Evolution and overview of EFlows assessment principles and methodologies

Workshop

Environmental Flow Assessments and Implementation: An International Perspective

Exchanging Indian, European and International Experiences

Delhi, India

October 2019

Cate Brown
Southern Waters
South Africa

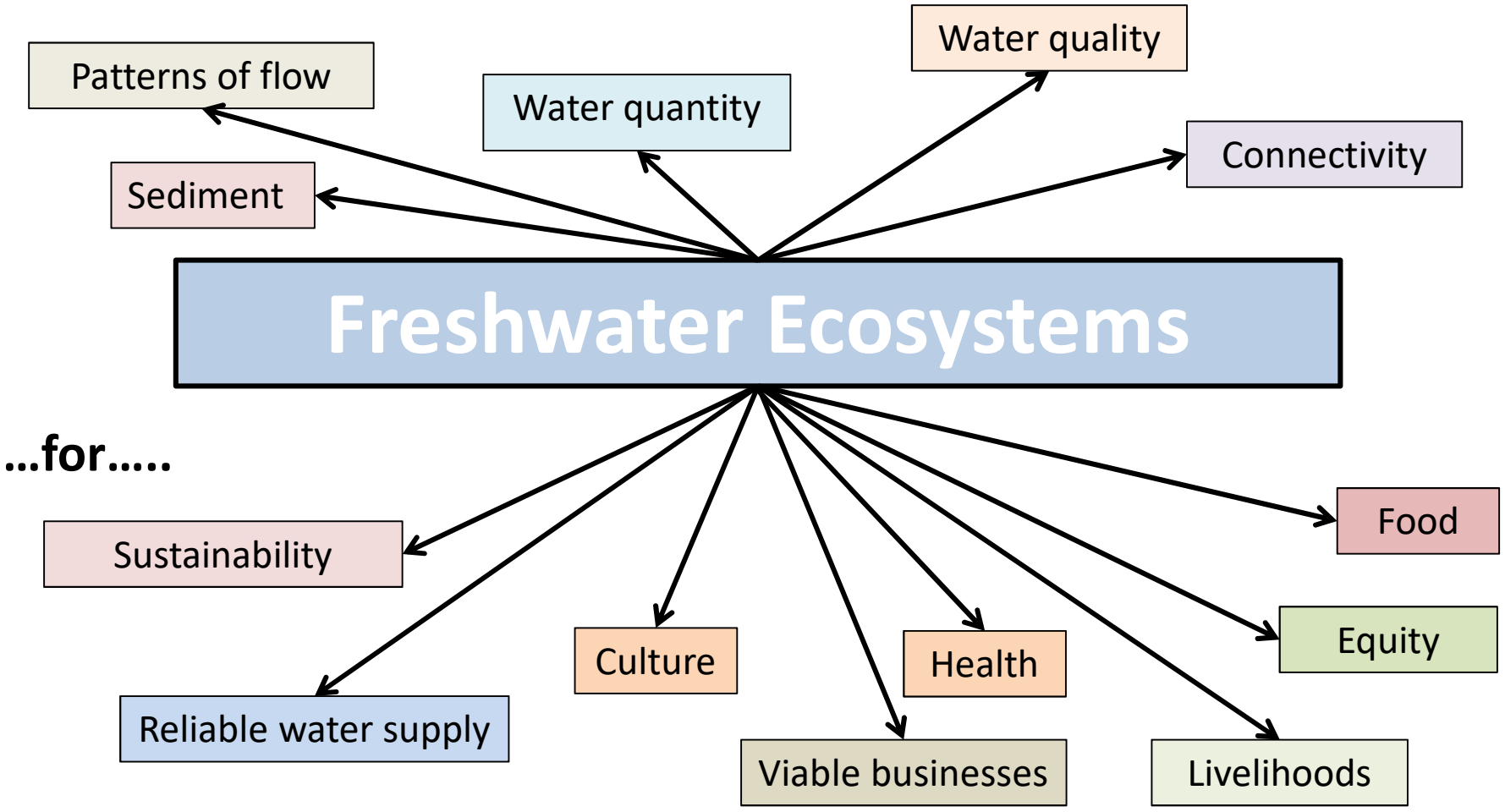
INDIA-EU WATER PARTNERSHIP

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by giz

NAMAMI GANGE

Environmental Flows emerged to guide ecosystem health



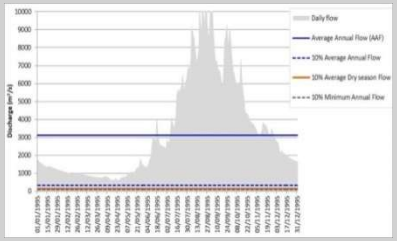
