

Relative Risk Model (Demonstration)

Former DuPont Waynesboro Site, Virginia
Area of Concern (AOC) 4



October 25, 2016



Acknowledgement



– Wayne G. Landis

– Lara Gaasland-Tatro

– Meagan Harris

– Scarlett Graham



Agenda

- Objectives
- Overview
- Model Framework
- Applications
- Demonstrations



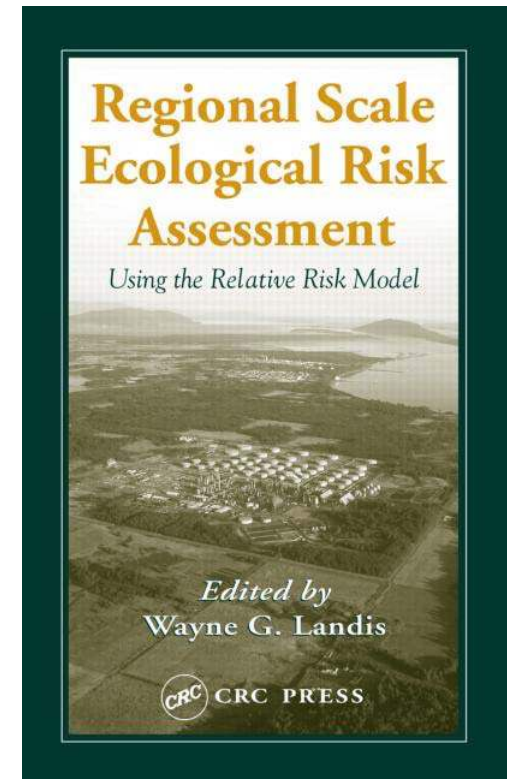
Objectives

- Refresh/Review the Model Framework
- *Provide a demonstration of the RRM*



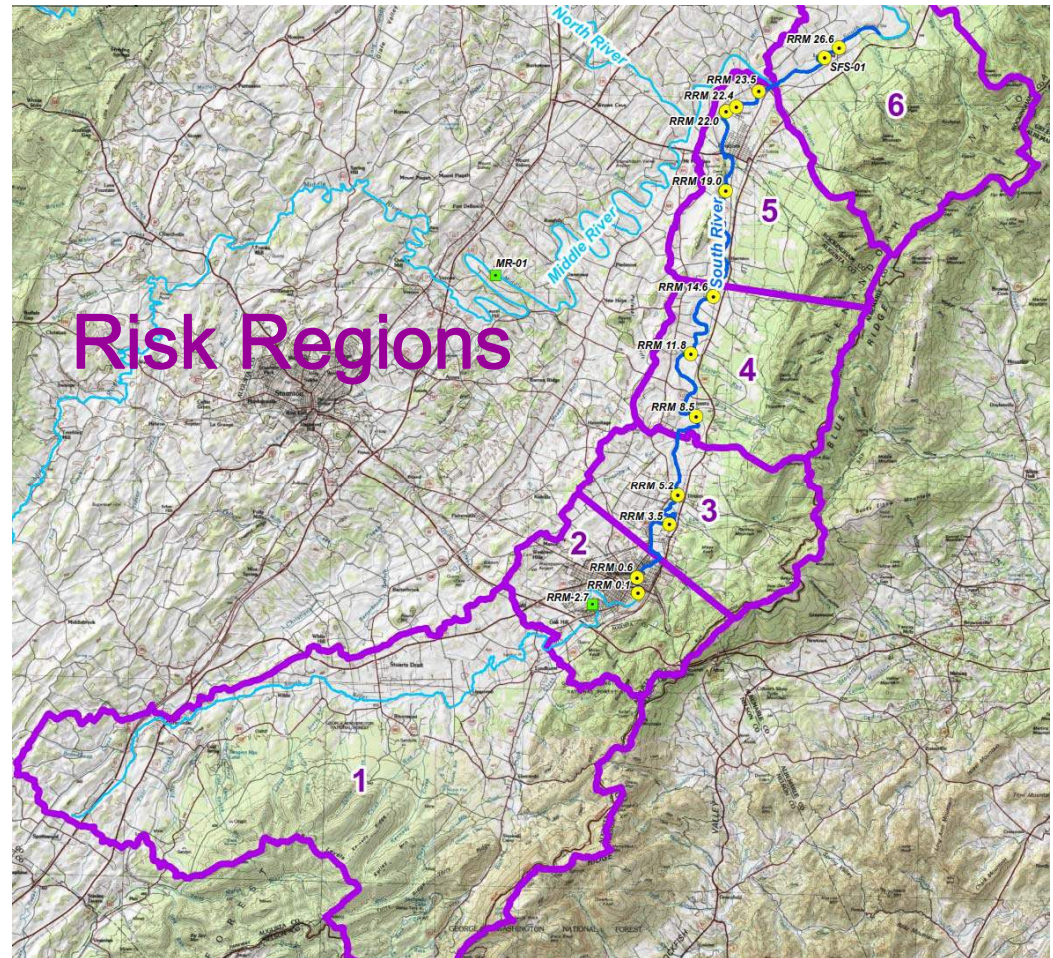
Overview – Relative Risk Model (RRM)

