Delta Mercury Control Program Stakeholder Process

Scientific Foundation for TMDL Development & Basin Planning

** Part 1 **

Michelle Wood
14 May 2009

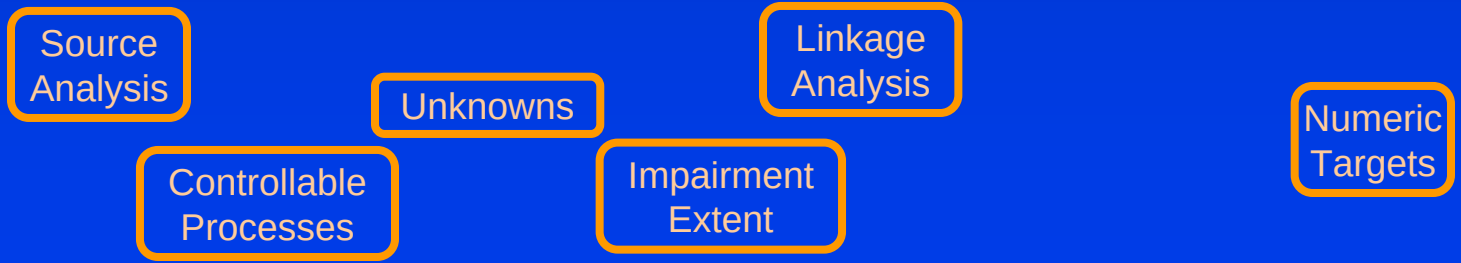
Outline

- What are the “bricks” in the scientific foundation for the TMDL?
- How is this scientific information used in developing a Basin Plan amendment?

Please ask questions as they occur to you!

Scientific Foundation

How the Scientific Information is Used



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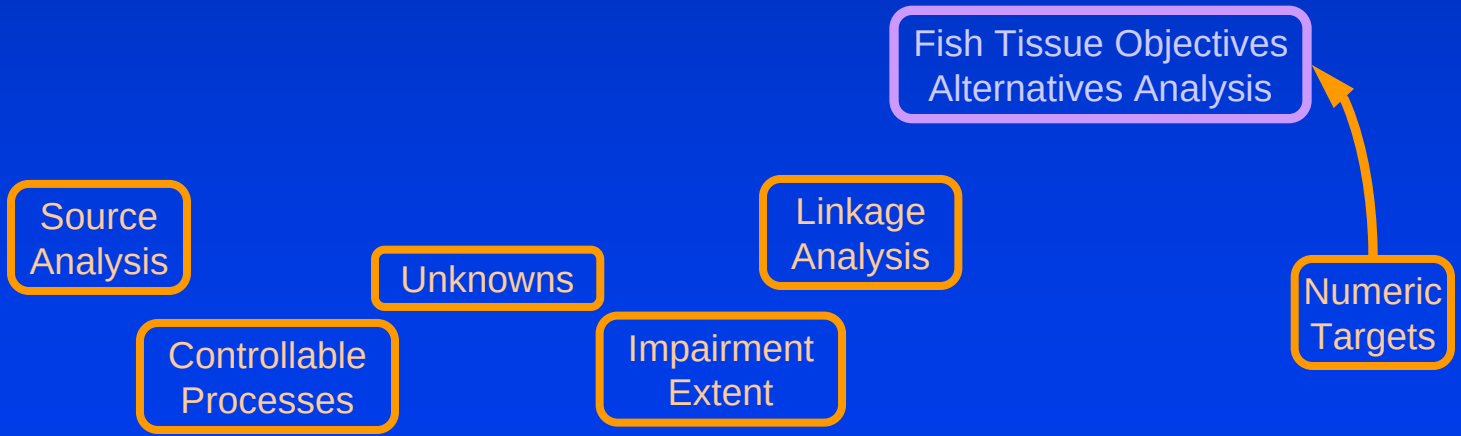

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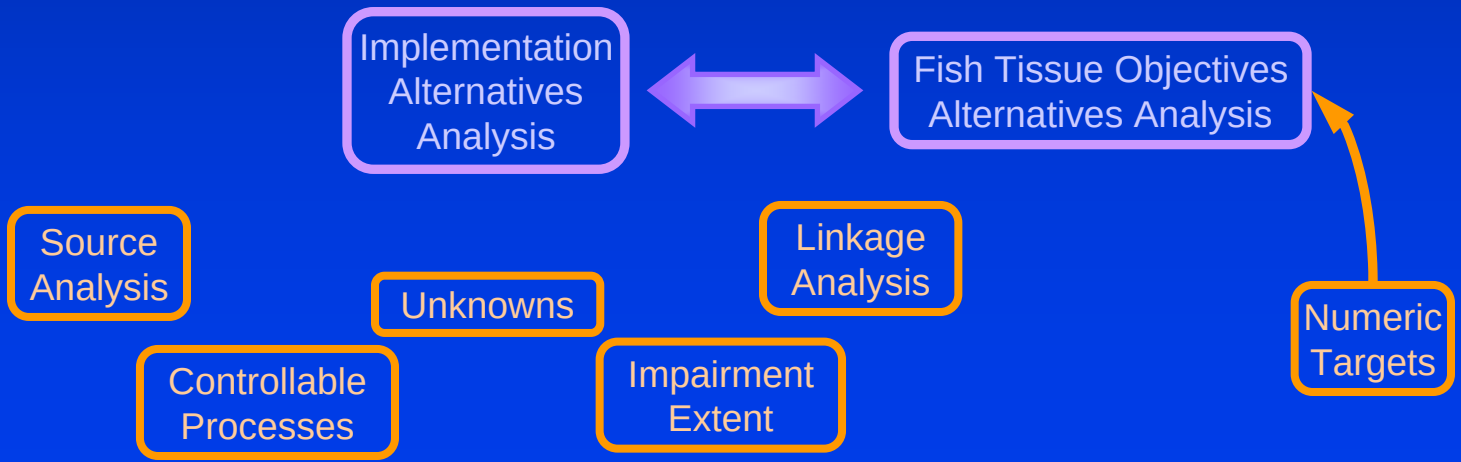

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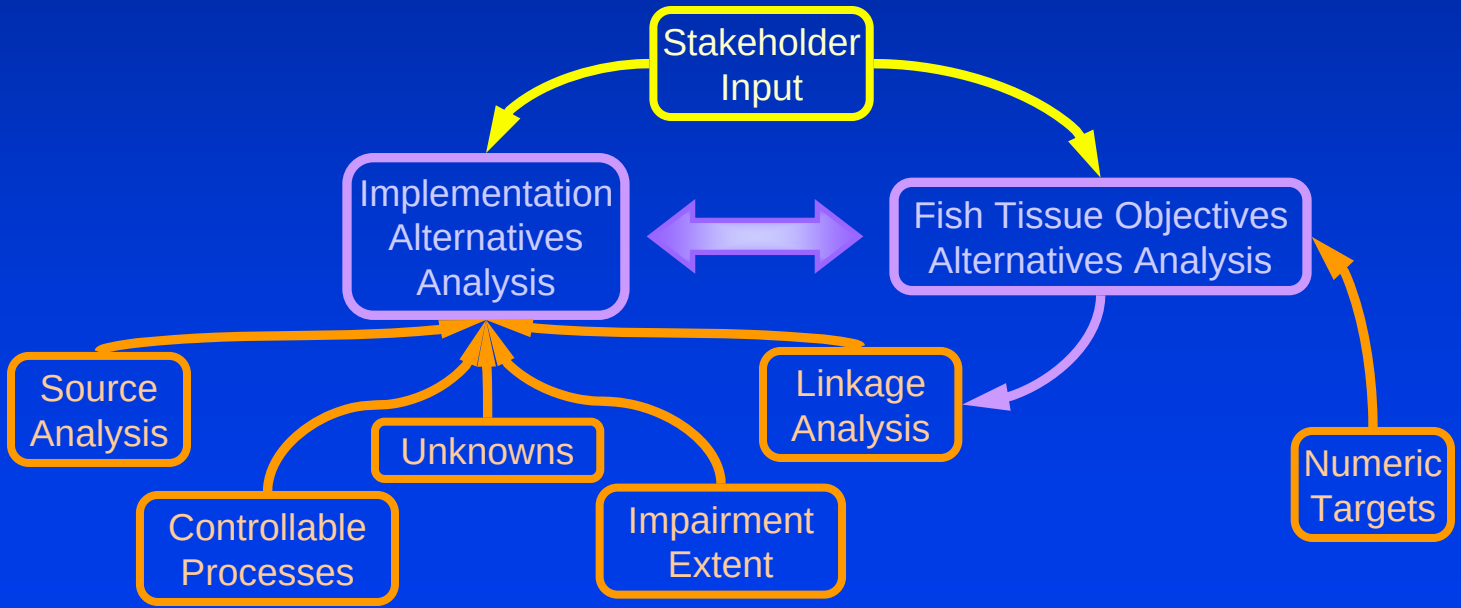