Supporting the systems that support us

1970

Evolution of EFlows discipline

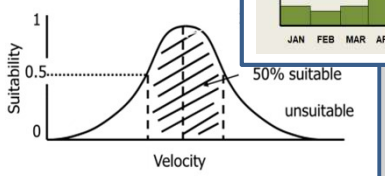
2020

Hydrological
$Q_{95;}$ 10% AAF

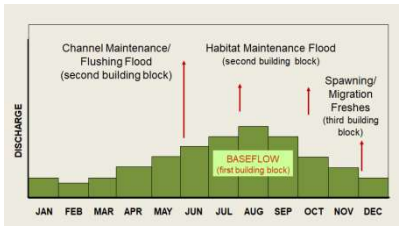


Hydraulic
Wetted perimeter

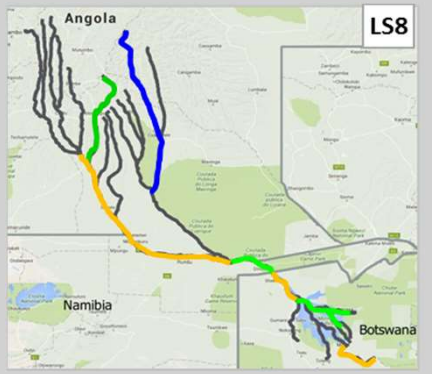
Habitat ra
IFIM; PHAE



Holistic
BBM; Benchmarking



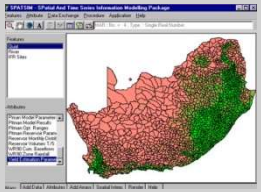
Ecosystem/social models
DRIFT; RANA-ICE, CaSiMiR



Forces pushing:

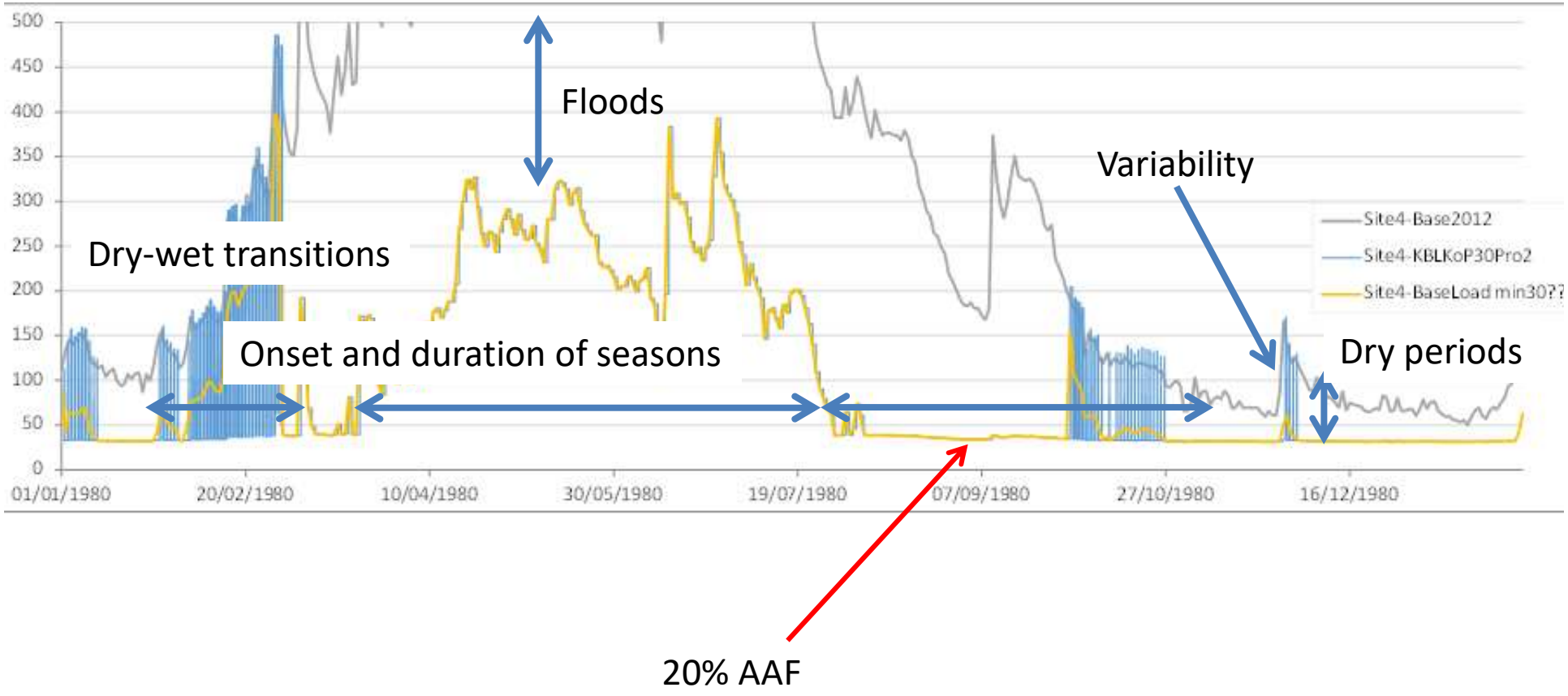
- Black box
- Ecosystems
- Social concerns
- Negotiations
- Capacity building
- Monitoring targets