- What is a RRM?
 - A scoring / ranking process based on, but not specifically designed as, a more typical ecological risk assessment
 - Currently utilizes a probabilistic approach with more quantitative (robust) estimates of “risk”
- Capabilities
 - Combines literature data, field data, and expert judgment
 - Allows assessment of multiple stressors and endpoints
 - Can model specific habitats and/or receptors, in a specific location; or more holistically across a watershed
 - Can accommodate stakeholder values, and an ecosystem services framework



Overview – AOC 4 RRMs

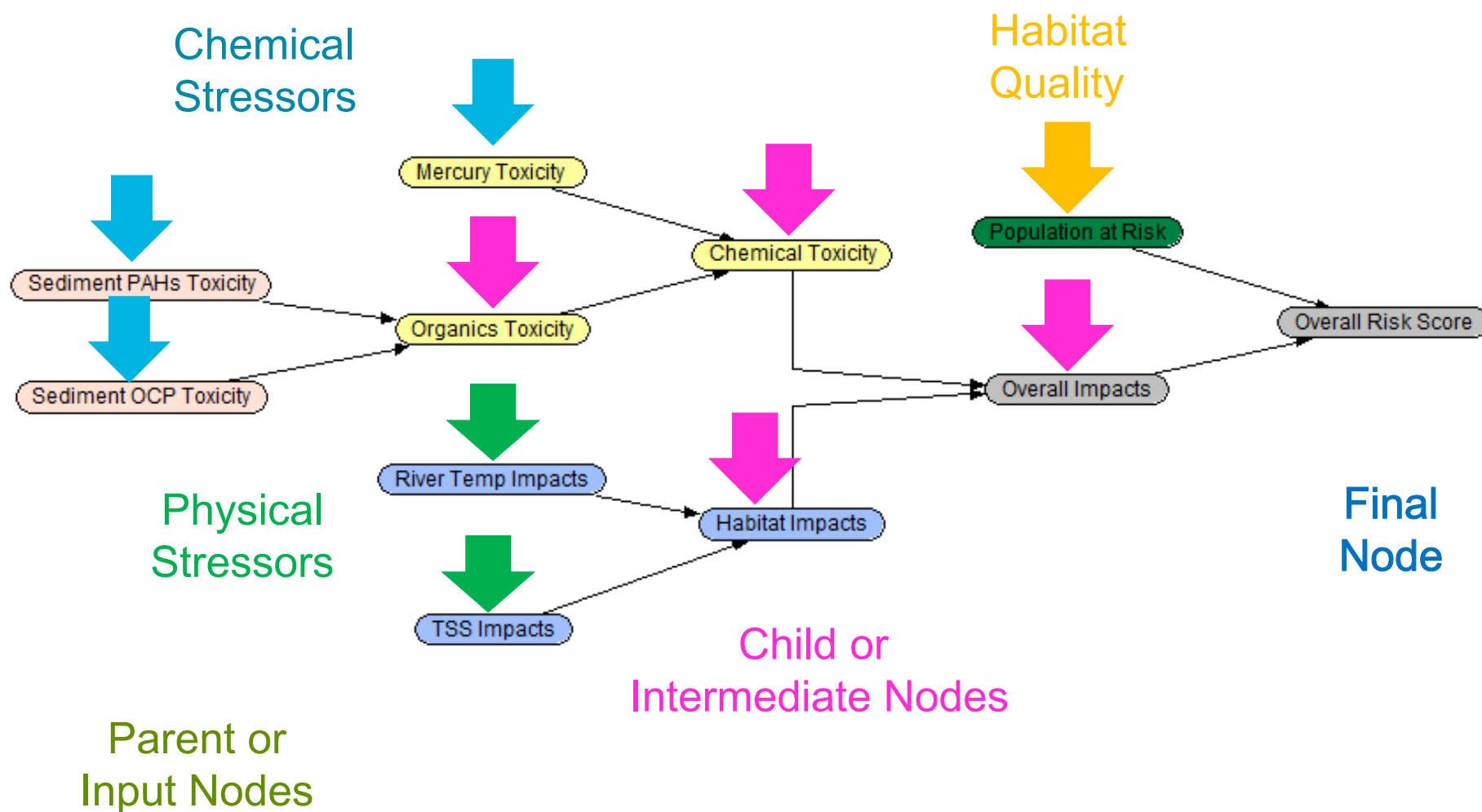
- Watershed/
Regional Scale
- *Relative* Risk
- *Multiple* Stressors
- *Multiple* Endpoints