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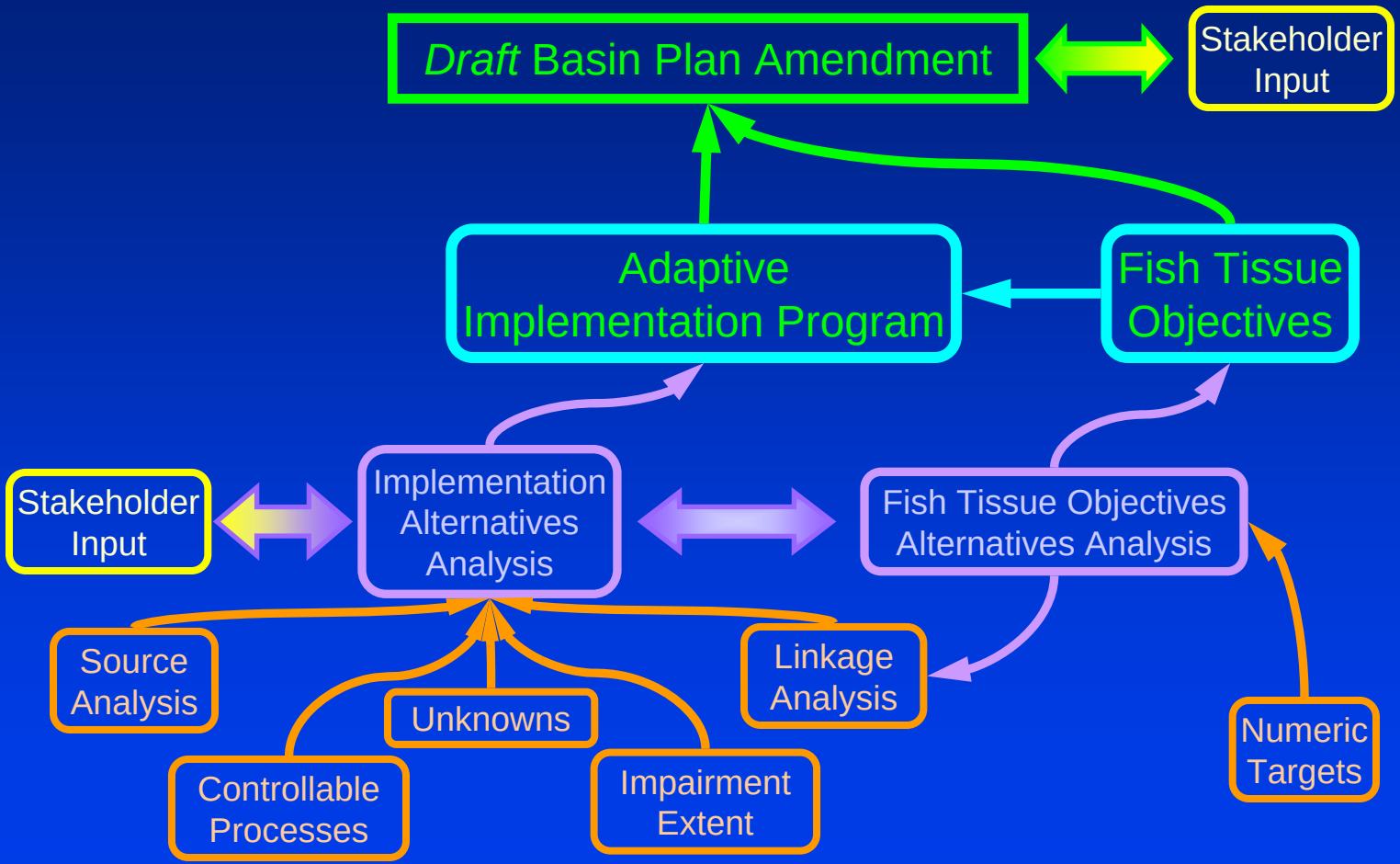

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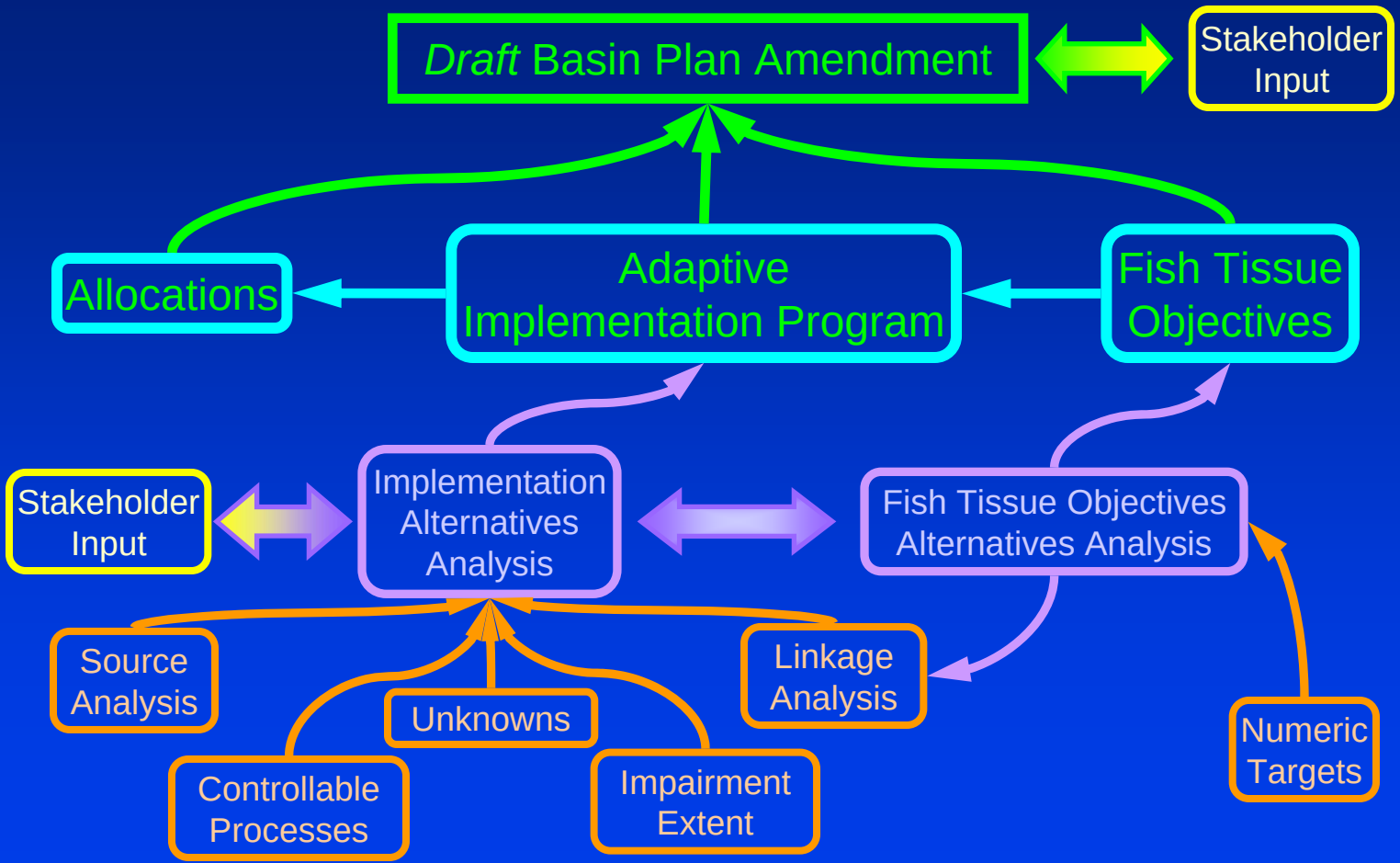

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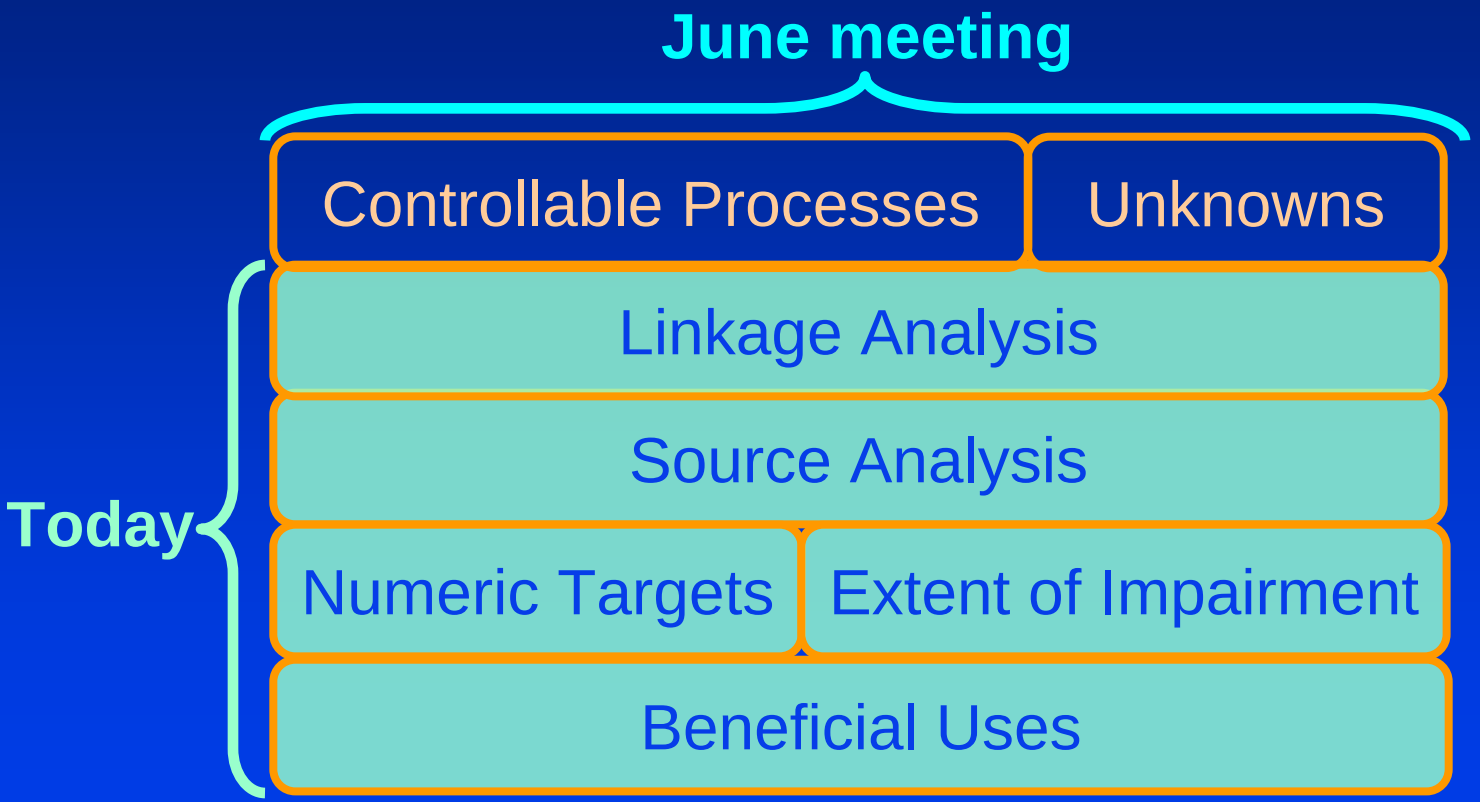

