

Initial Study Report Meeting

Study 5.7 Mercury Assessment and Potential for Bioaccumulation

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Study 5.7 Objectives

- Summarize **available and historic mercury information** for the Susitna River basin, including data collection from the 1980s Alaska Power Authority (APA) Susitna Hydroelectric Project
- **Characterize the baseline mercury concentrations** of the Susitna River and tributaries. This will include collection and analyses of vegetation, soil, water, sediment pore water, sediment, piscivorous birds and mammals, and fish tissue samples for mercury
- Utilize **available geologic information** to determine if a mineralogical **source of mercury** exists within the inundation area
- **Map mercury concentrations** of soils and vegetation within the proposed inundation area. This information will be used to develop maps of where mercury methylation may occur
- Use the **water quality model to predict** where in the reservoir **conditions** (pH, dissolved oxygen [DO], turnover) are likely **to be conducive to MeHg formation**
- Use **modeling to estimate MeHg** concentrations in fish.
- **Assess potential pathways for MeHg** to migrate to the surrounding environment
- **Coordinate study results with other study areas**, including fish, instream flow, and other piscivorous bird and mammal studies

Study 5.7 Components

- Vegetation (ISR Part A, Section 4.2.1; pg 3)
- Soil (ISR Part A, Section 4.2.2; pg 3)
- Water (ISR Part A, Section 4.2.3; pg 4)
- Sediment and Sediment Porewater (ISR Part A, Section 4.2.4; pg 7)
- Piscivorous Birds and Mammals (ISR Part A, Section 4.2.5; pg 8)
- Fish Tissue (ISR Part A, Section 4.2.6; pg 9)

Study 5.7 Variances

- Table 5.7-5 in Study Plan Section 5.7.4.2.3 summarizes the proposed water sampling locations for mercury analysis in water. PRM 225.5 (Susitna near Cantwell) could not be sampled due to limited access by helicopter. The sample site was relocated to PRM 235.2 (Susitna River adjacent to Oshetna Creek). See subsection 4.2.3.4 in this ISR.
- RSP Section 5.5.4.4.2 indicated that water samples would be collected at three locations along each transect for mainstem samples. Water samples were collected from just one position in the river due to limited access by wading at PRM 235.2 (Susitna River adjacent to Oshetna Creek) and 187.2 (Susitna at Watana Dam site). See subsection 4.2.3.4 in this ISR.
- Study Plan Attachment 5-1 indicated that an Ekman dredge or modified Van Veen grab sampler would be deployed from a boat; however, this approach was impractical and other approaches (wading) were employed (as identified in the QAPP). See subsection 4.2.4.1 in this ISR.
- EPA Method 1631 recommends digestion of mineral soil with aqua regia and oxidized with bromine monochloride (BrCl) to extract mercury from samples for analyses. The soil samples collected in 2013 contained a significant fraction of peat and organic material mixed with soil. For these types of organic soils, EPA recommends digestion with HNO₃/H₂SO₄ digestion before using BrCl. Given the soil was a mix of organic and inorganic components, each sample was split and analyzed them using both digestion methods, giving two analytical results for each sample.

Study 5.7 Variances

- RSP Section 5.7.4.6.1 indicated seven to ten of each target species of fish would be collected; however, additional fish were collected for some species (Arctic grayling and round whitefish). The Study Plan also indicated that only adult fish would be collected; however, some juvenile specimens were incidentally collected. While most were released, if a juvenile fish was captured accidentally and died, it was analyzed.
- The Study Plan indicated that all fish would be speciated; however, two fish could not be successfully speciated. Also, it was not possible to successfully extract otoliths from all fish captured; however, sufficient otolith data is available from other studies.
- The Study Plan required determination of the sex and sexual maturity of the fish, however, determination of gender for the fish proved to be problematic in the field, and the sex of only 12 fish was determined. The proposed field collection period for fish was from August to September; however, the sample period was extended into October to obtain sufficient samples. Polyethylene sheets rather than Teflon sheets were used for the fish when placed in the sample bag. See subsection 4.2.6.1.