Model Framework

Example: RRM for Smallmouth Bass in Risk Region 2

Model Framework

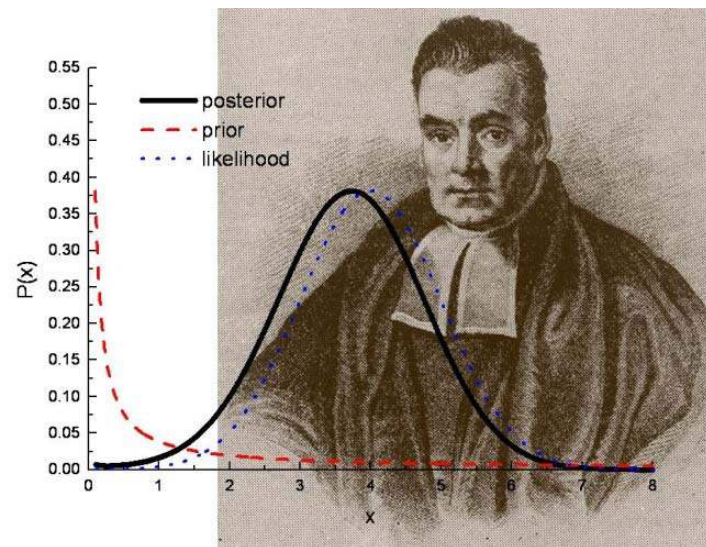


Platform/Algorithm

- NETICA® (v5.23)
- Bayes Net “BN”
- Conditional Probabilities



http://www.norsys.com/tutorials/netica/nt_toc_D.htm



Source: Chennai Bayes (2016)

Model Input – Parent/Input Node

– ≥ 2 States

– State Criteria/Definition

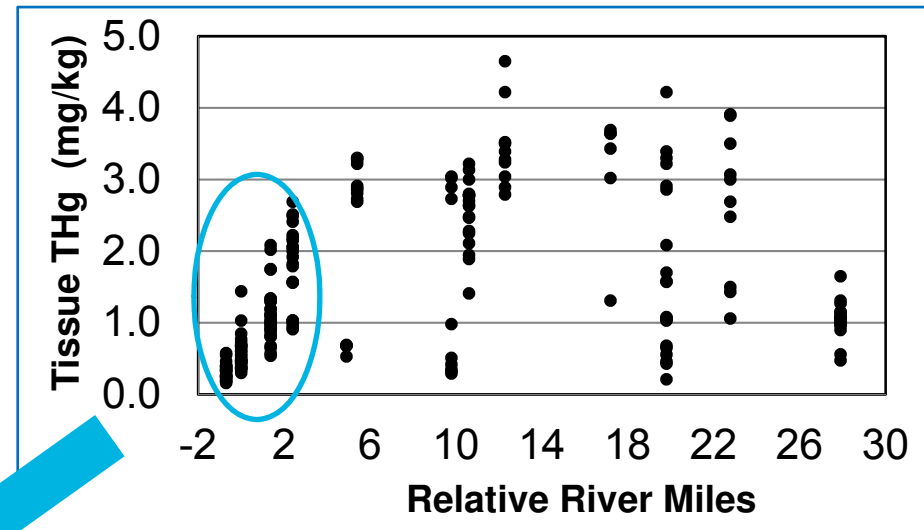
– Input Data Distribution

MeHg *Toxicity* to SMB

Input	States	Criteria	Basis	References
Fish Tissue MeHg (mg/kg)	Zero	< 0.2	< 5% lethality or equivalent endpoints	Dillon et al (2010) USEPA (2009)
	Low	0.21-1.1	5 - 24% lethality or equivalent	
	Med	1.2-2.8	24 - 50% lethality or equivalent	
	High	> 2.9	> 50% lethality or equivalent	

