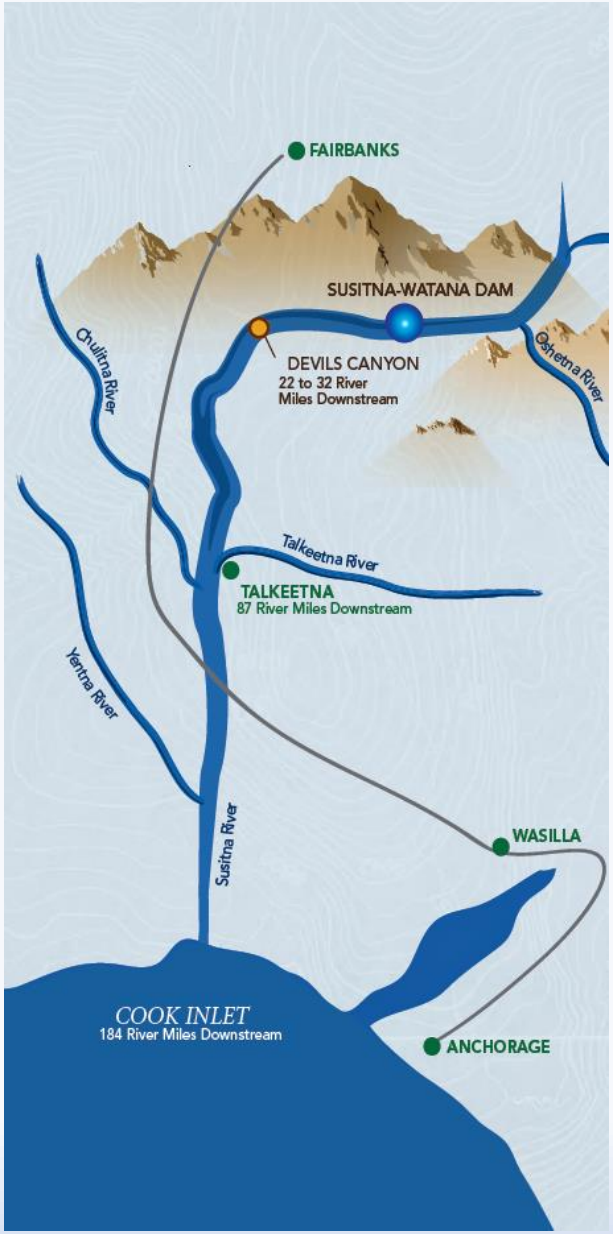


Initial Study Report Meeting

Study 5.7 Mercury Assessment and Potential for Bioaccumulation

March 23, 2016

Prepared by
URS and Tetra Tech, Inc.

Study 5.7 Status

- **ISR Documents (ISR Part D, Section 4)**
  - Initial Study Report Parts A, B, and C (Jun 3, 2014)
  - Evaluation of Continued Mercury Monitoring Beyond 2014 (Sept 30, 2014)
  - 2014-2015 Study Implementation Report (Nov 6, 2015)

- **Data collection and analyses has been completed (vegetation, soil, water, sediment/porewater, fish tissue, piscivorous mammals).**
- **Determined no geologic source for mercury in inundation zone.**
- **Completed mapping of mercury concentrations in soils and vegetation.**
- **Completed Harris and Hutchison modeling of anticipated mercury concentrations in fish post inundation.**
- **Performed pathway analyses for mechanisms by which MeHg could enter terrestrial environment.**

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)
- **Modeling**

Study 5.7 Variances

- **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) **(ISR Part A, Section 4.2.3.4).**
- Due to limited access, **water samples were collected from just one position in the river** by wading **at PRM 235.2** (Susitna River adjacent to Oshetna Creek) and **187.2** (Susitna at Watana Dam site) **(ISR Part A, Section 4.2.3.4).**
- 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) **(ISR Part A, Section 4.2.4.1).**
- 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 (EPA recommends **digestion with HNO3/H2SO4 digestion before using BrCl**). Each sample was split and **analyzed using both digestion methods**, giving two analytical results for each sample.

