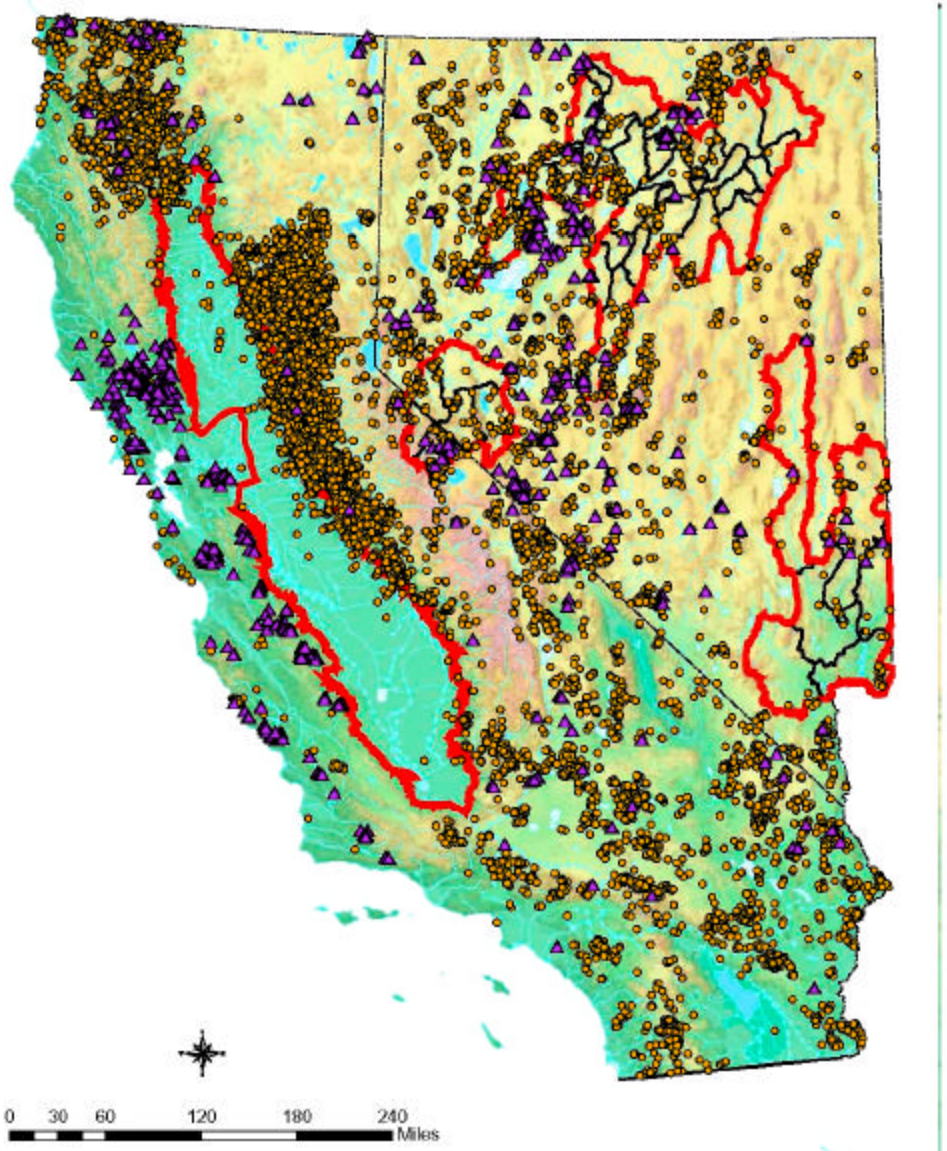
DISTRIBUTION OF MERCURY IN USEPA REGION IX R-EMAP STUDY AREAS

Robert K. Hall[1], Anthony Olsen[2], Daniel T. Heggem[3], Peter Husby[4], and Linda Chambers[5]

[1]USEPA Region IX, San Francisco, CA 94105
[2]USEPA NHEERL-WED 200 SW 35th St., Corvallis, OR 97333
[3]University of Nevada, Reno, NV 89557
[4]USEPA Region IX Laboratory, Richmond CA 94804
[5]USEPA Region IX, San Francisco, CA 94105