Model Input – Parent/Input Node

- ≥ 2 States
- State Criteria/Definition
- Input Data Distribution

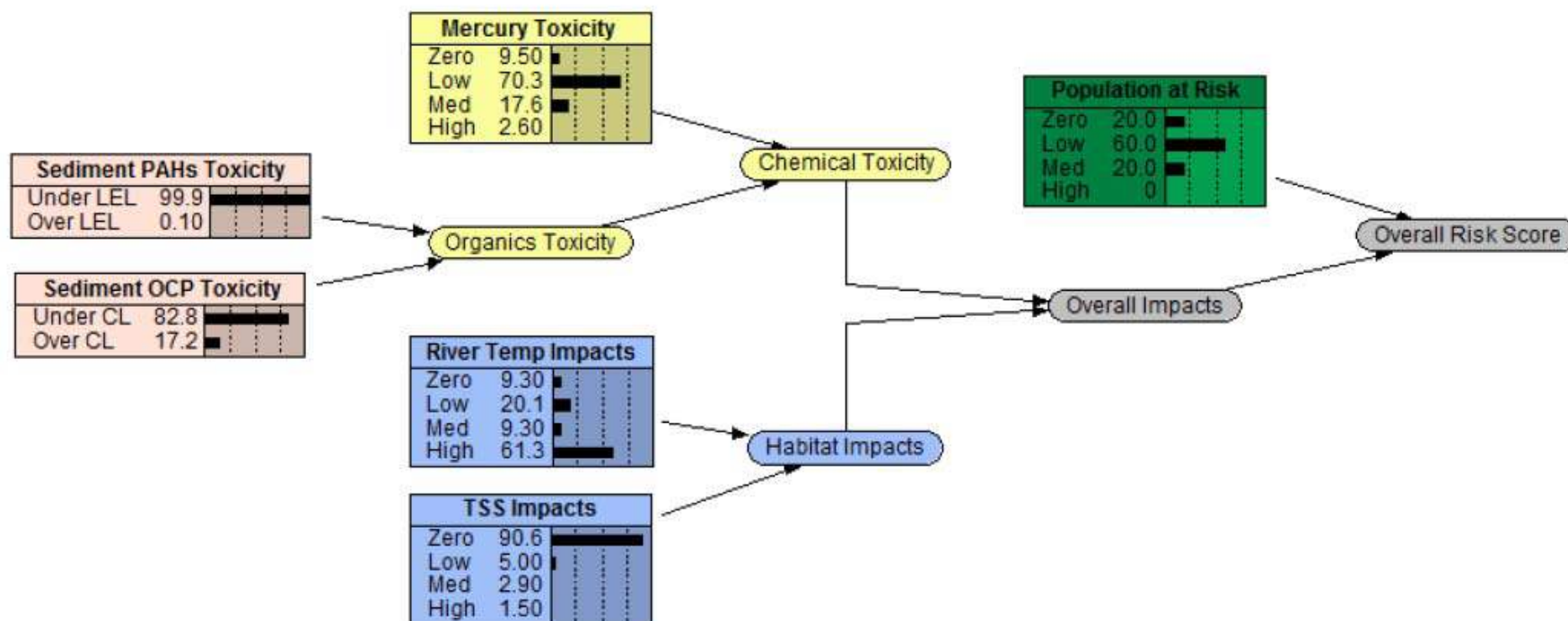


States	Criteria (mg/kg)
Zero	< 0.2
Low	0.21-1.1
Med	1.2-2.8
High	> 2.9