Study 5.7 Variances

- The Study Plan indicated that all fish would be speciated; **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, **gender for the fish proved to be problematic** in the field, and the **sex of only 12 fish was determined**. **Sample period was extended beyond September into October** to obtain sufficient samples. **Polyethylene sheets rather than Teflon sheets were used for the fish** when placed in the sample bag. **See ISR Part A, Section 4.2.6.1.**
- Water quality sampling for mercury was continued after March 2014 despite mercury concentrations not exceeding regulatory criteria or thresholds. Additional **total mercury sampling was performed in 2014 due to laboratory results that were qualified as "estimated"**.
- 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). **If incidentally captured juveniles died, they were analyzed**.

Study 5.7 Variances

- Sediment in the upper Susitna River was generally very coarse. Test pits were dug to attempt to locate the finest grained sediment for sampling. Only **30% of the samples had more than 5% fines as required** in the Study Plan. This **does not appear to have adversely impacted the study results** because mercury concentrations in the sediments appear to be only poorly correlated with grain size.
- Sample locations for sediment, and sediment porewater **sites in the Upper River were modified slightly due to lack of access** (landing access for helicopters, river stage levels, property ownership, and boat availability) (ISR Part A Section 4.2.4.1.). These minor relocations **did not impact AEA's ability to meet the study objectives**.
- The decision to collect additional **samples from piscivorous birds and mammals has been deferred** until the pathways analysis has been completed and a determination made as to **the potential for mercury to bioaccumulate in aquatic receptors**.
- The RSP Section 5.7.4.5 stated **hair-snag "traps" would be placed at or near the mouths of tributaries** near the proposed dam site, **including Fog, Deadman, Watana, Tsusena, Kosina, Jay, and Goose Creeks, and the Oshetna River**. During the aquatic furbearers study (Study 10.11) **evidence of aquatic furbearers (tracks) was only observed on Kosina and Deadman Creeks**. Hair snags were not placed at the remaining creeks.

Summary of Results

(SIR Section 5)

Vegetation:

- Total mercury = 7.00 to 16.1 ng/g dw
- Little correlation between plant species and mercury concentrations, little variation in species.

Soil:

- Total mercury concentrations = 27.1 to 119 ng/g dw, with a mean of 61 ng/g dw.
- Periodic detection of relatively high (> 1 ng/g) concentrations of MeHg.

Water:

- non-detect (<0.5 ng/L) to 78.3 ng/L
- Samples analyzed for dissolved mercury typically were one to two orders of magnitude lower concentration than total mercury.
- Little variation in river by location or depth.
- Concentrations of mercury generally decreased moving upriver
- Higher concentrations noted in the spring, and diminishing in the fall and winter

Summary of Results

(SIR Section 5)

Sediment:

- **1.00 to 17.4 ng/g dw.**

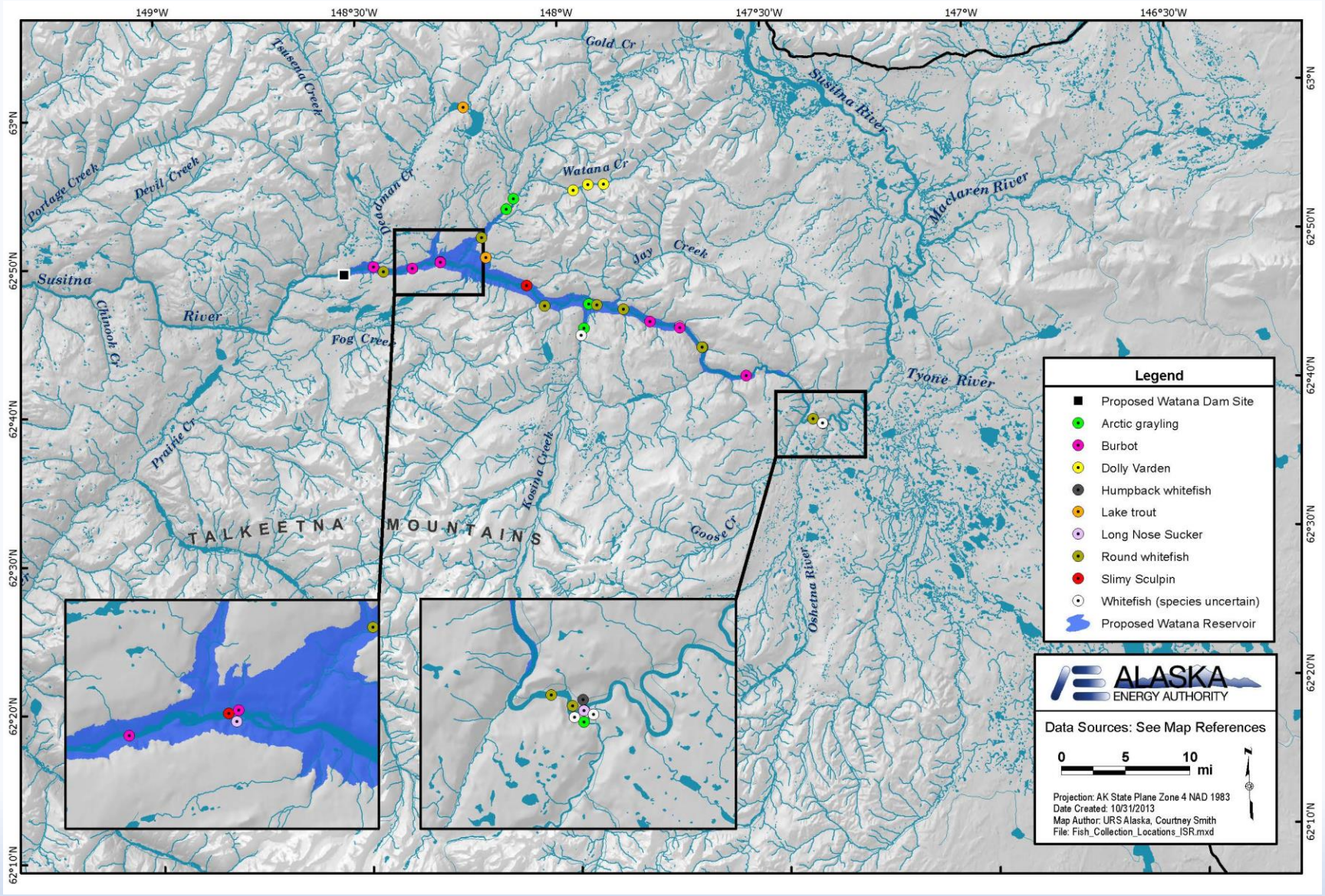
Porewater:

- Results ranged from **non-detect (< 0.51 ng/L) to 9.54 ng/L**
- 24 of the 30 analytical results under 2 ng/L

Birds and Mammals:

- No bird samples
- One river otter pelt and two mink pelts were obtained in late winter 2014
  - **6,330 to 7,670 ng/g dw**
  - Location not well recorded
- Nine hair snares were set at Kosina Creek and Deadman Creek during March/April 2014
  - The effort produced only four hairs from a single river otter
  - Total mercury = **417 ng/g ww (~1,500 ng/g dw)**.