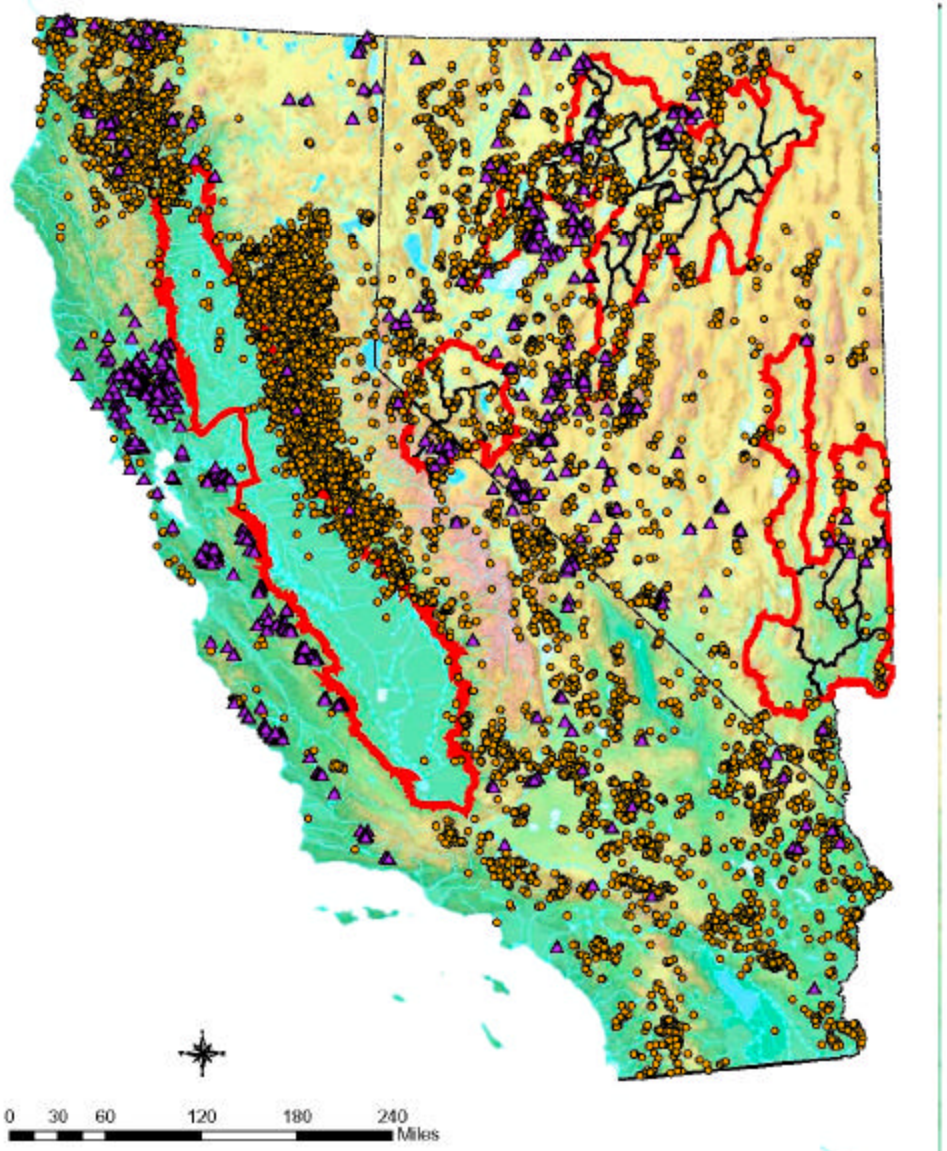
Figure 1
Location Map of Gold and Mercury Mines in California and Nevada from the USGS Mineral Assessment System (MAS) Database.



Mining in California

- **Mercury mining occurred in the Coast Ranges transported across the valley to the Sierra Nevada gold mining operations.**
- **Majority of mercury lost to the environment is from hydraulic mining.**
- **Significant amount of Gold Rush era mercury still exists in the northwestern Sierra Nevada watersheds. Concentrations in streams has decreased do to trapping by foothill reservoirs.**
- **The distribution of mercury in the Central Valley was deposited prior to the construction of the dams.**
- **And/or the Coast Range rather than the Sierras is the dominant source of mercury to the central Valley.**

Figure 1
Location Map of Gold and Mercury Mines in California and Nevada from the USGS Mineral Assessment System (MAS) Database.



