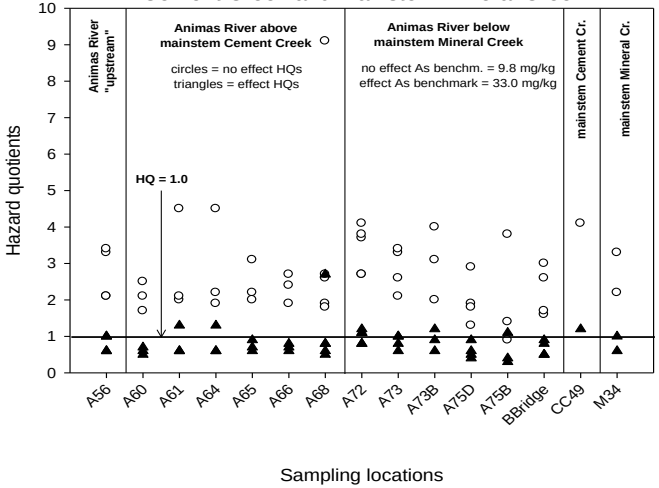

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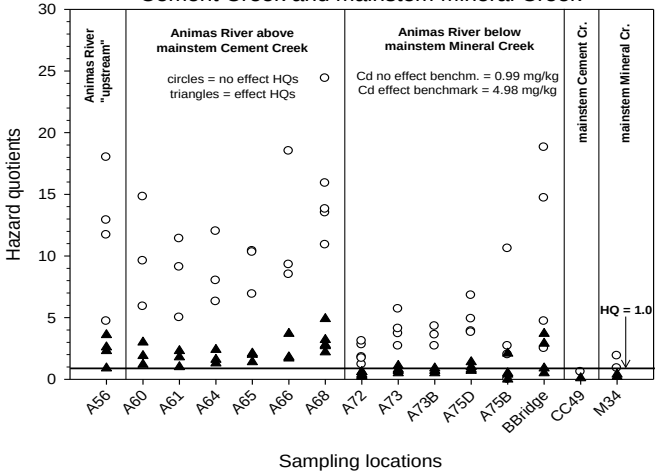

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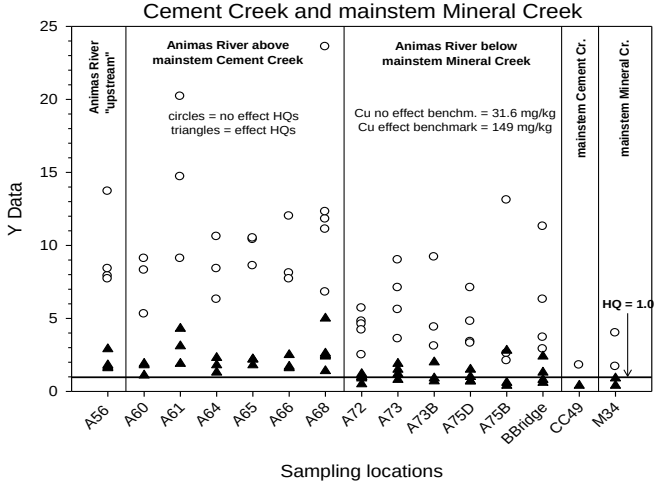

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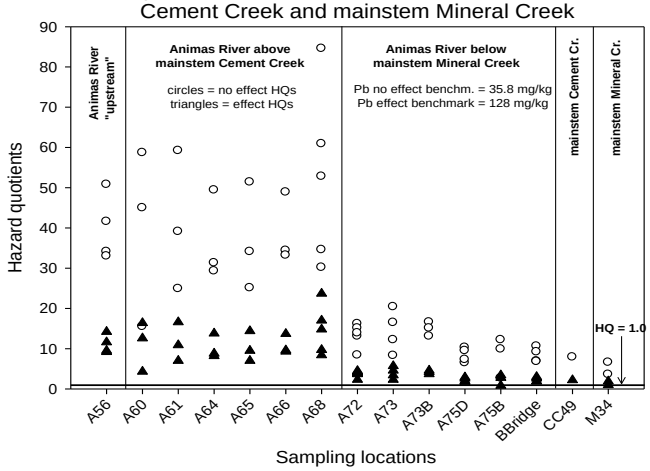

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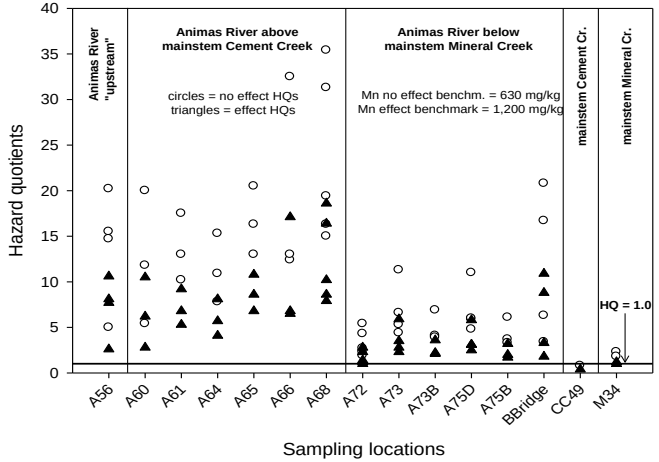

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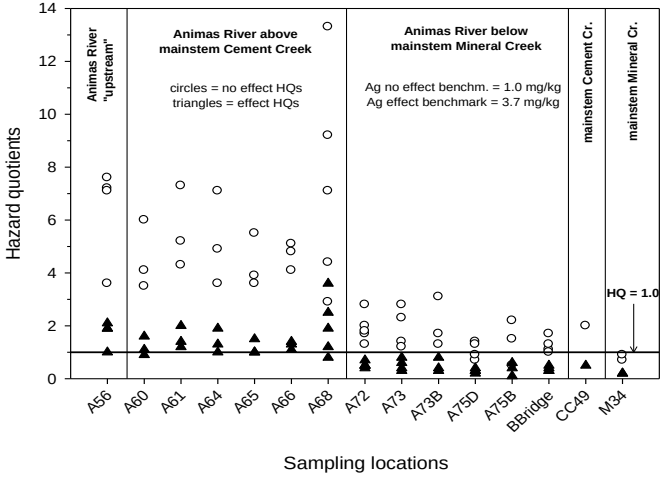

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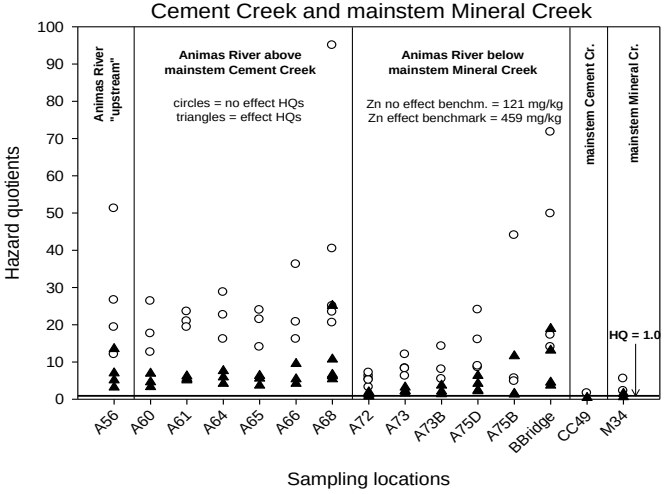

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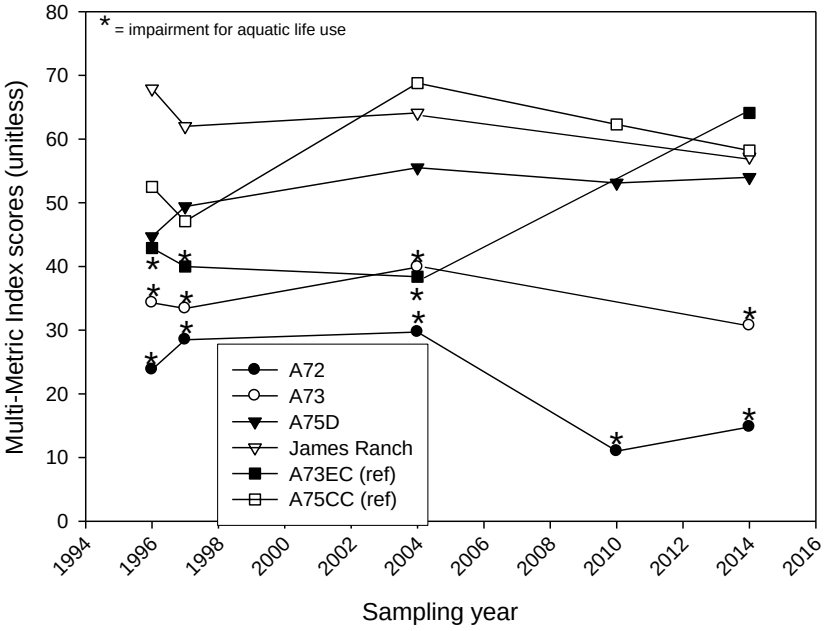
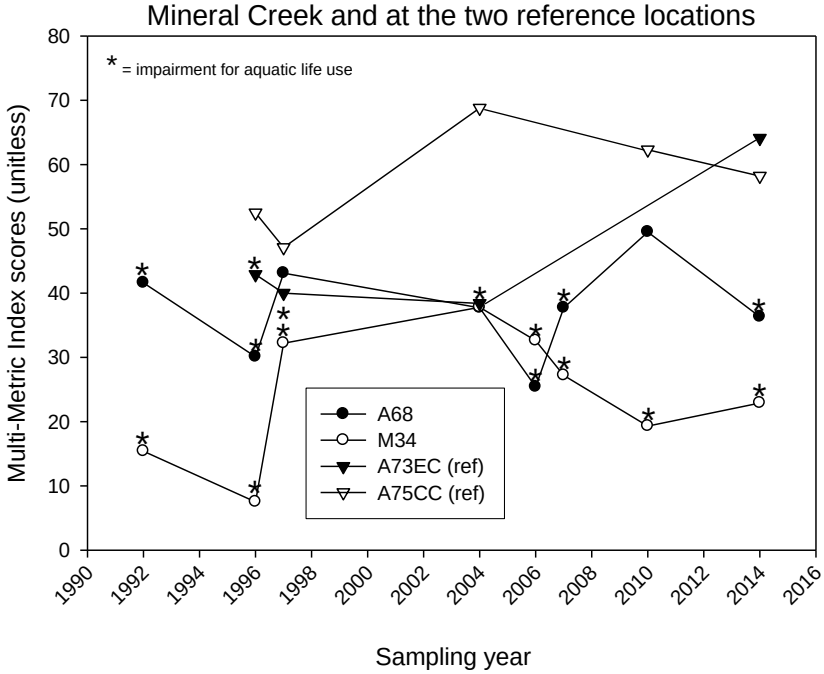


Figure 5.3b: MMI scores over time for sampling location A68 above mainstem Cement Creek, in mainstem Mineral Creek and at the two reference locations



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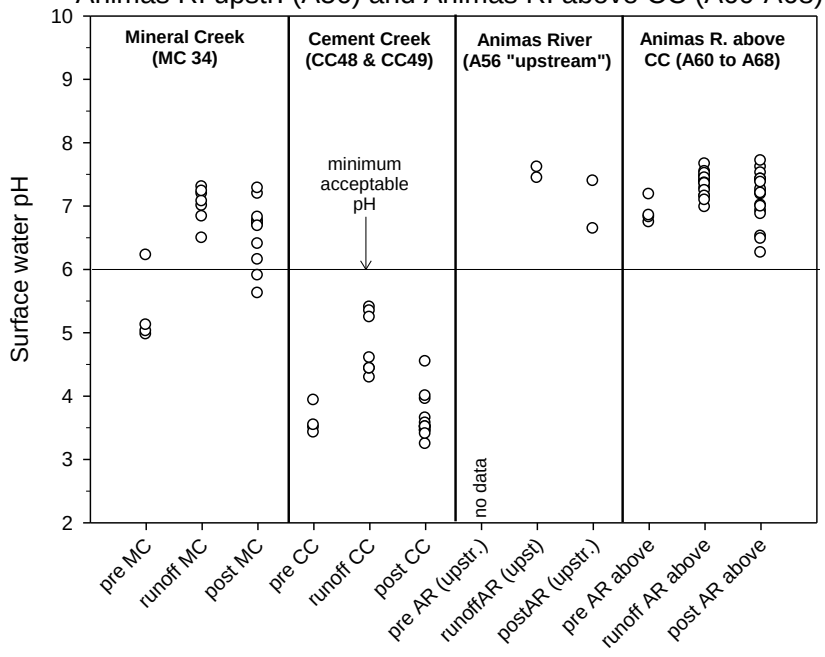