Collection of Fish Species for Tissue Analysis



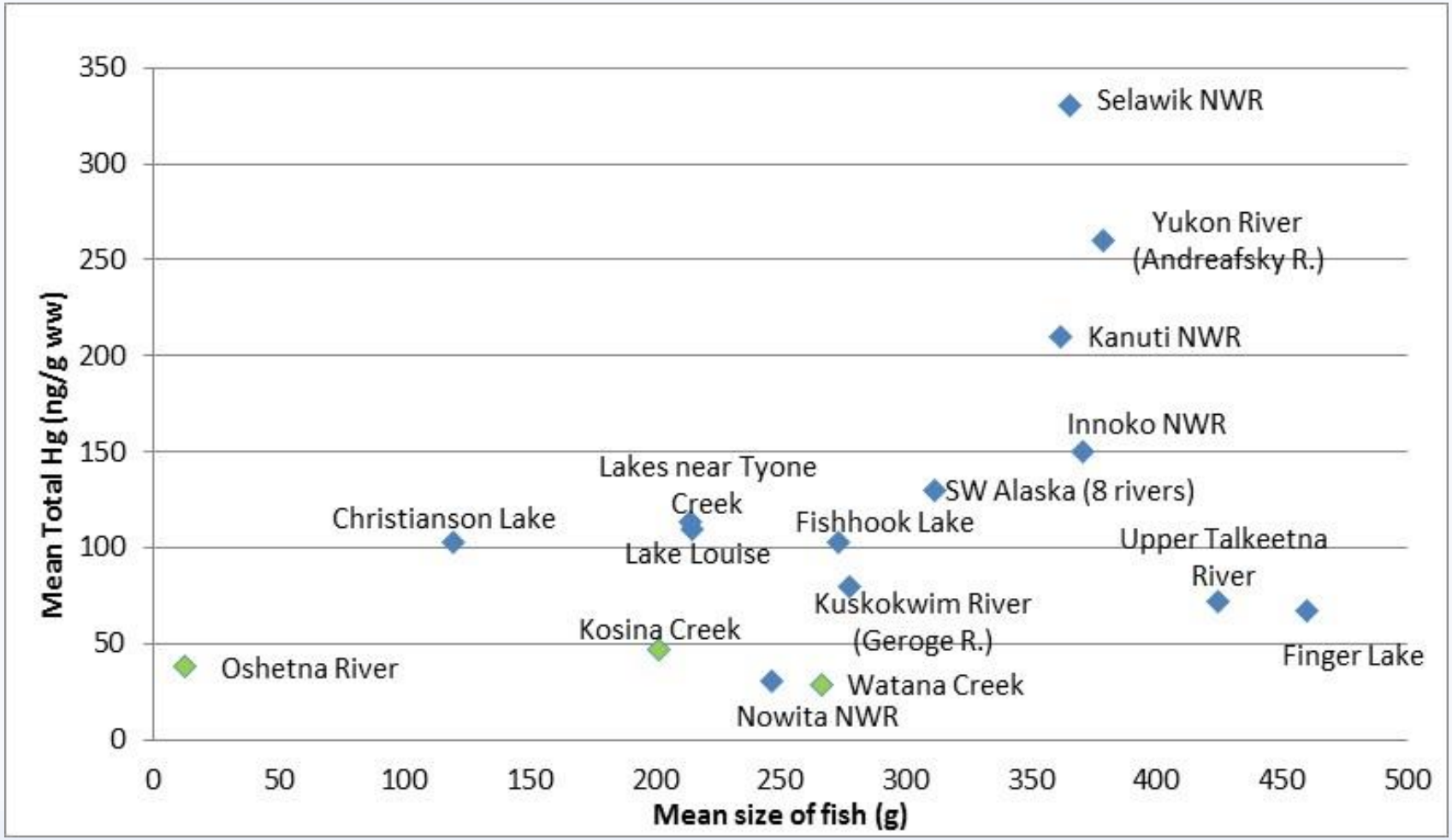
Summary of Results – Fish Tissue

(SIR Section 5.7)

- **Lake Trout (9)**
  - 7 to 26 years old, 355 to 625 mm, 500 to 2,200 g, 136 to 637 ng/g ww THg
- **Longnose Sucker (7)**
  - 7 to 10 years old, 315 to 430 mm, 303 to 500 g, 33.1 to 138 ng/g ww THg
- **Dolly Varden (7)**
  - 3 to 4 years old, 177 to 204 mm, 47 to 70 g, 20.8 to 83.7 ng/g ww THg
- **Arctic Grayling (16)**
  - 0.5 to > 8 years old, 75 to 340 mm, 12 to 385 g, 19.3 to 100 ng/g ww THg
- **Burbot (8)**
  - 3 to 5 years old, 390 to 467 mm, 312 to 553 g, 39.6 to 113 ng/g THg ww
- **Slimy Sculpin (7)**
  - Not aged, 74-100 mm, 3.4 to 6.9 g, 23.3 to 85.1 ng/g ww THg
- **Whitefish (sp) (14)**
  - 1 to 20 years old, 130 to 450 mm, 55 to 495 g, 18.3 to 102 ng/g ww THg