Study 5.7 Summary of Results in ISR (ISR Study 5.7, Part A – Section 5)

- Samples collected in 2013 include:
 - Vegetation and soil samples collected from ten locations at five different sites within each location.
 - Water quality samples collected from 17 baseline sites and 7 focus areas.
 - Sediment and sediment porewater samples collected from 4 sites.
 - 60 fish tissue samples collected including tissues from trout, longnose sucker, Dolly Varden, Arctic grayling, slimy sculpin, burbot, and whitefish.
- 2013 Lab results for mercury concentrations in vegetation, soil, water, sediment, sediment porewater, and fish tissue were not received in time for inclusion in the ISR. Results have been QA/QCd and will be included in the USR.

Study 5.7 Summary of Results since ISR

(Evaluation of Continued Mercury Monitoring Beyond 2014, September 2014 Tech Memo)

- Average concentration of dissolved mercury in the water column was 1.06 ng/L from 2013 results . This concentration is substantially lower than the criterion for chronic effects.
- The average sediment mercury result was 23.01 ng/g . One result from mercury in sediment (220 ng/g) exceeded the recommended SQuiRT Threshold from a total of 13 results.
- Background information for mercury in fish tissue was acquired from recent fish tissue analysis by ADEC with results ranging from 29.07ng/g (total mercury in Sockeye salmon) – 380.0 ng/g (total mercury in lake trout) in the Susitna Drainage (ADEC 2012). The average concentration among several species of fish sampled in 2013 from the Susitna drainage was within the range described by ADEC.

Study 5.7 Summary of Results since ISR Cont.

(Evaluation of Continued Mercury Monitoring Beyond 2014, September 2014 Tech Memo)