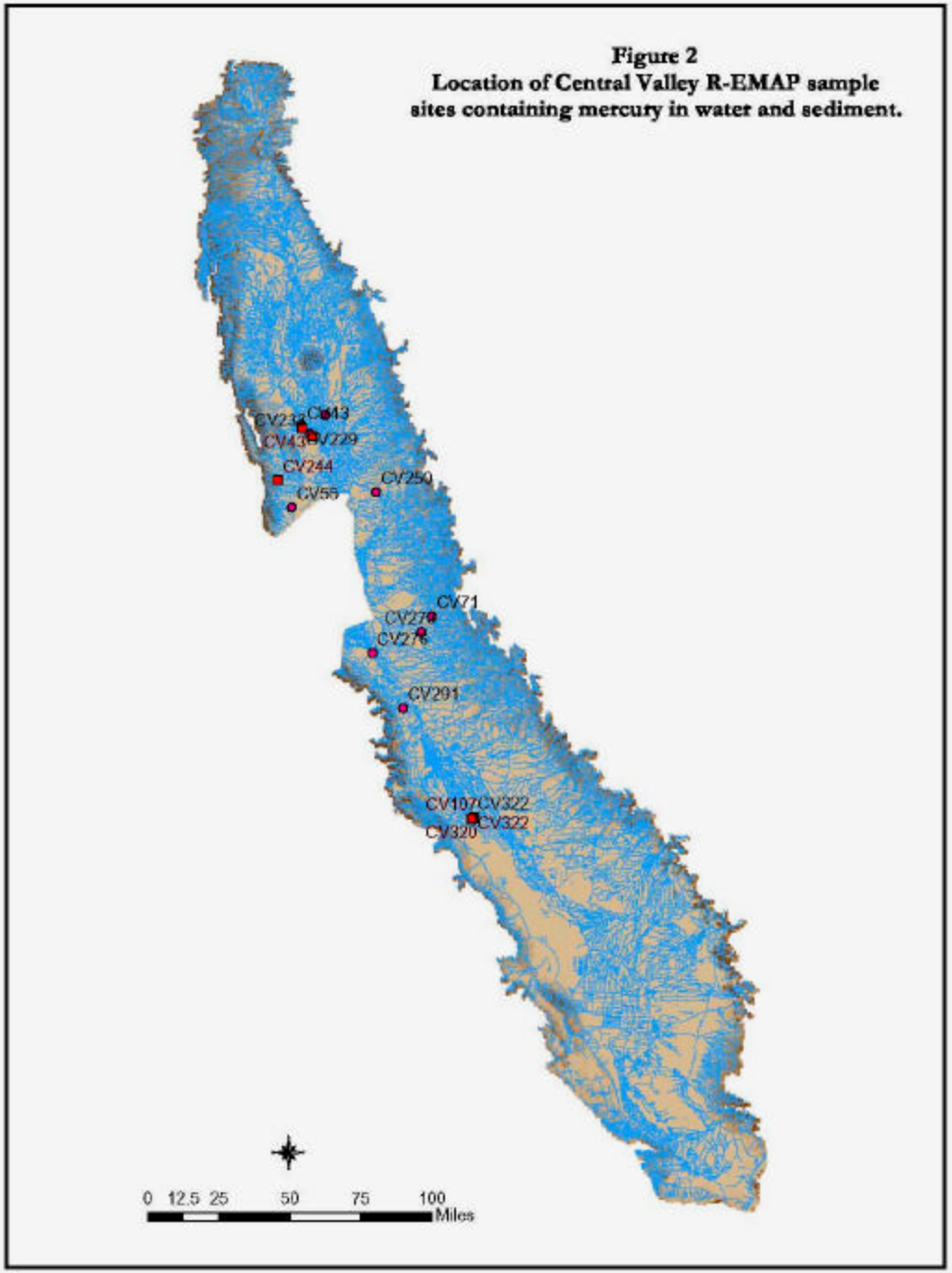
Distribution of Mercury in the Central Valley, CA

- **In the Central Valley drainages, total mercury concentrations in water range from 0.12-0.32 ug/L, in sediment concentrations range from 0.07 – 0.66 mg/kg dry weight.**

- **Predominant point sources of mercury are associated with abandoned mercury and gold mines in the Coast Ranges and Sierras.**