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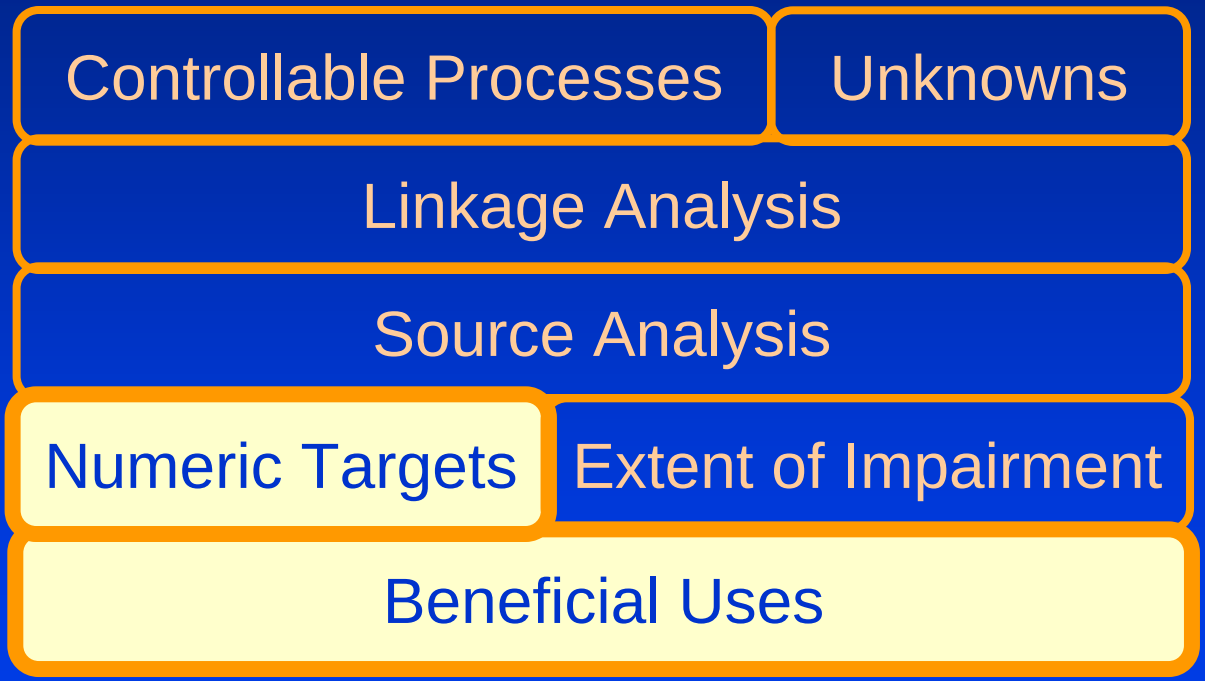

Delta Beneficial Uses

↑ High mercury levels

- Fish consumption advisories for human consumption
- Freshwater & wildlife habitat

April 2009 Meeting Discussion

- *Do we need to be concerned about mercury in drinking water?*

Numeric Targets: Safe Fish Mercury Levels for Wildlife

TL3: carp & bluegill

TL4: bass & catfish

Species	Trophic Level Food Group		Target (mg/kg)
Bald eagle	150-500 mm	TL4 Fish	0.31
		TL3 Fish	0.11
Osprey	150-350 mm	TL4 Fish	0.26
		TL3 Fish	0.09
River otter		TL4 Fish	0.36
		TL3 Fish	0.04
Western grebe		TL3 Fish	0.08
Common merganser		TL3 Fish	0.09
Kingfisher	50-150 mm	TL2-3 Fish	0.05
Mink		TL2-3 Fish	0.08
Double-crested cormorant		TL2-3 Fish	0.09
California least tern	<50 mm	TL2 Fish	0.03
Western snowy plover		TL2 Fish	0.10

April 2009 Meeting Discussion

Several Questions:

- *Do the differences in targets for different wildlife species imply different sensitivities to mercury?*
- *What harmful effects is the bird reference dose based on?*
- *What is the safety factor?*
- *There is a 10x difference in target levels for least tern and bald eagles; does this mean there is a 10x difference in mercury levels between the two trophic levels of fish prey?*
- *How did you select the species on the list?*

Safe Level for Wildlife

Delta fish-eating wildlife are expected to be protected with a mercury concentration of **0.3 mg/kg** in bass and catfish

Numeric Targets: Safe Levels for Humans

Targets vary based on how many meals/week and what types of fish are consumed…

Numeric Target (catfish & bass, mg/kg)	# of Meals per Week	Consistent with USEPA Criterion for Sport Anglers	Consistent with USFWS Recommend-ations	Consistent with S.F. Bay WQOs	Consistent with USEPA Criterion for Subsistence Fishers
0.58	0.5 (mix)	√			
0.29	0.5 (just bass & catfish)	√	√		
0.24	1 (mix)	√	√	√	
0.05	4 (just bass & catfish)	√	√		√

April 2009 Meeting Discussion

Several Questions & Observations:

- *Is the 4 meals/week consumption rate a default rate recommended by USEPA?*
- Local consumers in the Delta eat more than 1 meal/week of local fish and are opposed to the Board's recommended target.
  Why doesn't the Board have to protect the most sensitive group of consumers?
- The Clear Lake WQO doesn't protect Native American consumers.

How low can we reasonably go?

*"Mercury concentration in fish from streams and rivers throughout the western U.S."**

provides useful information about regional conditions…

- 2,707 large TL3 and TL4 fish
- 626 streams and river segments
- Used a probability design

* Peterson, S.A., J. Van Sickle, A.T. Herlihy, and R.M. Hughes. 2007. *Environmental Science & Technology*, 41(1): 58-65.

How low can we reasonably go?

(Peterson *et al.*, 2007)

- None of the study waterways had fish populations with mercury as low as 0.05 mg/kg in large fish like bass
  - A target based on 4 meals/week of catfish & bass may not be attainable
- About 30% to 40% had fish populations with mercury lower than 0.24 mg/kg in large fish like bass
  - A target based on 1 meal/week of a mix of species is likely to be attainable
  - It's already attained in the Central Delta

April 2009 Meeting Discussion

- *Why do the concentrations of mercury in fish elsewhere matter for the Delta TMDL?*
- *Why not have an objective lower than 0.24 mg/kg?*

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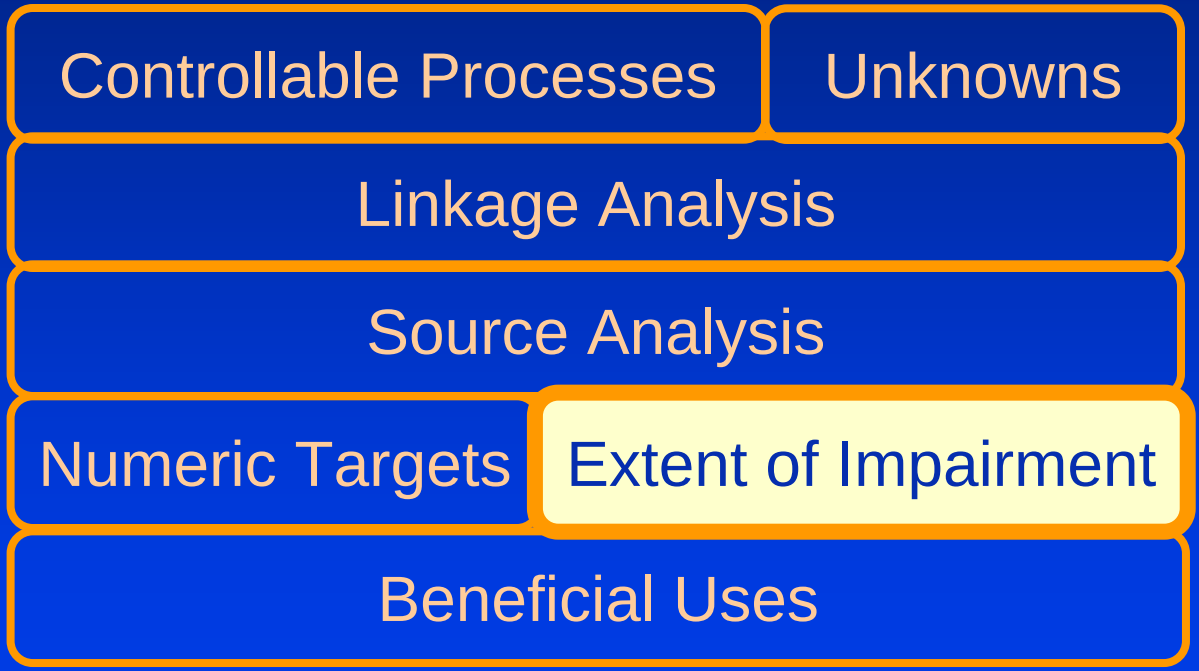
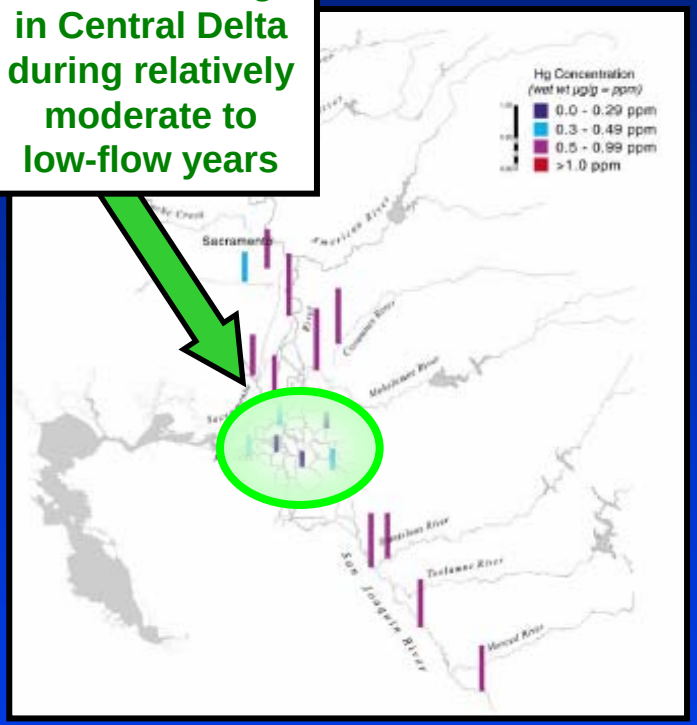


CalFed Mercury Program Fish Sampling

Lower fish Hg in Central Delta during relatively moderate to low-flow years



Average Hg Concentrations in largemouth bass, 2000 (Davis *et al.*, 2003)

Inland silverside Hg & MeHg Concentrations, Fall 1999 (Slotton *et al.*, 2002)

