A decision support process to identify instream flows for the Willamette River ecosystem

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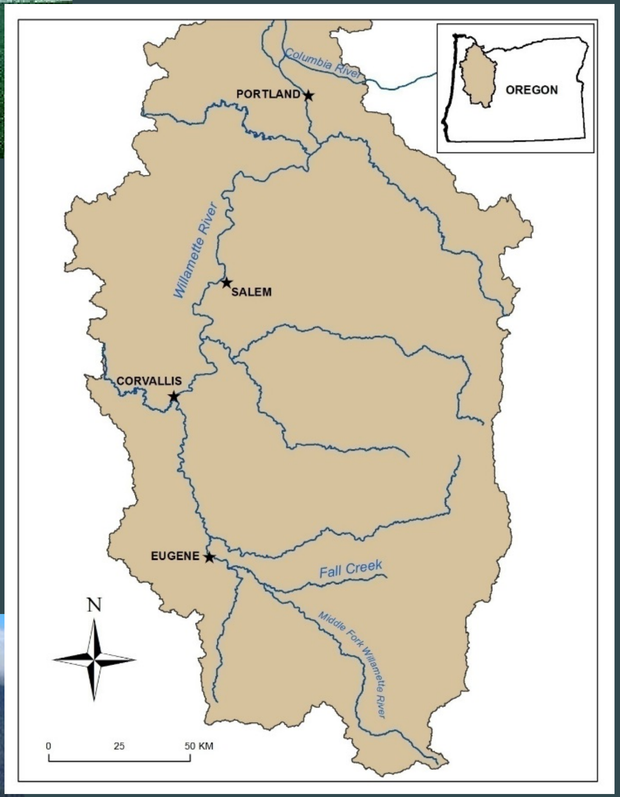
Context: Water Resource Management in the Northwest



Water allocation:

Agricultural irrigation

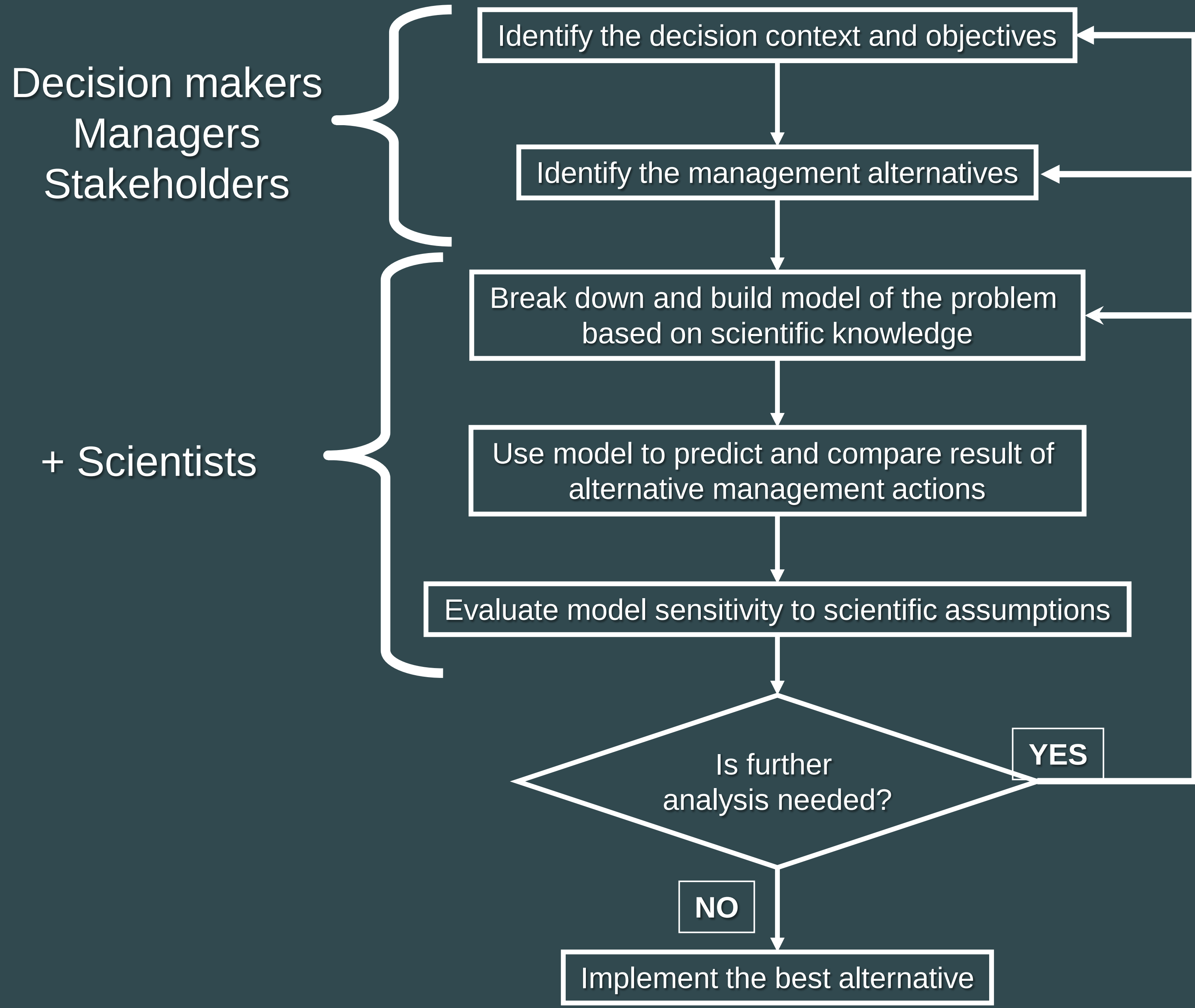
Increasing urbanization

Industrial use

Recreation & Tourism

Ecosystem needs

Structured Decision Making Process



Willamette Instream Flows

Purpose: Identify instream flows to sustain the river ecosystem and dependent fish, wildlife, and vegetation

- Social and economic water use considered separately

Interdisciplinary Team:

Hydrologists

Geomorphologists

Water quality modelers

Ecologists

Managers

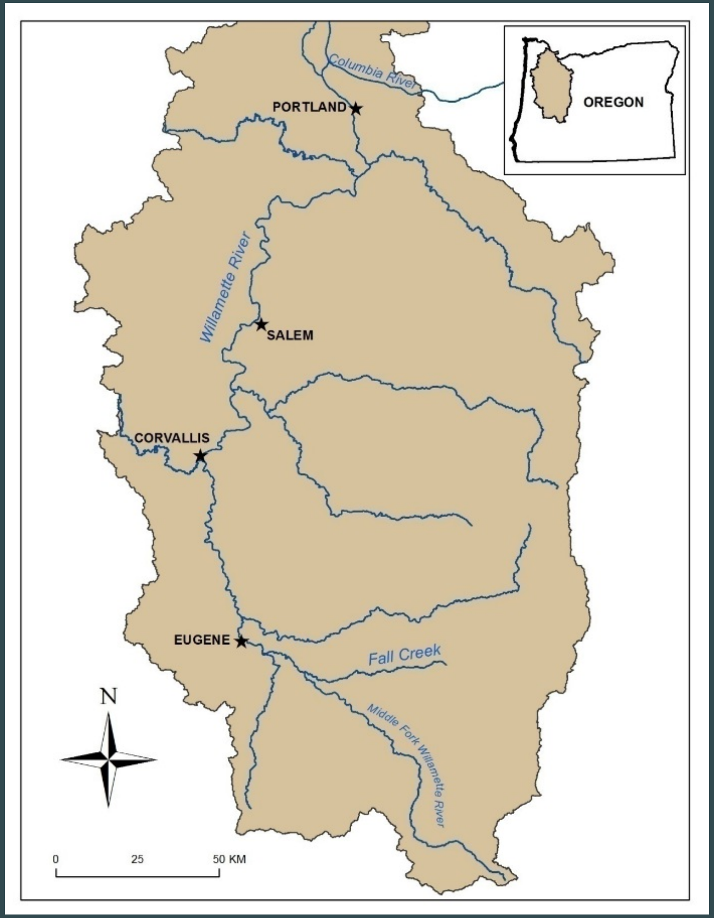
Stakeholders

Decision Context

Location: Willamette River system above Willamette Falls

Time Period: April-October (conservation storage season)

Purpose: Identify instream flow needs for river ecosystem and dependent fish, wildlife and vegetation

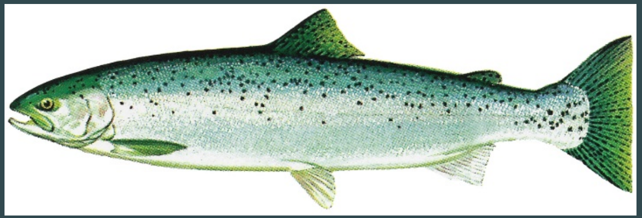


Mostly Mainstem focused

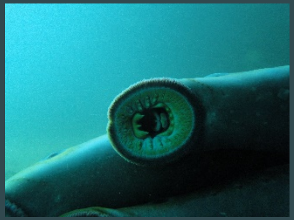
Objectives
Aspects we care about

<u>Fisheries</u>

- Wild Chinook salmon
- Wild Steelhead
- Native fish diversity
- Lamprey
- Mussels



By Oregon Department of Fish & Wildlife



By Dino Kanlic - Own work, CC BY-SA 4.0

Objectives
Aspects we care about

Riparian plants

- Native riparian plants
  - Black cottonwood

By Amiyashrivastava CC BY-SA 3.0

Wildlife

- Western pond turtle
- Native Amphibians
  - Red legged frog

By Yathin S Krishnappa - Own work, CC BY-SA 3.0,

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Objectives

Aspects we care about

How are the objectives affected by river flow?