Figure 5.4.b: pH in pre-runoff, runoff, and post-runoff surface water samples from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)

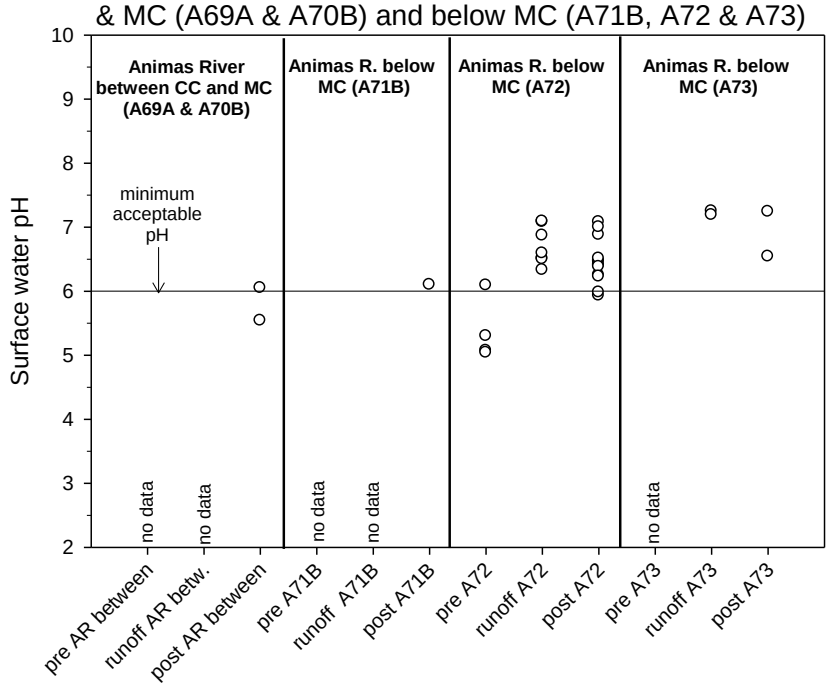

Figure 5.4 (cont'd): Scatter plots of pH in surface water

Figure 5.4.c: pH in pre-runoff, runoff, and post-runoff surface water samples from the Animas River below Mineral Creek (A73B, A75D, A75B, and Bakers Bridge)

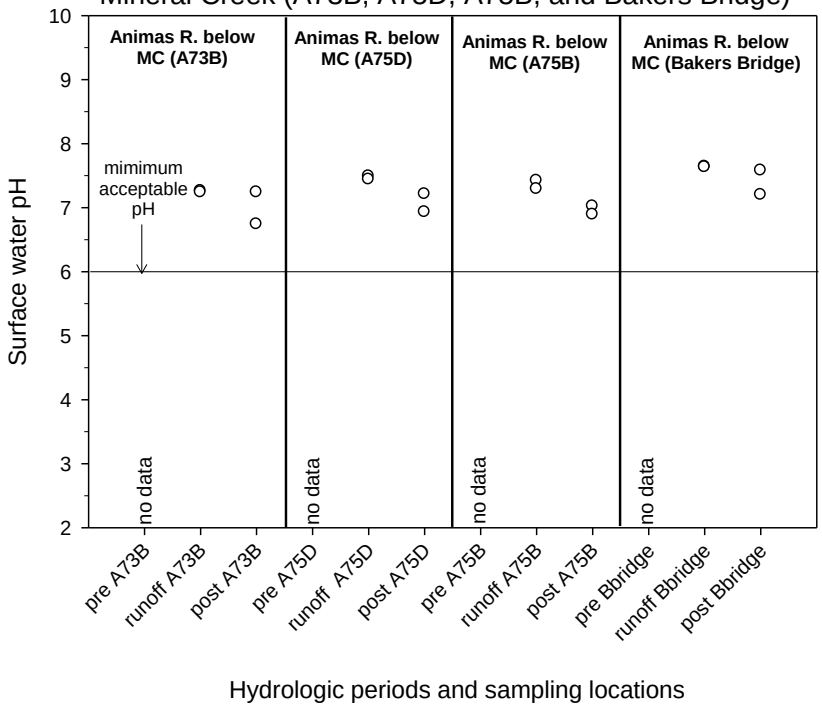

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Figure 5.5.a: Total Al HQs in pre-runoff, runoff, and post-runoff surface water samples from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60-A68)

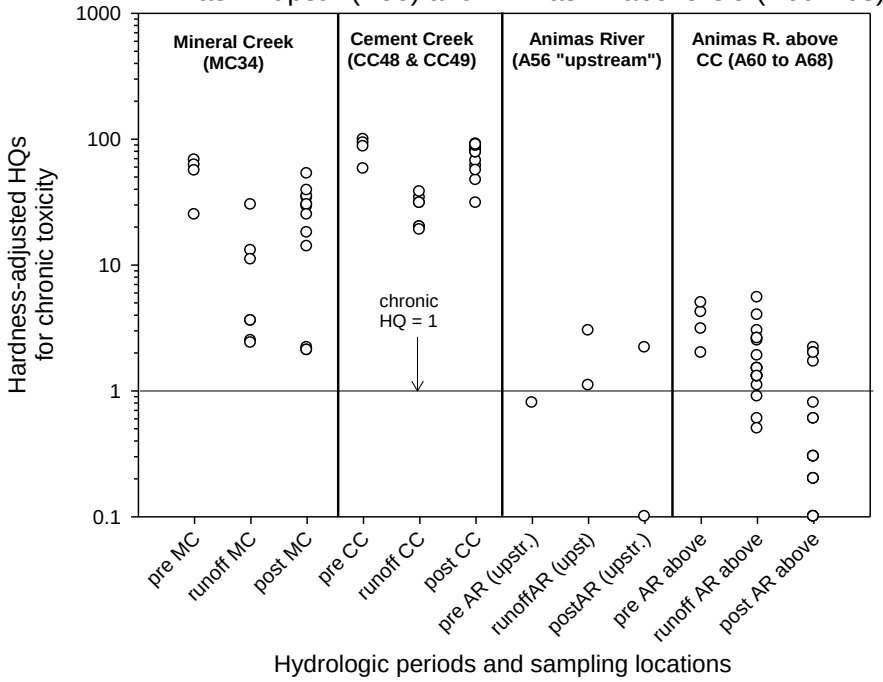

Figure 5.5.b: Total Al HQs in pre-runoff, runoff, and post-runoff surface water samples from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)

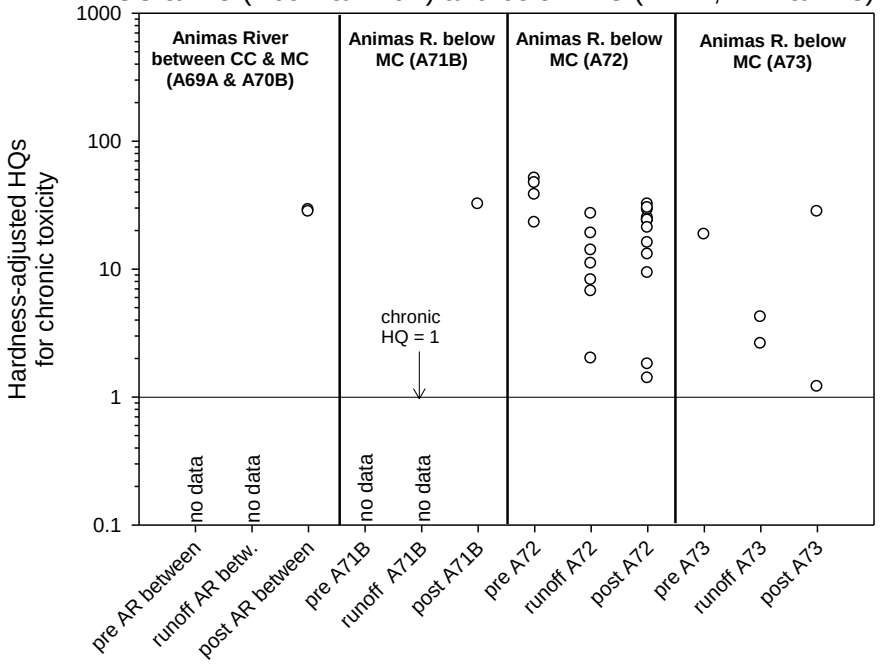

Figure 5.5 (cont'd): Scatter plots of total Al chronic HQs in surface water

Figure 5.5.c: Total Al HQs in pre-runoff, runoff, and post-runoff surface water samples from the Animas River below MC at locations A73B, A75D, A75B, and Bakers Bridge

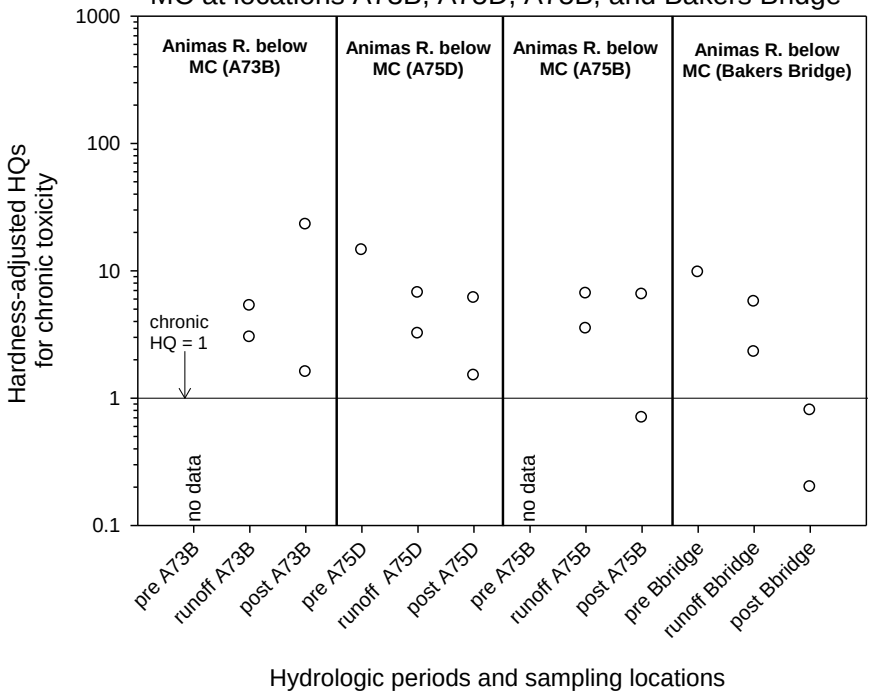

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Figure 5.6.a: Dissolved Cd HQs in pre-runoff, runoff, and post-runoff surface water samples from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)

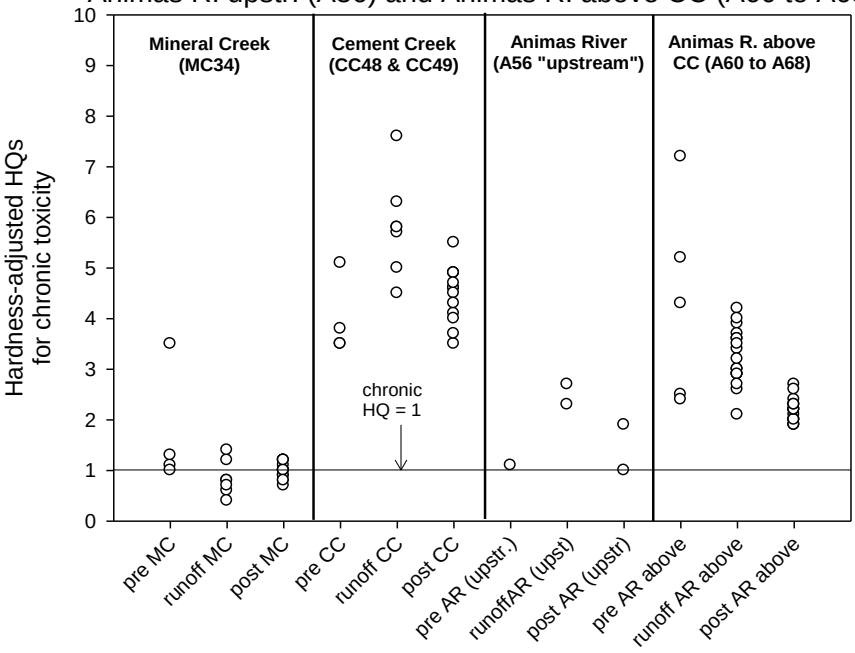


Figure 5.6.b: Dissolved Cd in pre-runoff, runoff, and post-runoff surface water samples from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)