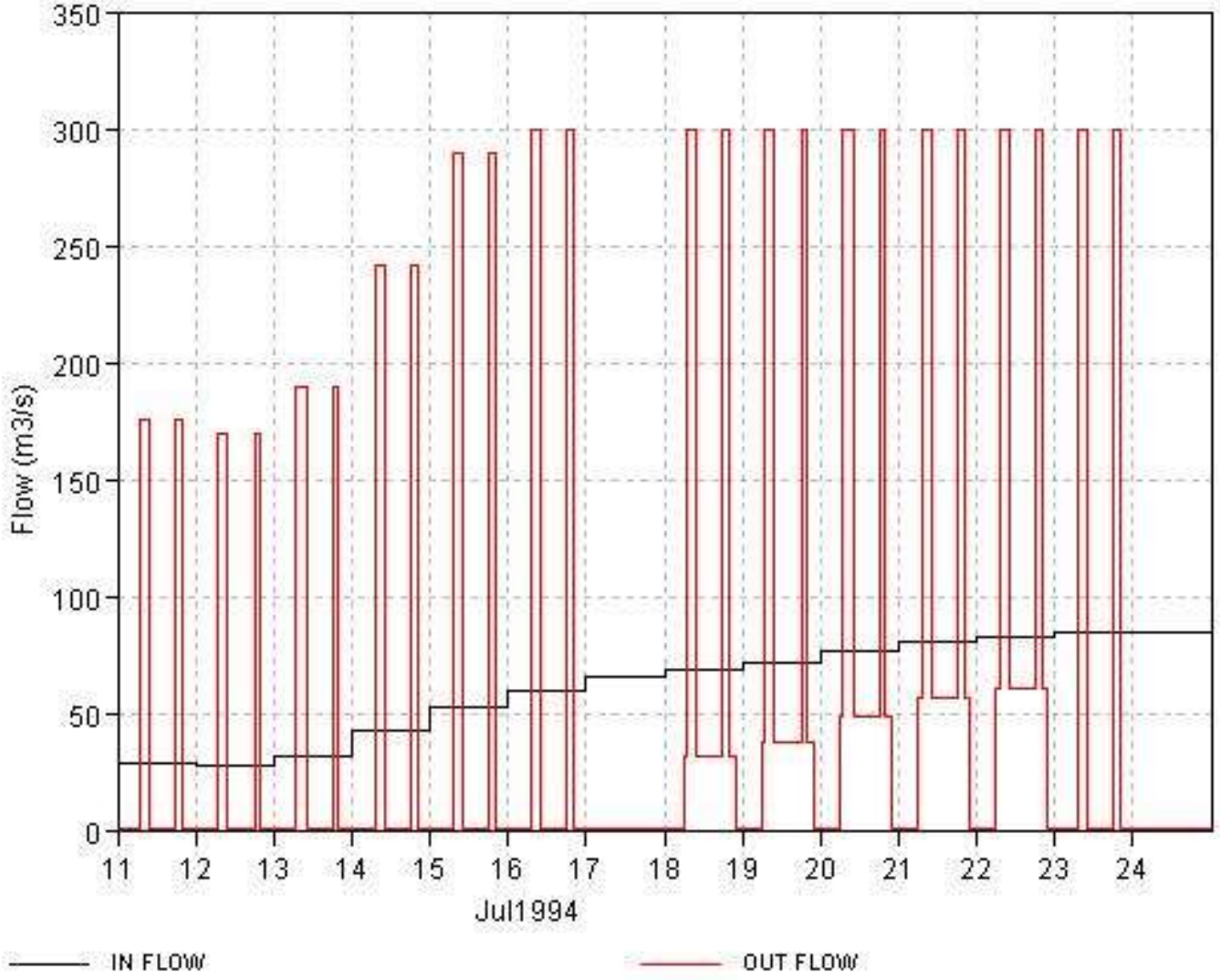
Rapid Frameworks
Desktop; ELOHA



Hydrological methods:

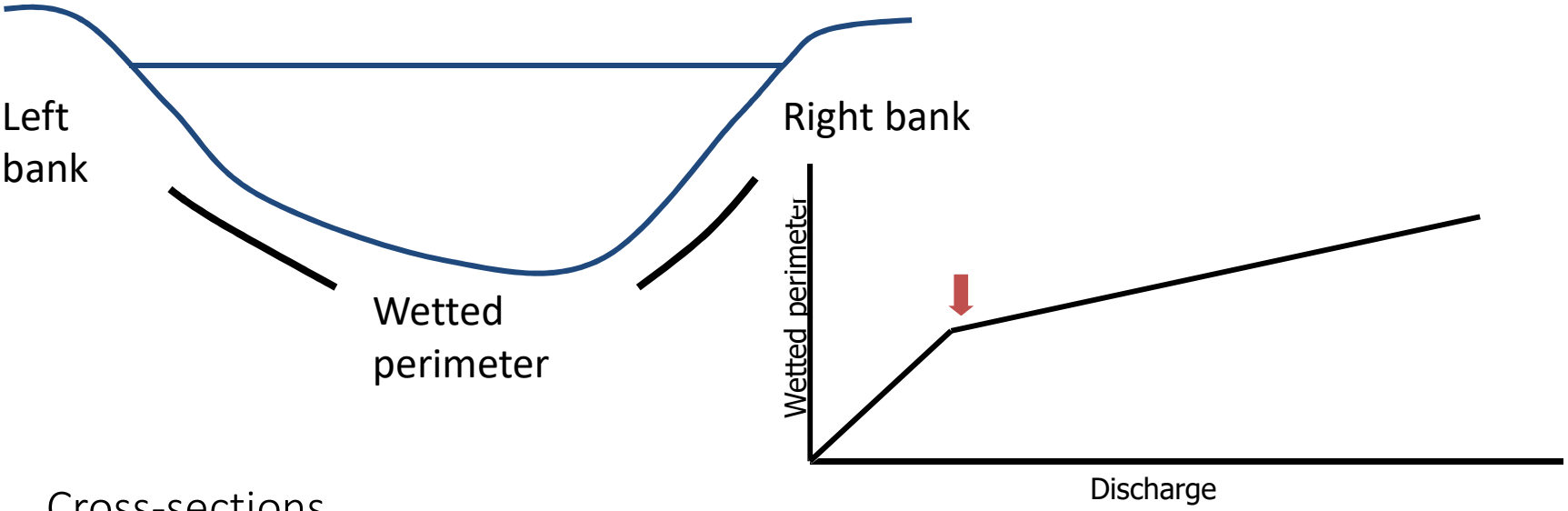
e.g., %AAF rule




350
300
250
200
150
100
50
0
Flow (m3/s)
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Jul1994
IN FLOW
OUT FLOW

Hydraulic-rating methods:

e.g., Wetted perimeter method

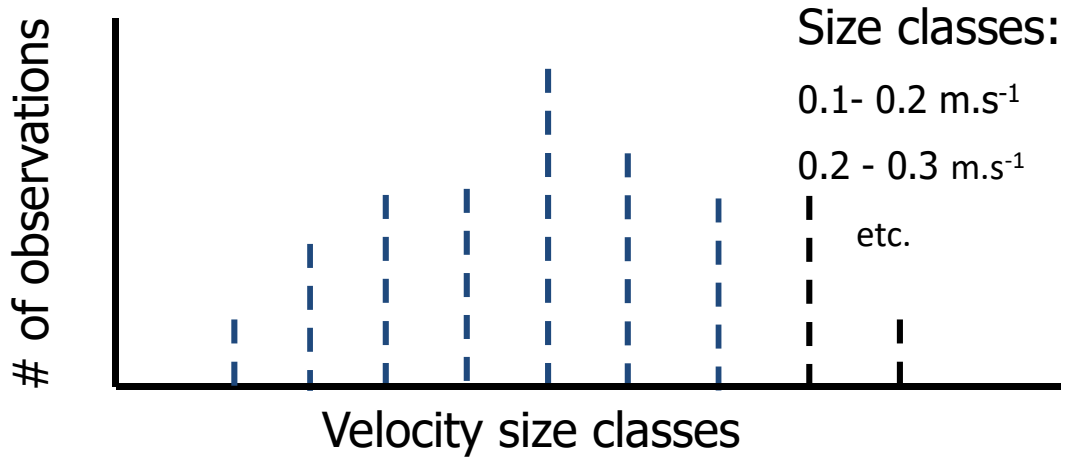


- Cross-sections
- Create wetted perimeter vs discharge plot
- Look for inflection point - assumes this is where area of aquatic habitat starts to decline rapidly
- BUT:
  - there may be more than one inflection point
  - does not reveal details of habitat