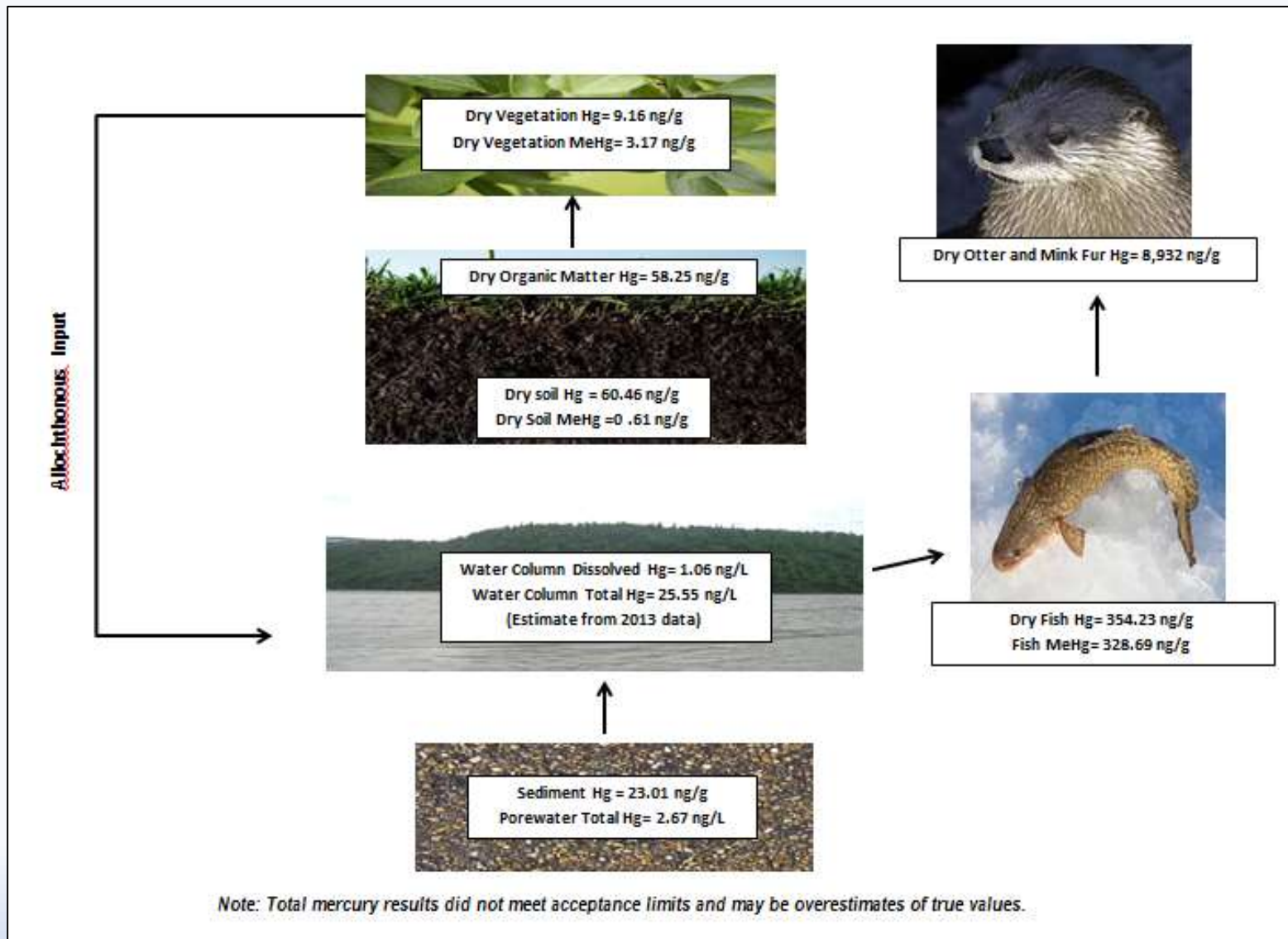
Sample Matrix	Max (ng/g dry or ng/L wet)	Min (ng/g dry or ng/L wet)	Criteria or Threshold
Hg in Dry Vegetation	16.1	6.71	
MeHg in Dry Vegetation	5.15	2.54	
Hg in Dry Organic Matter	129	26.8	
Hg in Dry Soil	119	27.1	
MeHg in Dry Soil	4.34	0.096	
¹ Dissolved Hg in Water Column	58.7	0.5	Acute = 2,040 ng/L
Total Recoverable Hg in Water Column	See note ²	See note ²	Aquatic Life: Chronic = 12 ng/L Acute = 2,400 ng/L Human Health = 50 ng/L
Hg in Sediment	220	1.82	(SQuiRT) 174 ng/g
Hg in Sediment Porewater	12.5	0.5	
Dry Fish Tissue Hg (no liver included)	2,920	26.9	³ 29.07 ng/g – 380 ng/g
Dry Fish MeHg (no liver included)	2,860	25.2	
Dry Otter/Mink Fur Hg	29,950	2070	

¹ Dissolved acute criterion is 85% of total recoverable mercury.

² Based on results from 2013 sampling, the total mercury concentrations for 2013 from water column samples are considered high estimates as results did not meet acceptance limits for laboratory performance. A correction factor will be developed for the 2013 results following QA/QC review of 2014 data

³ Indicates range of total mercury reported from ADEC (2012) Susitna Basin study from several species with minimum concentration in Sockeye Salmon and maximum concentration in lake trout. (not an AWQS).

Study 5.7 Summary of Results since ISR Cont.



AEA Proposed Modifications to Study 5.7 in ISR (ISR Study 5.7, Part C – Section 7.1.2)

7.1.2.1. Extension of Mercury Water Quality Sampling

- “Estimated” laboratory results call for more total mercury sampling in 2014 (change from RSP Section 5.7.4.2.3.)
 - Parameters affected: total metals (except Ca and Mg), total mercury, total phosphorus, total Kjeldahl nitrogen, total nitrate+nitrite-nitrogen, and dissolved aluminum

7.1.2.2. In-Accessible Sediment Sampling Locations

- Six sediment samples (planned for 2013) located on CIRWG lands will be collected for mercury analysis in 2014 (change from RSP Section 5.7.4.2.4.)