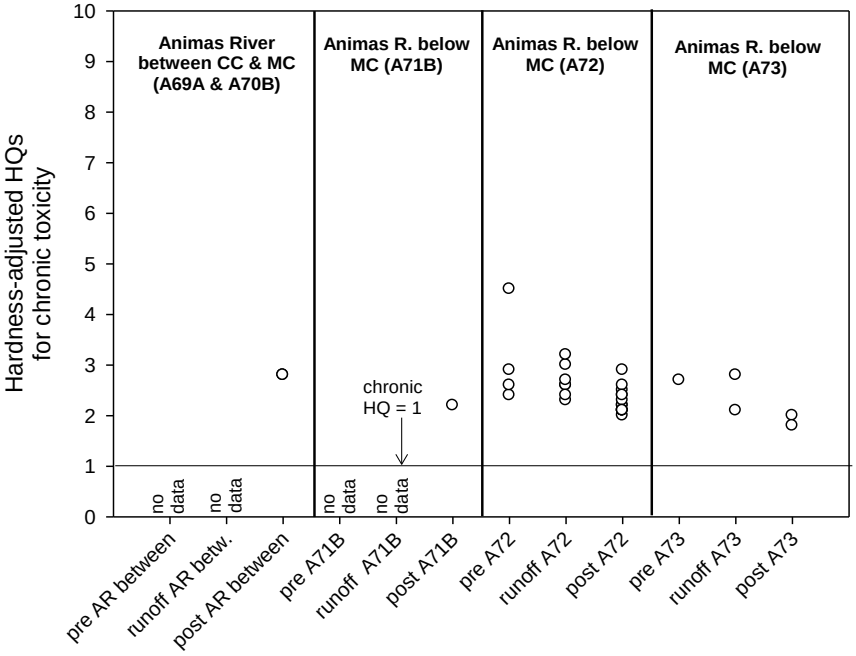


Figure 5.6 (cont'd): Scatter plots of dissolved Cd chronic HQs in surface

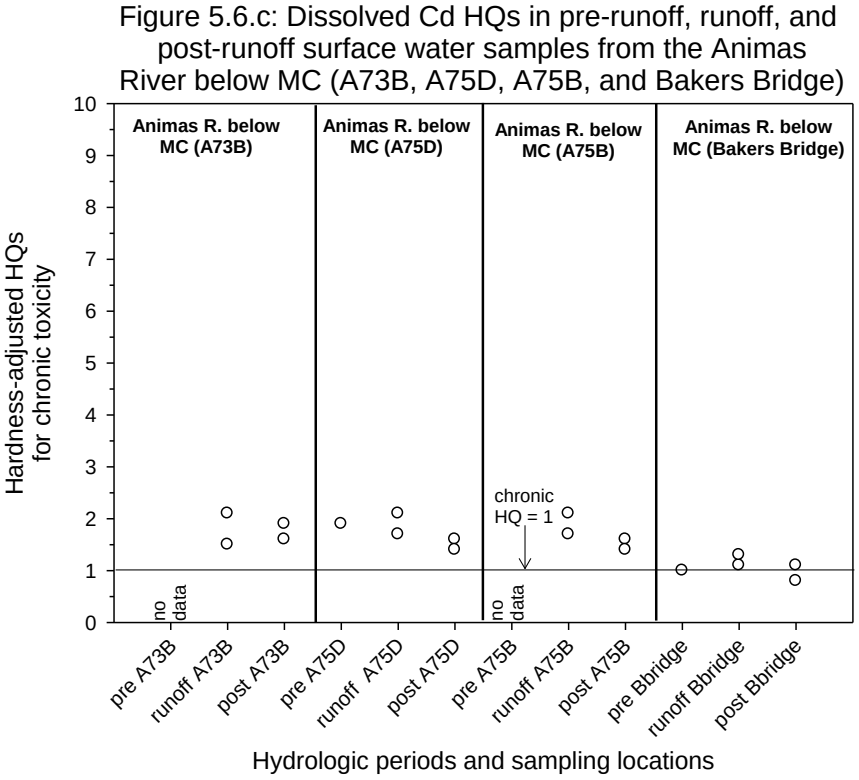
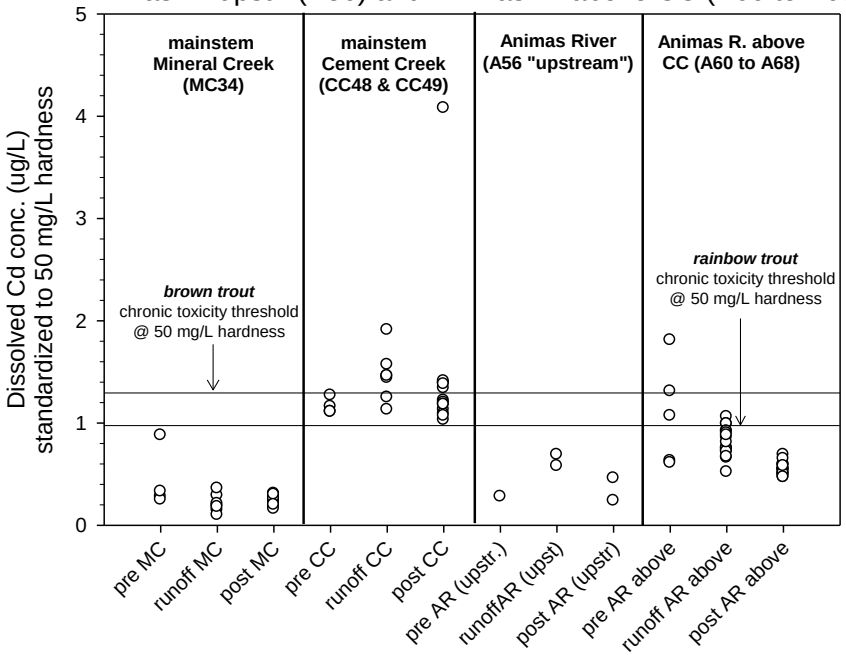


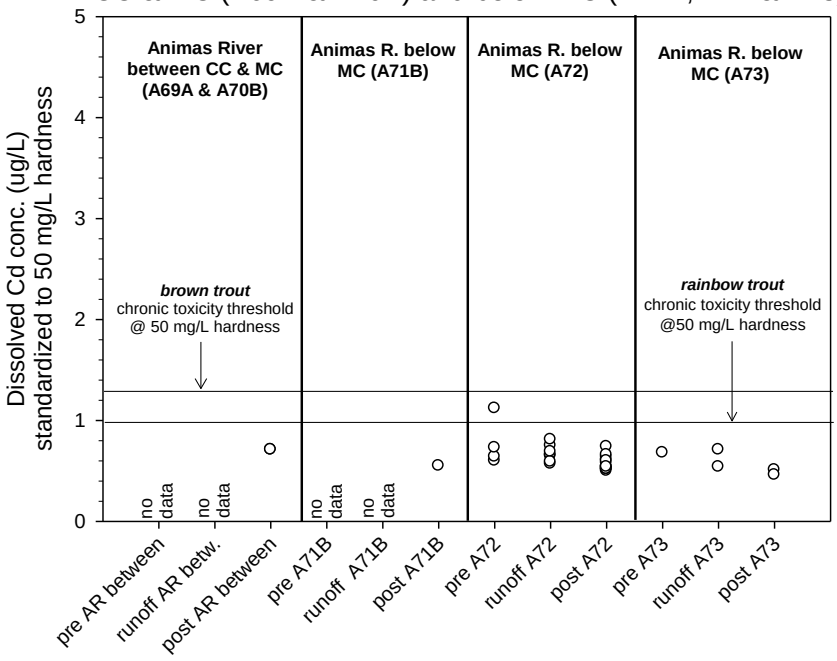
Figure 5.6*: Scatter plots of dissolved Cd concentrations adjusted to a hardness of 50 mg/L

Figure 5.6*.a: [Cd] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)



Hydrologic periods and sampling locations

Figure 5.6*.b: [Cd] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)



Hydrologic periods and sampling locations

Figure 5.6* (cont'd): Scatter plots of dissolved Cd concentrations adjusted to a hardness of 50 mg/L

Figure 5.6*.c: [Cd] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from the Animas River below MC (A73B, A75D, A75B, and Bakers Bridge)

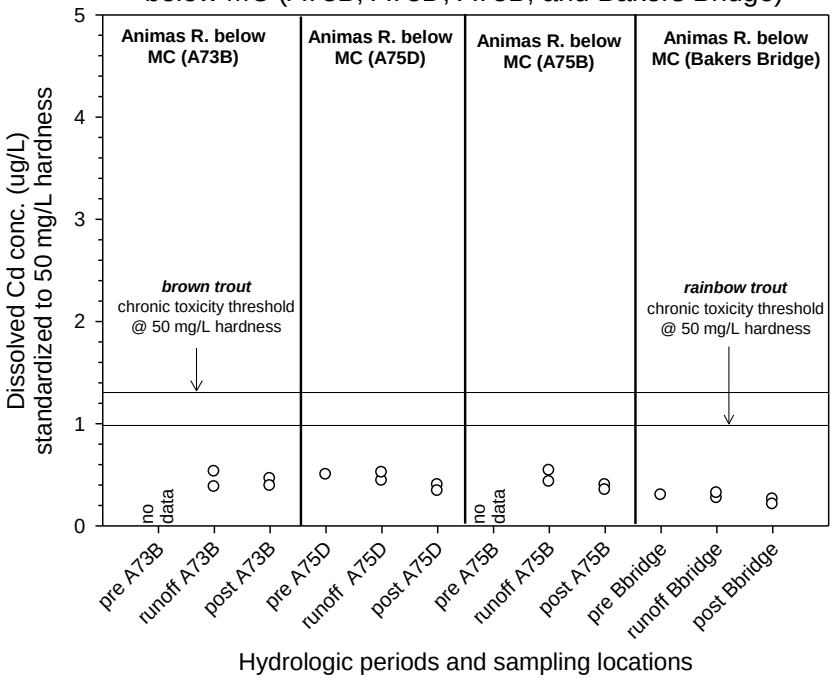


Figure 5.7: Scatter plots of dissolved Cu chronic HQs in surface water

Figure 5.7.a: Dissolved Cu HQs in pre-runoff, runoff, and post-runoff surface water samples from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)

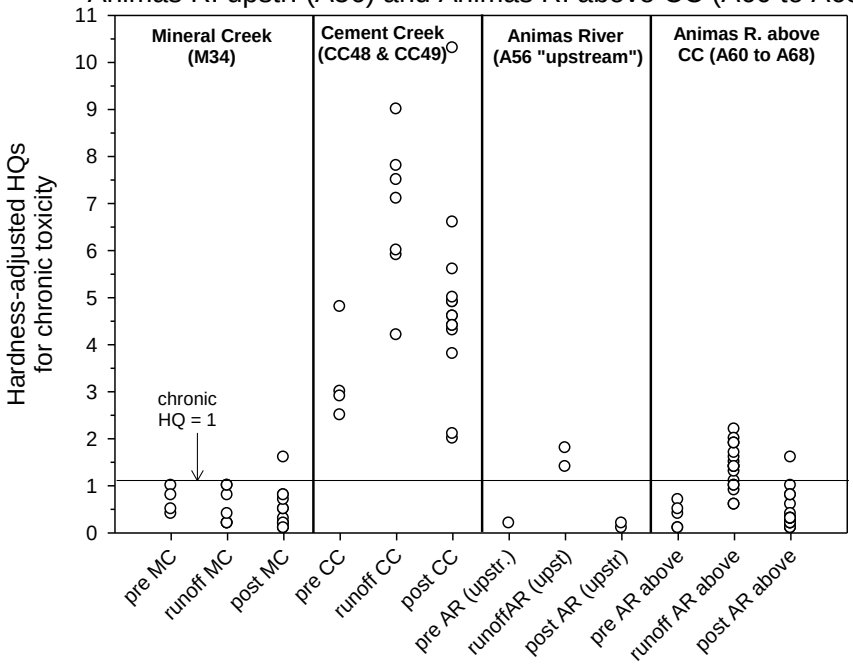


Figure 5.7.b: Dissolved Cu HQs in pre-runoff, runoff, and post-runoff surface water samples from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)