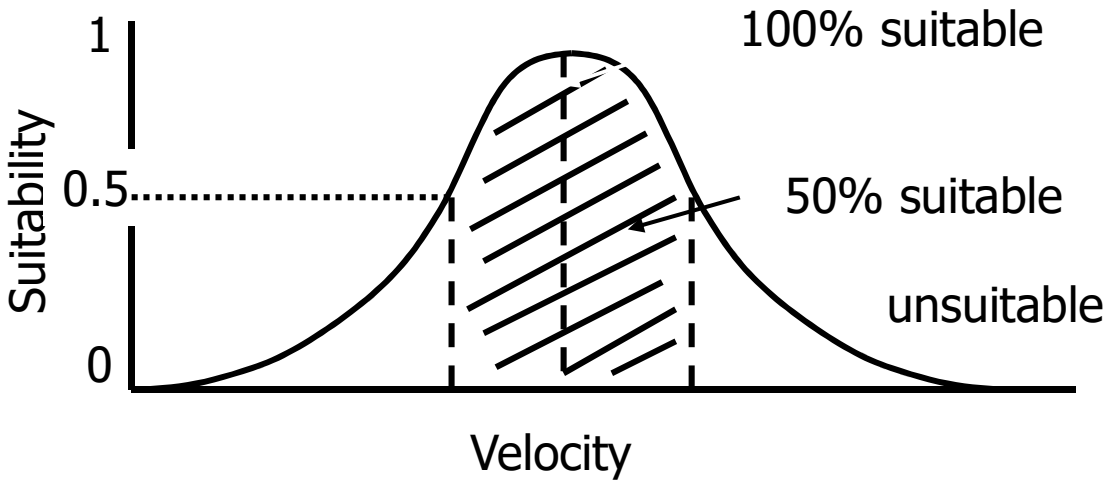
Habitat-rating methods

e.g. Instream Flow Incremental Methodology (IFIM)

Allocate values to size classes and create a frequency plot



4. Normalise by allocating value of 1 to the highest frequency class

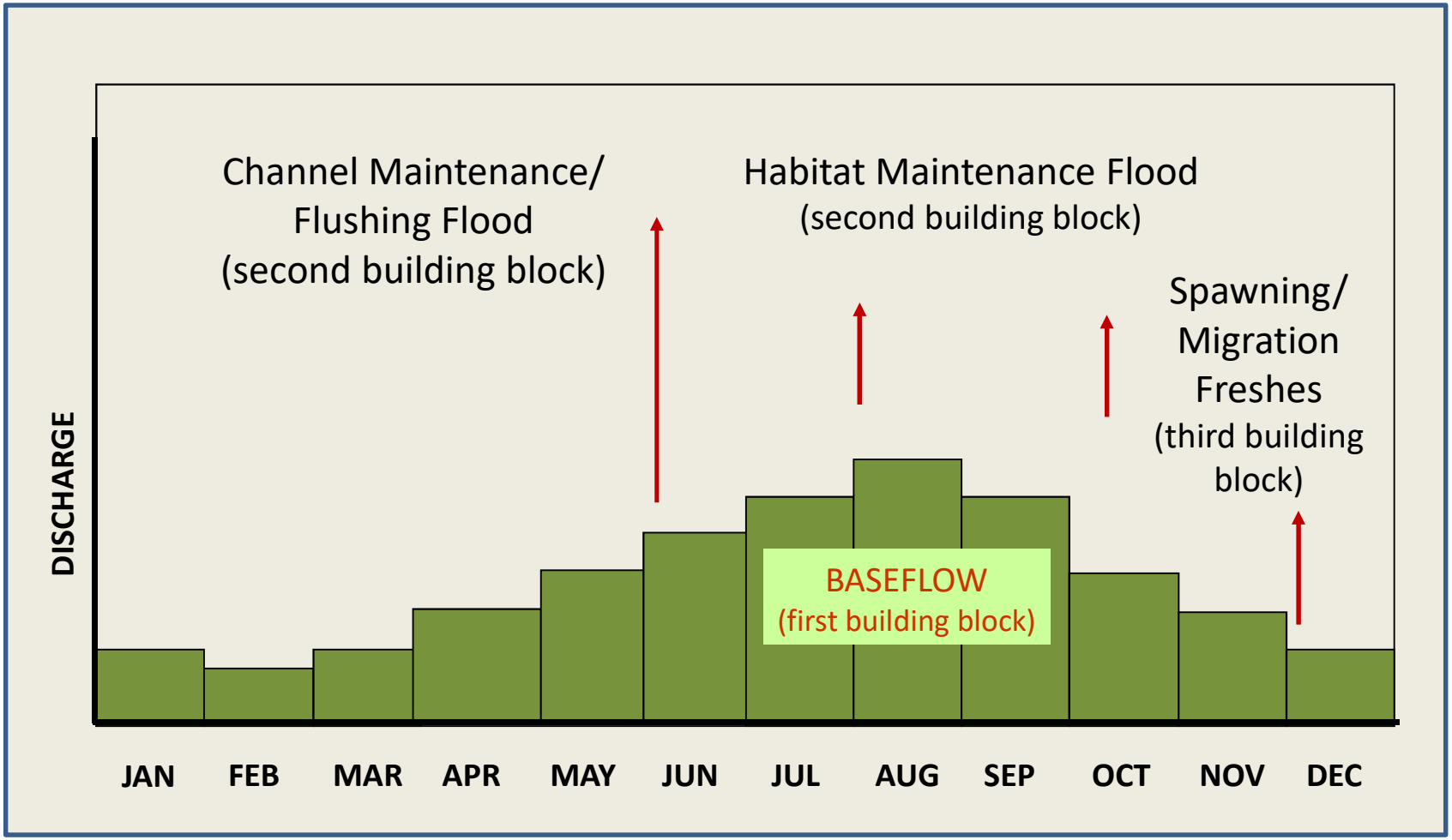


This is an SI (Suitability Index) curve describing the current speed in which a named species was most often found