7.1.2.3. Modifications to Sediment Sampling Methods

- Originally planned to use a Van Veen sampler lowered from a boat (RSP Section 5.7.4.2.4.), but a boat in the upper river has proven impractical
 - Back to sediment sampling methods used in 2013 (ISR 5.5; Section 4.5)

AEA Proposed Modifications to Study 5.7 in ISR (ISR Study 5.7, Part C – Section 7.1.2) (Continued)

7.1.2.4. Modification of Sediment, Water, and Porewater Sampling Locations

- Sample locations for water, sediment, and sediment porewater sites in Upper River were modified slightly due to lack of access
 - Available data shows river as well mixed and water quality to have little variability

7.1.2.5. Modification of Fish Tissue Sampling

- Previous fish sampling in Upper Susitna Basin indicate humpback whitefish to be rare, they have been taken out of the study
- Rainbow trout and stickleback not found in inundation zone and also take out of the study
- Round whitefish were added to the study (all changes from RSP Section 5.7.4.6.1. and 5.5.4.7.)
- Only older aged burbot were caught, no younger (no additional sampling planned)

AEA Proposed Modifications to Study 5.7 in ISR (ISR Study 5.7, Part C – Section 7.1.2)

7.1.2.6. Modification of Piscivorous Wildlife Tissue Sampling

- Initial evaluation of the potential for bioaccumulation will focus on the aquatic environment
 - Samples for mercury study collected in 2014 only from water and sediment for analysis of mercury and methylmercury
- Collection of tissue samples from piscivorous wildlife for mercury analysis described for various species groups in Studies 10.11, 10.14, 10.15, and 10.16 is being consolidated under Study 5.7
- Very few samples of river otter or mink hair have been attained (trappers and hair snags)
 - Last resort would be to hire trappers for lethal collection of animals in study area for mercury analysis

AEA Proposed Modifications to Study 5.7 in ISR (ISR Study 5.7, Part C – Section 7.1.2) (Continued)