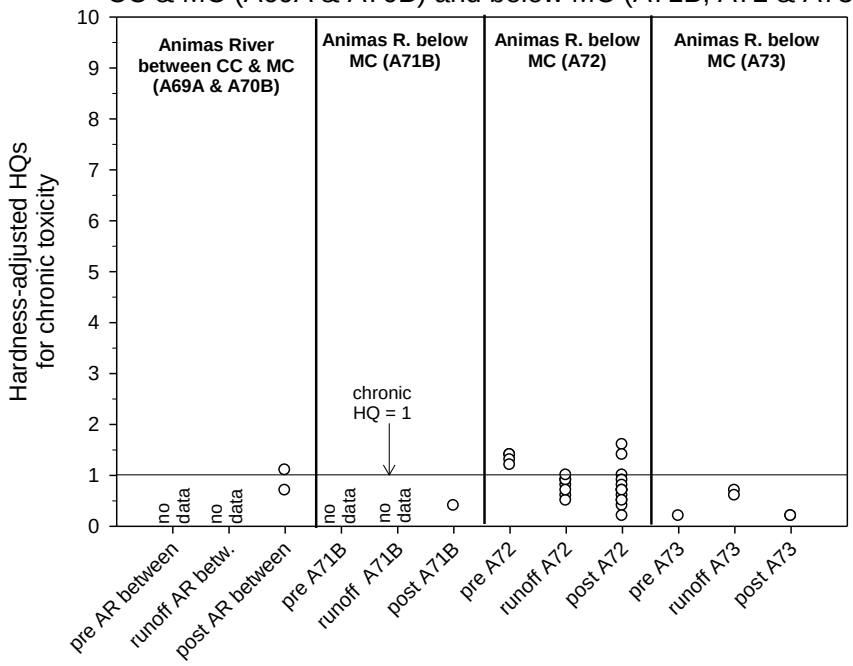


Figure 5.7 (cont.d): Scatter plots of dissolved Cu chronic HQs in surface

Figure 5.7.c: Dissolved Cu HQs in pre-runoff, runoff, and post-runoff surface water samples from the Animas River below MC (A73B, A75D, A75B, and Bakers Bridge)

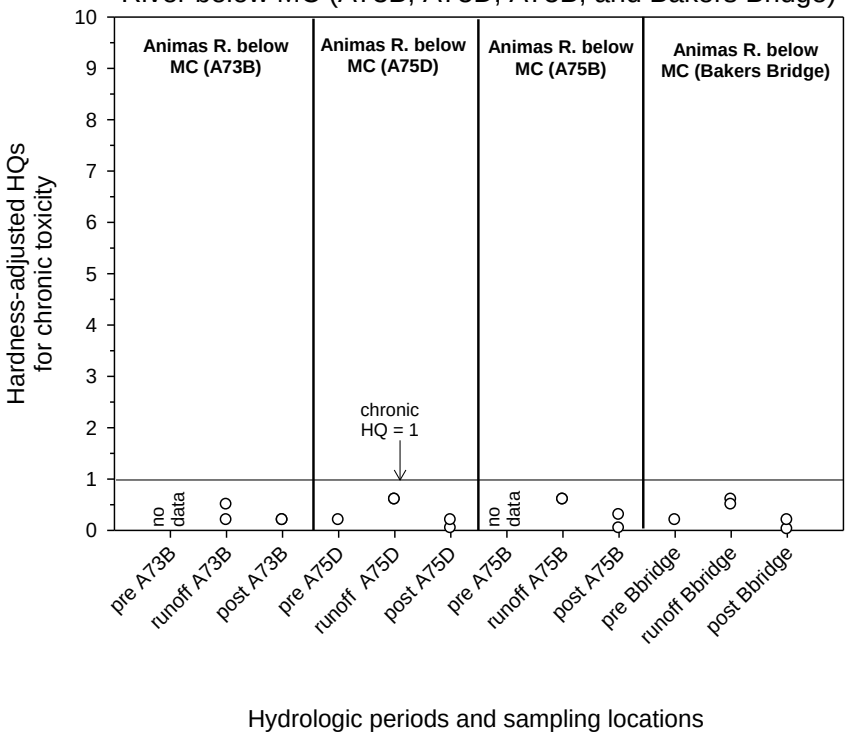
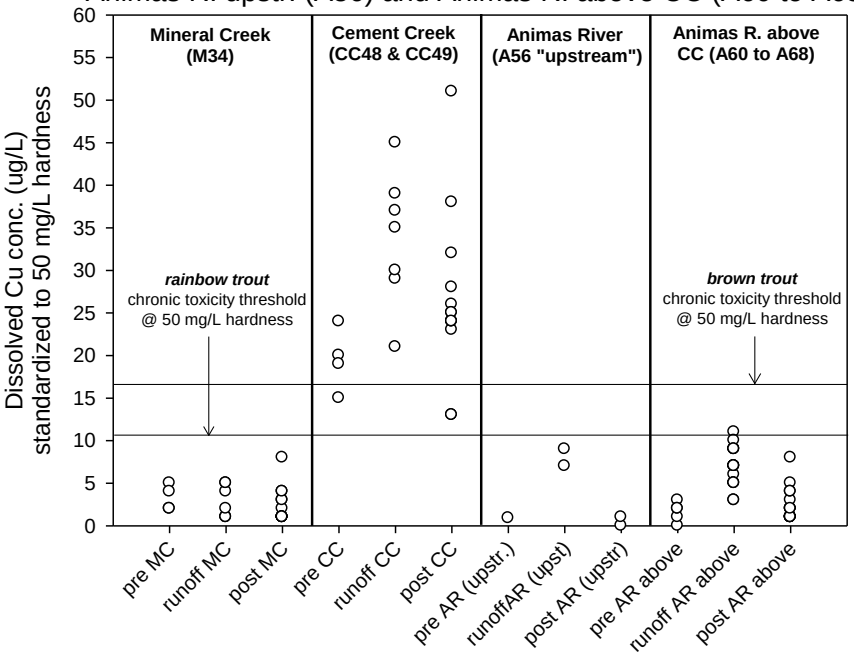


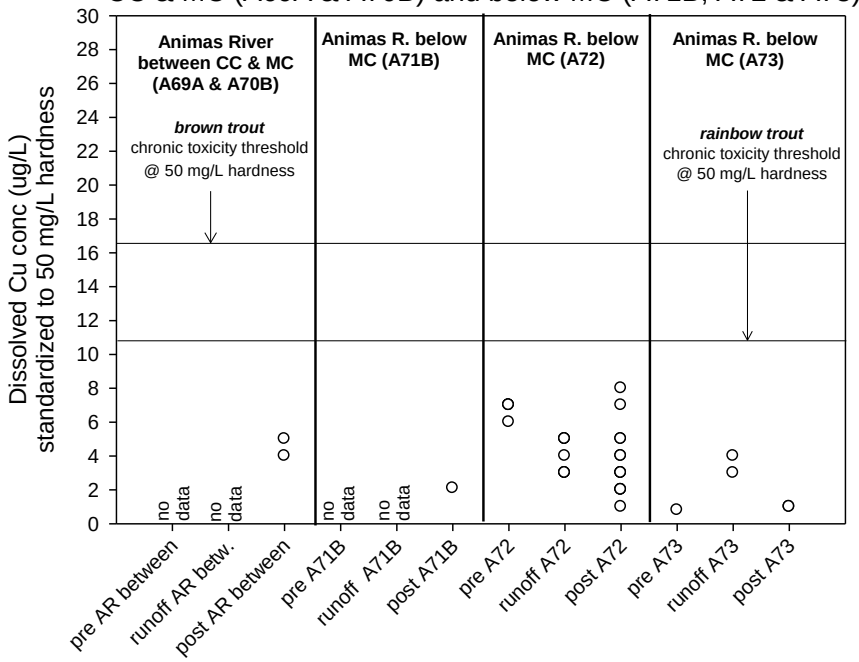
Figure 5.7*: Scatter plots of dissolved Cu concentrations adjusted to a hardness of 50 mg/L

Figure 5.7*.a: [Cu] @ 50 mg/L hardness in pre-runoff, runoff, and post- runoff surface water from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)



Hydrologic periods and sampling locations

Figure 5.7*.b: [Cu] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)



Hydrologic periods and sampling locations

Figure 5.7* (cont'd): Scatter plots of dissolved Cu concentrations adjusted to a hardness of 50

Figure 5.7*.c: [Cu] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from the Animas River below MC (A73B, A75D, A75B, and Bakers Bridge)

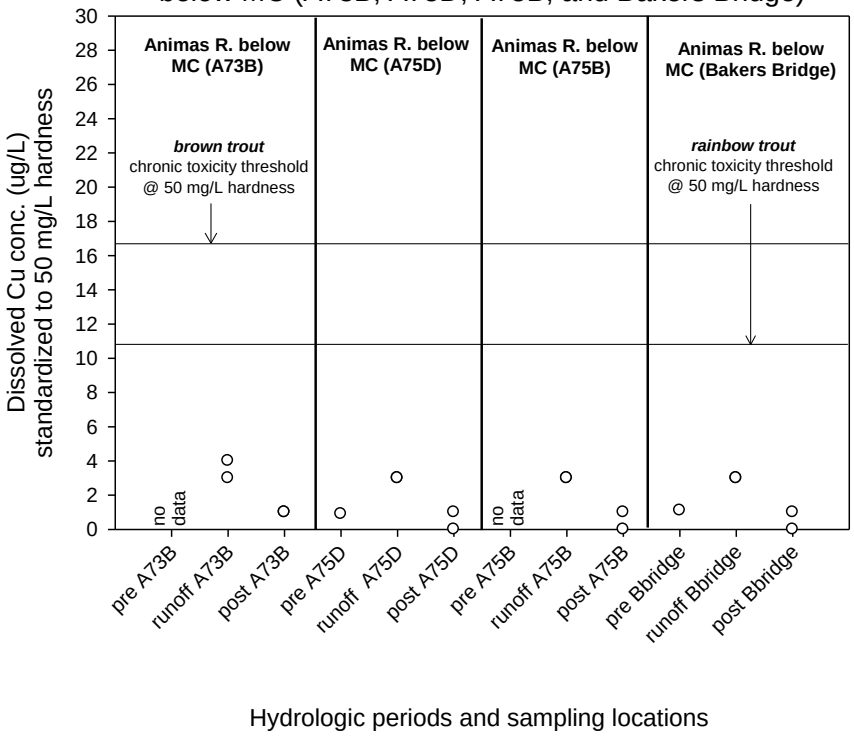


Figure 5.8: Scatter plots of dissolved Mn chronic HQs in surface water

Figure 5.8.a: Dissolved Mn HQs in pre-runoff, runoff, and post-runoff surface water samples from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)

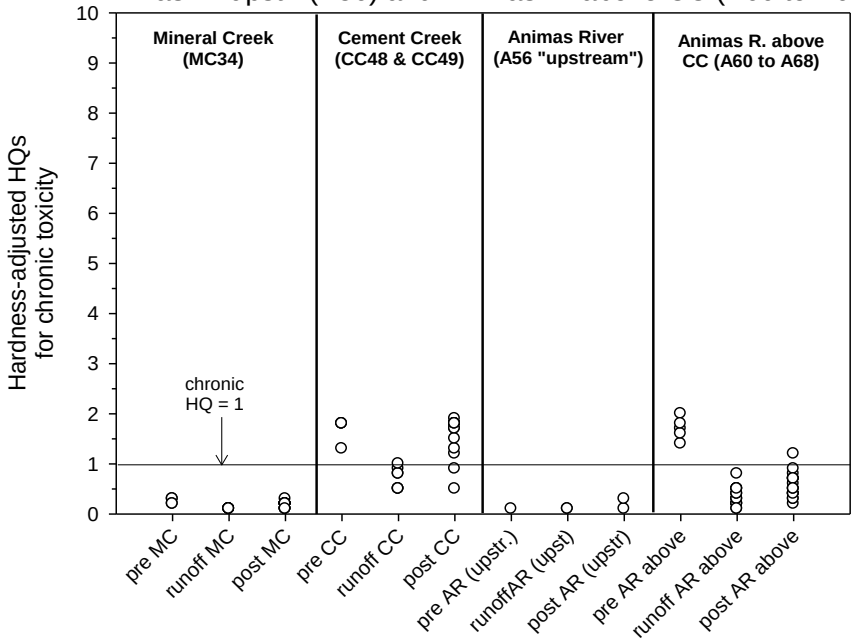


Figure 5.8.b: Dissolved Mn HQs in pre-runof, runoff, and post-runoff surface water samples from the Animas River between CC and MC (A69A & A70B) and below MC (A71B, A72 & A73)