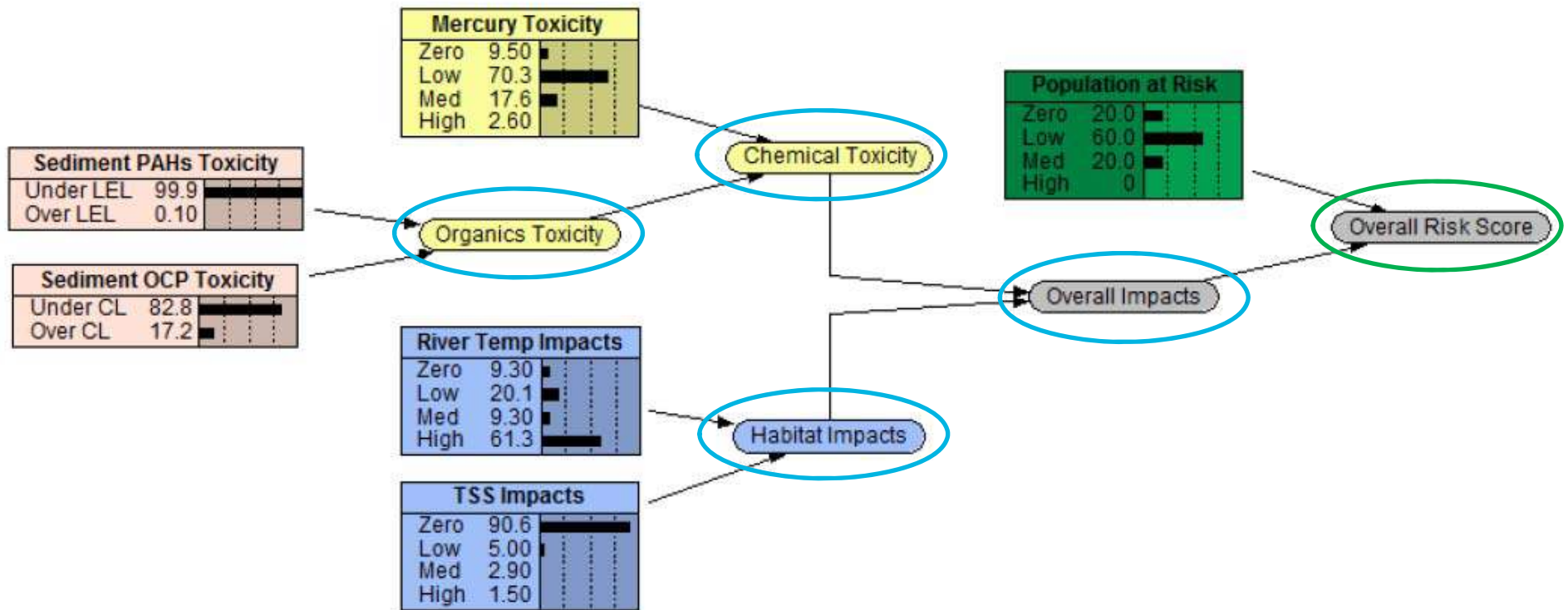


Mercury Toxicity			
Zero	9.50		
Low	70.3		
Med	17.6		
High	2.60		

Model Input – Parent/Input Nodes



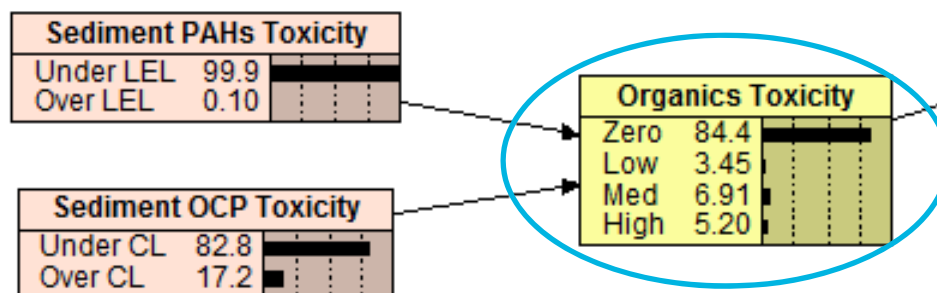
Model Parameter – Child Nodes - Conditional Probab



