



Fish Tissue Collection, Analysis, and Recovery along the Kalamazoo River

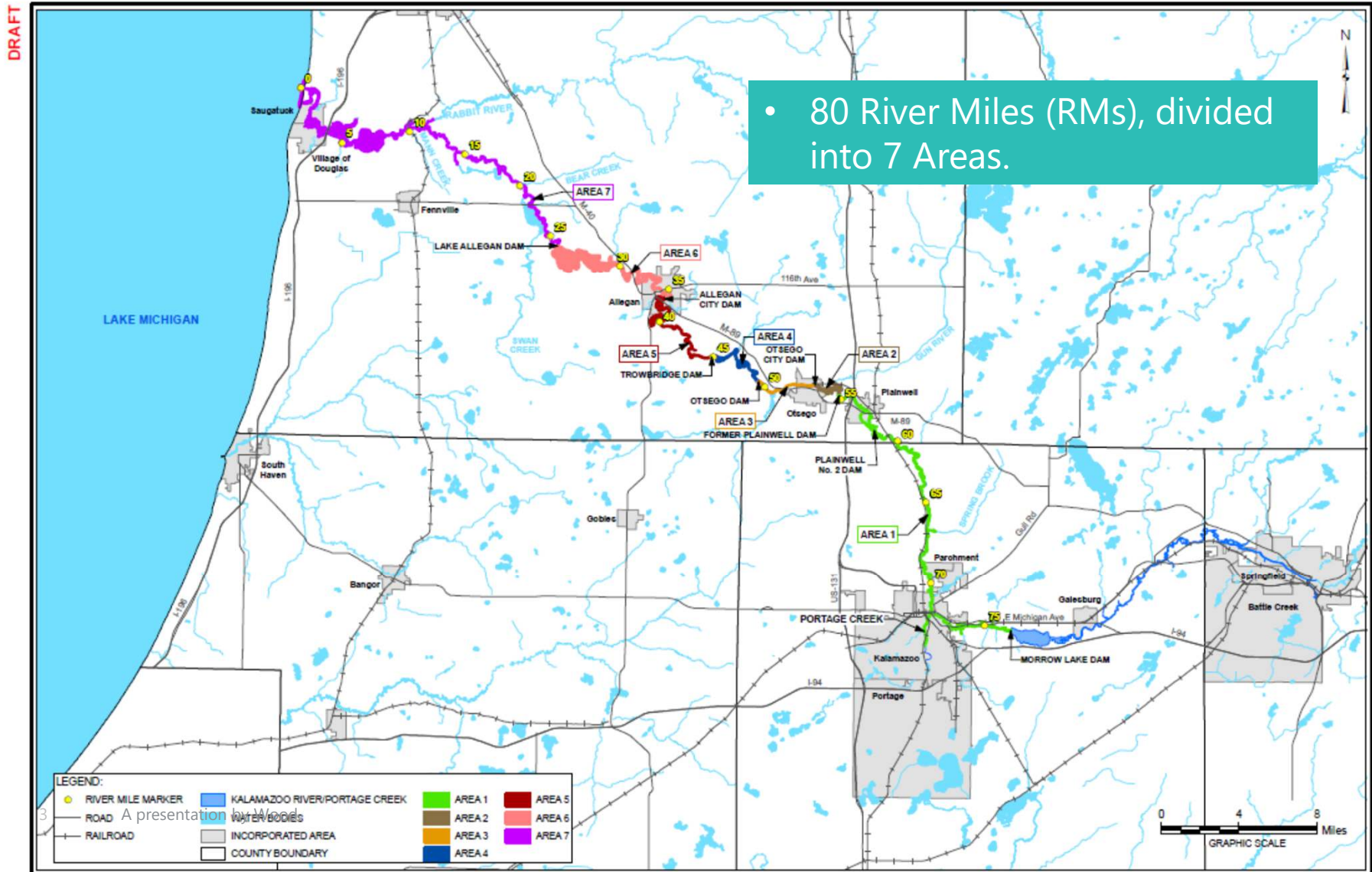
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Discussion Topics

- Background
- Fish Tissue Collection
- Current Fish Tissue Concentrations and Changes Over Time
- Remediation and Fish Tissue Recovery
- Long Term Monitoring (LTM)

Kalamazoo River Superfund Site



PCB Uptake and Recovery in Fish Tissue

Fish uptake PCBs in fatty tissue through

- ▶ Exposure to surface sediment containing PCBs
- ▶ Consuming lower trophic species in the food chain

Fish recover (PCBs decrease in fish tissue) through

- ▶ Reduction in surface sediment concentrations through natural processes
 - ▶ Incoming cleaner sediment
- ▶ Reduction in sediment concentrations through remediation
- ▶ Annual winter loss of fat content
- ▶ Spawning
- ▶ Cycle of Life: Passing of older generation and growth of next generation

Recovery limited by upstream or reference area contributions of PCBs



PCB Uptake and Recovery in Fish Tissue

Remedial efforts performed to advance fish recovery

- ▶ Area 1 Time Critical Removal Action (TCRA) sediment, bank, and dam removal
- ▶ Portage Creek TCRA sediment removal
- ▶ Area 3 TCRA sediment and dam removal, bank removal / protection

Remedial efforts to be Initiated in 2020

- ▶ Area 1 sediment hot spot removal
- ▶ Area 2 design for remediation of sediment, floodplain, & anabranches
- ▶ Area 4 TCRA design for sediment removal, bank protection



Fish Remedial Action Objectives (RAO)

Protect people who consume Kalamazoo River fish

- ▶ Reduction of PCBs in fish tissue to the Michigan fish advisory level for smallmouth bass
 - ▶ Two meals per month (0.11 mg/kg total PCB concentration)
- ▶ Protective of sports fishermen who eat more fish than an average person
 - ▶ Assumes a person eats 125 half pound fish meals per year (about 10.5 meals per month)
 - ▶ Non-cancer related goal of 0.072 mg/kg total PCB concentration
 - ▶ Cancer related goal of 0.042 mg/kg total PCB concentration

Consideration given to reference area / upstream concentrations



Fish Tissue Collection

Sampling Protocol

- ▶ September collection
- ▶ Measure length and weight
- ▶ Analyze for PCBs and lipids

Sampling Locations

- ▶ 15 Aquatic Biota Sampling Areas (ABSAs) from Area 1 to 7
- ▶ 3 Reference/upstream ABSAs

Fish Tissue Collection

Smallmouth Bass (SMB) Fillet (skin-on)