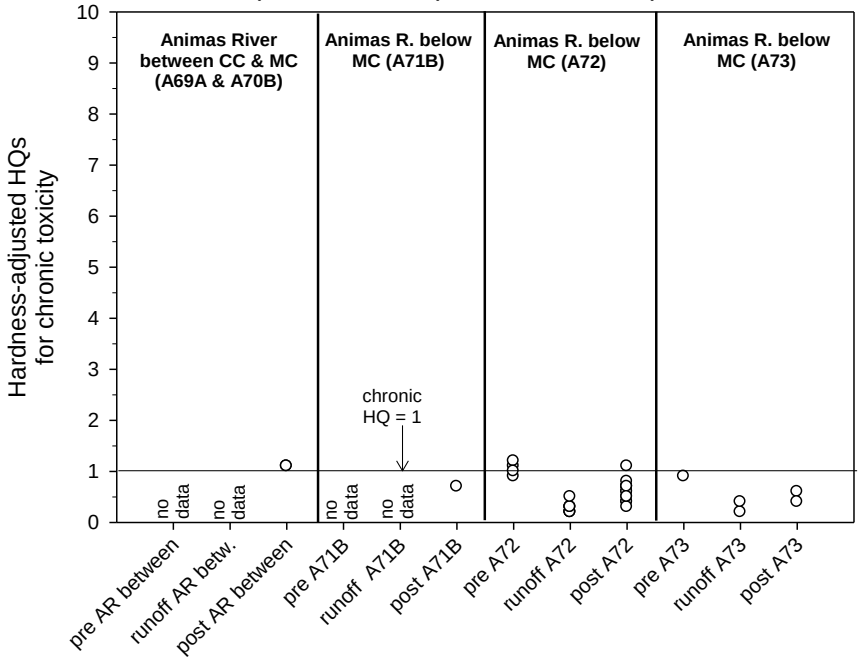


Figure 5.8 (cont'd): Scatter plots of dissolved Mn chronic HQs in surface

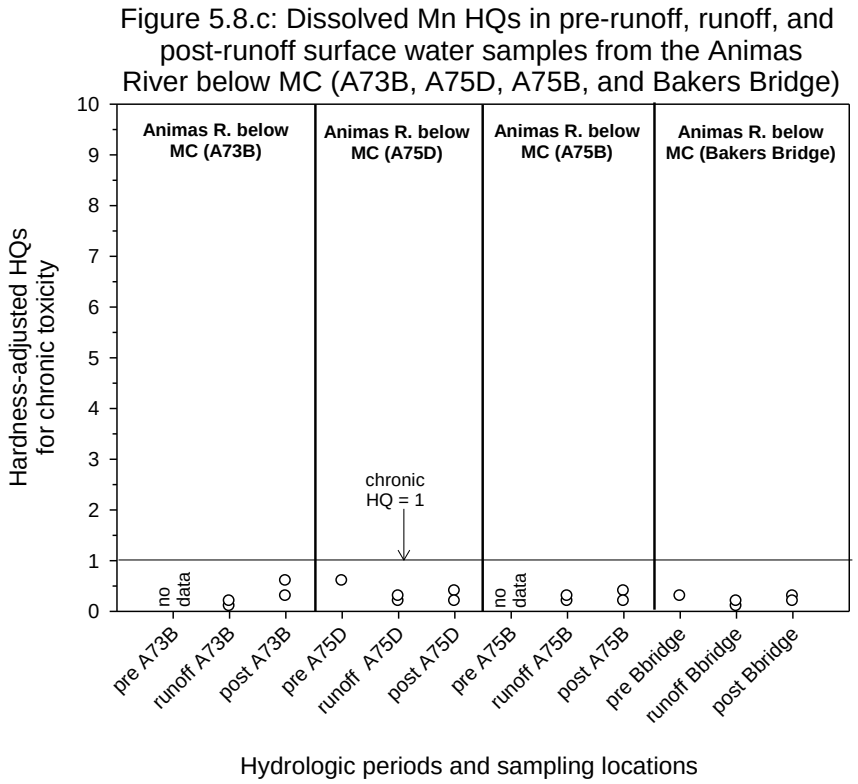


Figure 5.9: Scatter plots of dissolved Pb chronic HQs in surface water

Figure 5.9.a: Dissolved Pb HQs in pre-runoff, runoff, and post-runoff surface water samples from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)

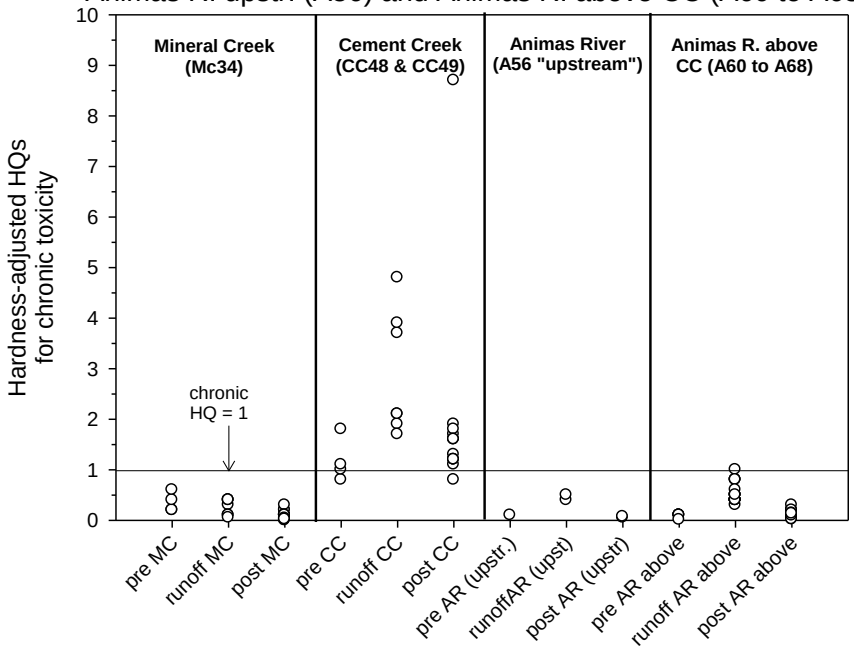


Figure 5.9.b: Dissolved Pb HQs in pre-runoff, runoff, and post-runoff surface water samples from the Animas River between CC and MC (A69A & A70B) and below MC (A71B, A72 & A73)

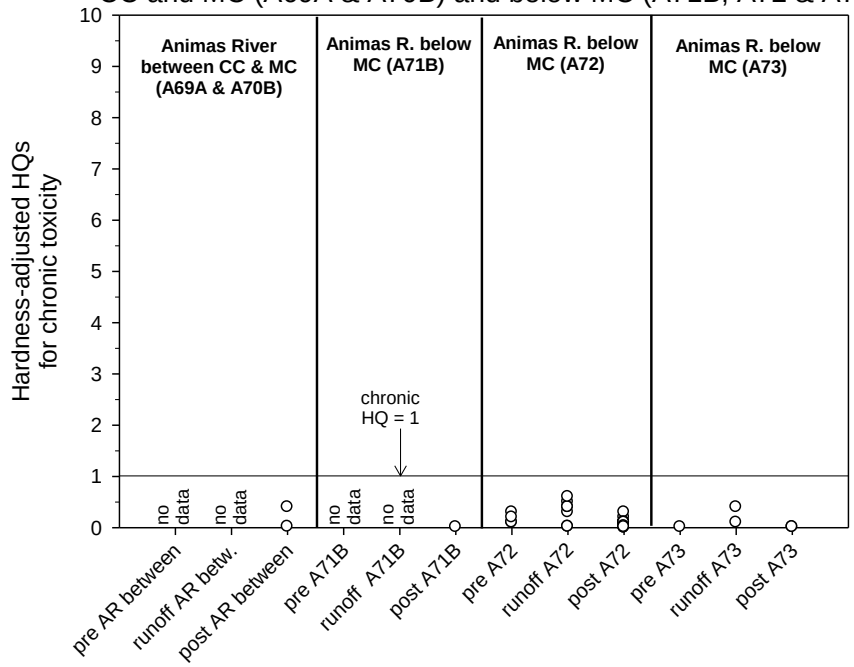


Figure 5.9 (cont'd): Scatter plots of dissolved Pb chronic HQs in surface

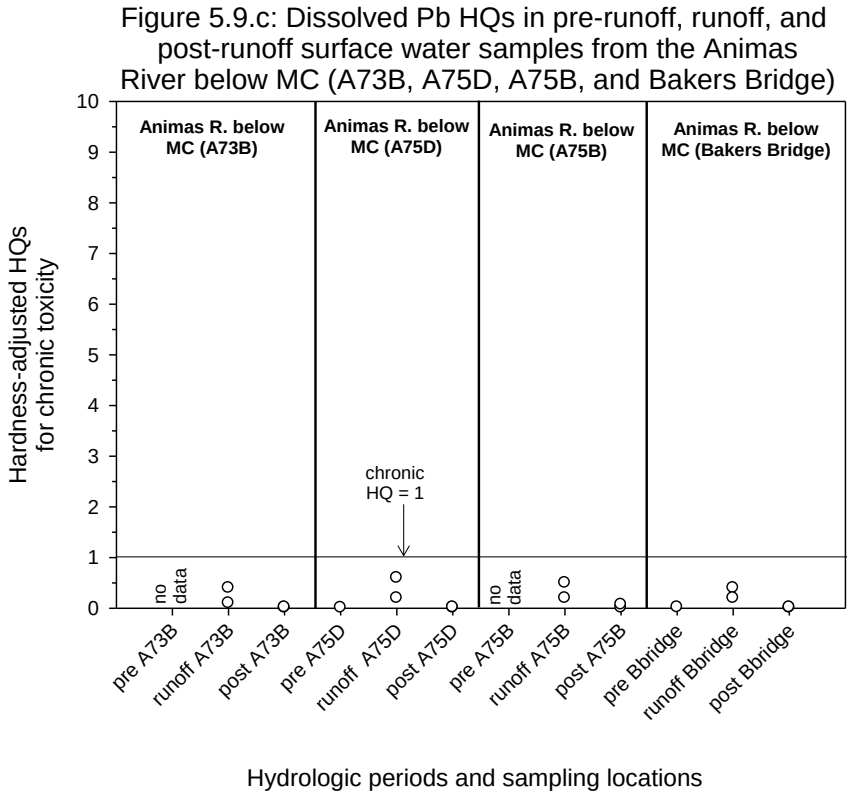


Figure 5.10: Scatter plots of dissolved Zn chronic HQs in surface water

Figure 5.10.a: Dissolved Zn HQs in pre-runoff, runoff, and post-runoff surface water samples from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)