- Expert judgement
- Empirical evidence

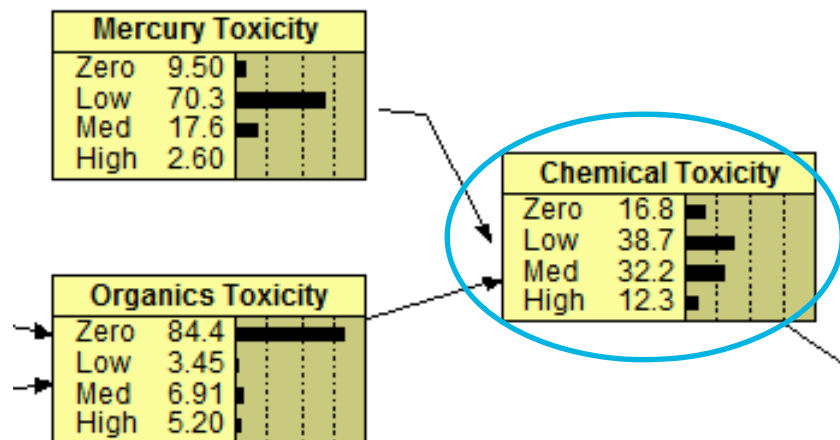
- Equations
- Case file learning

Model Parameter – Child Nodes - Conditional Probab



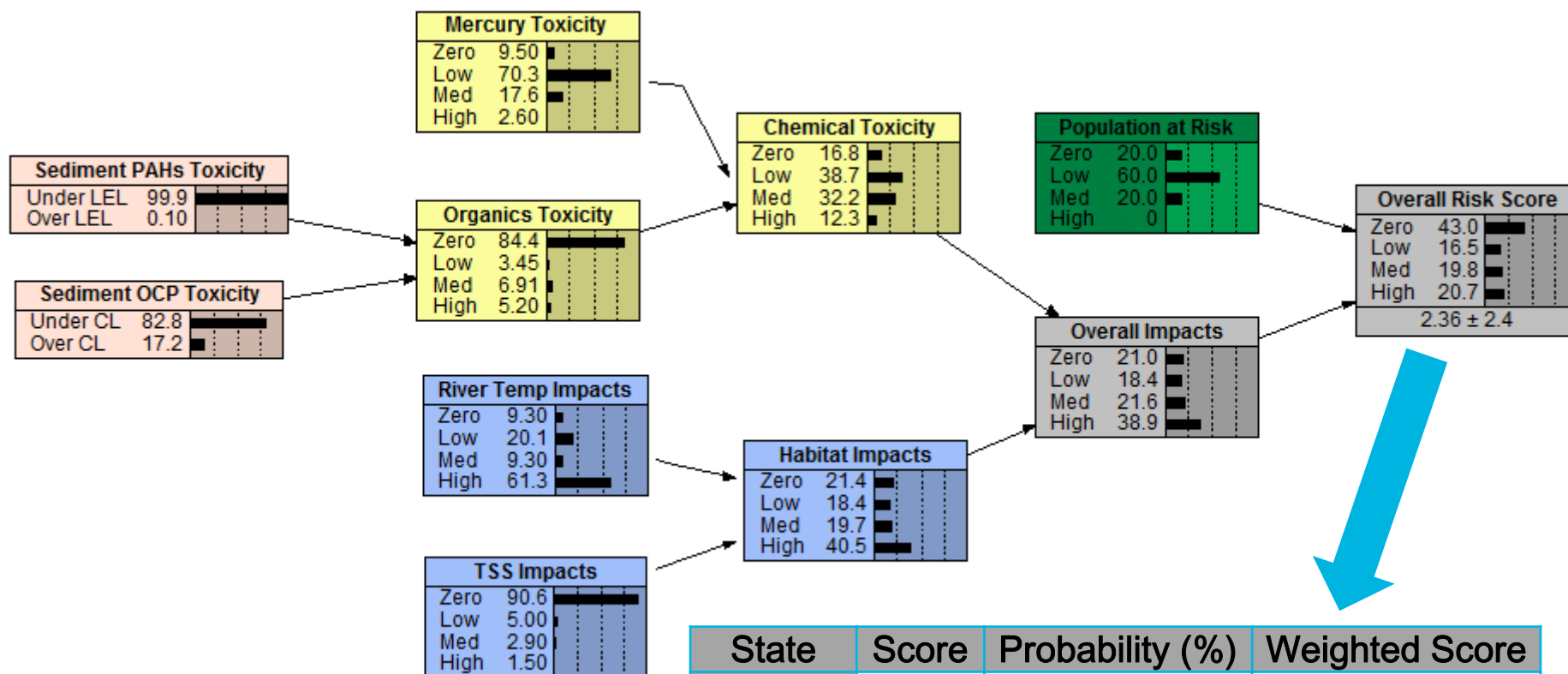
Condition 1	Condition 2	Outcome (Organics Tox)			
PAHs Tox	OCP Tox	Zero	Low	Medium	High
Under LEL	Under CL	100	0	0	0
	Over CL	10	20	40	30
Over LEL	Under CL	10	20	40	30
	Over CL	0	0	0	100

Model Parameter – Child Nodes - Conditional Probab



Condition 1	Condition 2	Outcome (Overall Toxicity)			
Mercury Tox	Organics Tox	Zero	Low	Medium	High
Zero	Zero	100	0	0	0
	Low	80	20	0	0
	Medium	50	40	10	0
	High	25	30	40	5
Low	Zero	10	50	30	10
	Low	25	45	30	0
	Medium	10	35	45	10
	High	5	25	50	20
Medium	Zero	5	30	55	10
	Low	0	15	50	35
	Medium	0	5	35	60
	High	0	0	15	85
High	Zero	5	10	15	70
	Low	0	5	15	80
	Medium	0	0	10	90
	High	0	0	0	100

Complete Model/Calculations



State	Score	Probability (%)	Weighted Score
Zero	0	43.0	0.00
Low	2	16.5	0.33
Medium	4	19.8	0.79
High	6	20.7	1.24
Overall		100.0	2.36

AOC 4 RRM's – Overall Results



Region	Biotic Endpoints				Water Quality				Totals		
	SMB	WS	BK	CW	WQ	WF	WS2	WB	Biotic	Water	Overall
2	2.4	3.6	2.5	1.1	4.9	1.6	4.5	4.4	9.6	15.4	25.0
3	2.7	3.1	1.5	1.9	4.5	1.5	4.6	4.6	9.2	15.2	24.4
4	4.3	2.4	2.1	3.0	4.5	2.1	4.3	4.2	11.8	15.1	26.9
5	4.5	1.3	2.2	2.9	4.8	1.9	4.8	4.7	10.9	16.2	27.1
6	3.3	1.7	1.5	2.5	4.3	1.2	4.6	4.5	9.0	14.6	23.6
Totals	17.2	12.1	9.8	11.4	23.0	8.3	22.8	22.4	50.5	76.5	127.0