- ▶ 10 - 18 inch fish
- ▶ Collected every 5 years

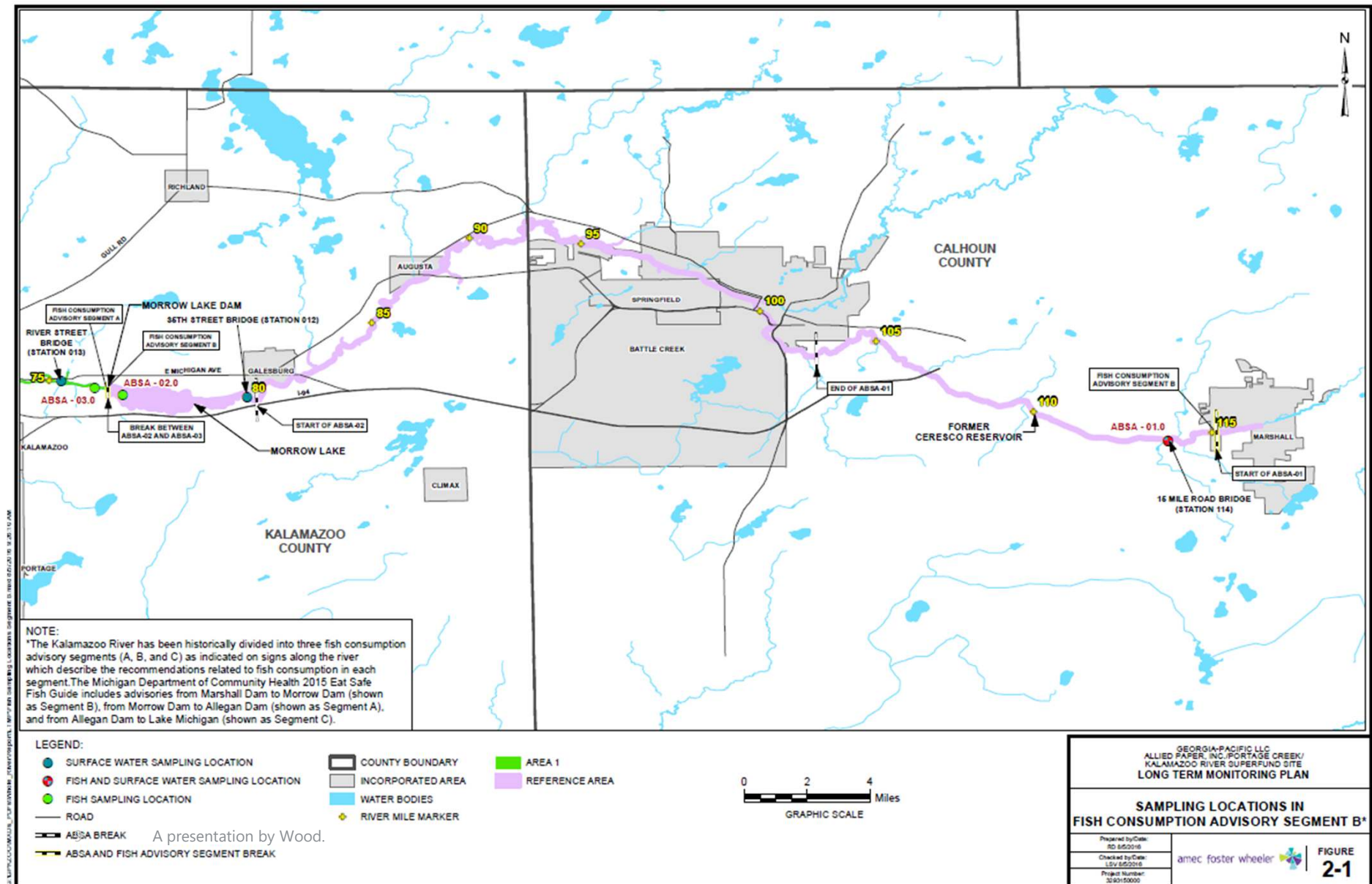
Carp Fillet (skin-off)

- ▶ 13 - 34 inch fish
- ▶ Collected 2 times every 5 years

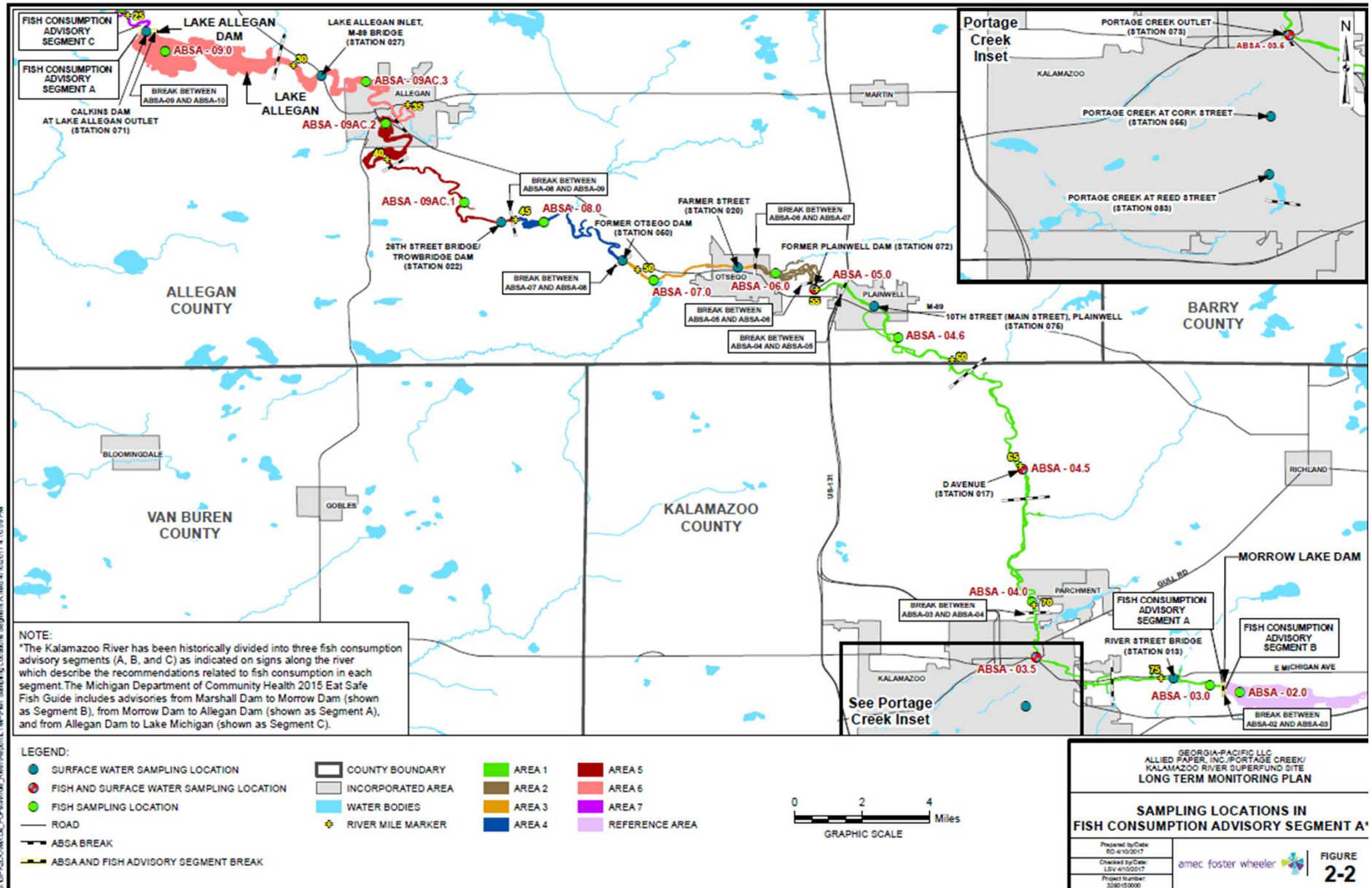
SMB Young of Year Whole Body (YOY WB) composite