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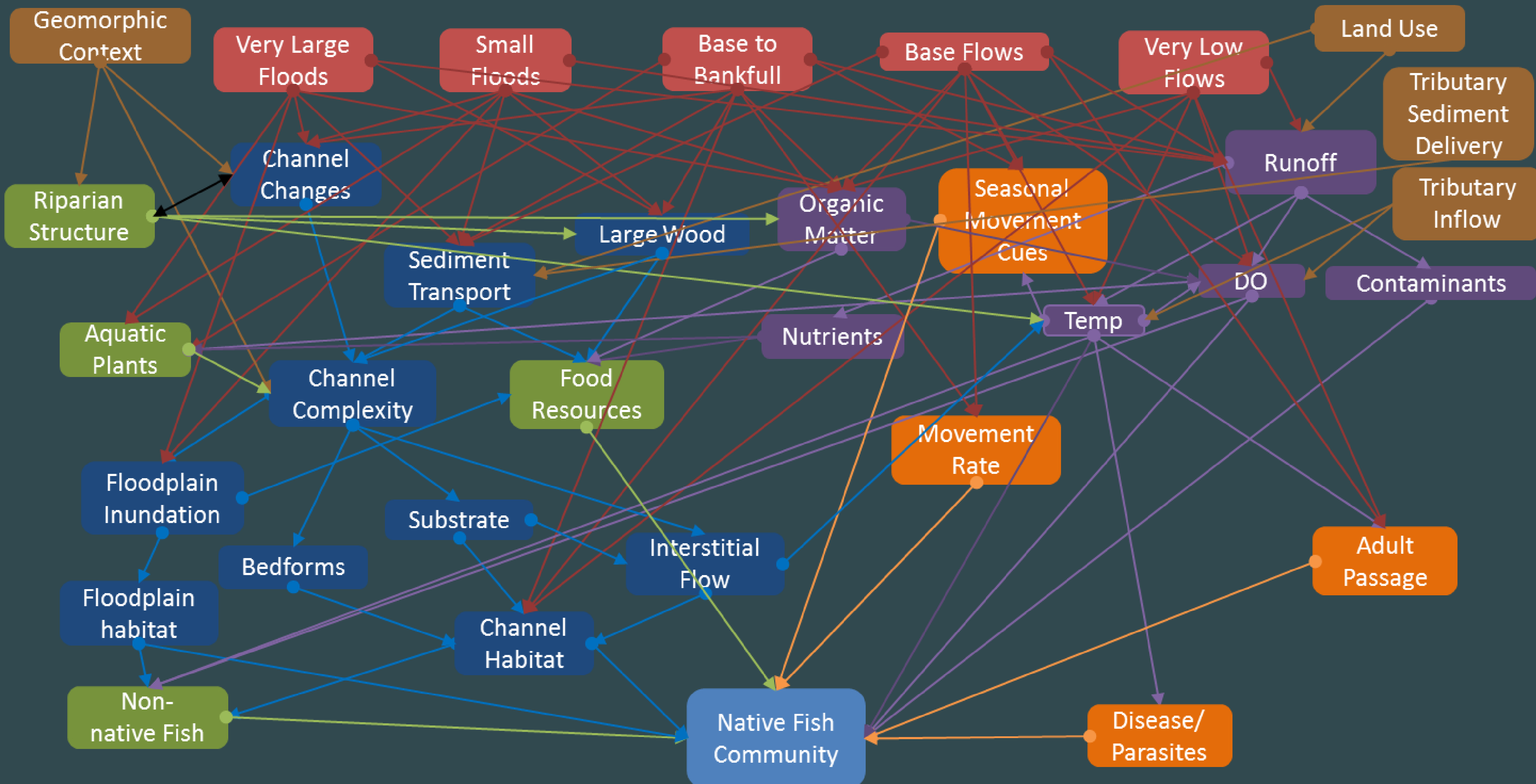
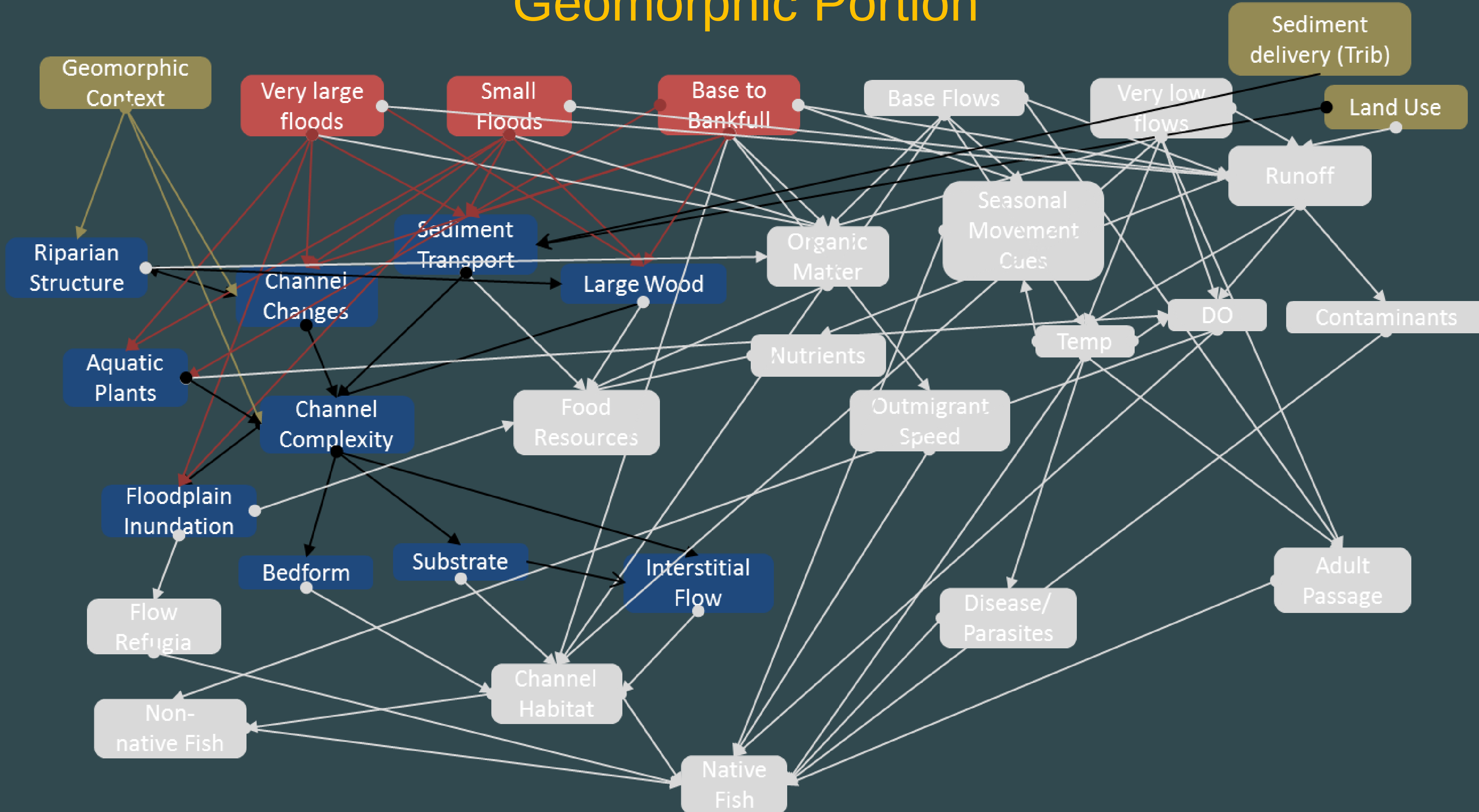
Integrated Conceptual Models