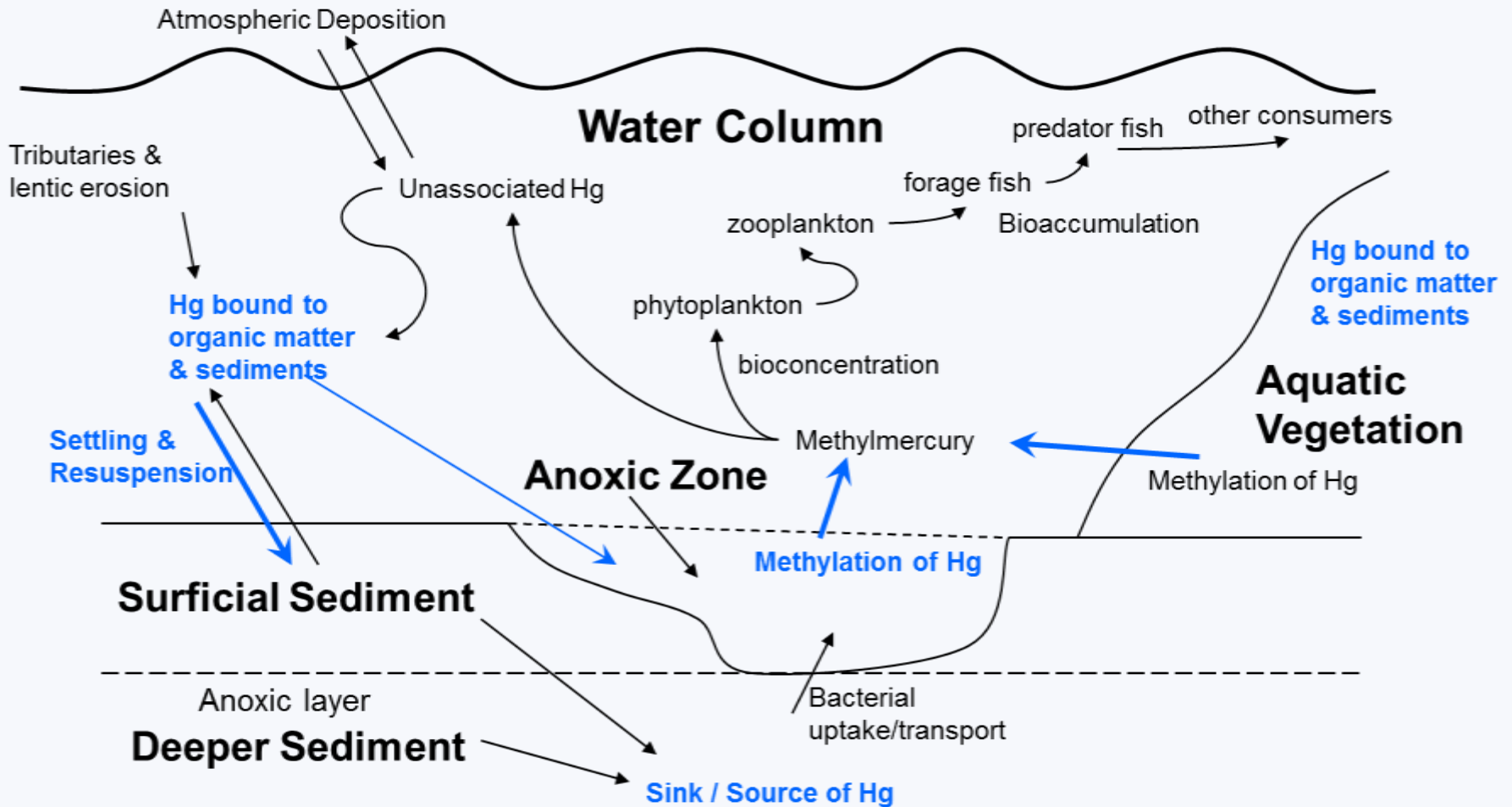
7.1.2.6. Modification of Piscivorous Wildlife Tissue Sampling

- Collecting feathers from vacated nests of piscivorous birds was found to be unproductive
 - Study 10.14 added three tasks to assist Study 5.7: provide info on distribution, abundance, foot habits and diet of piscivorous raptors, collect feather samples from active nests after nesting season for characterization of mercury levels, and provide information on the effects of methylmercury on piscivorous raptors
 - Possible use of contractor to capture live Bald Eagles to obtain blood and feather samples for mercury analysis
- Collecting feathers from vacated nests of piscivorous waterbirds (Study 10.15) was unsuccessful
 - Possible hiring of highly skilled specialty contractor to do live tissue sampling for mercury analysis
- Single target species of piscivorous landbird (Belted Kingfisher) because the species is rare and no nests were found
 - No longer considered suitable target species for mercury analysis

Current Status and Steps to Complete Study 5.7

- In 2013, vegetation, soil, and fish tissue mercury sampling was completed and referenced in the ISR Study 5.7 Section 5.
- Planned activities for 2014 as referenced in ISR Study 5.7, Part C- Section 7.1 that have been completed include
 - Collection of sediment samples at the six remaining sites located on CIRWG lands (RSP Section 5.7.4.2.4)
 - Limited winter water quality sampling occurred in January and March of 2014 (RSP Section 5.7.4.2.3)
 - Summer monthly water sampling from June to September 2014 (see ISR Section 5.5 for details)
- Pathway analysis has not yet been completed and is the next major component of this study that will determine potential sources for bioaccumulation.
- Based upon its preliminary review of the mercury results measured in each of the media, AEA is not proposing any additional sampling for mercury in 2015.

Potential Mercury Processes in Aquatic Ecosystems



Potential Mercury Pathway in a Mature Reservoir

Licensing Participants Proposed Modifications to Study 5.7?

- Agencies
- CIRWG members and Ahtna
- Public