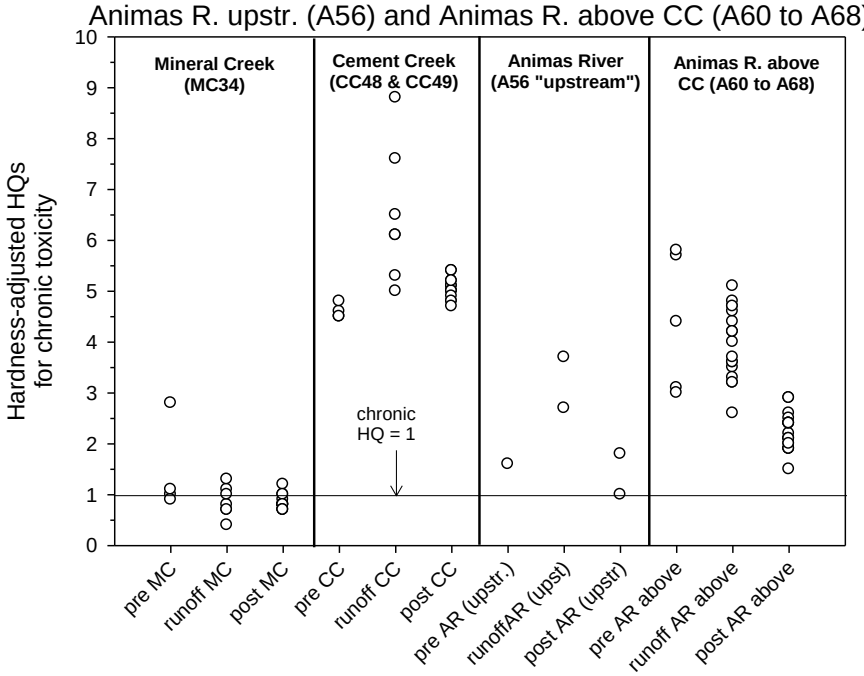


Figure 5.10.b: Dissolved Zn HQs in pre-runoff, runoff, and post-runoff surface water samples from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)

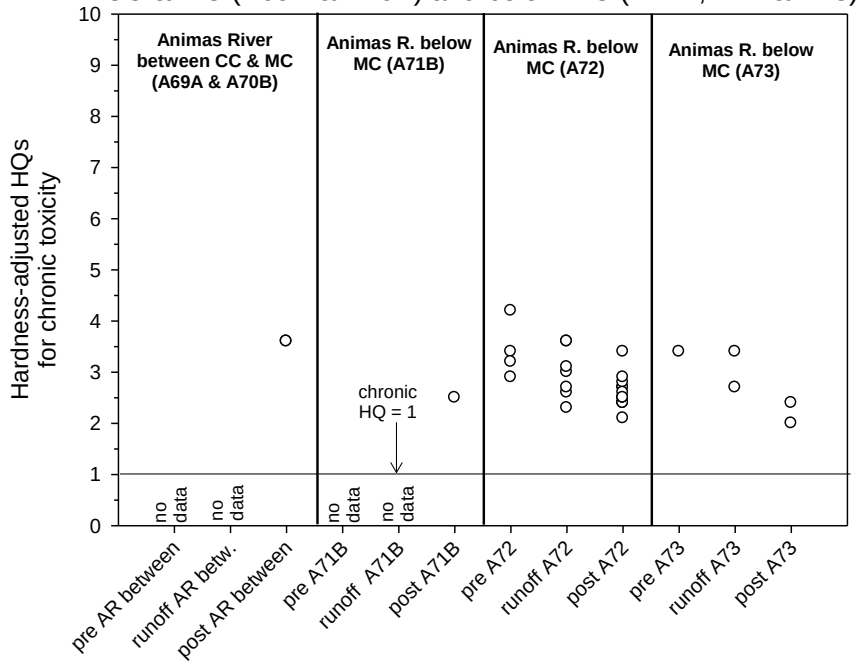


Figure 5.10 (cont'd): Scatter plots of dissolved Zn chronic HQs in surface

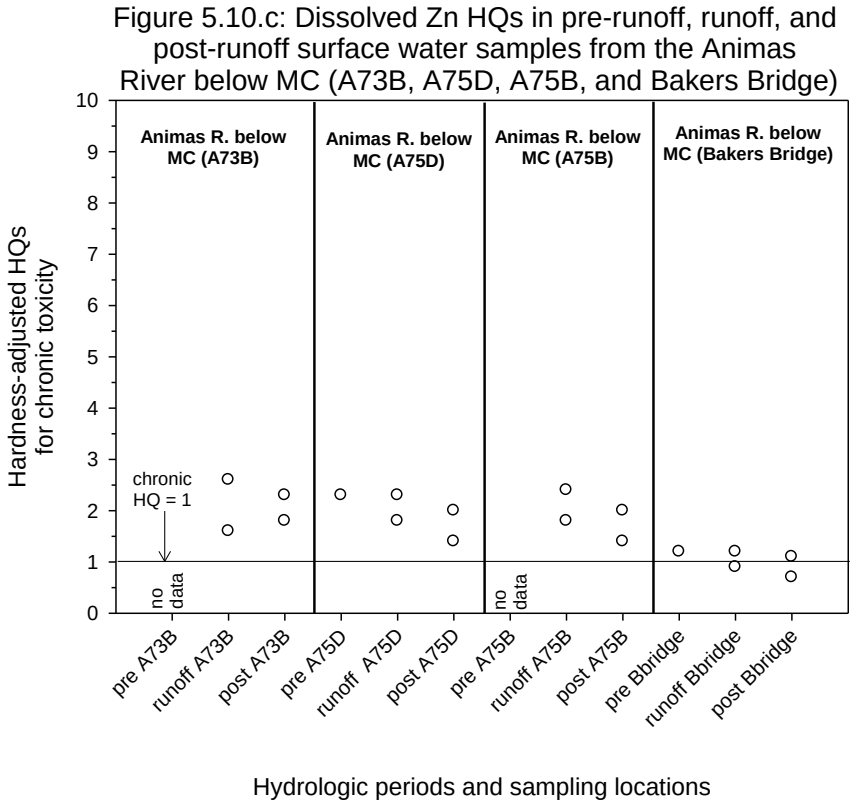
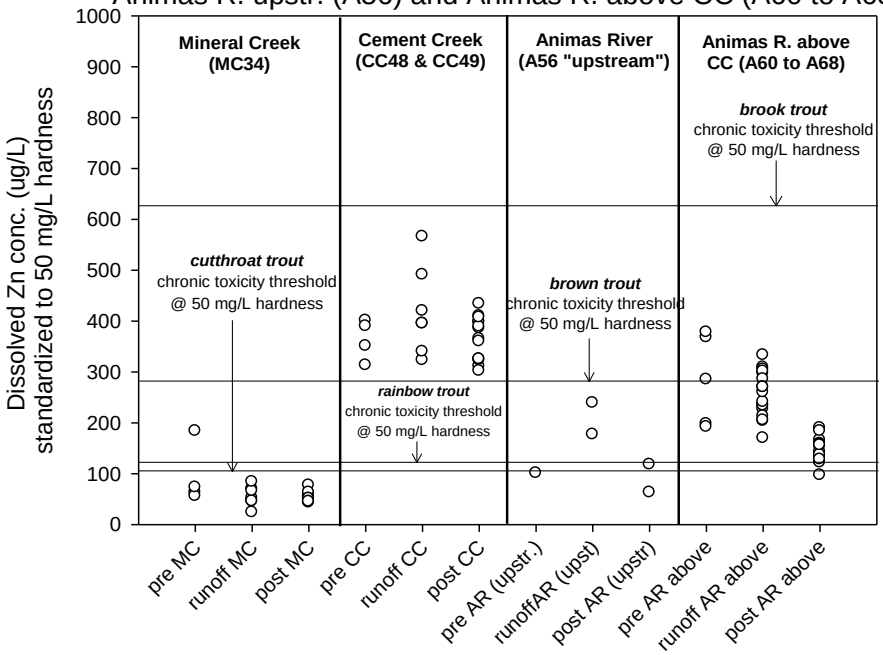


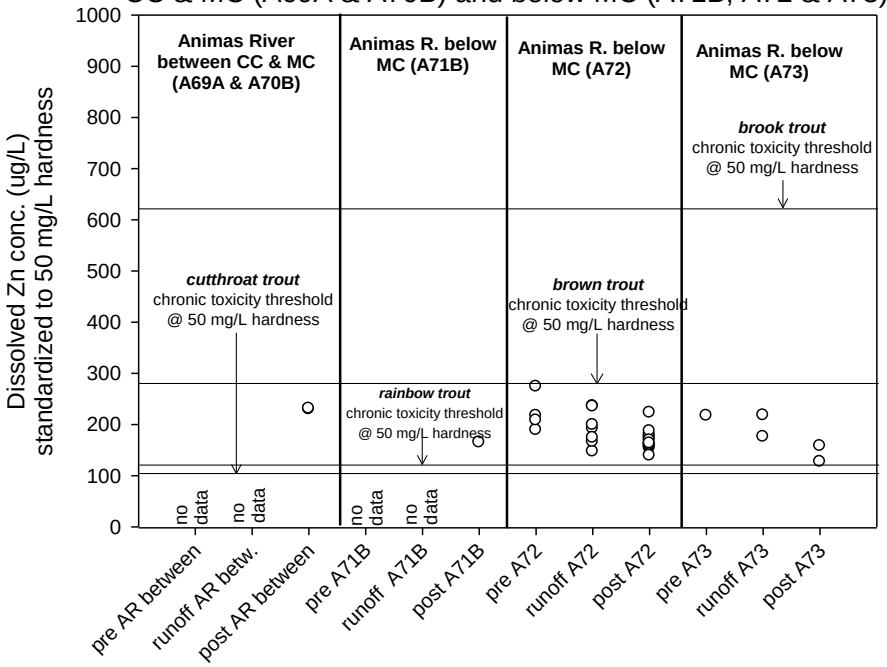
Figure 5.10*: Scatter plots of dissolved Zn concentrations adjusted to a hardness of 50 mg/L

Figure 5.10*.a: [Zn] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from Mineral Cr., Cement Cr., Animas R. upstr. (A56) and Animas R. above CC (A60 to A68)



Hydrologic periods and sampling locations

Figure 5.10*.b: [Zn] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from the Animas River between CC & MC (A69A & A70B) and below MC (A71B, A72 & A73)



Hydrologic periods and sampling locations

Figure 5.10* (cont'd): Scatter plots of dissolved Zn concentrations adjusted to a hardness of 50 mg/L

Figure 5.10*.c: [Zn] @ 50 mg/L hardness in pre-runoff, runoff, and post-runoff surface water from the Animas River below MC (A73B, A75D, A75B, and Bakers Bridge)

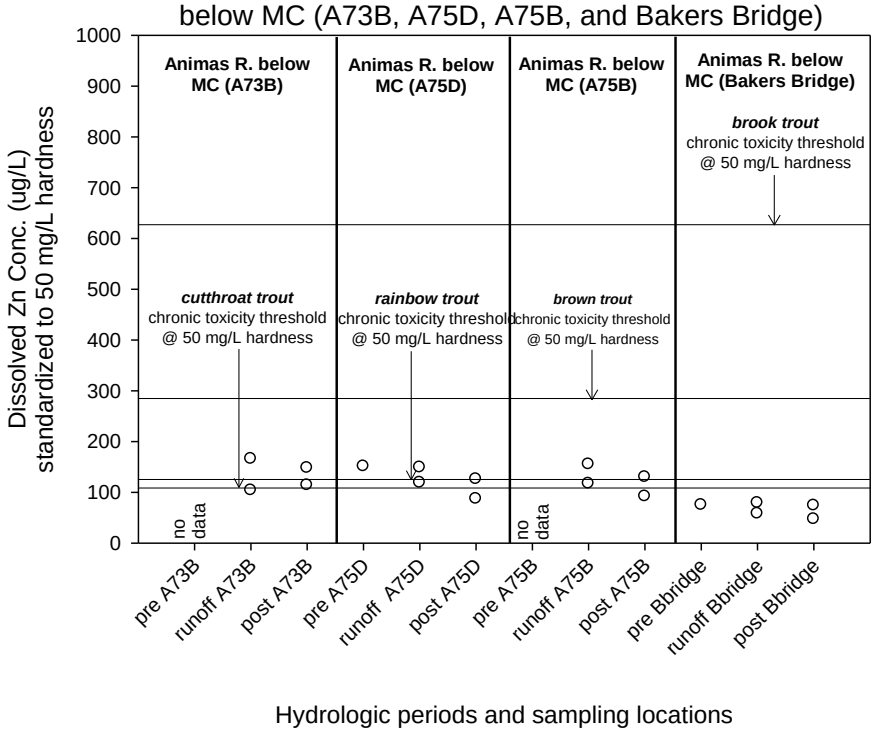


Figure 5.11: Scatter plots of dissolved metals chronic HQs in surface water samples collected using MiniSipper sampling devices in 2014

Figure 5.11a: Chronic HQs for dissolved Al in surface water collected in 2014 from the Animas River using MiniSipper samplers at locations A56, A73, A75D and Bakers Bridge