Generic Fish Model



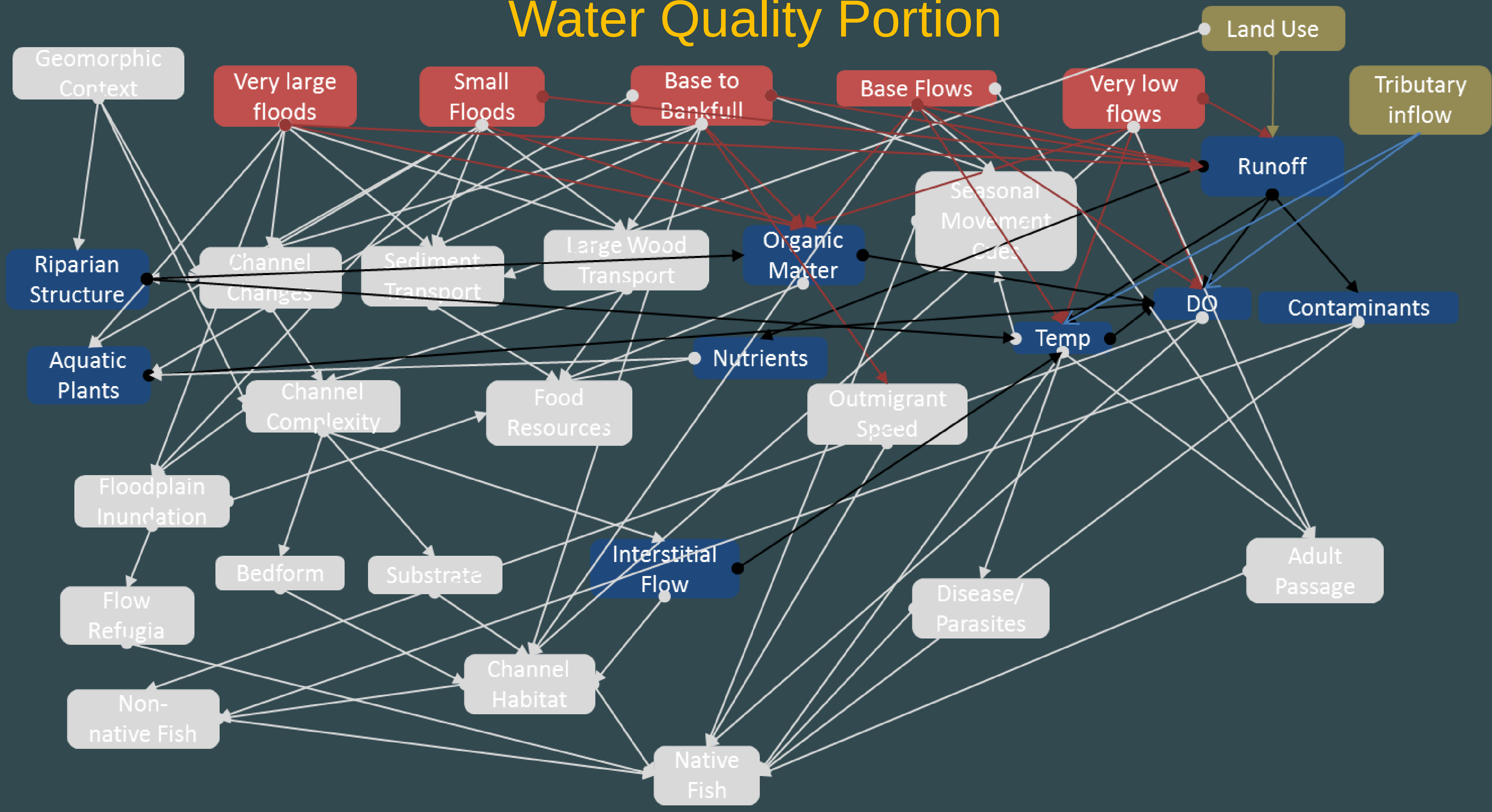
Integrated Conceptual Models

Geomorphic Portion



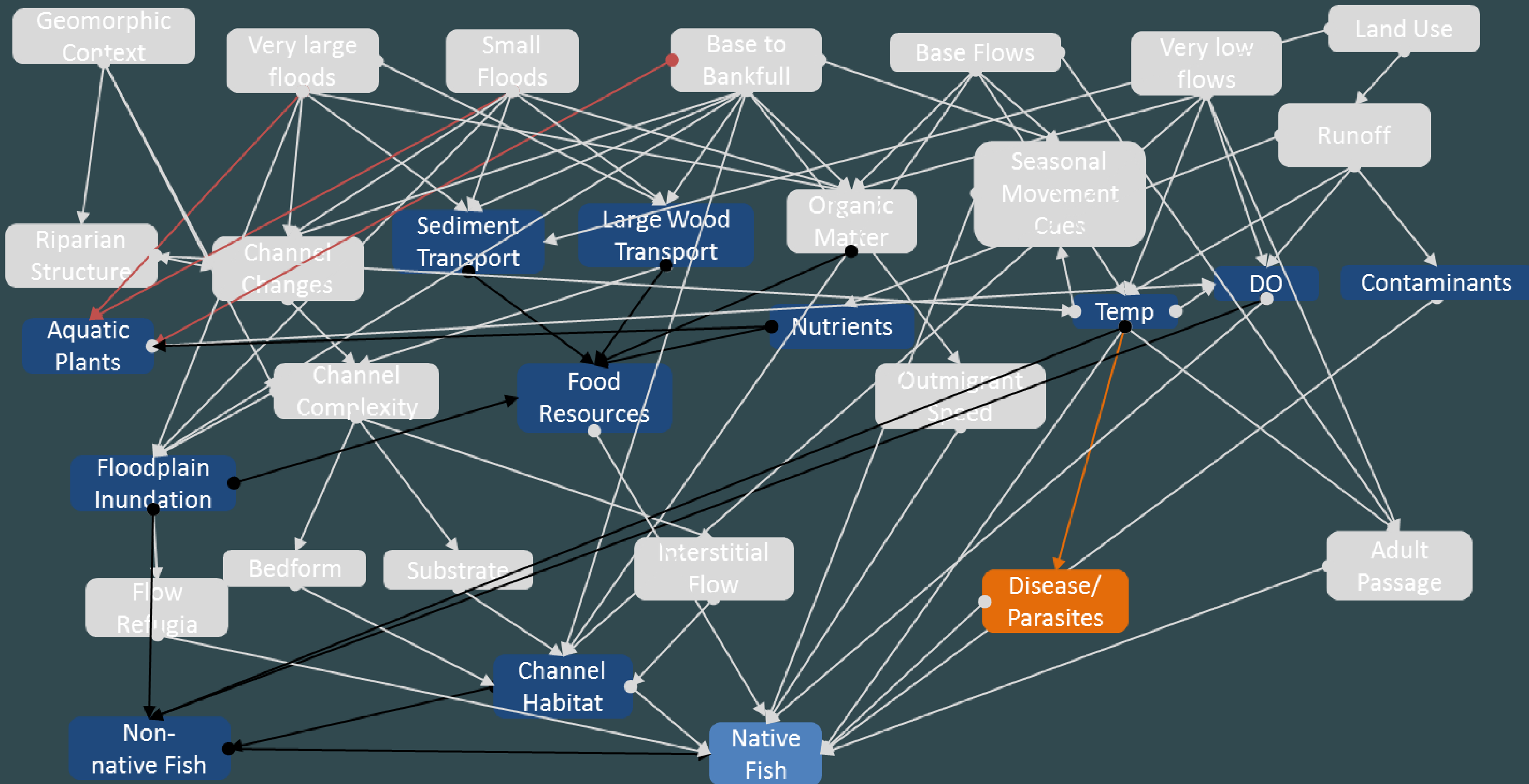
Integrated Conceptual Models

Water Quality Portion

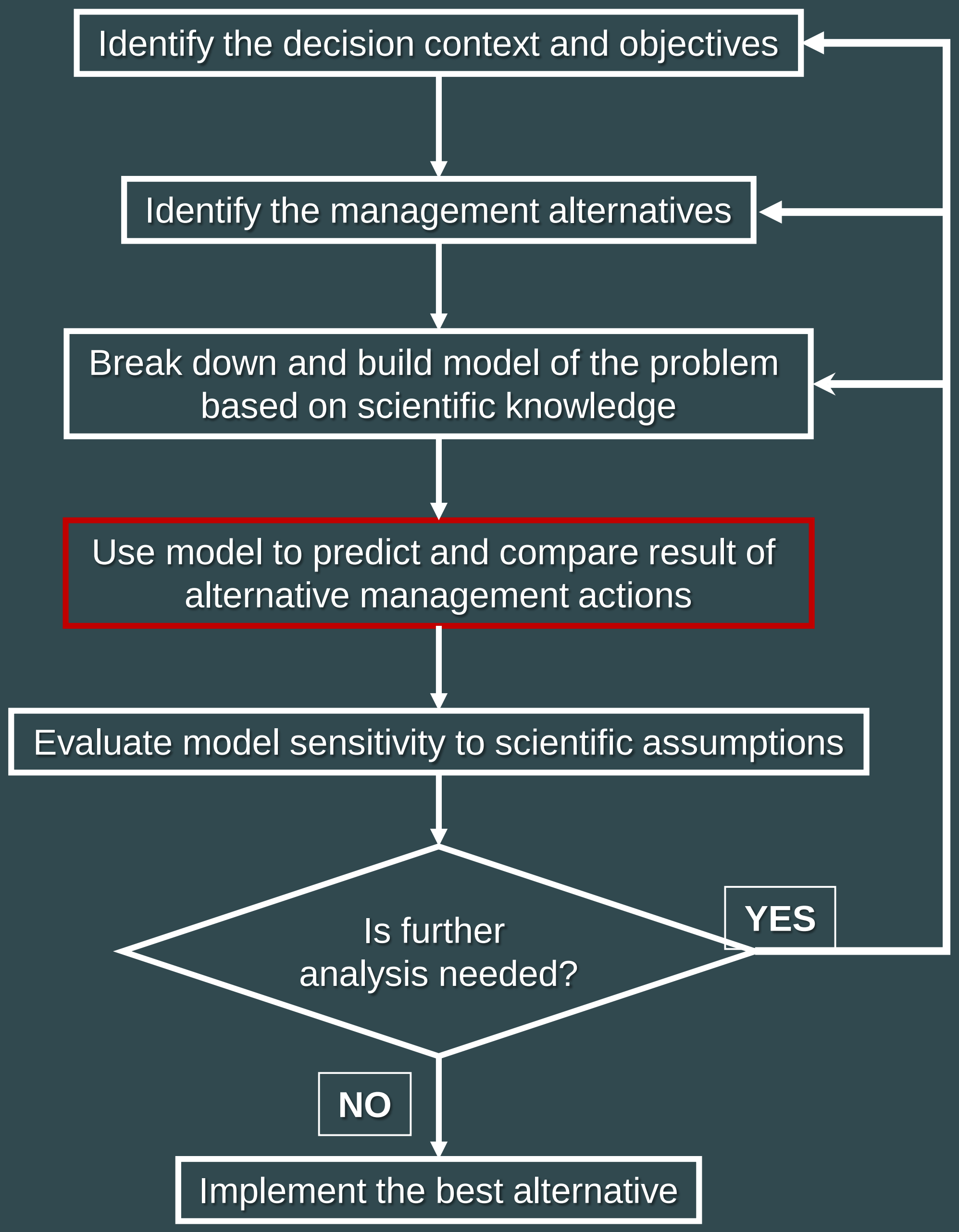