Summary of Results – Fish Tissue

(SIR Section 6.7)



Arctic Grayling Mean Size and Total Hg

Summary of Results – Harris & Hutchison Model

(SIR Section 6.8.1)

Maximum predicted concentration for piscivorous fish species:

- **1,047 ng/g ww THg in muscle tissue**

Maximum predicted concentration for non-piscivorous fish species:

- **212 ng/g ww THg in muscle tissue**

AK-DHSS Guidelines:

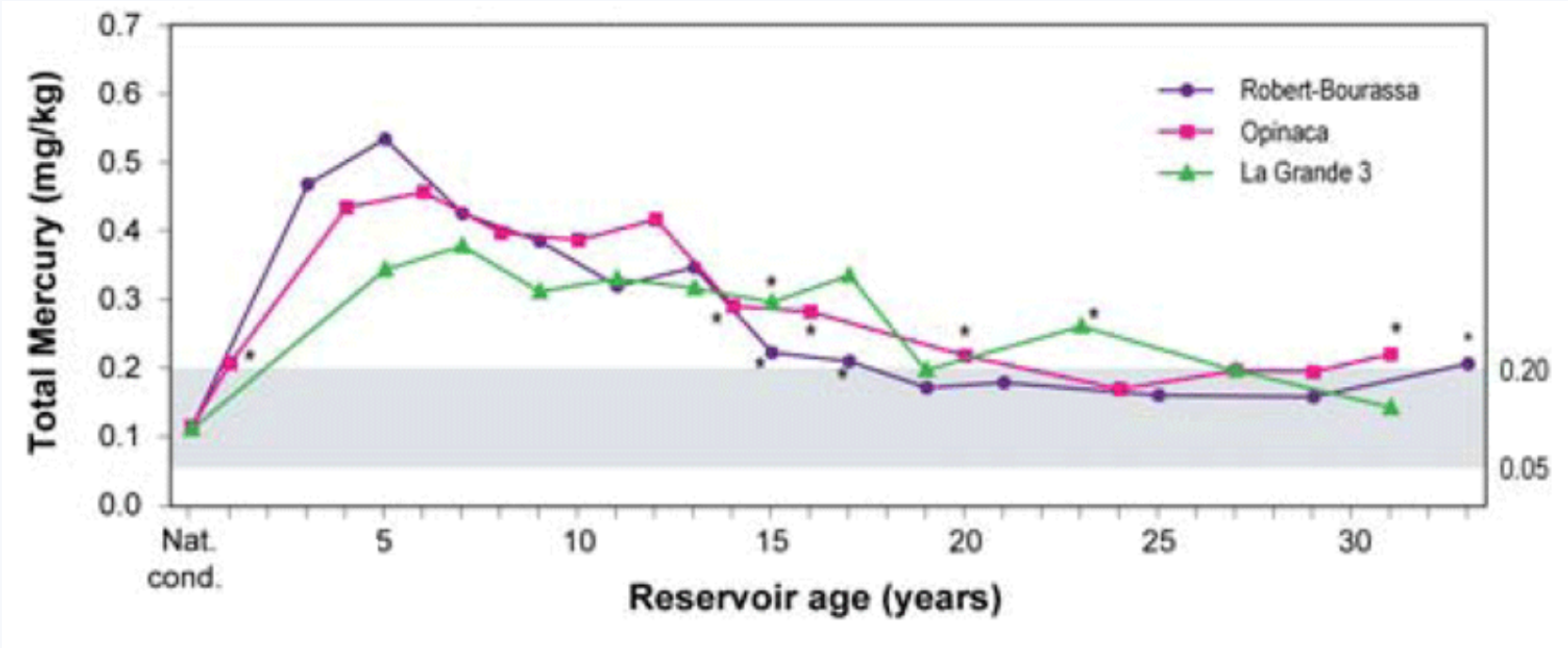
- 0 to 150 ng/g ww – unlimited fish consumption.
- 150 to 320 ng/g ww – limit to 4 meals per week.
- 320 to 400 ng/g ww – limit to 3 meals per week.
- 400 to 640 ng/g ww – limit to 2 meals per week.
- 640 to 1,230 ng/g ww – limit to 1 meal per week.
- >1,230 ng/g ww fish should not be routinely consumed.