- ▶ 3 - 5 inch fish
- ▶ Collected as needed

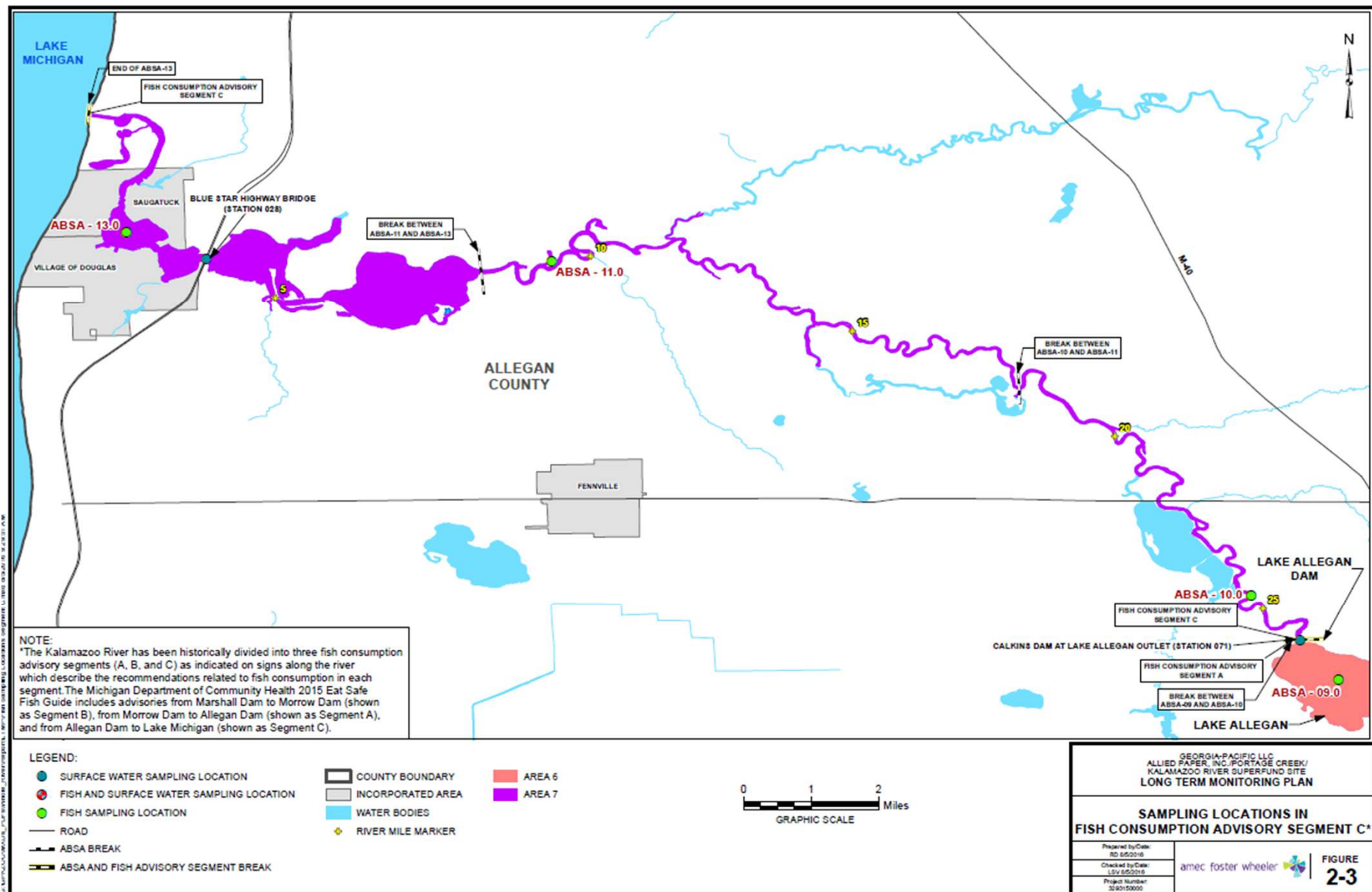
Fish Collection Locations



Fish Collection Locations

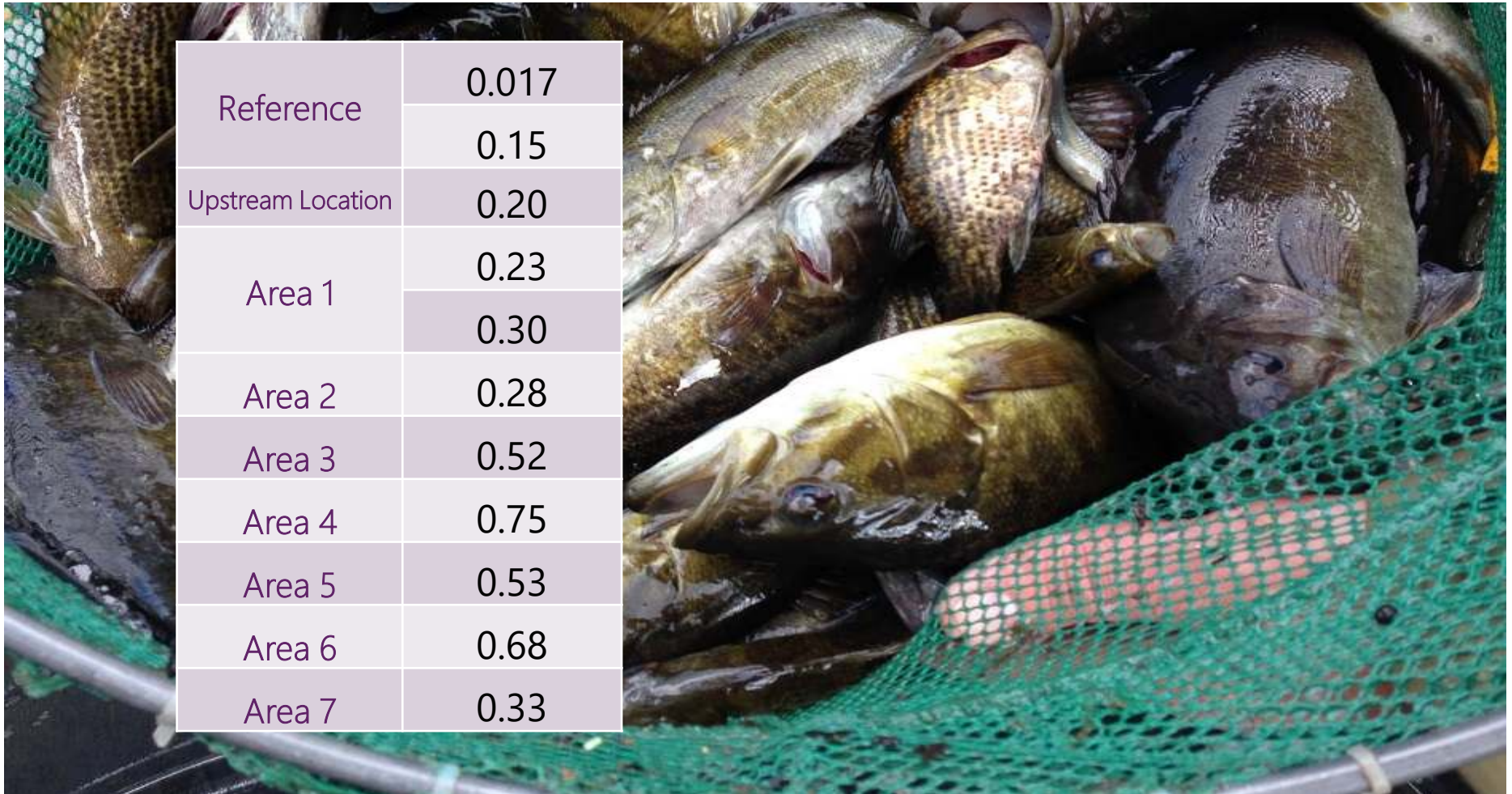


Fish Collection Locations



Current Fish Tissue PCBs Median Conc. (mg/kg)

2015/16 Smallmouth Bass Fillets



Reference	0.017
	0.15
Upstream Location	0.20
Area 1	0.23
	0.30