Site ID	Mercury (Hg) ug/L	Mercury (Hg) mg/Kg dry weight
* CV43	0.12	0.09
CV55	0.14	ND
* CV71	0.13	ND
CV107	ND	**0.30**
CV227	0.32	ND
CV229	0.32	ND
CV233	0.14	ND
CV235	ND	0.12
CV244	ND	0.14
CV250	0.27	ND
CV273S2	0.26	ND
CV276	0.11	ND
CV291	0.18	ND
CV320	ND	**0.66**
* CV322	0.14	**0.31**

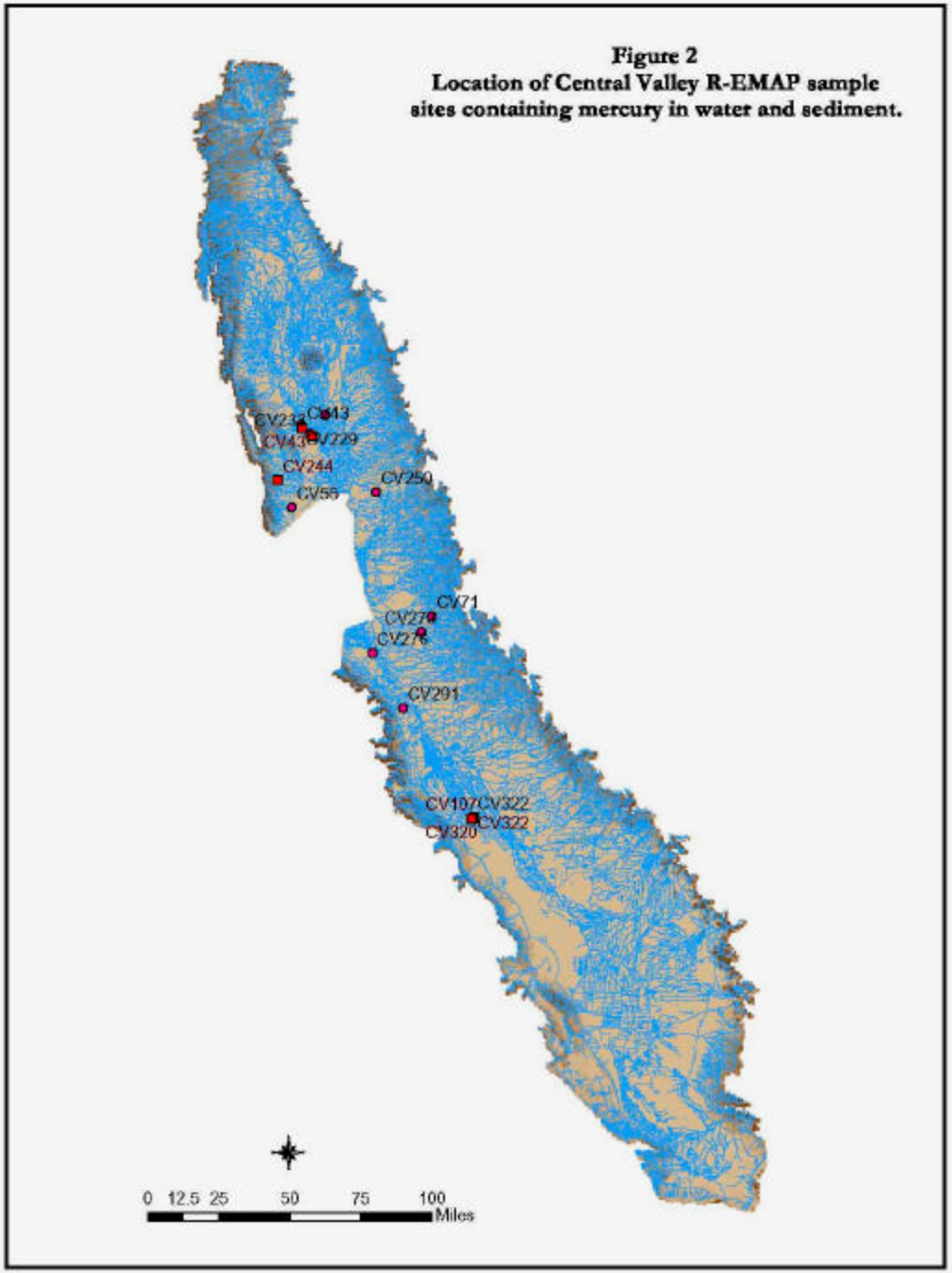
Figure 2
Location of Central Valley R-EMAP sample sites containing mercury in water and sediment.