Converting muscle data to whole body:

- 281 ng/g ww (piscivorous), and 67 ng/g ww (nonpiscivorous)
  - NOER of 200 ng/g ww (Beckvar et al. 2005)
  - LOER of 300 ng/g ww (Sandheinrich et al. 2011)

Summary of Results

(SIR Section 6.1.3)



from Hydro-Quebec, 2003

Summary of Results

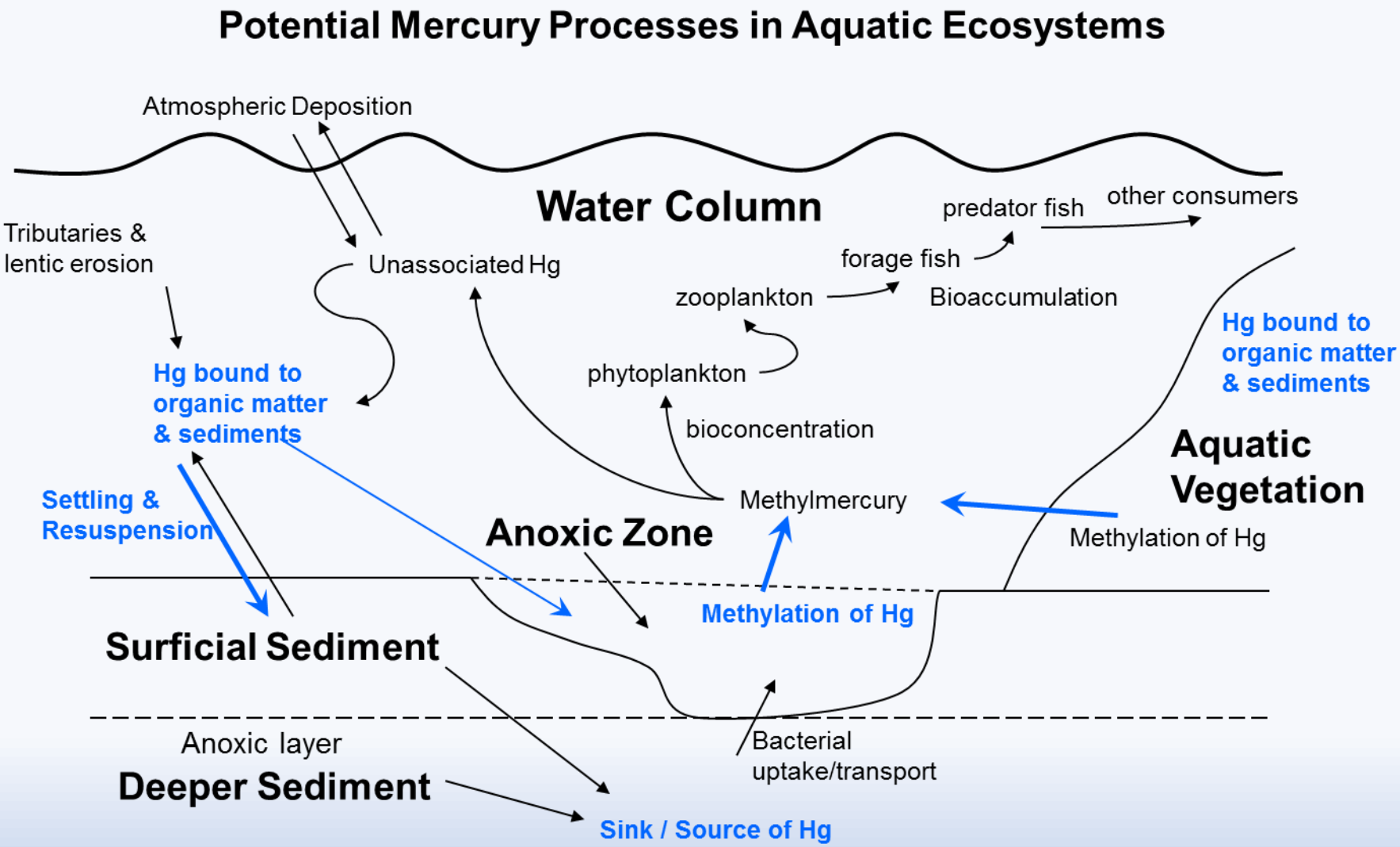
(SIR Section 6.2 – Section 6.7)