Area 2	0.28
Area 3	0.52
Area 4	0.75
Area 5	0.53
Area 6	0.68
Area 7	0.33

Current Fish Tissue PCBs Median Conc. (mg/kg)


2018 Carp Fillets



Reference	0.020
	0.32
Upstream Location	0.74
Area 1	2.0
	2.0
Area 2	1.5 (2016)
Area 3	2.5 (2015)
Area 4	1.7
Area 5	1.8
Area 6	1.4
Area 7	1.1

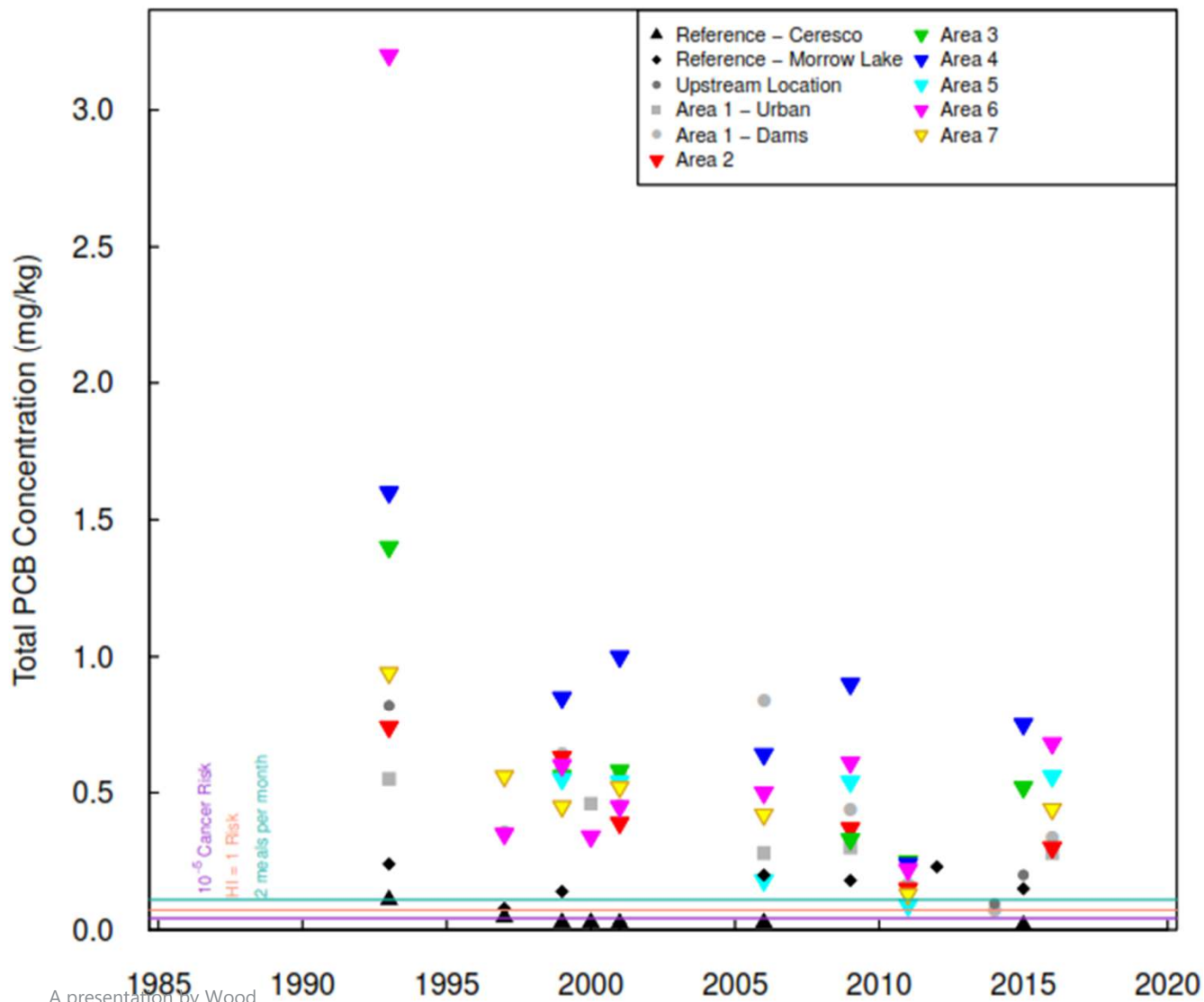
Current Fish Tissue PCBs Conc. (mg/kg)