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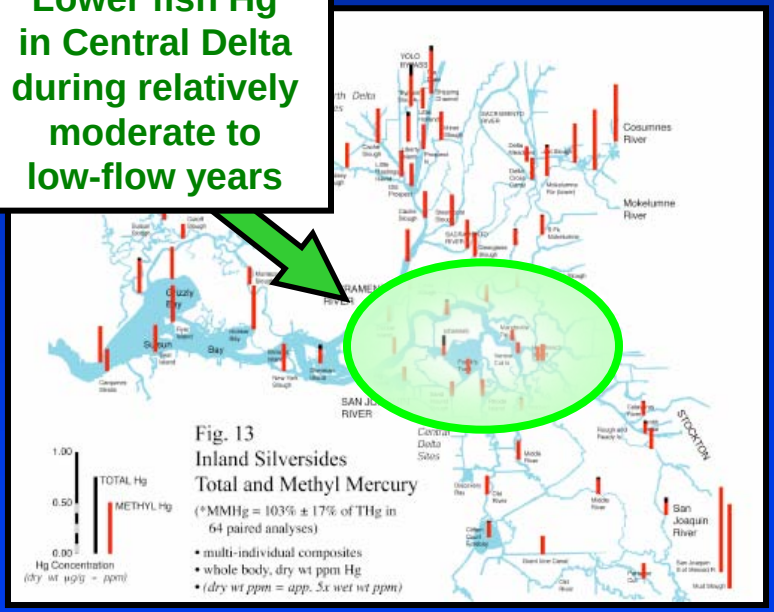

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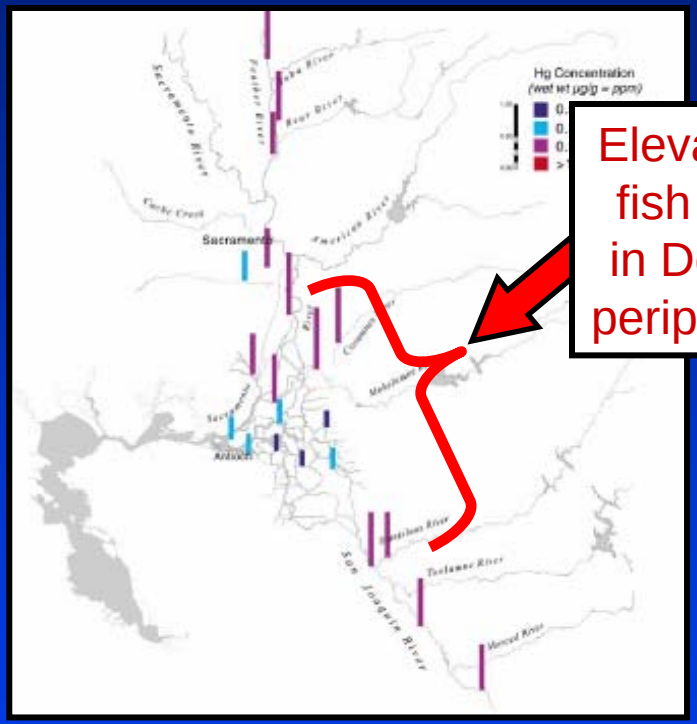
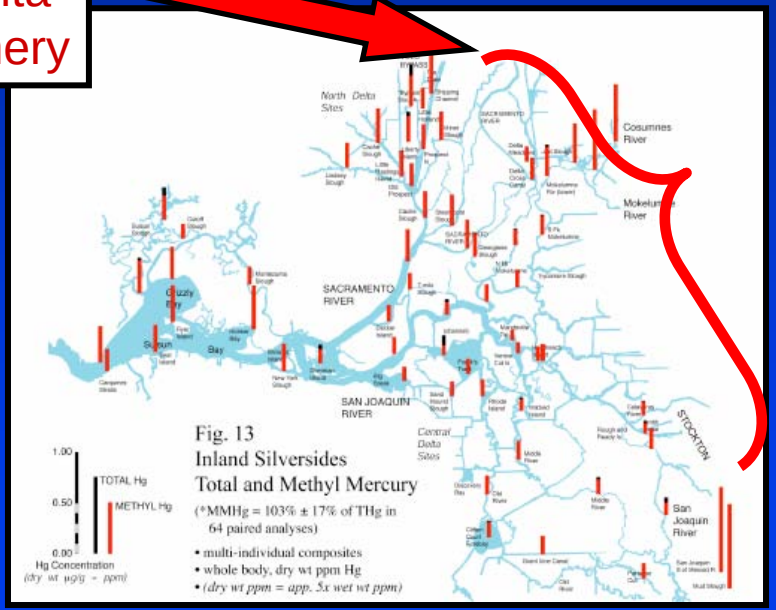


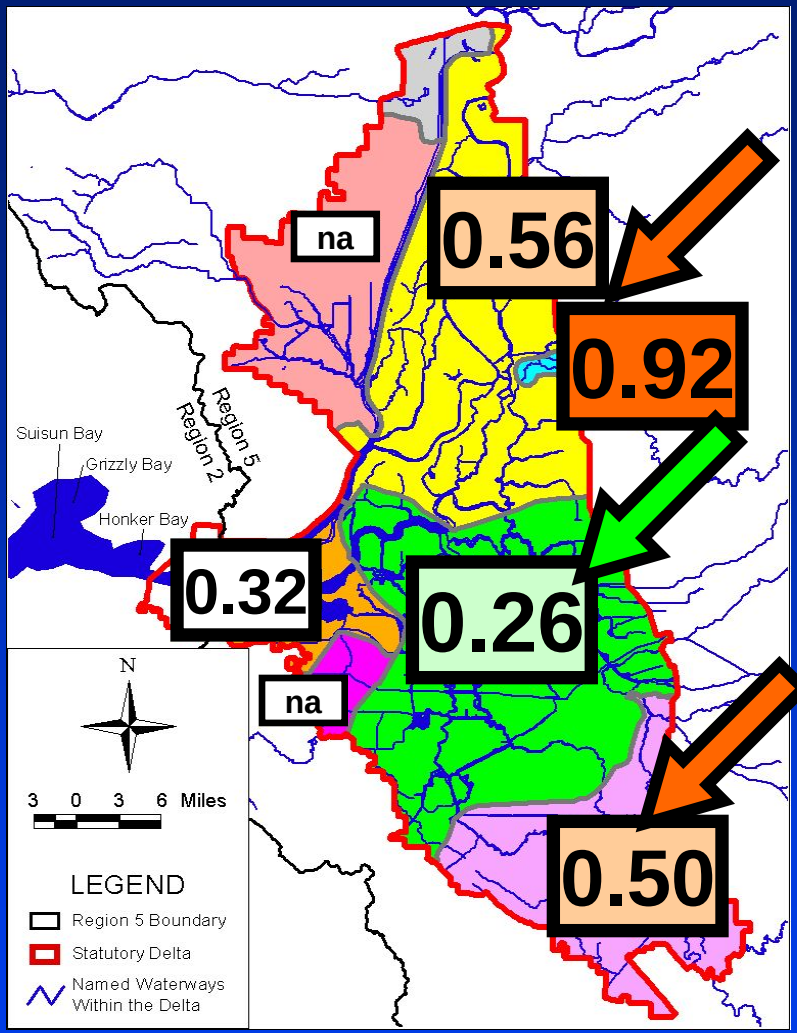
Average Hg Concentrations in largemouth bass, 2000 (Davis *et al.*, 2003)

Elevated fish Hg in Delta periphery

Inland silverside Hg & MeHg Concentrations, Fall 1999 (Slotton *et al.*, 2002)



Average Mercury Levels in Large Bass & Catfish (mg/kg)



How do we reduce fish mercury levels?

- Almost all mercury (Hg) in fish is in the form of *methylmercury (MeHg).*
- Local & nationwide studies:
  Most important, single factor in determining how much MeHg is in fish is water MeHg concentration
- Most direct way to reduce fish MeHg:
  Reduce the concentration of MeHg in water