Distribution of Mercury in the Sacramento Basin, Central Valley, CA

- **In the Sacramento River Watershed agricultural water is taken from all of the river drainages from the Sierra Mountains and coast ranges.**
- **Predominate crop in the Sacramento Basin is rice.**
- **A significant source of mercury to the Central Valley is Cache Creek, to the west, which drains Clear Lake.**

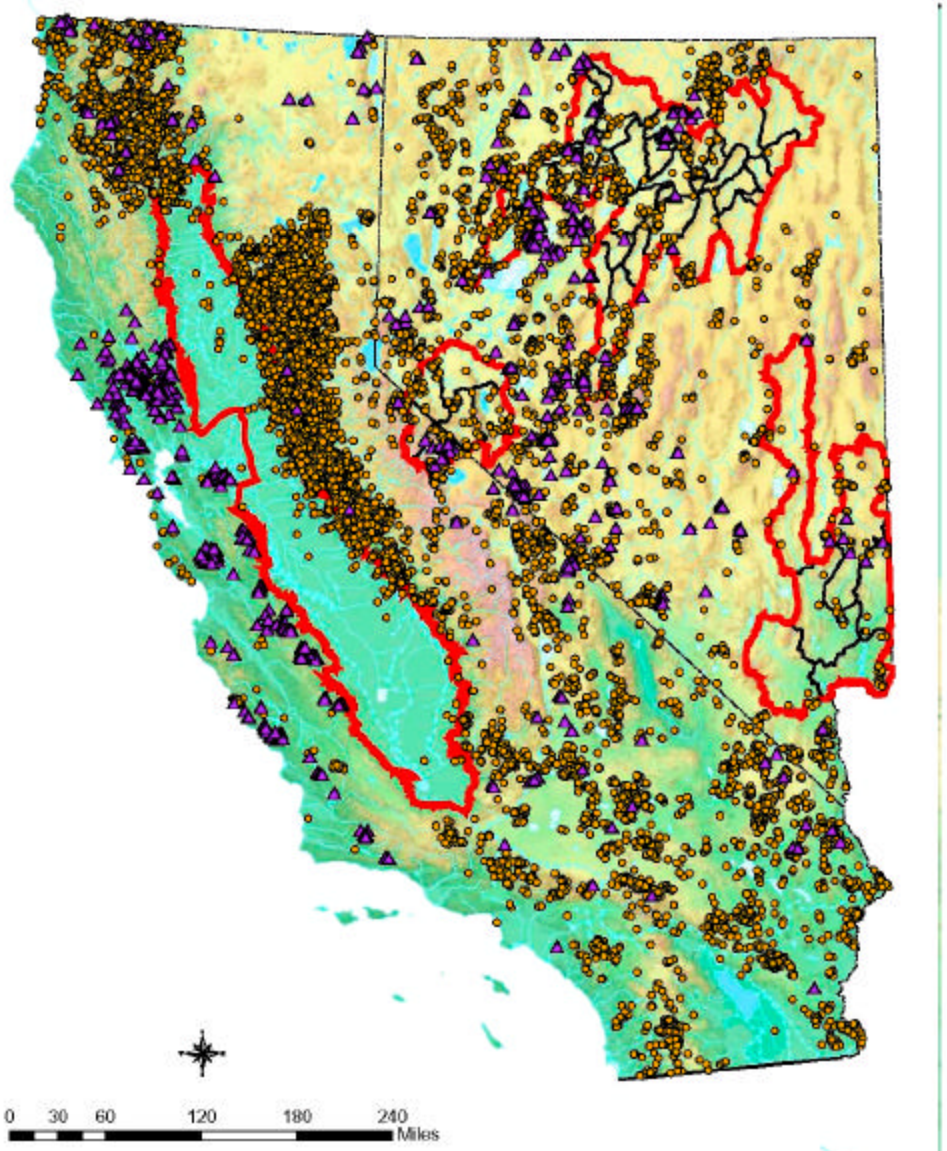
Figure 2
Location of Central Valley R-EMAP sample sites containing mercury in water and sediment.



Mining in Nevada

- **Nevada is the third largest producer of Gold in the World.**
- **The Humboldt Basin is the fifth largest Gold producing region in the World. Major modern mining activity occurs in the Reese River, south of Battle Mountain and in the Carlin Trend area.**
- **Walker, Muddy and Virgin watersheds have historical mine sites throughout the watersheds.**
- **Historical Mining Camps of Bodie and Auroura are in the East Fork Walker River.**

Figure 1
Location Map of Gold and Mercury Mines in California and Nevada from the USGS Mineral Assessment System (MAS) Database.