Holistic Methods:

e.g., Building block methodology

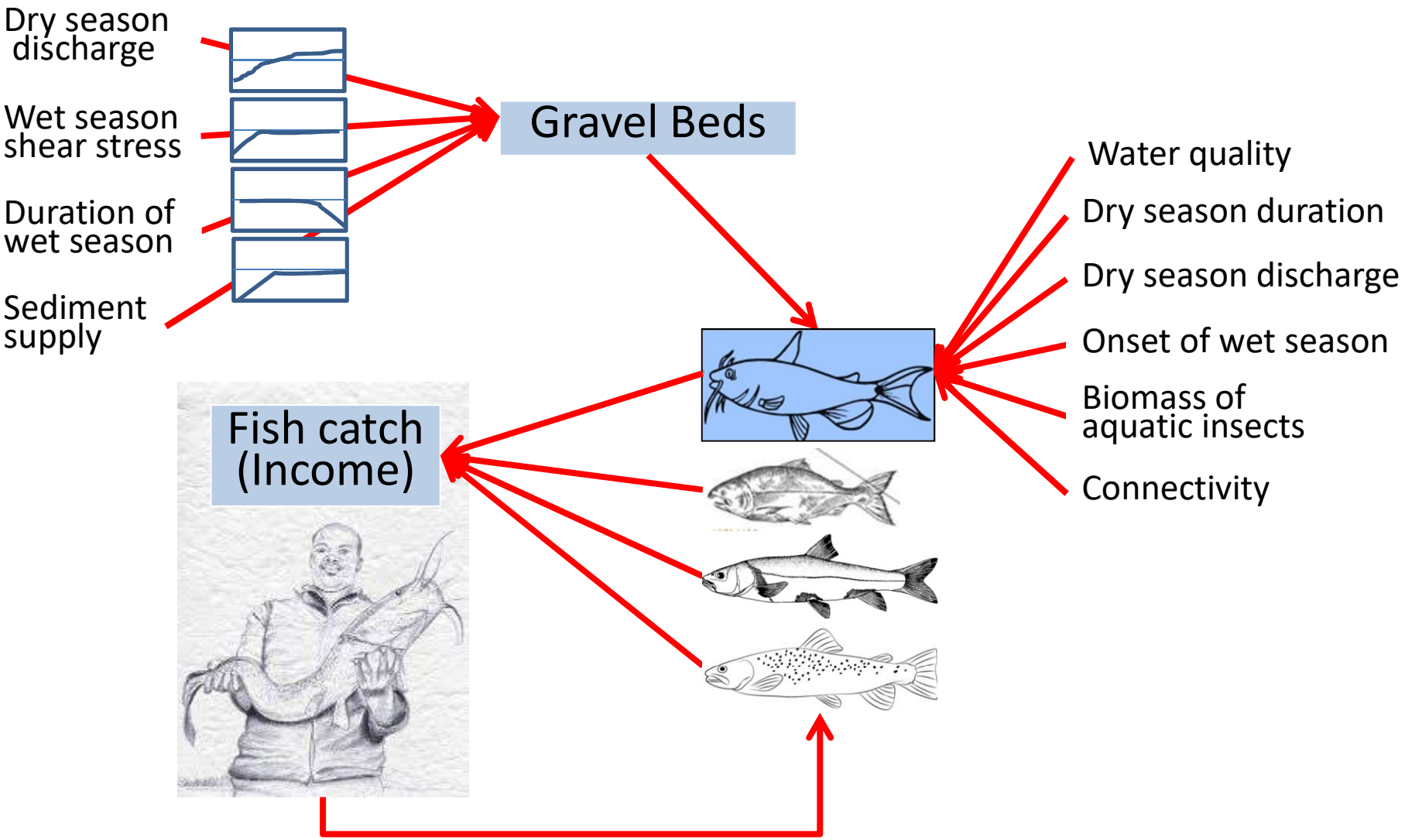
- Based on expert opinion
- Uses a team of biophysical specialists *(hydrology, hydraulics, fluvial geomorphology, water chemistry, vegetation, invertebrates, fish, water birds, social)*
- Focuses on discrete flow events to support habitat and biota in a given condition


Channel Maintenance/
Flushing Flood
(second building block)
Habitat Maintenance Flood
(second building block)
Spawning/
Migration
Freshes
(third building
block)
BASEFLOW
(first building block)
DISCHARGE
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