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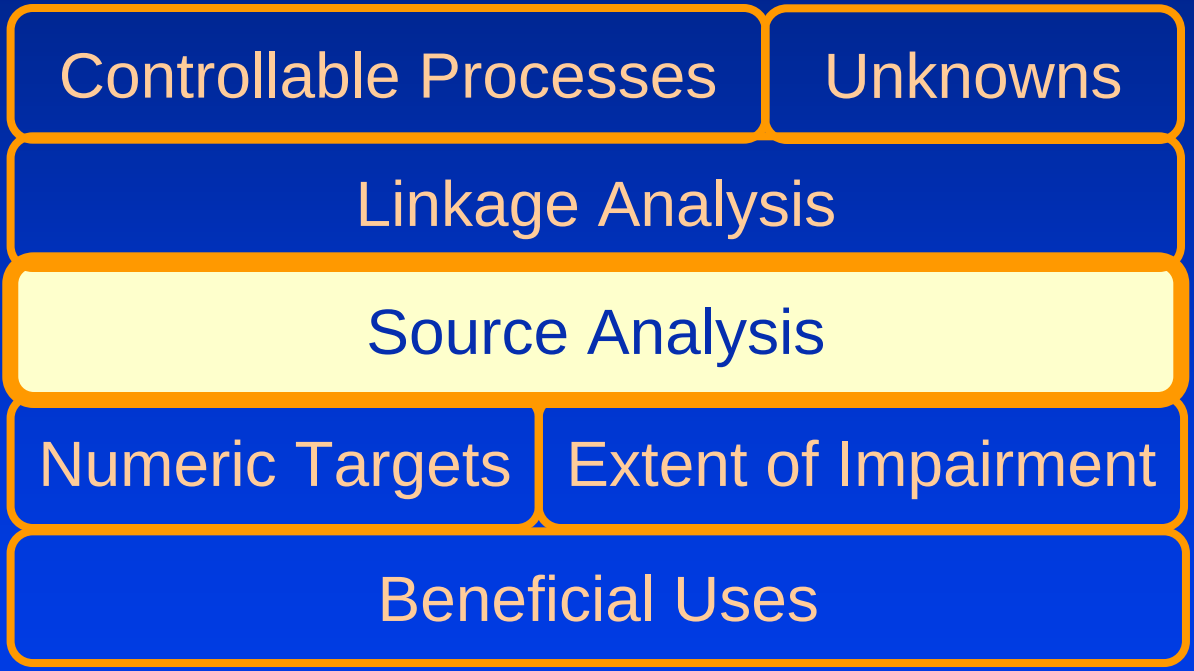
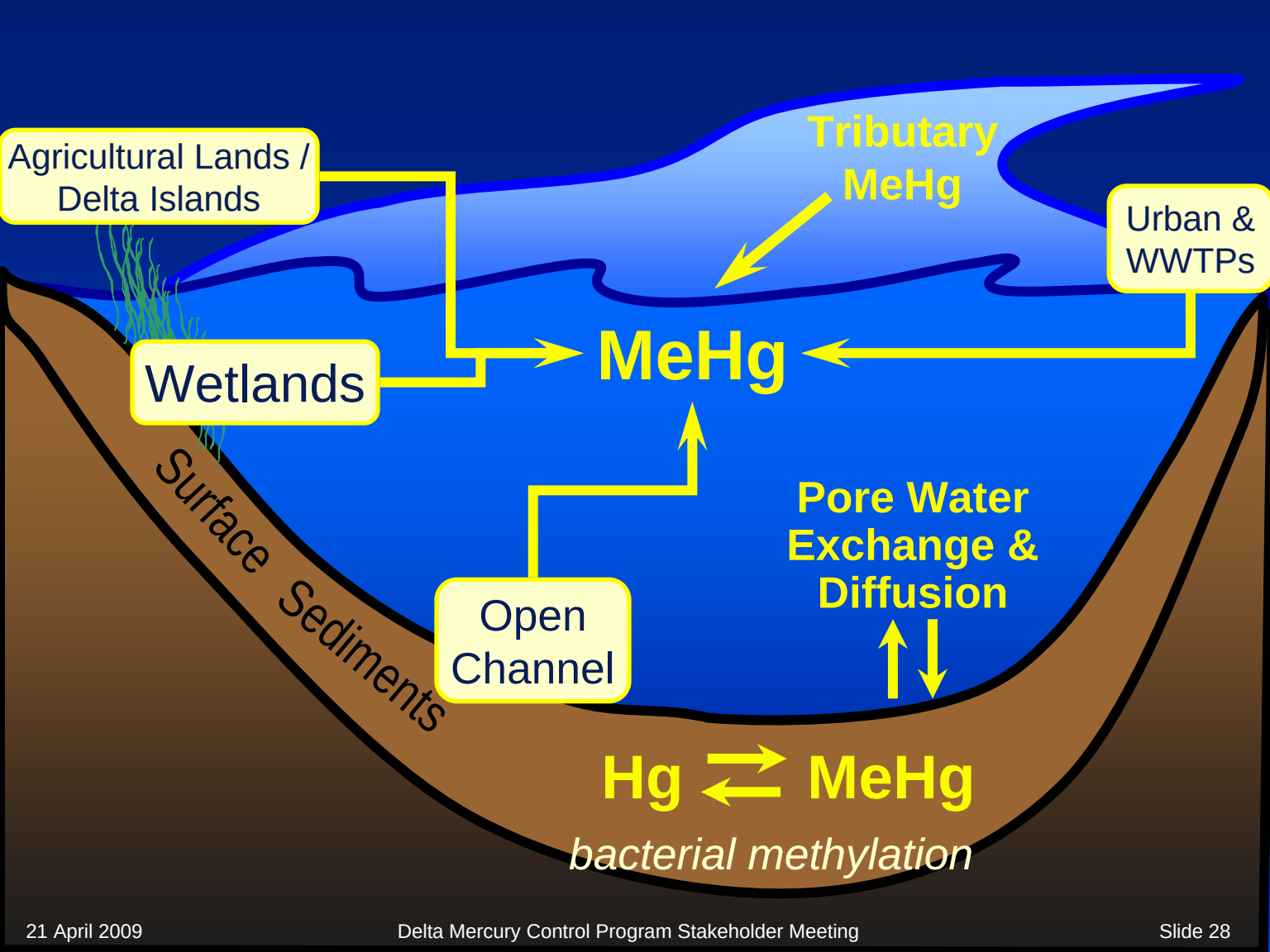
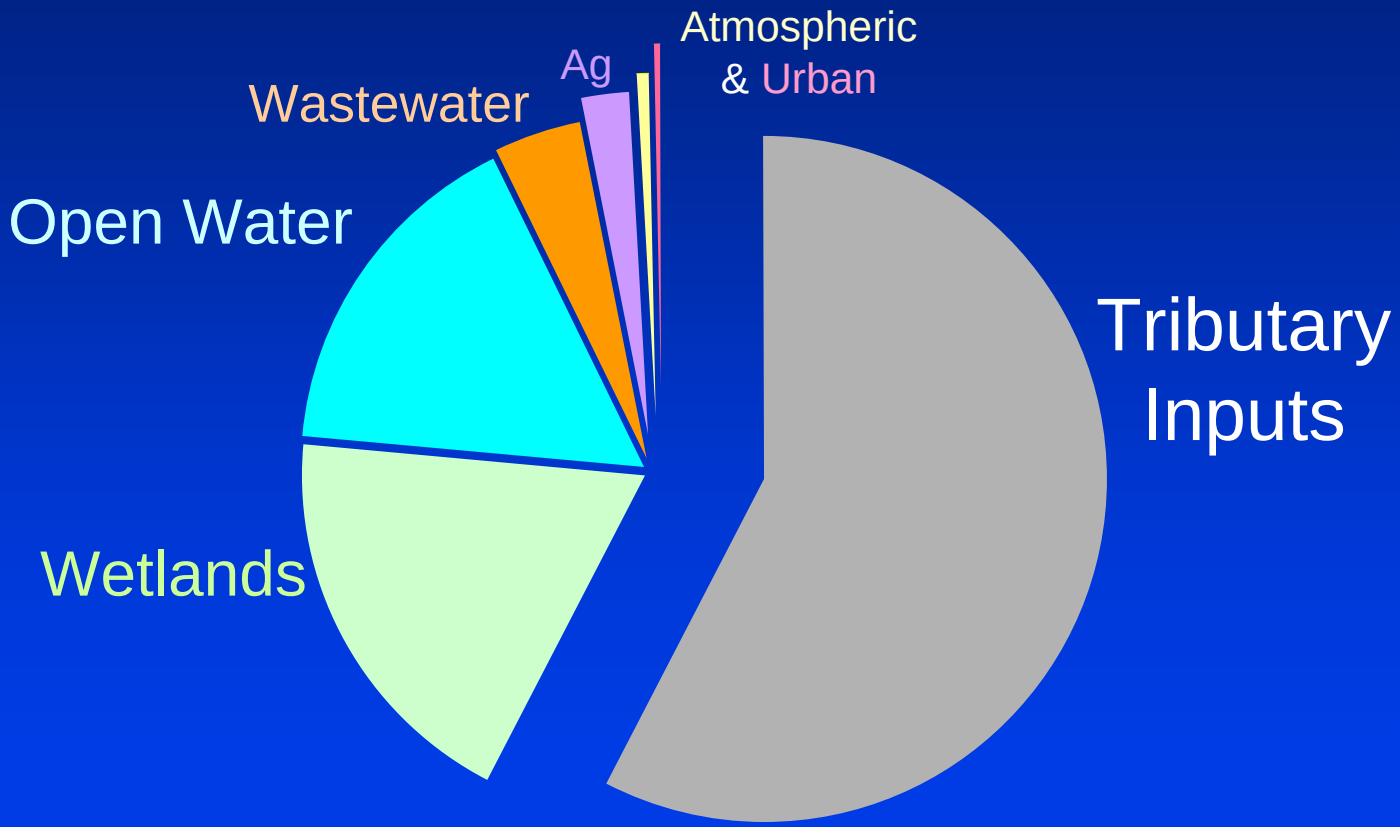
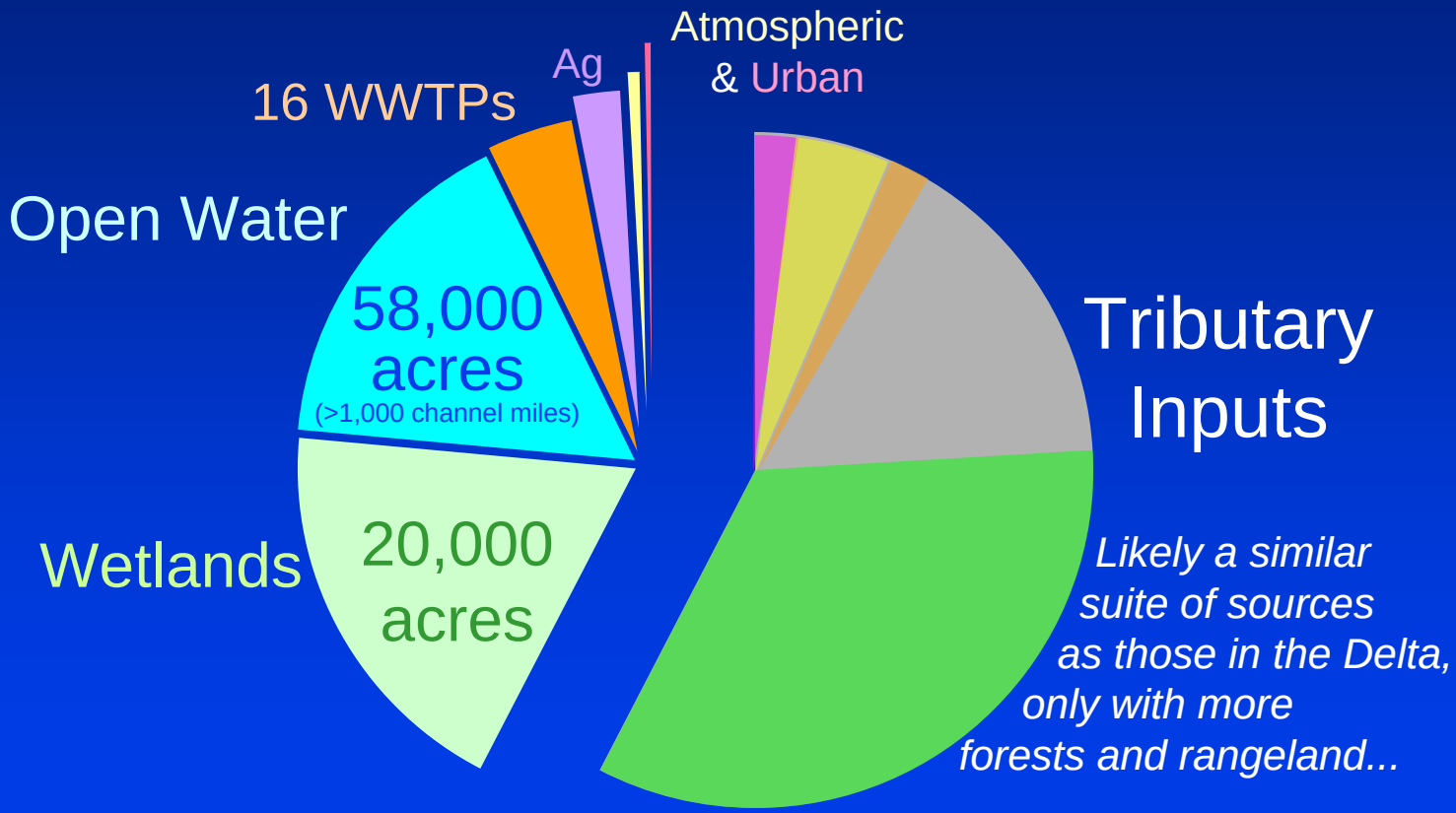