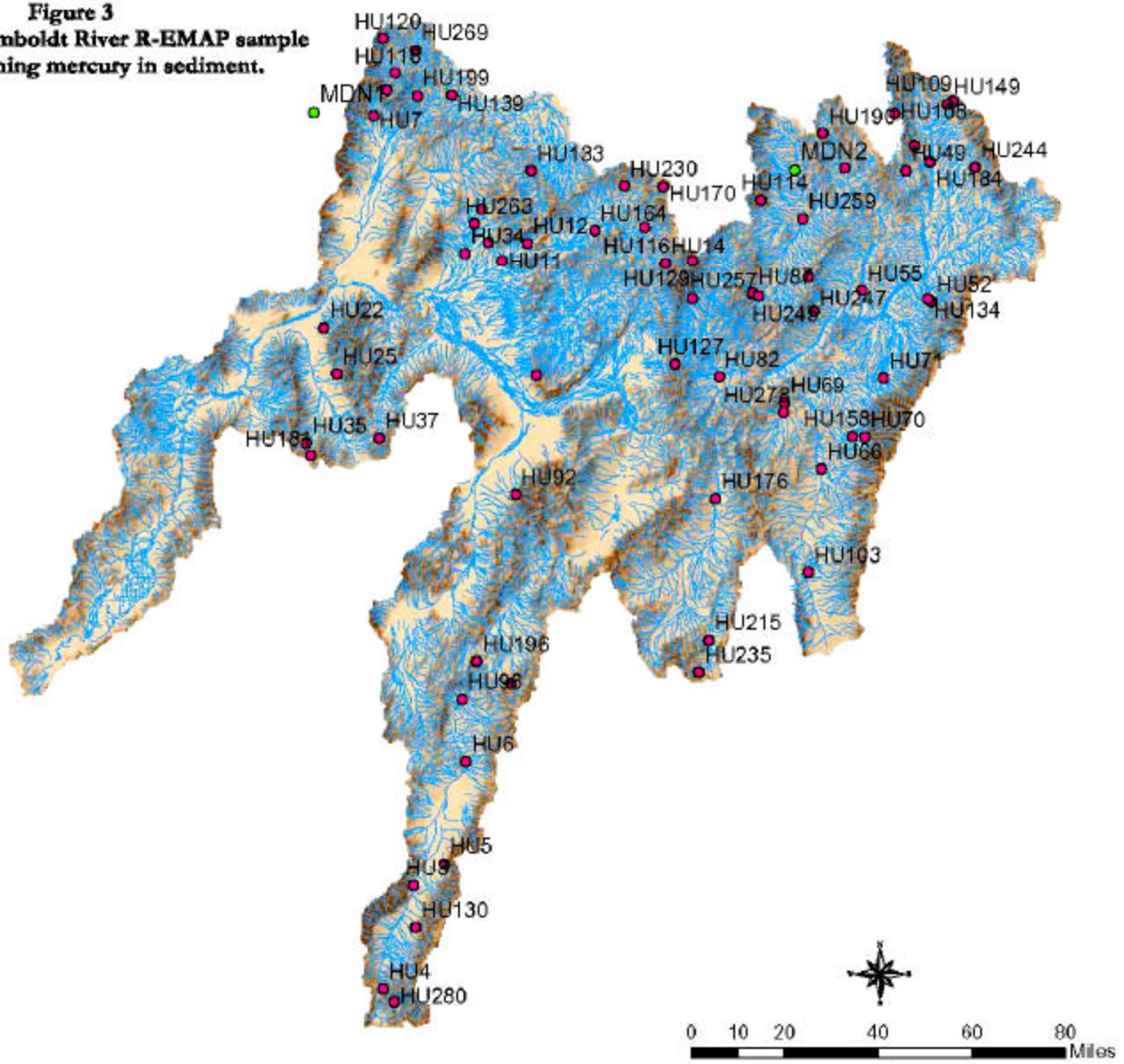


Distribution of Mercury in the Humboldt Basin

- **The Humboldt River drainage, located in northern Nevada, encompasses nearly 1/3 of the total area of the State of Nevada.**
- **The Humboldt River is the largest system that begins and ends in continental U.S.**
- **Mercury was analyzed in water and sediment samples from 35 randomly selected sites.**
- **Mercury concentrations in water were below the MDL of 0.1 ug/L in all samples.**
- **Mercury in sediment was detected at 26 sites ranging in concentration from 0.07 - 1.50 mg/Kg**