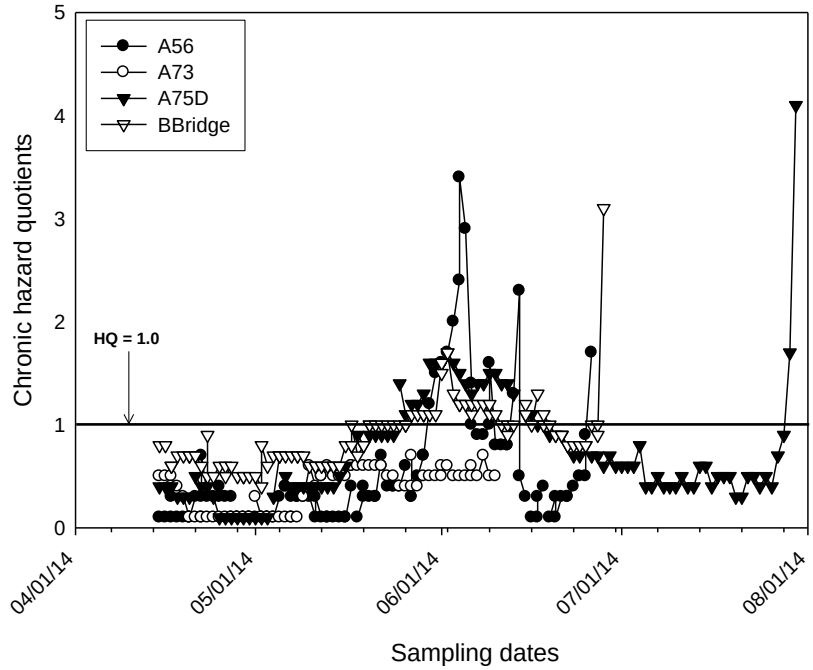


Figure 5.11b: Chronic HQs for dissolved Cd in surface water collected in 2014 from the Animas River using MiniSipper samplers at locations A56, A73, A75D and Bakers Bridge

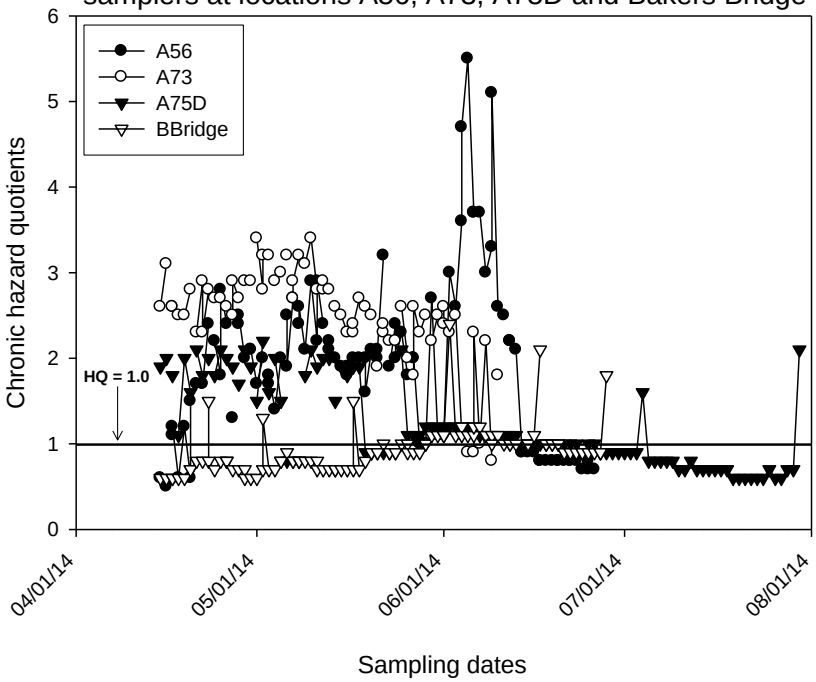


Figure 5.11 (cont'd): Scatter plots of dissolved metals chronic HQs in surface water samples collected using MiniSipper sampling devices in 2014

Figure 5.11c: Chronic HQs for dissolved Cu in surface water collected in 2014 from the Animas River using MiniSipper samplers at locations A56, A73, A75D and Bakers Bridge

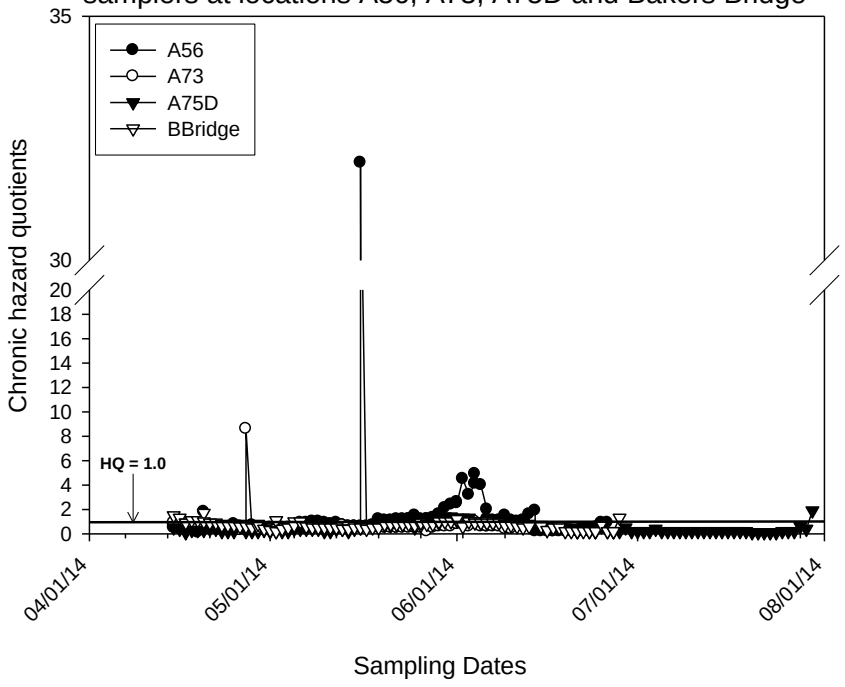


Figure 5.11d: Chronic HQs for dissolved Pb in surface water collected in 2014 from the Animas River using MiniSipper samplers at locations A56, A73, A75D and Bakers Bridge

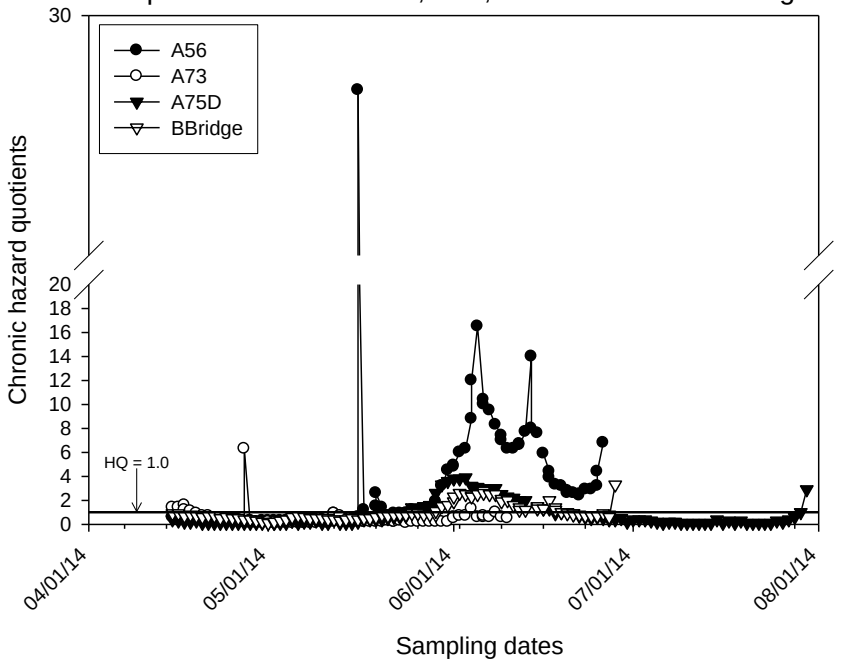


Figure 5.11 (cont'd): Scatter plots of dissolved metals chronic HQs in surface water samples collected using MiniSipper sampling devices in 2014

Figure 5.11e: Chronic HQs for dissolved Zn in surface water collected from the Animas River in 2014 using MiniSipper samplers at locations A56, A73, A75D and Bakers Bridge

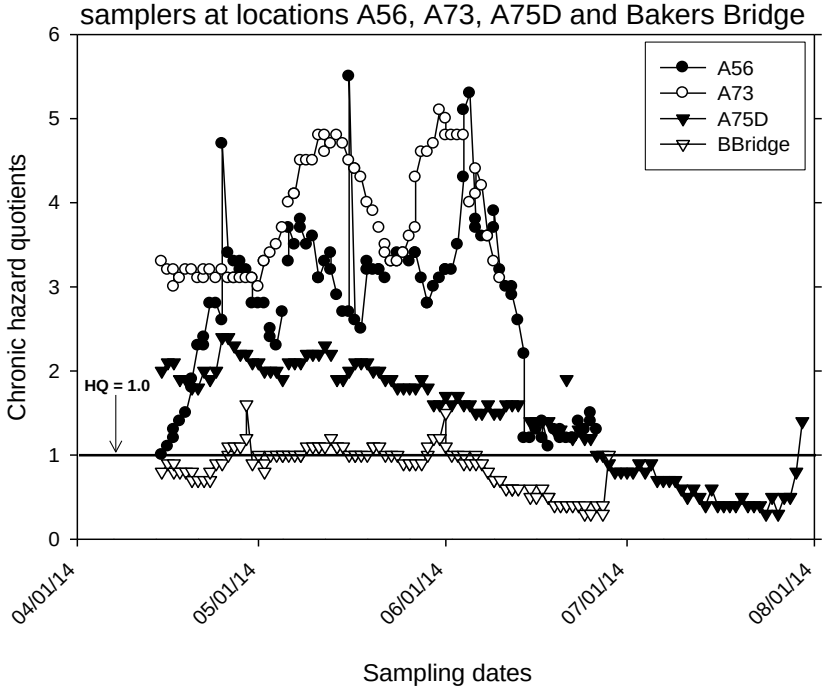


Figure 5.12: Trout densities over time at four locations on the Animas River

Figure 5.12.a: Brook trout densities (fish/mile) at four sampling locations on the Upper Animas River between 1992 and 2014

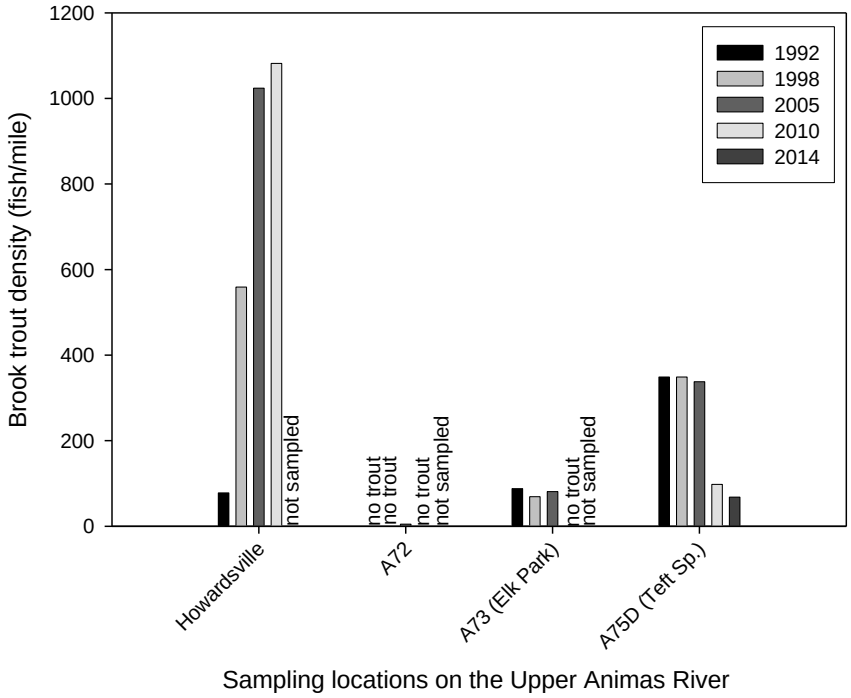


Figure 5.12.b: Rainbow trout densities (fish/mile) at four sampling locations on the Upper Animas River between 1992 and 2014