Agricultural Lands / Delta Islands
Tributary MeHg
Urban & WWTPs
Wetlands
MeHg
Surface Sediments
Open Channel
Pore Water Exchange & Diffusion
Hg ⇄ MeHg
bacterial methylation

MeHg Sources

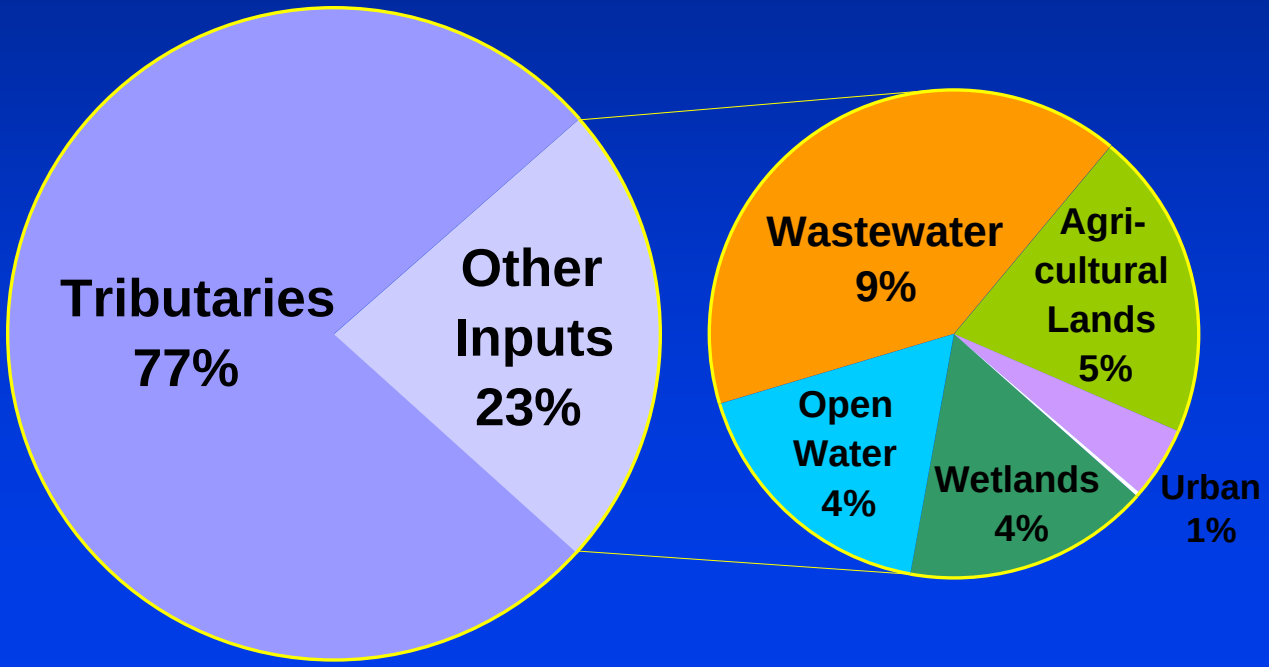


MeHg source categories are comprised of may individual discharges...



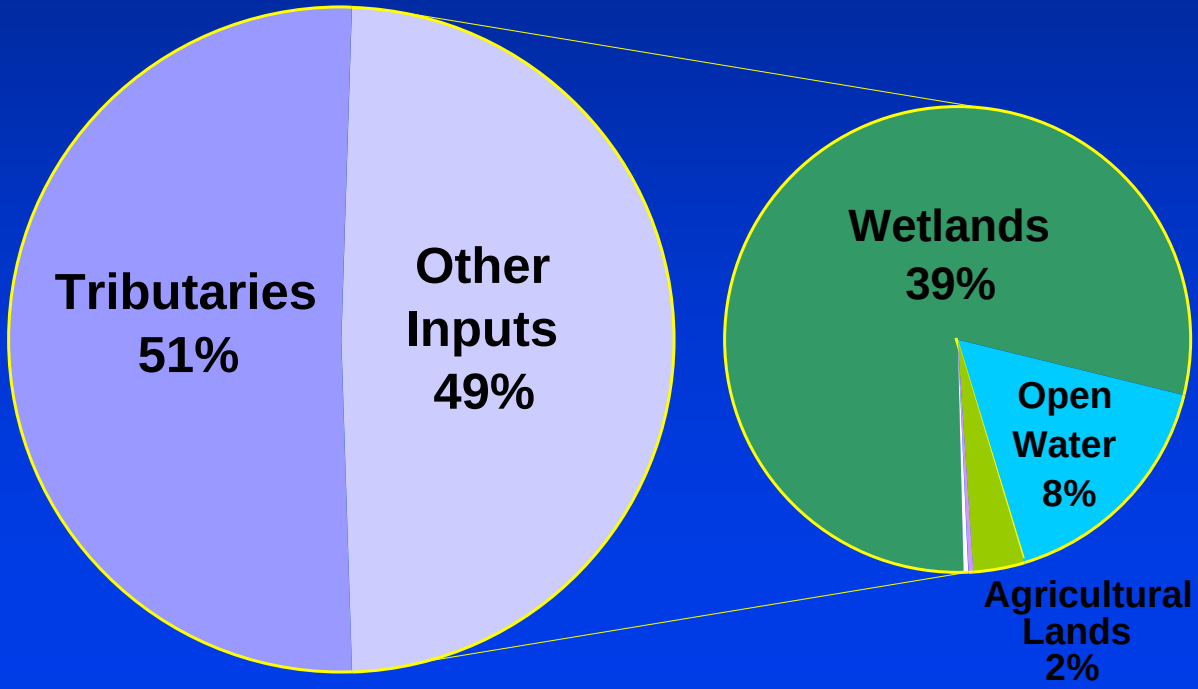
And different sources supply different areas of the Delta…

San Joaquin Area MeHg Sources



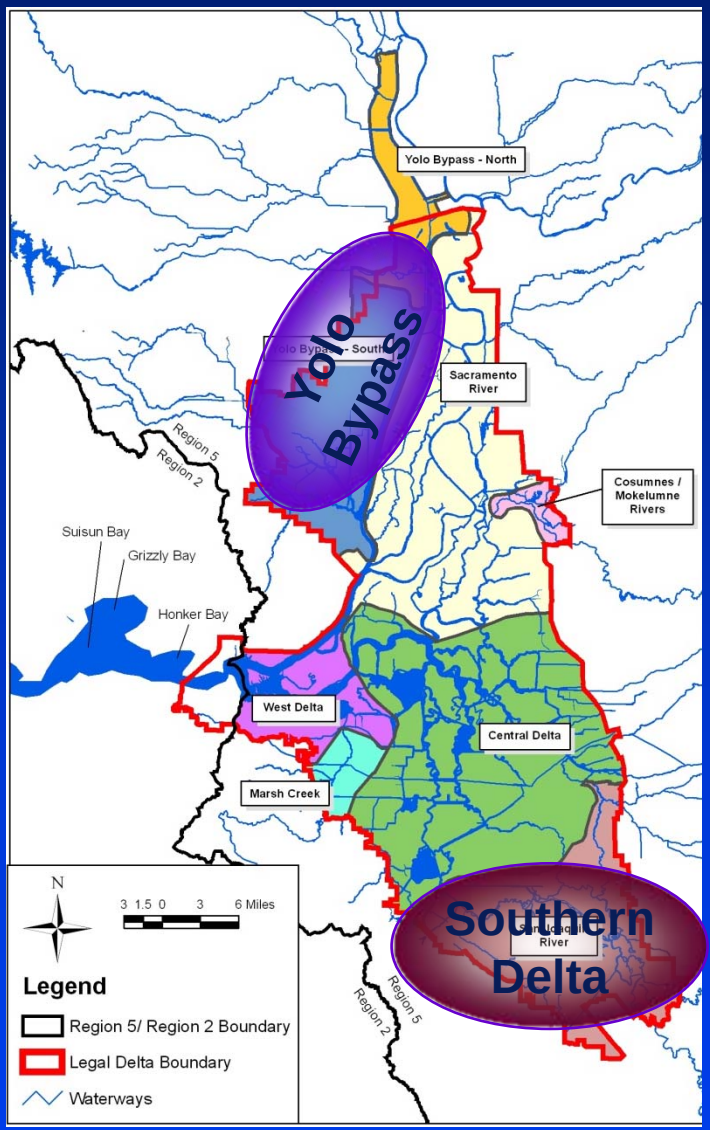
And different sources supply different areas of the Delta…

Yolo Bypass Area
MeHg Sources



Seven Control Programs in One…

…because different areas of the Delta are dominated by different MeHg sources



How do we know how much we need to reduce MeHg sources to each area?