Site ID	Mercury mg/Kg dry weight
HU3	0.14
HU4	0.16
HU5	0.12
HU6	**1.40**
HU7	0.12
HU11	0.17
HU12	0.18
HU14	**0.35**
HU15	0.14
HU22	**0.22**
HU29	0.18
HU34	**0.50**
HU37	0.18
HU49	**1.50**
HU53	0.15
HU55	0.09
HU66	0.19
HU82	0.09
HU92	0.11
HU101	0.16
HU103	0.11
HU108	0.16
HU109	0.10
HU116	**0.27**
HU118	0.09
HU120	0.10

Figure 3
Location of Humboldt River R-EMAP sample sites containing mercury in sediment.



Selected Nevada Mercury Mines

Mine Name (Owner)	Pounds of Mercury Released to the Atmosphere (TRI, 1999)	Ounces Gold Produced per Year
Carlin Operations (Newmont)	460	1,575,391
Betze-Post Mine (Barrick)	1500	1,498,683
Jerritt Canyon Mine (Independence)	9400	347,000

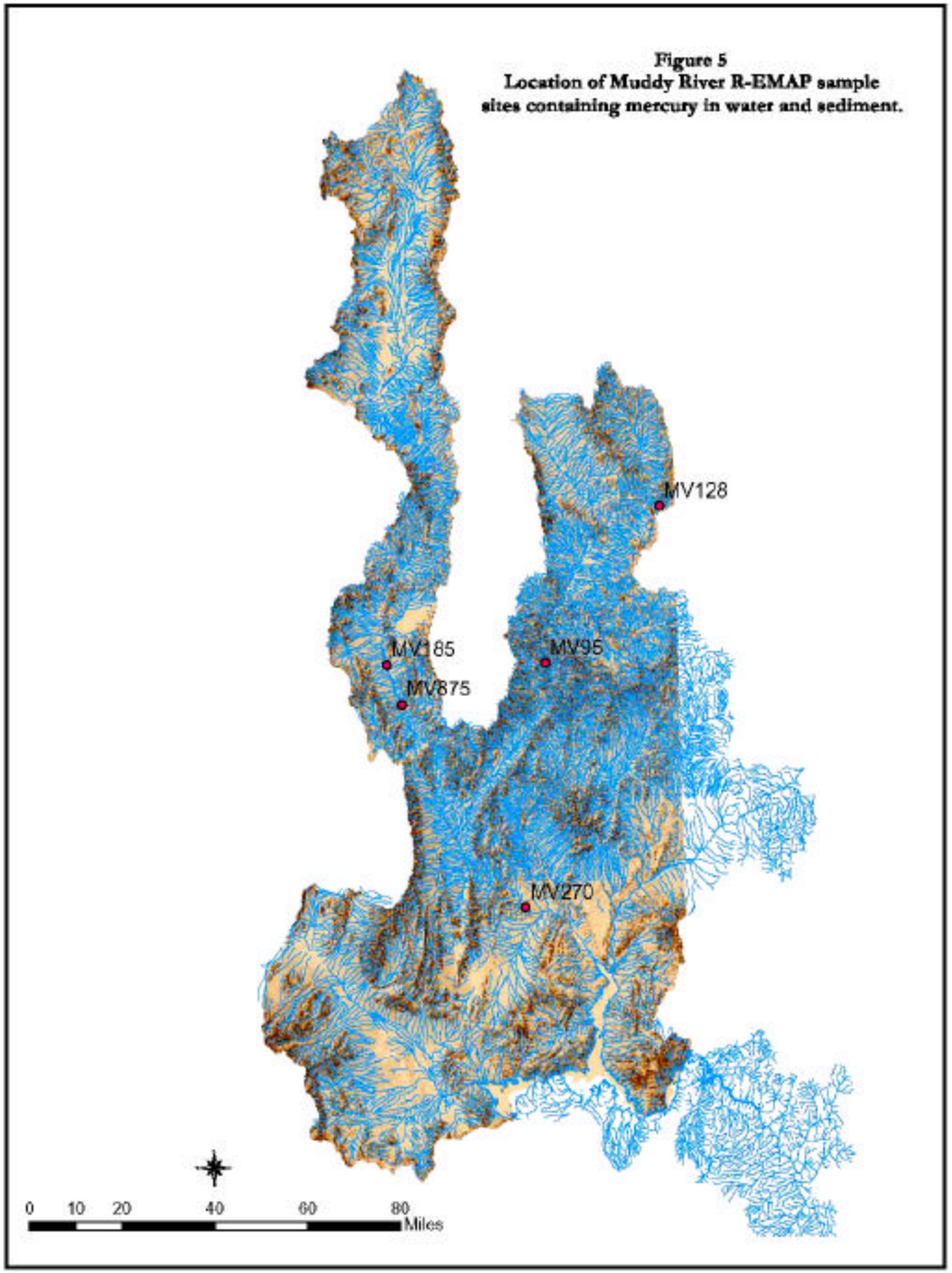
Figure 4
Location of Walker River R-EMAP sample sites containing mercury in sediment.