SMB – Smallmouth Bass

WS – White sucker

BK – Belted kingfisher

CR – Carolina wren

WQ – Water quality

WF – River use - fishing

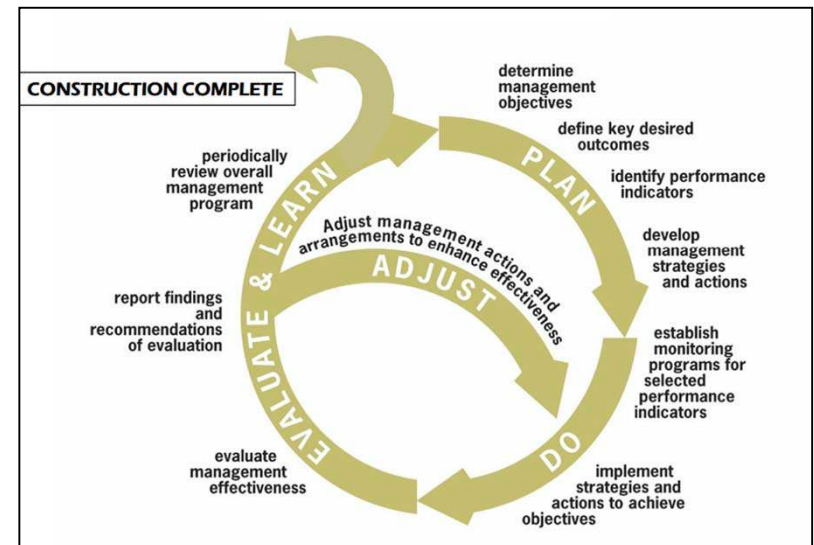
WS2 – River use - swimming

WB – River use - boating

Applications

Applications

- Evaluation of Factors Other Than Mercury
 - Input to monitoring framework
- Evaluate Management Options
 - Input to Enhanced Adaptive Management (EAM) Model
 - Incorporate “Changes” in the RRM



Enhanced Adaptive Management (EAM)