Integrated Conceptual Models

Biotic Portion



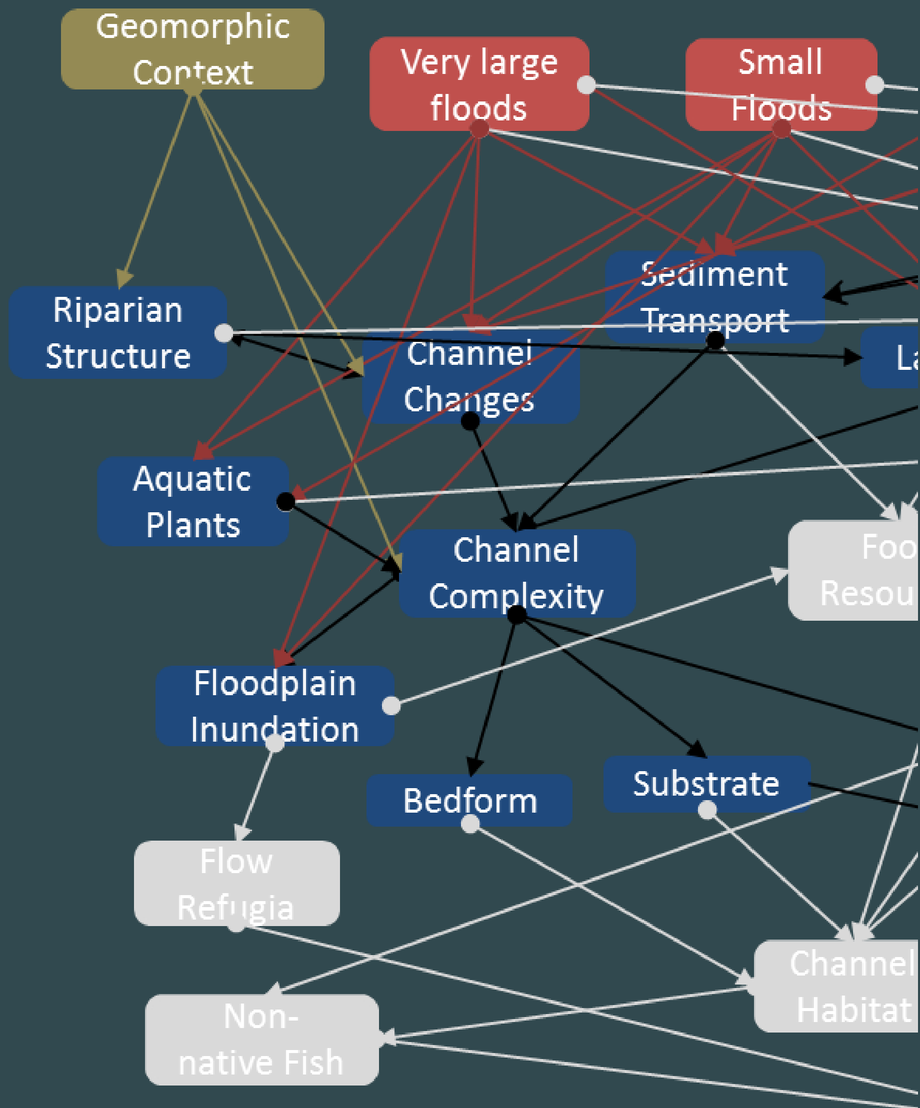
Structured Decision Making Process



Need a predictive model

- Requires scientific information

Structured Decision Making Process



Information Review:

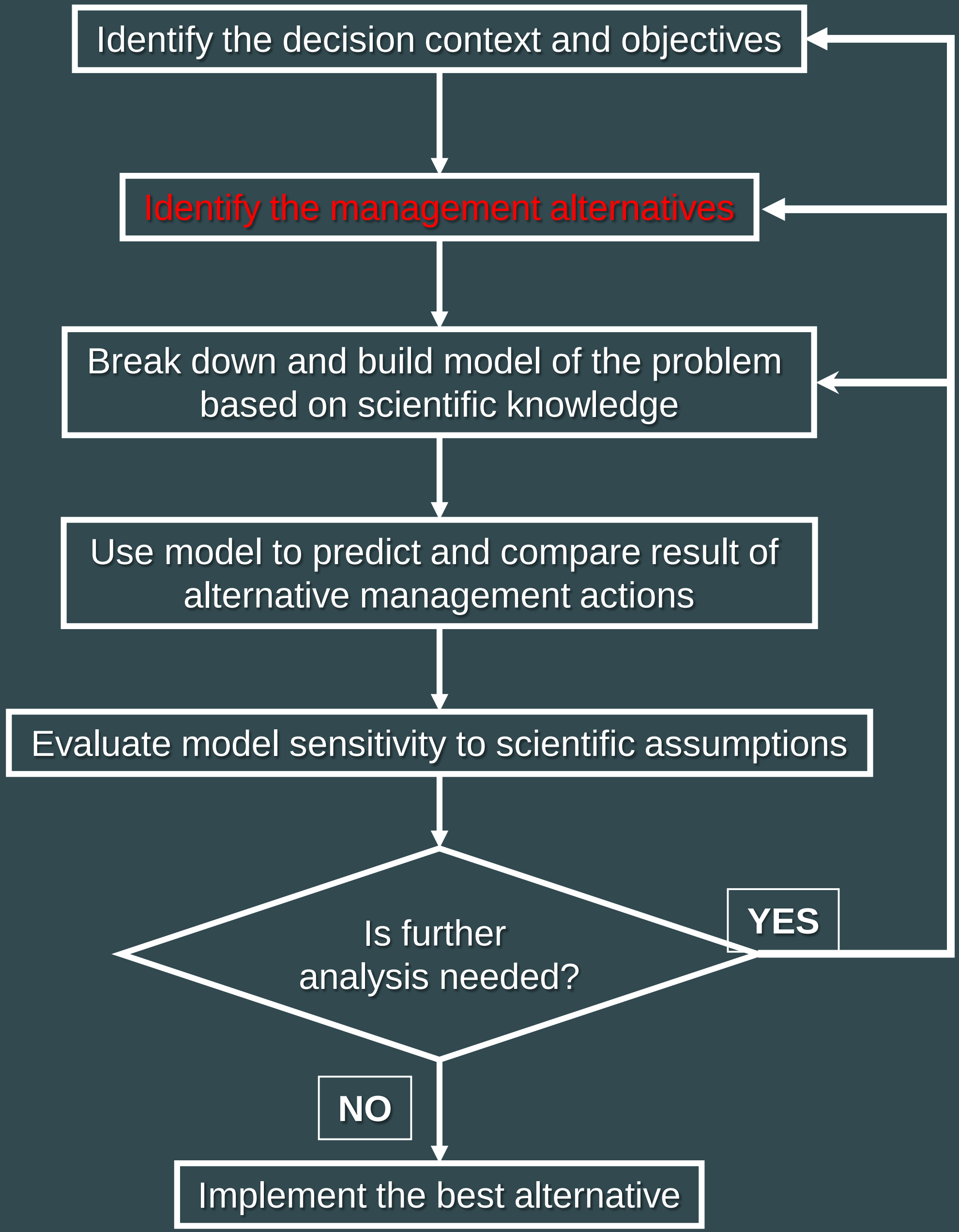
- To define relationships
- Identify knowledge gaps
- Prioritize analyses

Prioritization of Initial Studies

Key Knowledge Gaps & Analyses

- How does inundation/habitat relate to flow?
  - Habitat-flow study (later this morning)
- What is juvenile Chinook habitat?
  - Analysis of juvenile habitat preferences
- How does temperature vary with flow?
  - Thermal mosaic (later this morning)
- How are Chinook and steelhead affected by flow?
  - Recruitment analysis (up next)

Structured Decision Making Process



Management alternatives are rules to guide flow management

Not perfectly controllable

Initial flow scenarios developed

Scenario list – each with specified minimum flows for the mainstem

- BiOp – 2008 Biological Opinion flows
- Lower April – Reduced April minimum flows
- Recession – Gradual spring recession
- Lower April & Recession – Reduced April & Gradual Recession
- Pre-dam low flows – lower flows during summer
- Tributary – tributary minimum flows only