Site ID	Mercury (Hg) mg/Kg dry weight
* WA8	**0.67**
* WA28	**0.60**
* WA32	**0.78**
WA60	0.08
WA75	0.18
WA80	0.10
WA111	0.11

Distribution of Mercury in the Walker Basin

- **Walker River Watershed headwaters in the east-central portion of the Sierra Nevada mountains, California, and terminates in Walker Lake, NV**
- **Mercury occurs in 7 of 28 sites ranging from 0.1-0.78 mg/Kg dry weight.**
- **Site 28 (0.6 mg/Kg) is located on Bodie Creek a few miles downstream from the historic mining town of Bodie, CA.**
- **Site 8 (0.67 mg/Kg) is also on Bodie Creek below the confluence with Aurora Creek, which drains the historic mining town of Aurora.**
- **Site 32 (0.78 mg/kg) is located on the East Fork of the Walker River below the confluence with Bodie Creek.**
- **Hg_T throughout the watershed indicates the primary source of mercury is from historical mining sites.**

Figure 5
Location of Muddy River R-EMAP sample sites containing mercury in water and sediment.



Distribution of Mercury in the San Joaquin Basin, Central Valley, CA

- **Mercury was located at 7 sites in the San Joaquin Basin**
- **Site 71, San Joaquin Basin, is located on a cattle ranch on the east of the valley. The site is just blow a small beaver dam, and a livestock watering impoundment. Located several miles up stream is the California Gold Dredge placer mine.**
- **At three other sites in the San Joaquin Hg_T in sediment ranged from 0.3-0.66 mg/kg. Of these 3 sites only Site 322 had detectable mercury concentration 0.14 ug/L in the water column.**
- **Sulfate concentrations at sites 107 and 320 were 1490 mg/L and 3160 mg/L respectively the highest measured in the Central Valley study area. Sulfate concentration at Site 322 is 35 mg/L.**

Site ID	Mercury (Hg) ug/L	Mercury (Hg) mg/Kg dry weight
MV95	ND	0.10
MV128	ND	0.08
MV185	ND	**0.80**
* MV270	0.41	ND
MV875	ND	**0.20**

Distribution of Mercury in the Muddy and Virgin Basins

- **Muddy River Watershed study area included the Muddy River, White River, Pahranagat Wash, lower reaches of the Virgin River, Meadow Valley Wash and Las Vegas Wash.**

- **Mercury was detected in 5 of 37 sites, 4 in sediment Hg_T concentrations ranging 0.08-0.80 mg/Kg dry weight, and 1 site with a Hg_T concentration of 0.41 ug/L.**

- **Sites 95, 128, 185 and 875 are downstream of historic mine sites.**

- **Site 270 (0.41 ug/L) had a No Detect for mercury in sediment. Site 270 is located on the Muddy River below a stock watering pond. Land use upstream of Site 270 are agriculture, dairy and a landfill.**

Conclusion

- **Vast quantities of mercury from historic mining operations have been released to the environment.**
- **In the Central Valley, the distribution of mercury laden water through the canals, ditches and drains is an import transport mechanism in distributing mercury from a source to a potential sink.**
- **In the Humboldt Basin mercury distribution is indicative of the general geology and air transport appears to be the primary transport mechanism.**
- **The U.S. EPA Region IX R-EMAP synoptic survey indicates historic mining in California and Nevada is a point source of Hg_T in streams.**