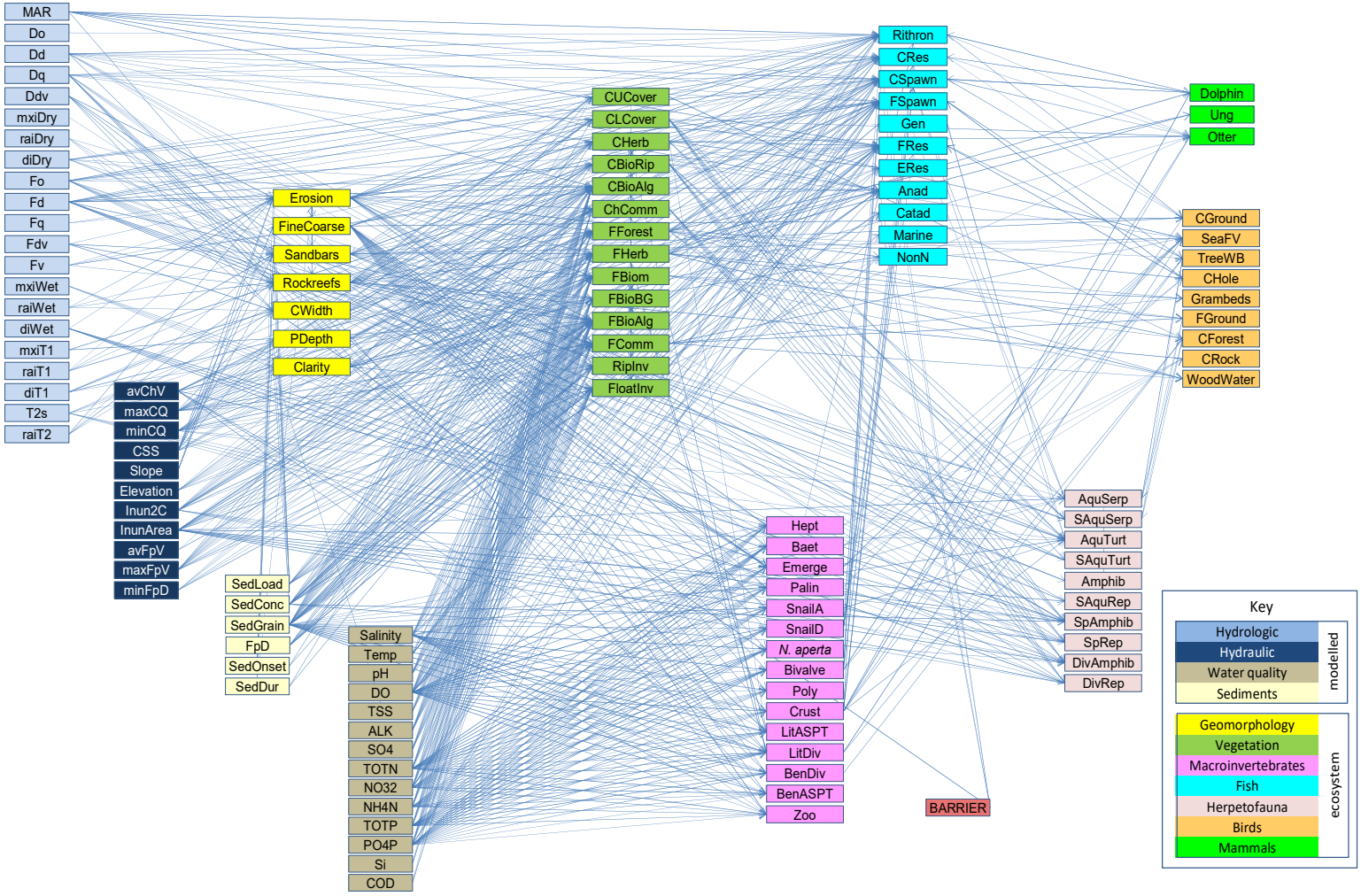
Eco-social Model Methods:

e.g., DRIFT

- Incorporates aspects of Wetted perimeter, IFIM and BBM
- Time-series based – responds to temporal changes
- Does not recommend an EFlows regime
- Aims to answer “What if” questions
- Defines relationships between suite of driving and responding indicators