Sample Matrix	Minimum THg	Maximum THg
Vegetation	7.00 ng/g dw	16.1 ng/g dw
Soil	27.1 ng/g dw	119 ng/g dw
Surface Water	<0.5 ng/L	58.7 ng/L
Sediment	1.00 ng/g dw	17.4 ng/g dw
Sediment Porewater	<0.5 ng/L	12.5 ng/L
Non-Piscivorous Fish Tissue	78.1ng/g dw	533 ng/g dw
Piscivorous Fish Tissue	592 ng/g dw	2,920 ng/g dw
Otter/Mink Fur	~1,500 ng/g dw[1]	7,670 ng/g dw

1 estimate

Summary of Results

(SIR Section 5.8.3 & Appendix A)



AEA Proposed Modifications

(ISR Part D, Section 6.3)

- Due to the very **low occurrence of Humpback Whitefish, Rainbow Trout and Stickleback** in the study area, no additional sampling will occur for these species.

- Study objectives related to the collection of **tissue samples of piscivorous wildlife for mercury** analysis, **described in Study 10.11** (Aquatic Furbearers; RSP Section 10.11.4.3), **Study 10.14** (Eagles and Other Raptors; RSP Section 10.14.4.1), **Study 10.15** (Waterbirds; RSP Section 10.15.4.3) and **Study 10.16** (Landbirds and Shorebirds; RSP Section 10.16.4.) will be **consolidated within Study 5.7**.

AEA Proposed Modifications

(ISR Part D, Section 6.3)

- **The need for further mercury analysis of wildlife tissue** will be **re-evaluated based on the predictive modeling results** (reservoir and riverine models) and **potential for transfer** from the aquatic environment to the terrestrial environment **using pathway analysis models**.
  - **If piscivorous bird sampling is determined to be necessary (March 7, 2014 TWG Meeting Notes):**
    - **Blood and feather samples from nestlings** (using a highly experienced subcontractor) will be collected, rather than shed feathers and unhatched eggs at nests.
    - List of 10 potential target species will be reduced to **4 target species (Bald Eagle, Common Loon, and Red-breasted and Common mergansers**) based on each species' abundance within the study area and the likelihood of obtaining usable samples.

Steps to Complete Study 5.7

(ISR Part D, Section 7)

- Phosphorous release modeling for evaluating potential mercury concentrations in fish after reservoir development. Completion of this modeling is dependent on completion of the EFDC modeling (Study 5.6) for the surface water.
- Update of the pathways assessment to include information generated from EFDC modeling (Study 5.6) for the surface water.
- A decision on additional terrestrial biological sampling (mammals and birds) will be made based on the results of the two previous bullet items. Based on the results of the Harris and Hutchison modeling, as well as currently available information, additional sampling of terrestrial tissues is not necessary given that concentrations of mercury in fish tissue from current analysis are unlikely to exceed levels of concern.

Licensing Participants Proposed Modifications to Study 5.7?

- Agencies
- CIRWG members and Ahtna
- Public