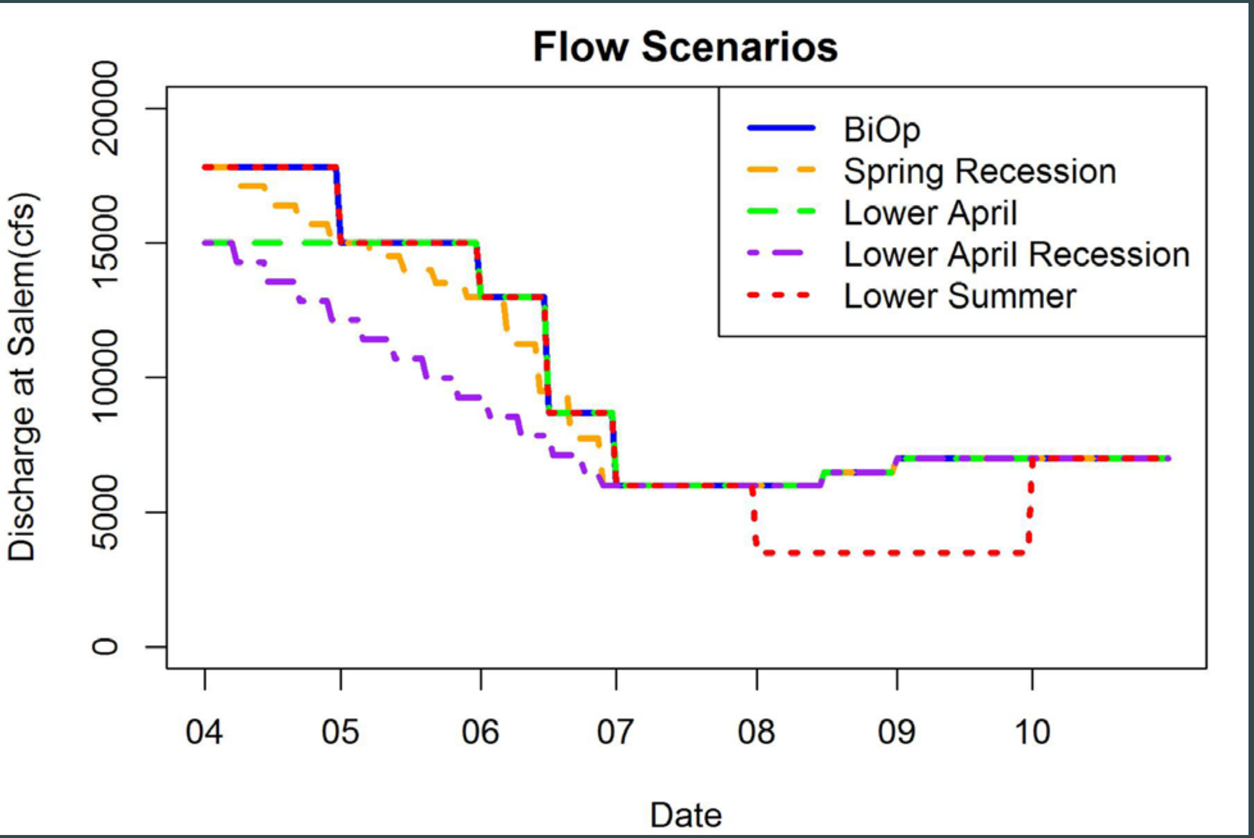
Most scenarios: Lower minimum flows in deficit years

Initial flow scenarios developed

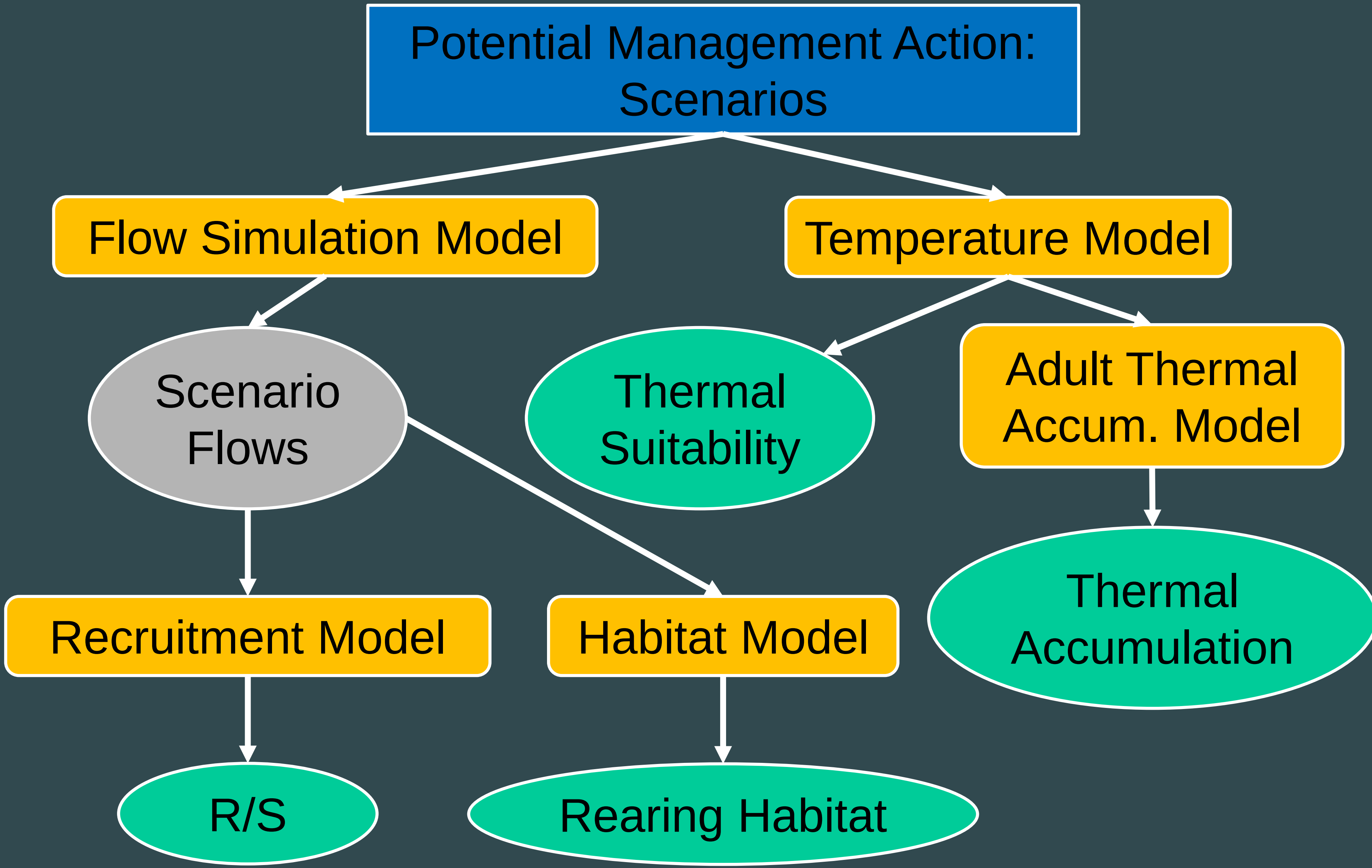
Scenario list BiOp

- Lower April
- Gradual Recession
- Lower April & Gradual Recession
- Pre-dam low flows
- Tributary