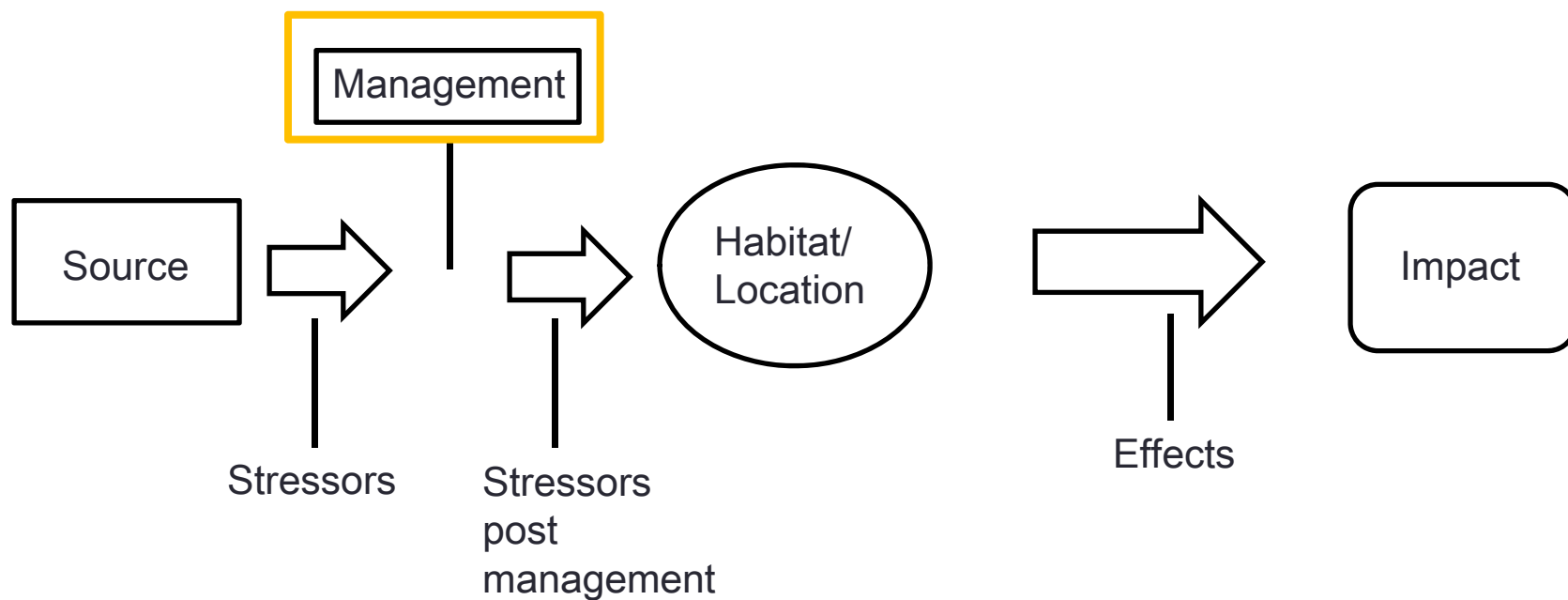
Inputs to the EAM Model



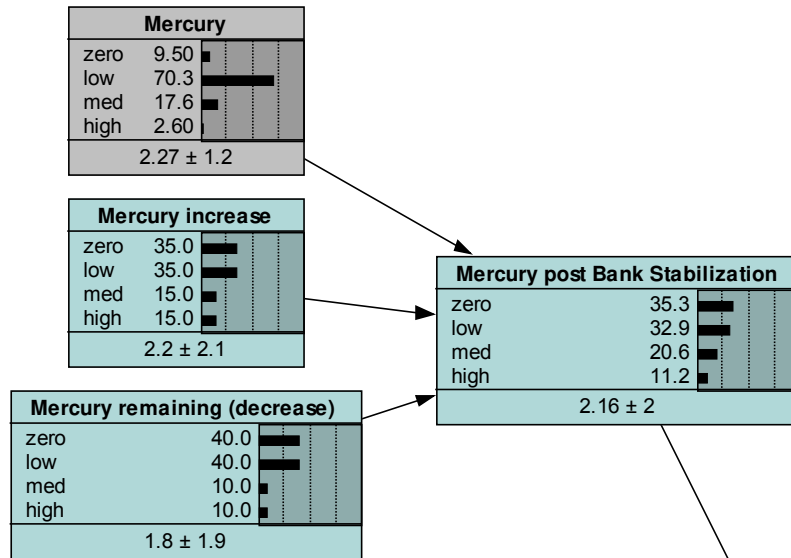
Scenario	Data Source/Models
Baseline	Default 2015 RRM
Interim Remedial Measures	Modified RRM for Risk Region 2 (assumes +10% shift in tissue mercury distribution and no change in water temperature)
Extensive Removal/ Bank Clearing	2015 Bank Management RRM for Risk Region 2

Evaluation Criteria	Metrics	Lowest Possible	Lowest Probable	Highest Probable	Highest Possible
Community Acceptance Criteria (Local Government, Landowners, and River Users)					
Fishing	Service risk	0	1.2	2.1	6
Swimming	Service risk	0	4.3	4.8	6
Boating	Service risk	0	4.2	4.7	6
State Acceptance Criteria (Technical and Administrative Issues)					
Small Mouth Population	Population risk	0	2.36	4.48	6
White Sucker Population	Population risk	0	1.33	3.62	6
Carolina Wren Population	Population risk	0	1.12	2.99	6
Belted Kingfisher Population	Population risk	0	1.47	2.53	6

Built-In Potential Impacts of Management



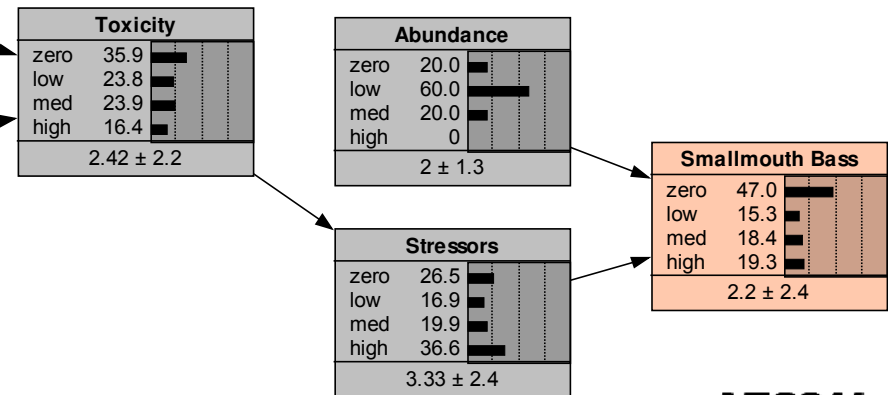
Impacts of Bank Stabilization



Nodes Impacted by Bank Stabilization

Relied on Bank Pilot Findings:

- Assumed same trend for post-management pore water as shown by the Bank Pilot results.
- Used TMDL fish fillet vs. water column Hg to extrapolate fish tissue Hg from pore water Hg.



Demonstration