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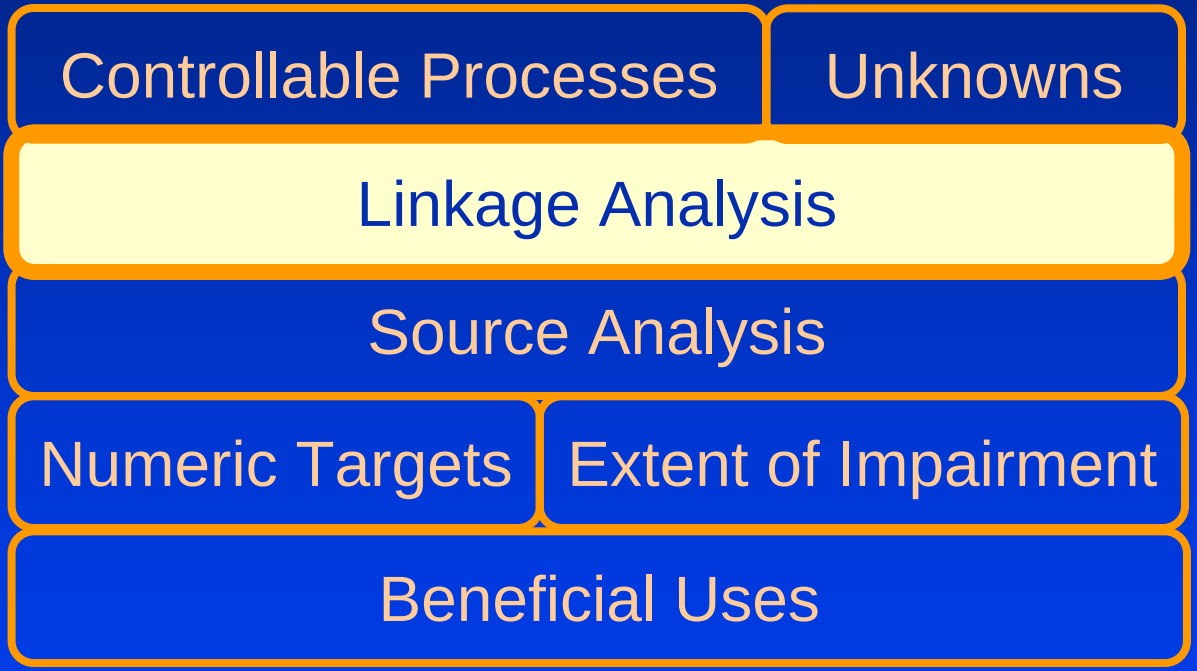
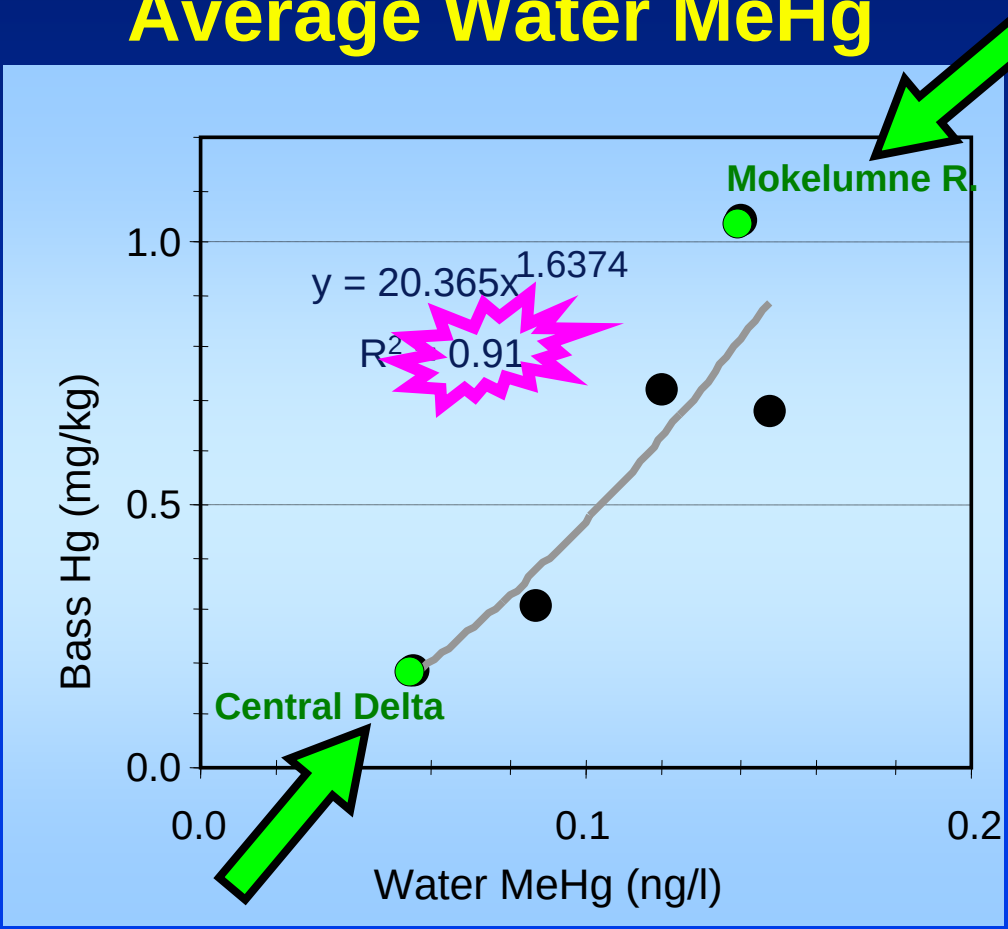


What is a linkage…

… a Delta-specific mathematical relationship between fish MeHg & water MeHg

so we know how much we need to reduce MeHg sources to fix the impairment…

MeHg Linkage: Largemouth Bass & Average Water MeHg



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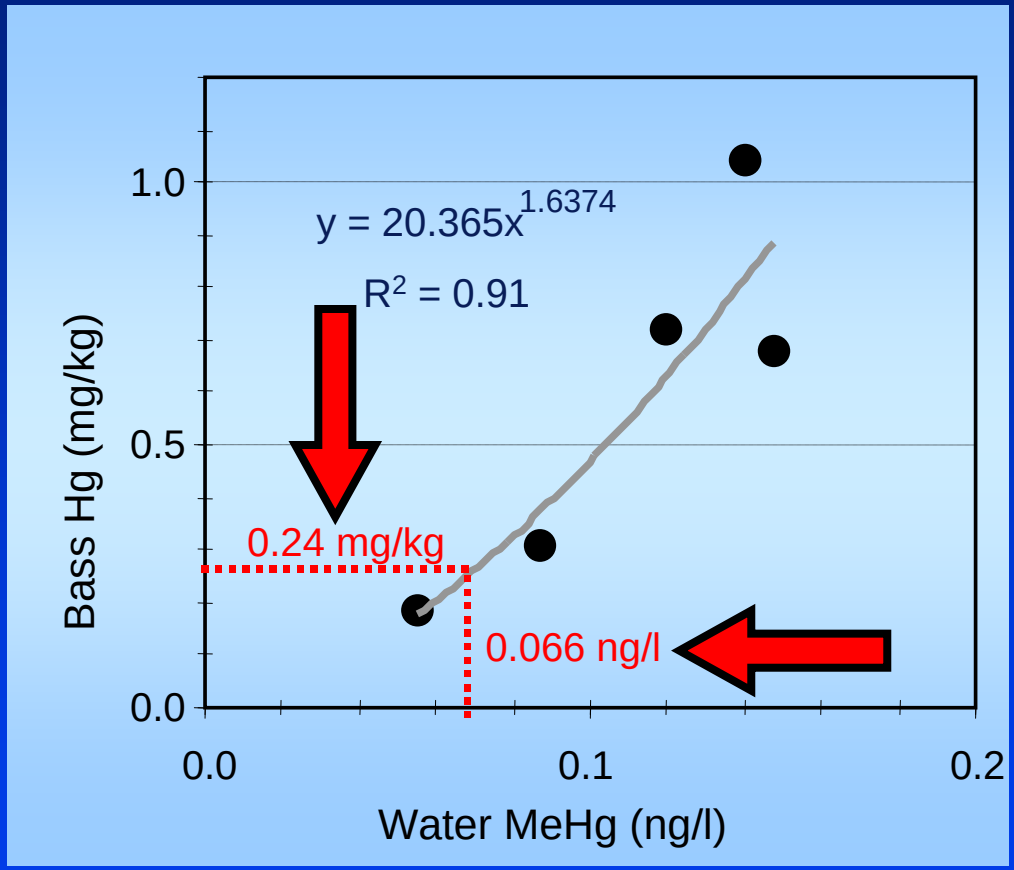
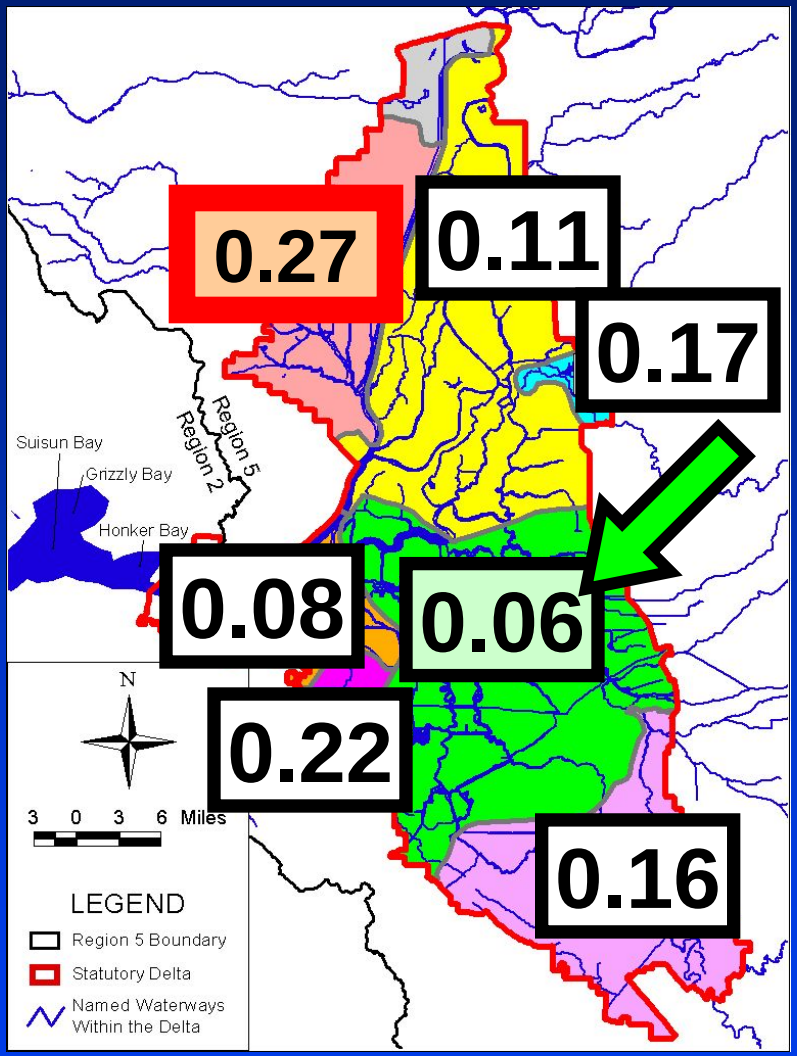
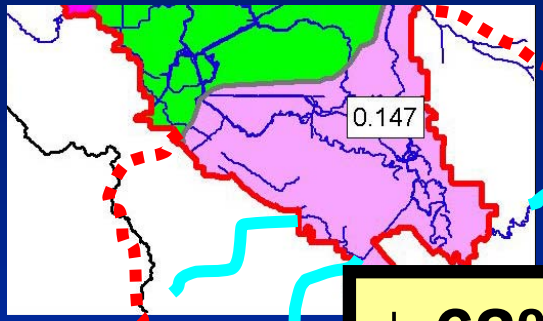