2018 Smallmouth Bass YOY Whole Body

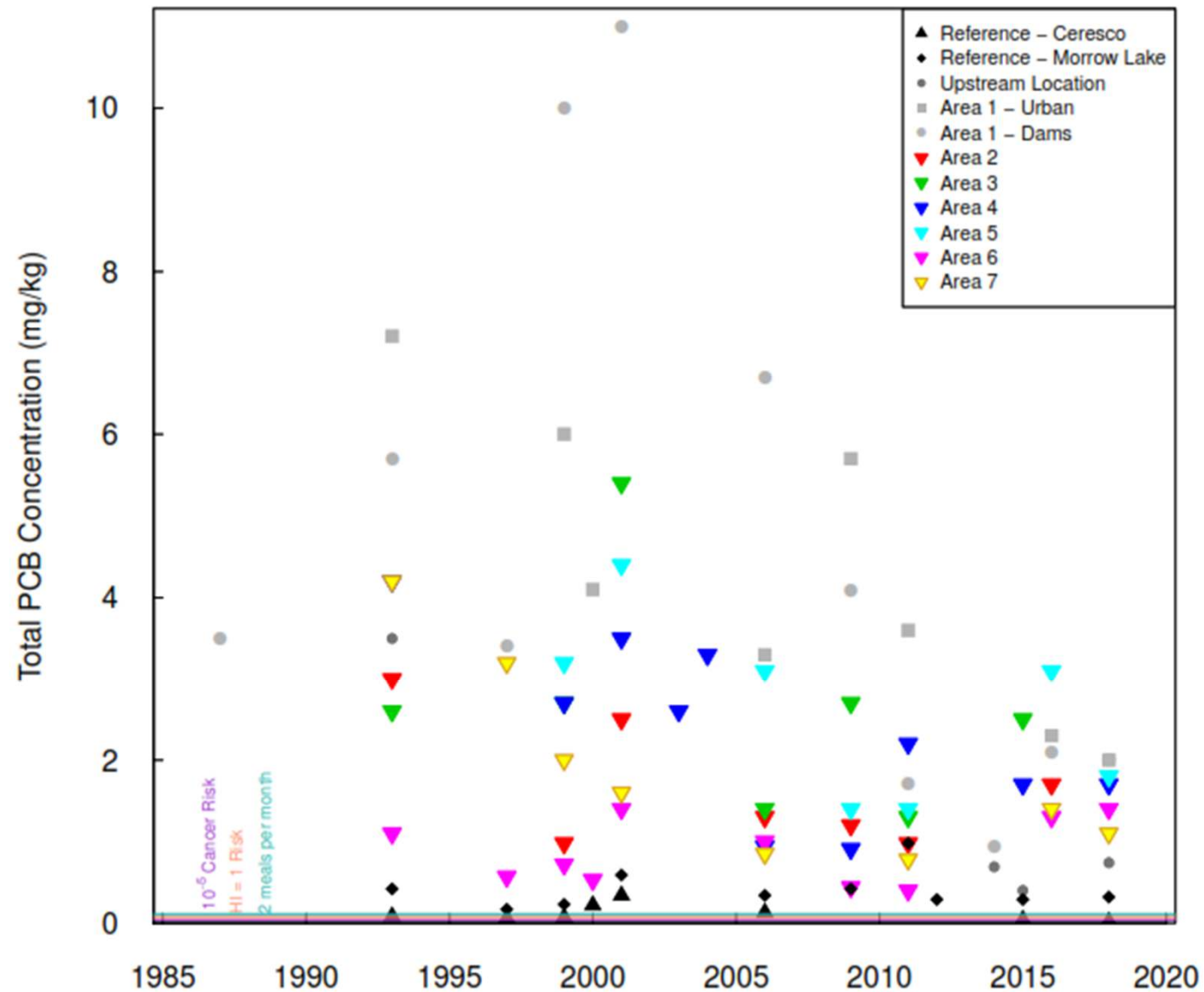


Reference	0.045
	0.33
Upstream Location	0.46
Area 1	0.66
	1.1
Area 2	0.85 (2011)
Area 3	1.4 (2015)
Area 4	0.94
Area 5	1.21
Area 6	1.3
Area 7	0.68

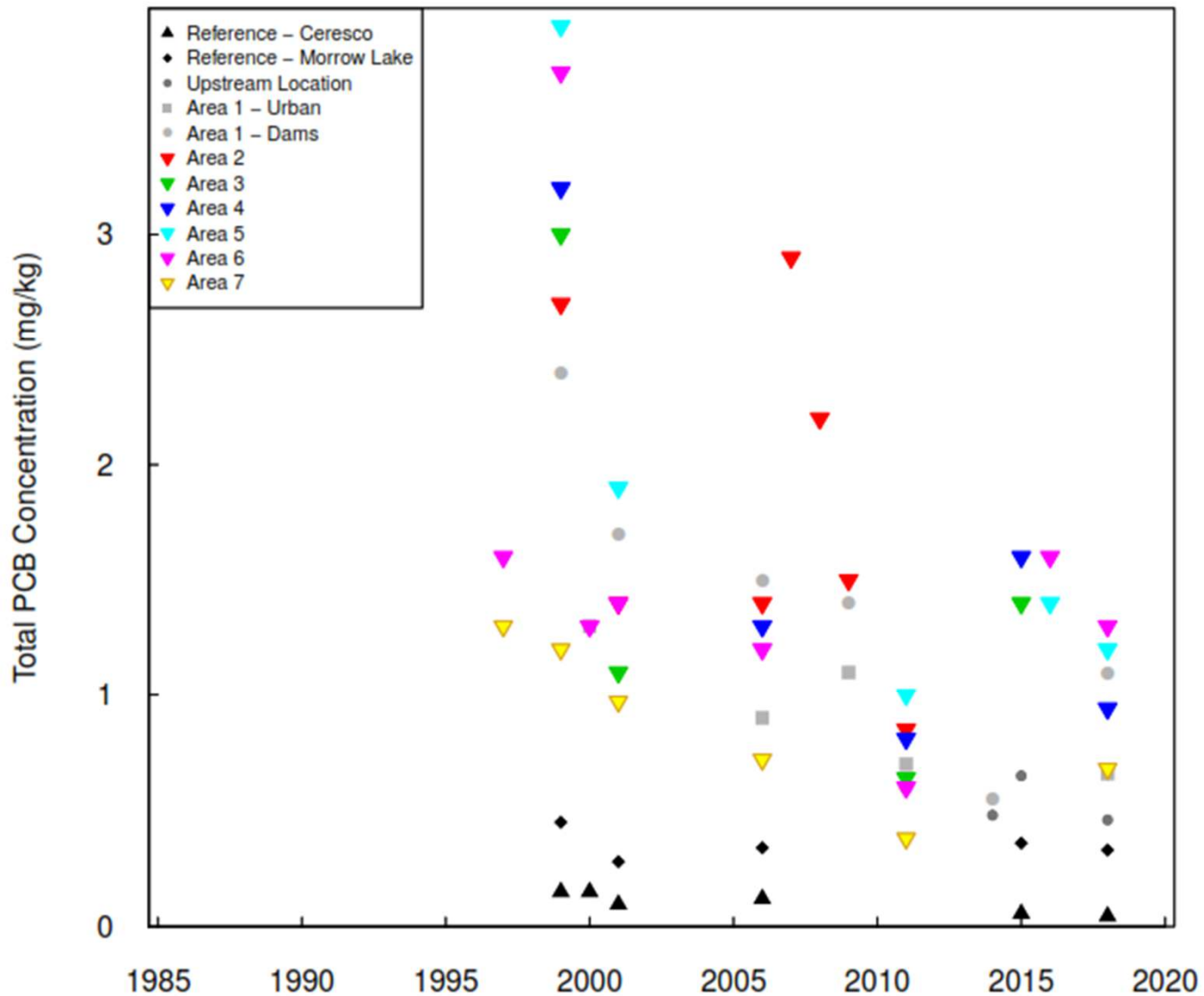
Trends Over Time for SMB Fillets with Skin



Trends Over Time for Carp



Trends Over Time for SMB YOY Whole Body



Fish Tissue PCB Concentration Changes Over Time

Overall reduction in Fish Tissue PCB Concentrations

Area	SMB Fillet	Carp	SMB YOY WB
1 - Urban	1.7%	4.0%	--
1 – Dams	2.6%	3.2%	2.9%
2	--	4.7%	5.8%
3	3.1%	--	3.4%
4	3.5%	7.7%	1.7%
5	--	4.4%	--
6	--	2.1%	--