Realized flows are different



Initial modeling efforts



Habitat & Recruitment

Preliminary Results

Water Availability	Scenario	Median R/S	Total Spring Habitat
Wet	BiOp	1.00	345%
	Low April	1.02	351%
	Recession	1.00	338%
	Low Apr Rec	1.02	341%
	Tributary	1.02	336%
	Pre-dam low	0.99	345%
Dry	BiOp	0.84	197%
	Low April	0.84	198%
	Recession	0.85	182%
	Low Apr Rec	0.84	191%
	Tributary	0.85	166%
	Pre-dam low	0.83	197%

Increase Relative to 12,000 cfs

Credit: Wallick et al., USGS

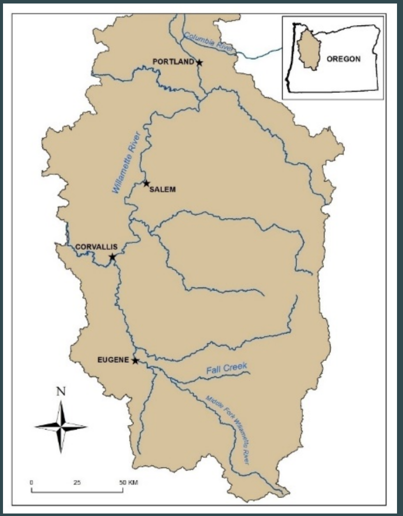
Temperature Results

Preliminary Results

Scenario	Water Type	4/1-5/31	4/15-6/15	6/16-9/30	McKenzie Median Thermal Exposure
2011	Observed	10.5	11.6	18.6	140.3
2015	Observed	15.3	17.7	22	265.8
2015-Low April	Adequate	14.9	16.9	21.7	252.1
2015-Recession	Adequate	14.9	17.0	21.7	256.6
2015-Rec & Low April	Adequate	15.0	17.0	21.7	260.7
2015-Low April	Deficit	14.8	16.9	22.4	262.9
2015-Recession	Deficit	15.2	17.3	22.3	258.7
2015-Pre-dam low	Deficit	14.9	16.9	22.7	263.7

Credit: Rounds and Buccola, USGS

Next Steps



Instream Flows

- Develop and review additional scenarios
- Integrate hydrology and temperature models
- Include tributary responses
- Include additional ecosystem objectives:
    - Native fishes, mussels, lamprey
    - Native amphibians
    - Native riparian plants
    - Western pond turtle

Next Steps

Instream Flows

- Identify key uncertainties:
  - Fish movement responses
  - Off channel habitat and flow
- Adaptive management
  - Predict responses to actions
  - Monitor and compare to predictions
  - Learn how the system works
  - Improve management

Water Allocation

- Instream flows and other uses reviewed
- See Willamette Basin Review for more details

Acknowledgements

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Jodie Lemmer
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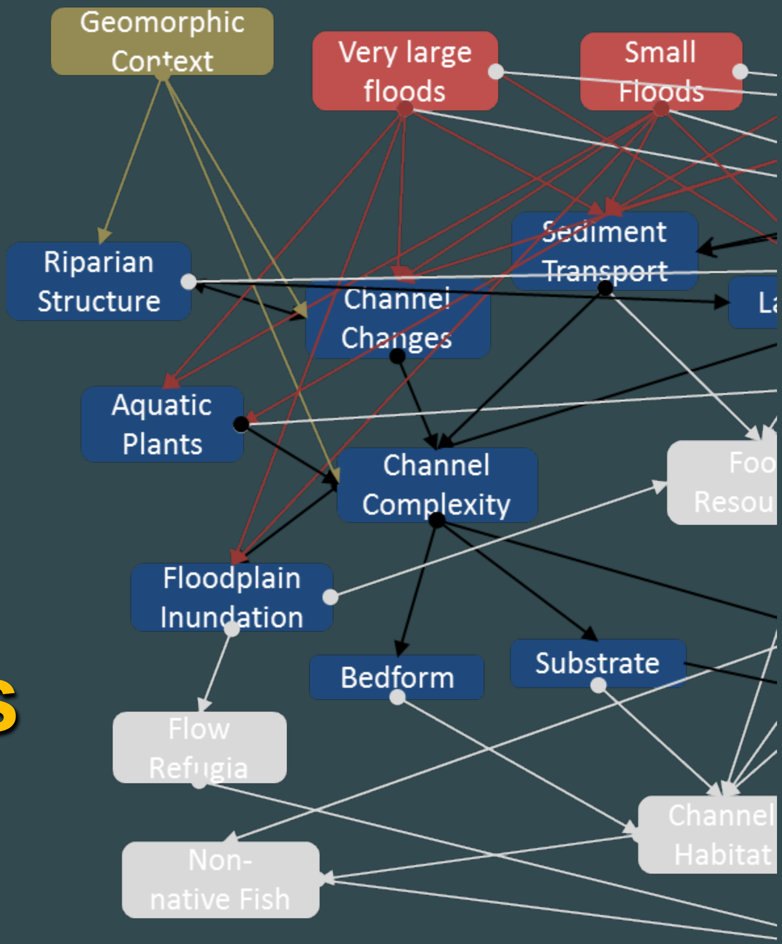

Geomorphic Context
Very large floods
Small Floods
Sediment Transport
Riparian Structure
Channel Changes
Aquatic Plants
Channel Complexity
Floodplain Inundation
Bedform
Substrate
Flow Refugia
Non-native Fish
Channel Habitat

Questions

Results Summary – In Progress

Preliminary Results – For Illustration Only

Metric	BiOp	1	2a	3a	7	8	Change relative to BiOp
R/S (wet)	x	+	+	+	+	-	+ > 0.02 < -
R/S (dry)	x	0	+	0	+	-	+ > 0.02 < -
Habitat (wet)	x	+	-	0	-	0	+ > 2% < -
Habitat (dry)	x	0	0	-	-	0	+ > 2% < -
Ranks, 1= best							
Temps (adequate)		1	2	3			
Temps (deficit)		1.5	3	1.5			
Thermal expos (adequate)			1	2			
Thermal expos (deficit)		1				2	