Average Annual Ambient MeHg Levels in Water (ng/l)



For example, need to reduce the sum of all sources in the south Delta & San Joaquin watershed by 63% to achieve the a numeric target based on 1 meal/week of a mix of TL3/4 fish



↓ 63%

Results from Other Studies Bracket the MeHg Concentration Predicted by the Delta Linkage…

- National survey of 106 stations from 21 basins (Brumbaugh *et al.*, 2001) :
  - One-time unfiltered MeHg water samples collected during the fall season were also positively correlated with largemouth bass tissue levels.
  - A MeHg concentration of **0.058** ng/l in water was predicted to produce three-year old LM bass with 0.3 mg/kg mercury tissue concentration.
- Cache Creek watershed (Slotton *et al*., 2003):
  - A MeHg concentration of **0.14** ng/l in unfiltered water corresponded with 0.23 mg/kg MeHg in large fish

Recent Delta studies' results support linkage…

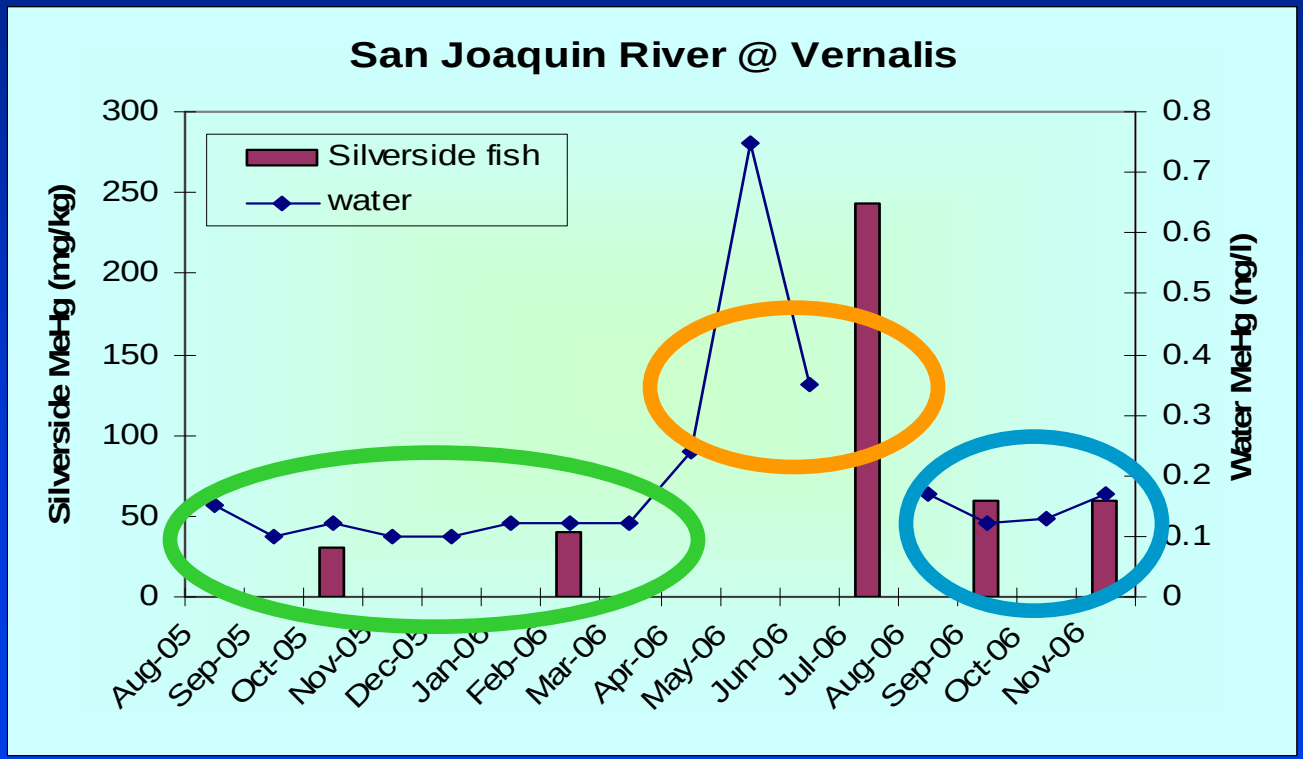
Sacramento River Local Bioaccumulation Study
(Larry Walker Associates & SRCSD, 2008)

- WWTP discharge contributed ~10% of river MeHg load during study period
- Short-lived biosentinel fish species downstream of the WWTP had MeHg concentrations about ~10% greater than upstream fish

Recent Delta studies' results support linkage…

Floodplain Inundation on the San Joaquin River: MeHg Before & After

(Slotton *et al*., 2008; Foe *et al*., 2008)



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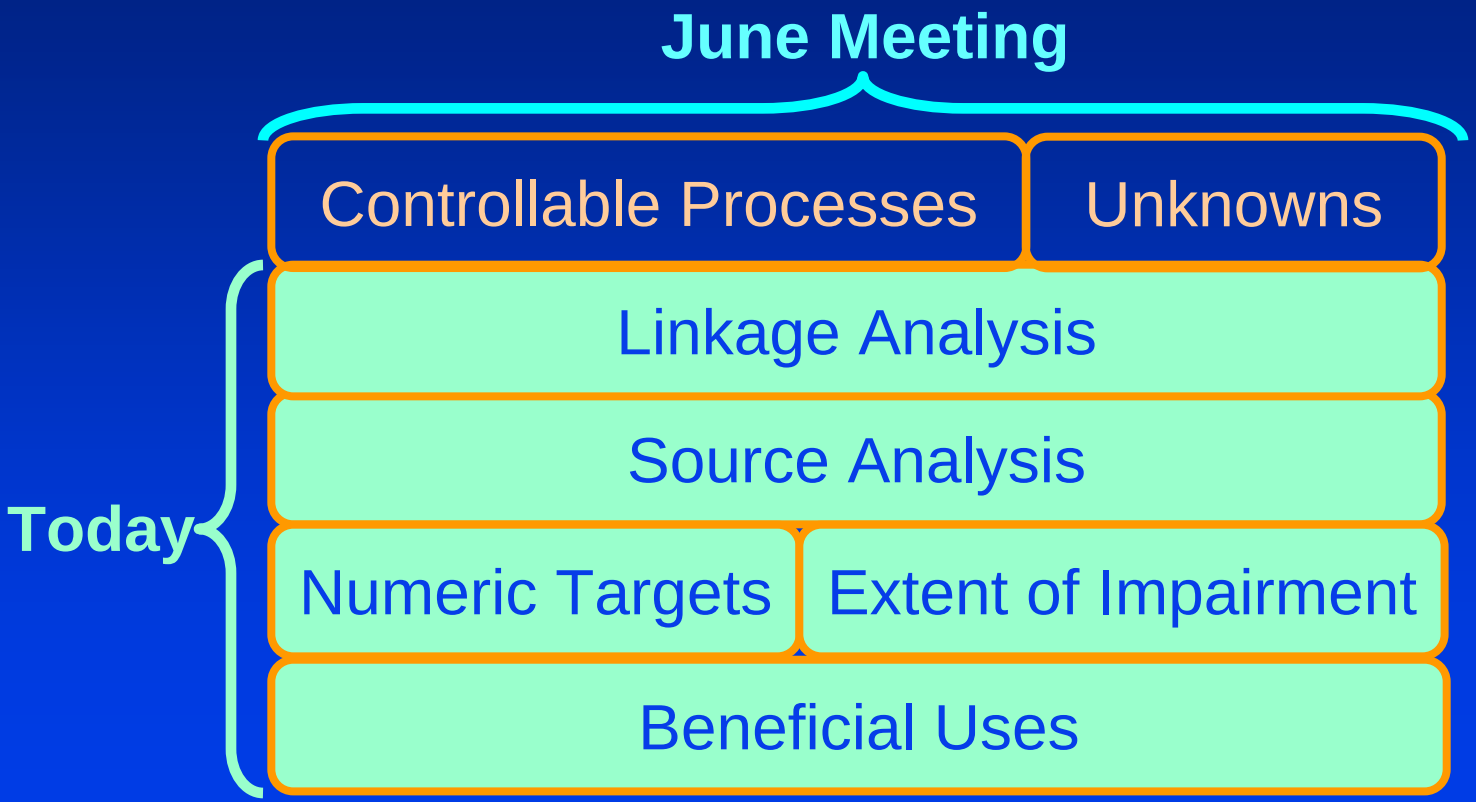

Preview for the Next Meeting: Controllable Processes

- Brief review of MeHg persistence, fate & transport in the region
- Ways to reduce MeHg in Delta fish and waters
  - Reduce inorganic Hg in sediment
  - Control activities that enhance MeHg production in wetlands & open-water areas
  - Reduce MeHg discharges from external sources
- Sources of inorganic Hg

Preview for the Next Meeting: Unknowns

- Characterization of existing MeHg and inorganic Hg sources in the Delta and its tributary watersheds (especially nonpoint sources)
- Identification of inorganic Hg reduction projects that will reduce sediment Hg in the Delta
- How can we reduce MeHg discharges from nonpoint and point sources?

Questions?

If you have a technical question you would like to discuss at the next meeting, contact Michelle Wood:

mlwood@waterboards.ca.gov