-- current rate is not a statistically significant downward trend

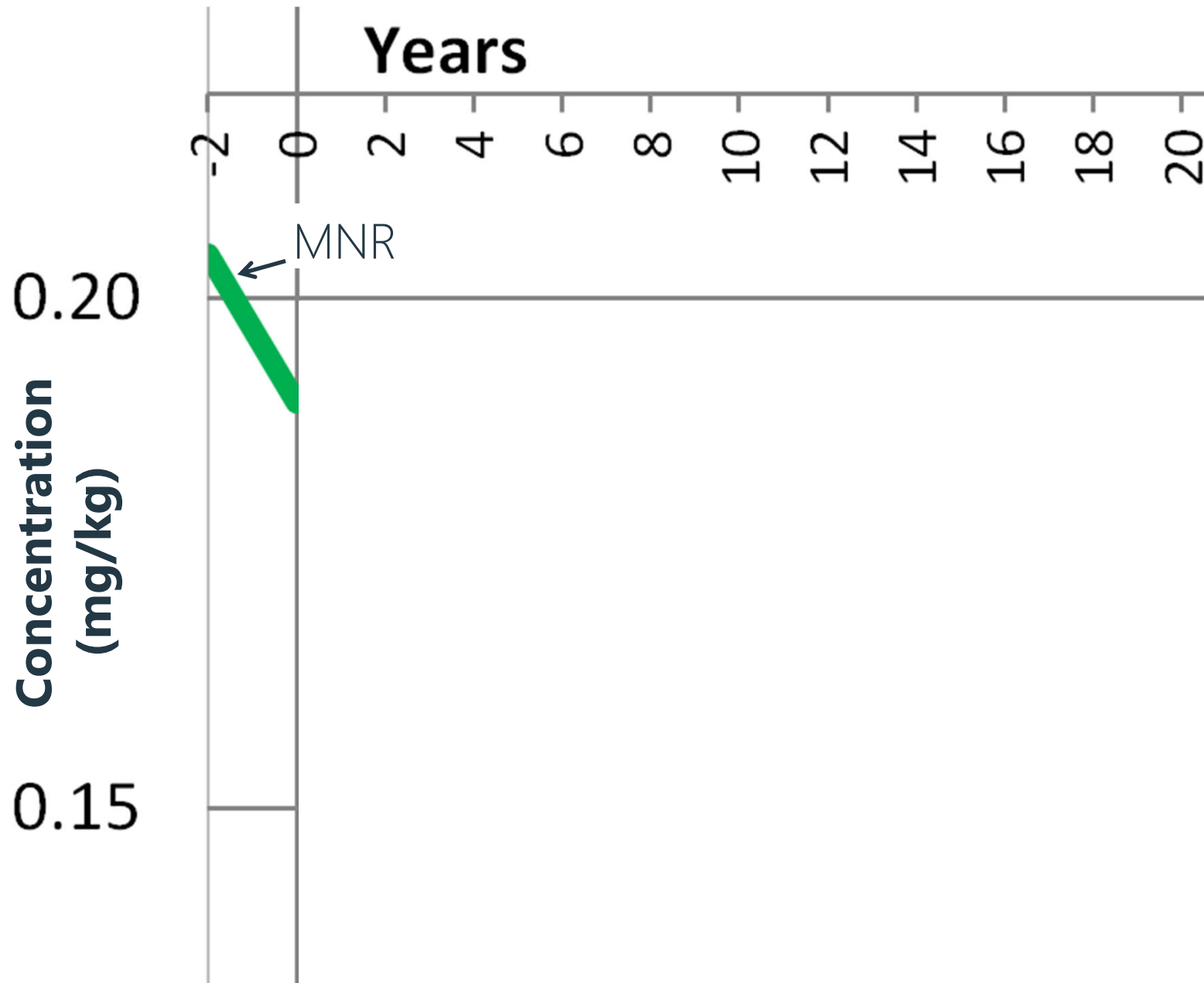
Remediation and Fish Tissue Recovery

- ▶ Step 1: Calculate current recovery rate with no remediation for each fish
- ▶ Step 2: Apply a “step down” in concentration based on previous recovery improvements after remediation along the Kalamazoo River
- ▶ Step 3: Apply an appropriate rate of recovery after remediation is complete
- ▶ Step 4: Estimate time to reach goal after remediation

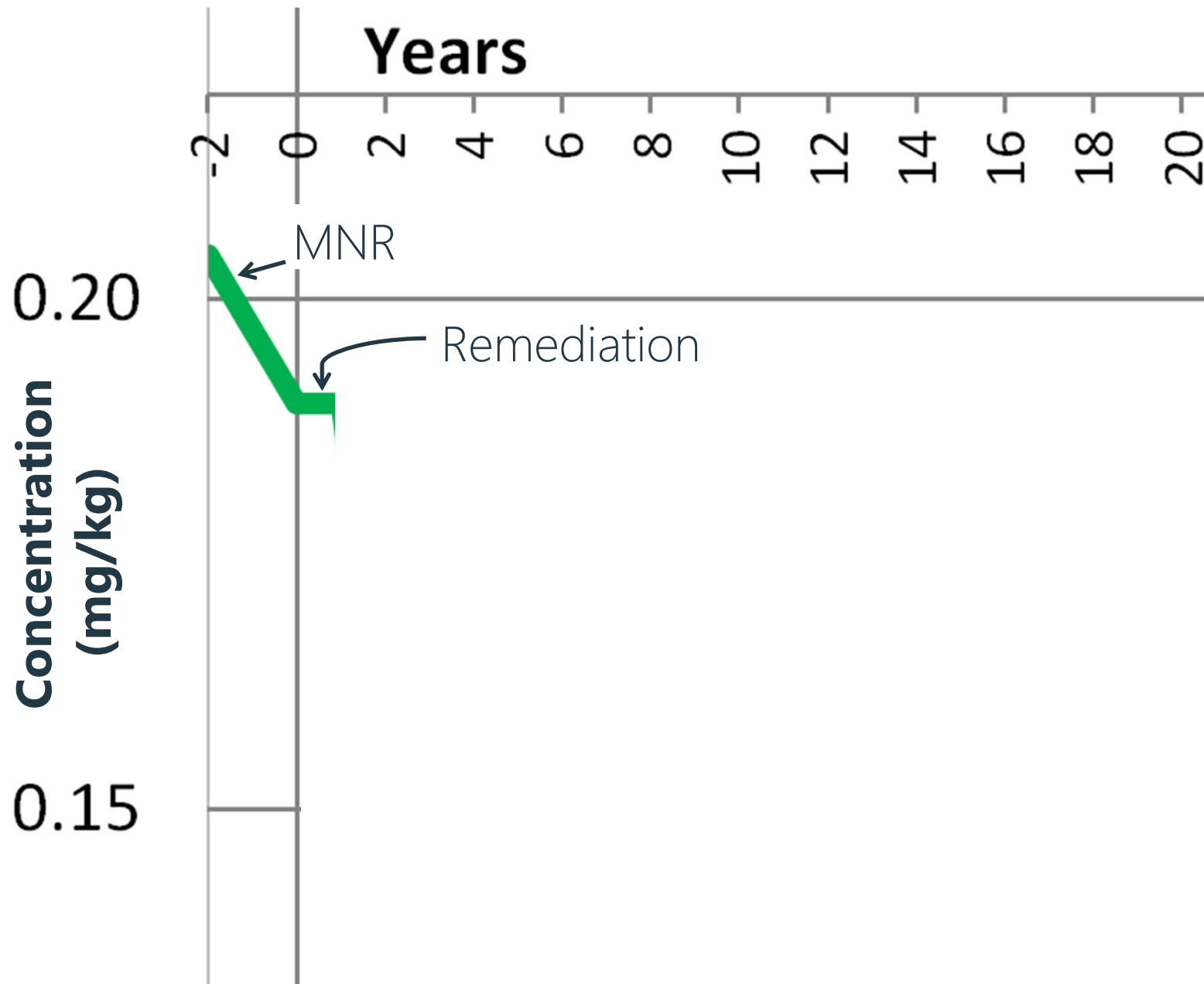
Review Example from the Area 1 Feasibility Study