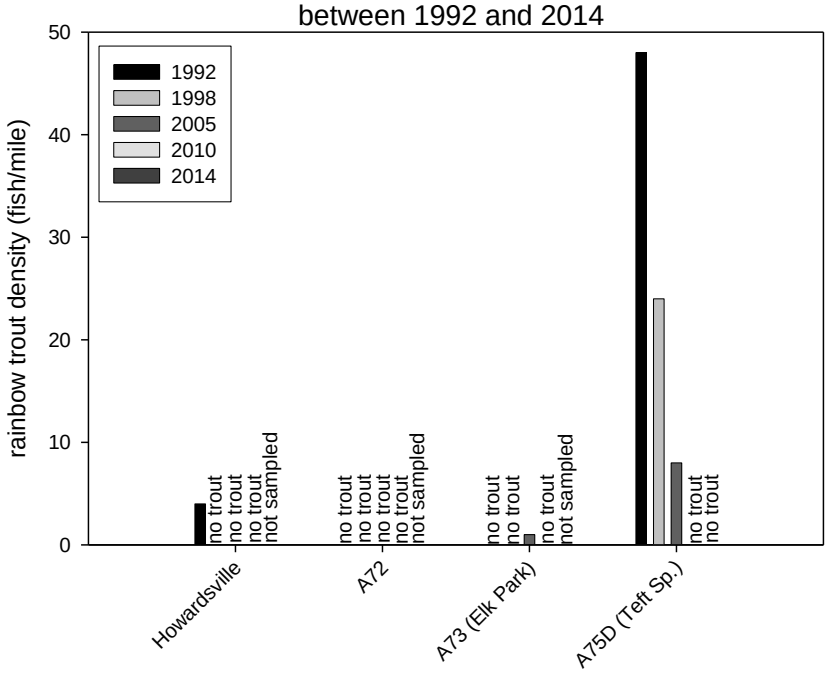


Figure 5.12 (cont'd): Trout densities over time at four locations on the Animas River

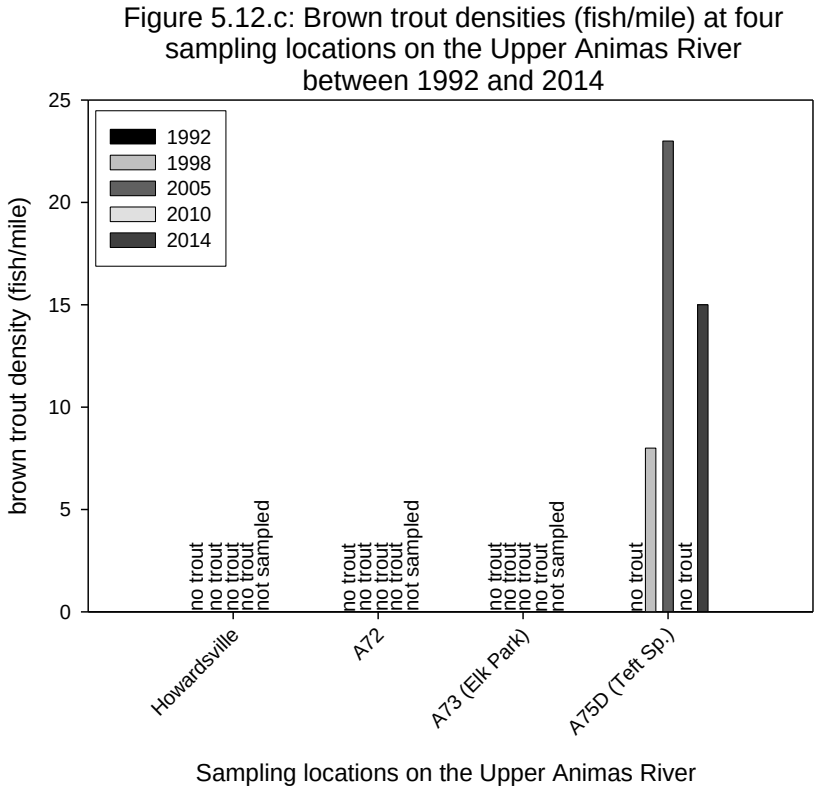


Figure 5.13: Geometric mean RME and CTE HQs for the four wildlife receptors evaluated using food chain modeling

Figure 5.13.a: Geometric mean RME and CTE HQs for the American Dipper feeding in the Animas River above Cement Creek and below Mineral Creek

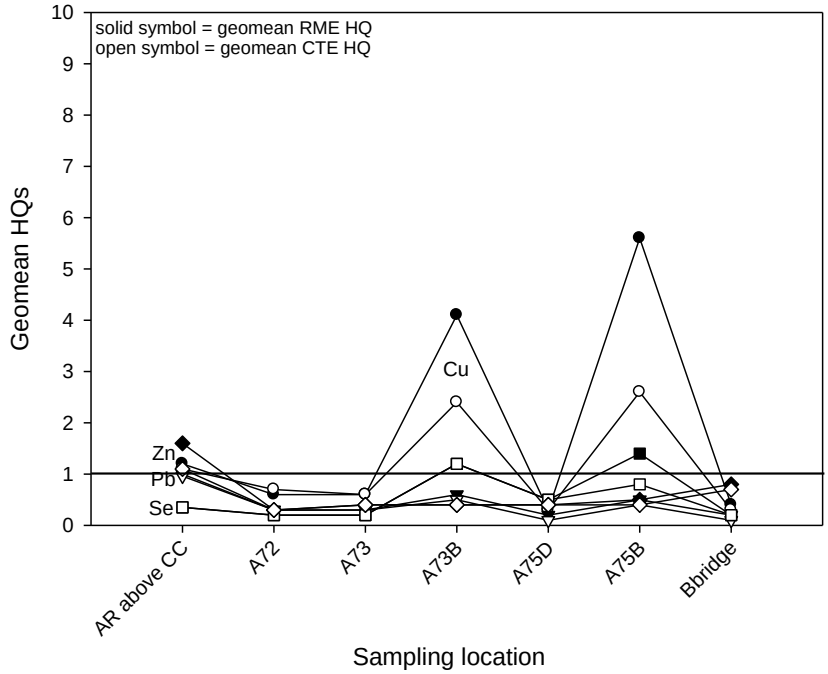


Figure 5.13.b: Geometric mean RME and CTE HQs for the belted kingfisher feeding in the Animas River above Cement Creek and below Mineral Creek

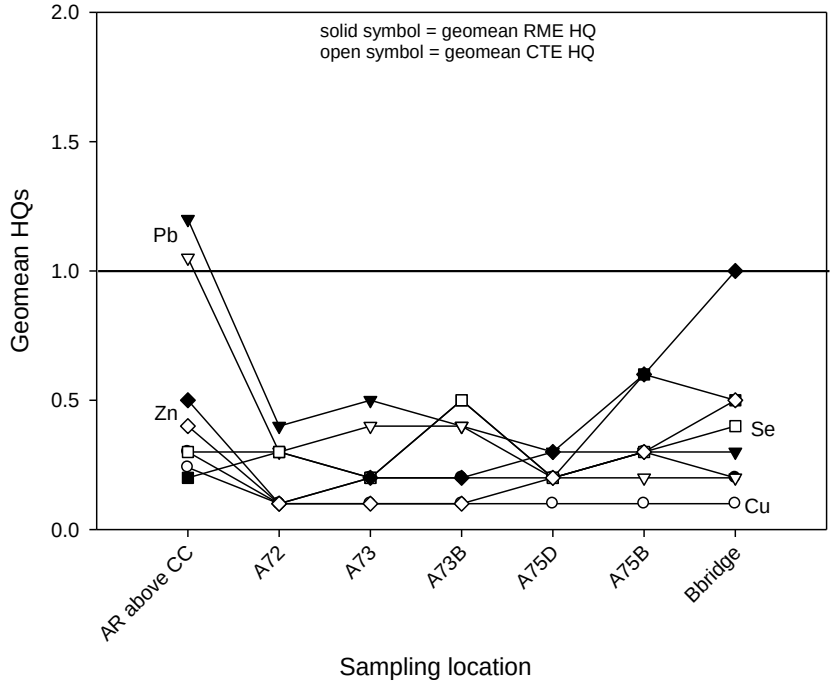


Figure 5.13 (cont'd): Geometric mean RME and CTE HQs for the four wildlife receptors evaluated using food chain modeling

Figure 5.13.c: Geometric mean RME and CTE HQs for the muskrat feeding in the Animas River above Cement Creek and below Mineral Creek

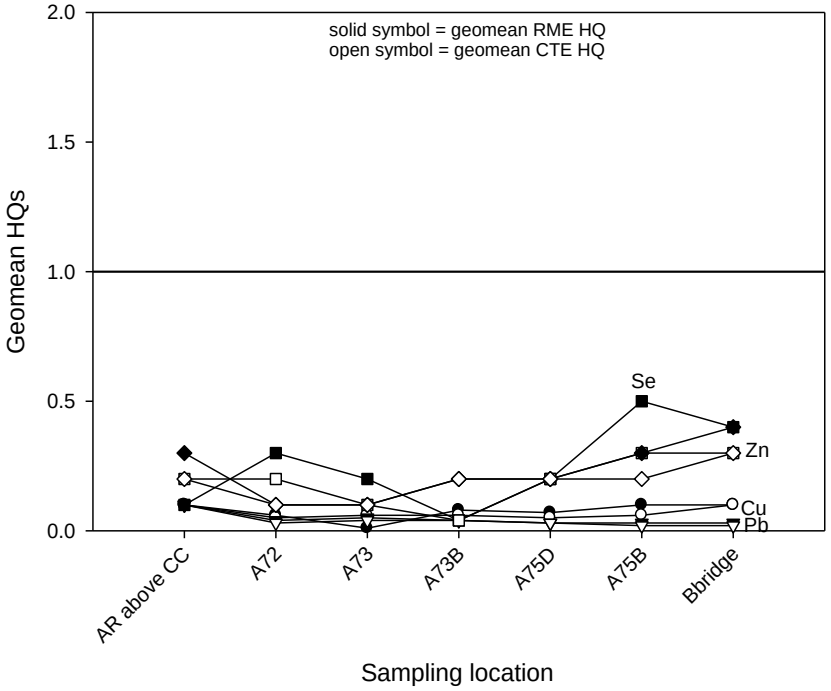


Figure 5.13.d: Geometric mean RME and CTE HQs for the mallard feeding on a 100% benthic invertebrate diet in the Animas River above Cement Cr. and below Mineral Cr.

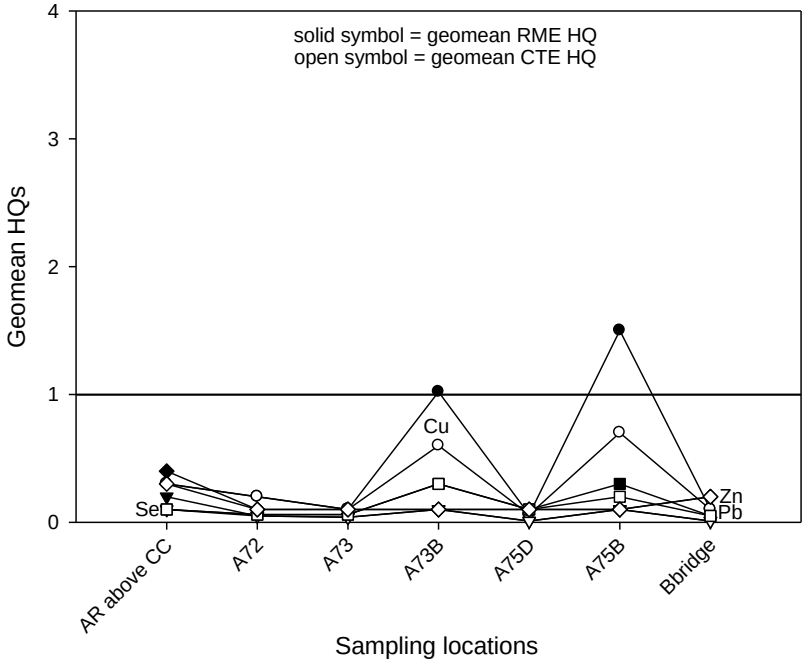


Figure 5.13 (cont'd): Geometric mean RME and CTE HQs for the four wildlife receptors evaluated using food chain modeling

Figure 5.13.e: Geometric mean RME and CTE HQs for the mallard (50%-50% diet) feeding in the Animas River above Cement Creek and below Mineral Creek