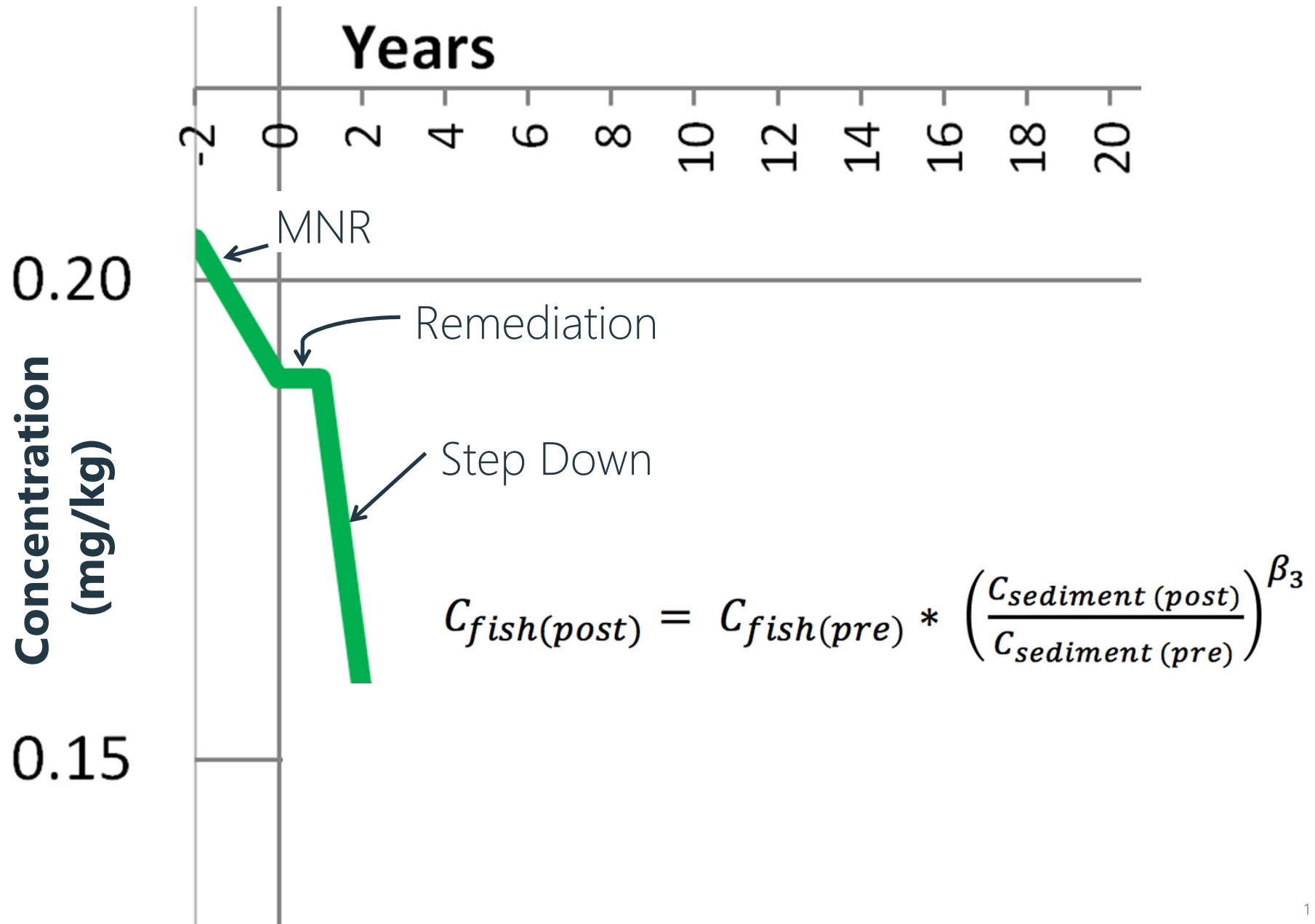
Area 1 Steps 2 - 3: Step Down, Recovery, & Projection



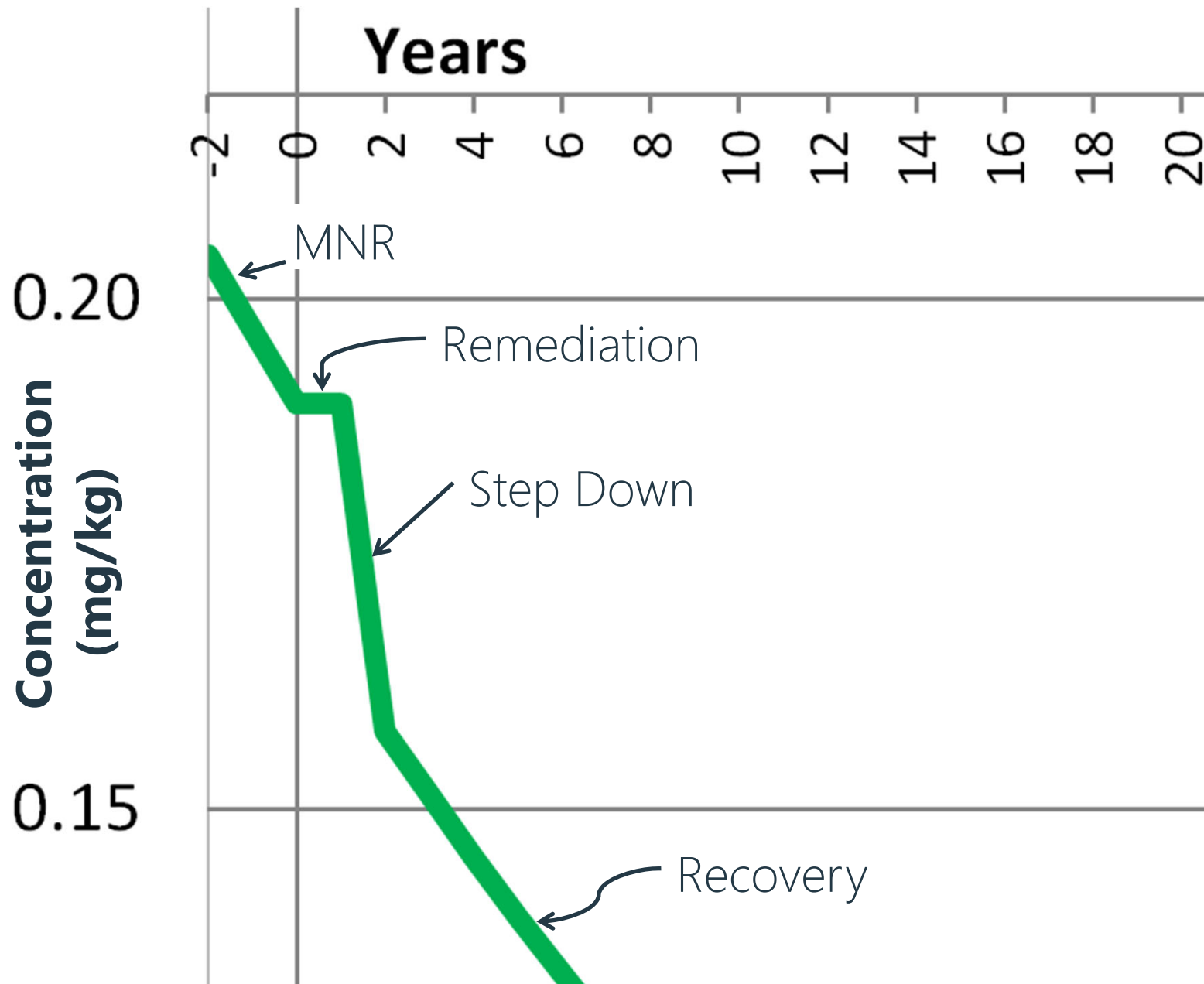
Area 1 Steps 2 - 3: Step Down, Recovery, & Projection



Area 1 Steps 2 - 3: Step Down, Recovery, & Projection

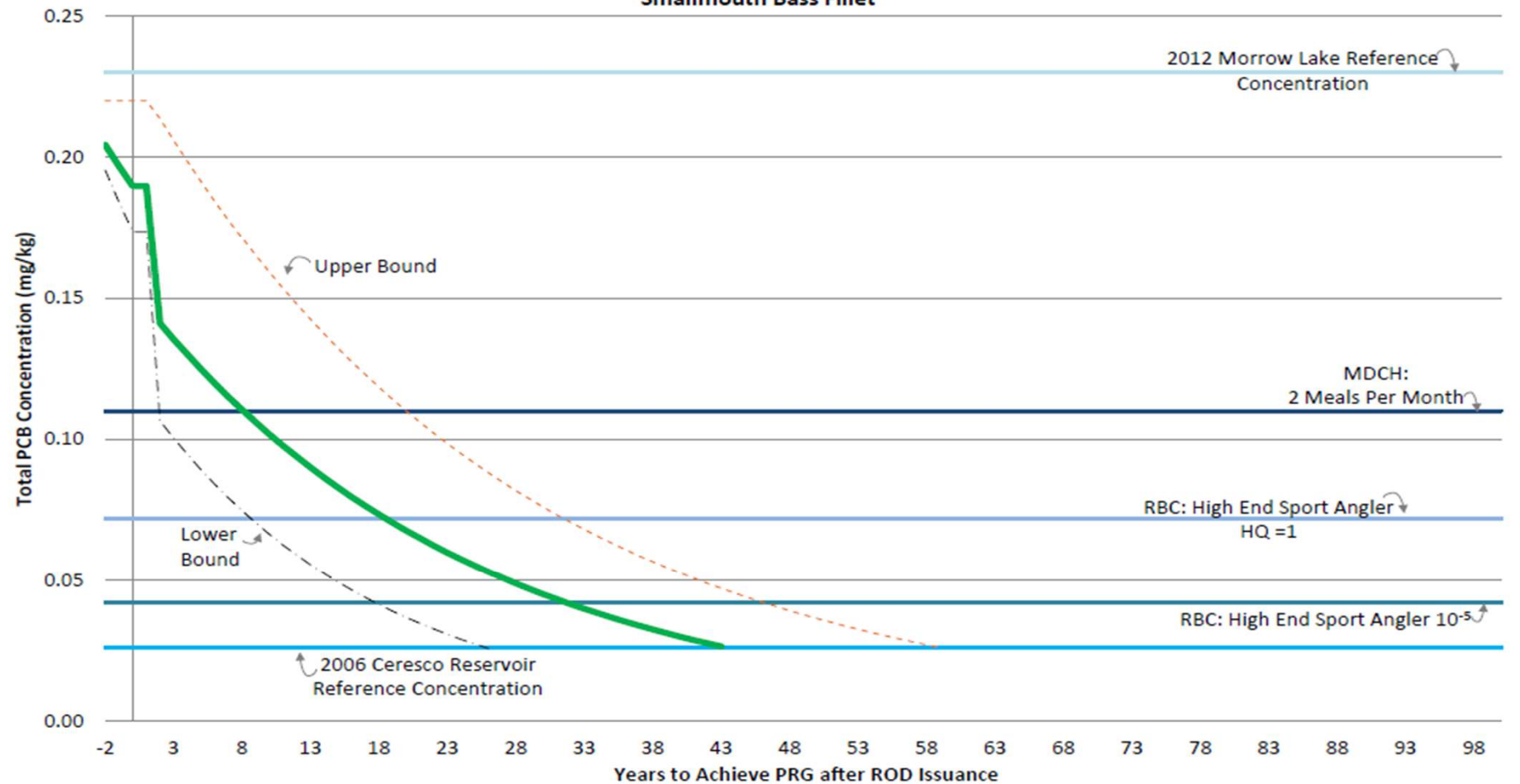


Area 1 Steps 2 - 3: Step Down, Recovery, & Projection



Area 1 Step 4: SMB Fillet Projection

Figure 4-2a
Fish Tissue Projections for S-3:
Smallmouth Bass Fillet



2012 Morrow Lake Reference Concentration = 0.23 mg/kg
 MDCH: 2 Meals Per Month = 0.11 mg/kg
 Human Health Fish Consumption RBC: High End Sport Angler (HQ = 1) = 0.072 mg/kg
 Human Health Fish Consumption RBC: High End Sport Angler (10⁻⁴) = 0.042 mg/kg
 Human Health Fish Consumption RBC: High End Sport Angler (10⁻⁵) = 0.026 mg/kg
 2006 Ceresco Reservoir Reference Concentration = 0.026 mg/kg
 Refer to Table 1-1 for definition of segments

--- Upper Bound S-3: Section 2-4 Hotspots (Upper Bound Step Down)
 — S-3: Section 2-4 Hotspots (Mid Approximation Step Down)
 - · - Lower Bound S-3: Section 2-4 Hotspots (Lower Bound Step Down)

Long Term Monitoring (LTM)

- ▶ LTM has and will continue throughout the investigative and feasibility study phases of Superfund
- ▶ A baseline LTM event will occur prior to remediation
- ▶ LTM will continue post remediation
- ▶ A report will be prepared every 5 years post remediation to document effectiveness of the remedy and rate of fish recovery