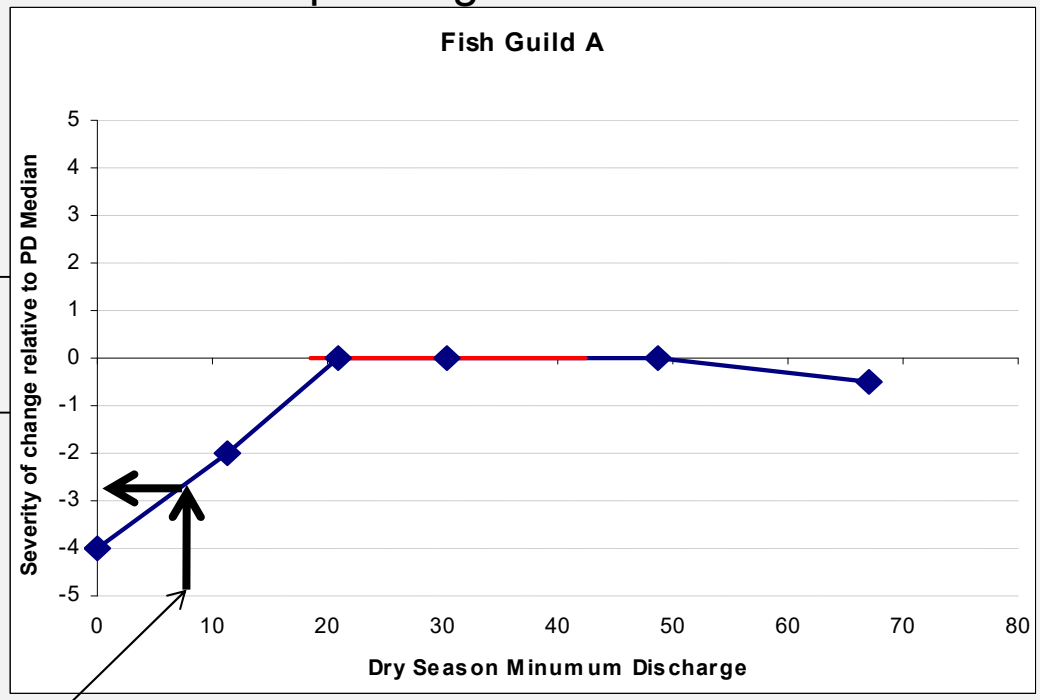

Dry season discharge
Wet season shear stress
Duration of wet season
Sediment supply
Gravel Beds
Water quality
Dry season duration
Dry season discharge
Onset of wet season
Biomass of aquatic insects
Connectivity
Fish catch (Income)

A simplified eco-social model that is true to the complexity of river ecosystems and social uses



External modelled time series

Each responding indicator

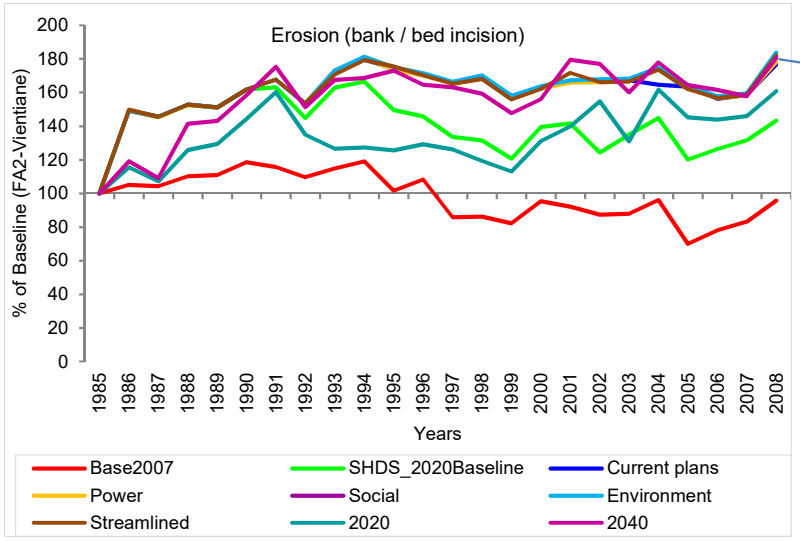


Transformed into time series of driving indicators

Curves combined using multi-criteria decision analysis procedures

Scenario: Dry season minimum discharge for each year

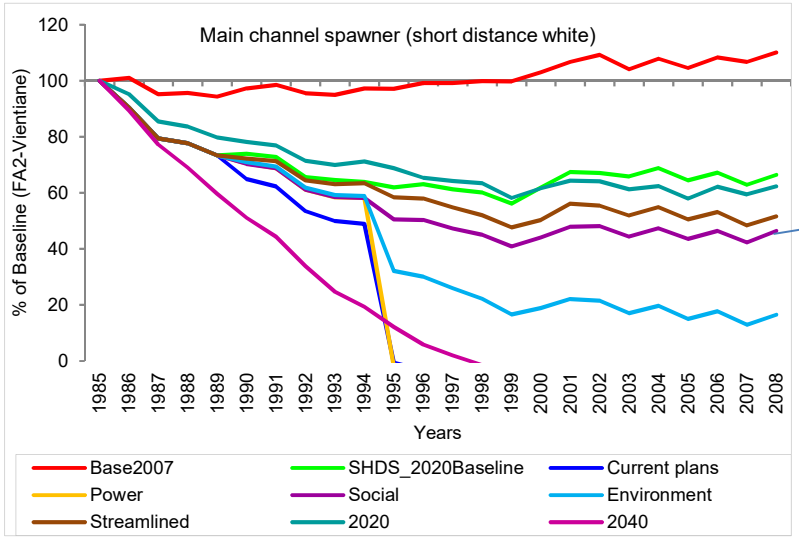
DRIFT basic output is annual time series of relative change per indicator



80% increase in erosion

‘Health’ of overall Habitat

B → D



50% reduction in white fish

Health of fish community

C → E

A Natural

B

C Moderately modified

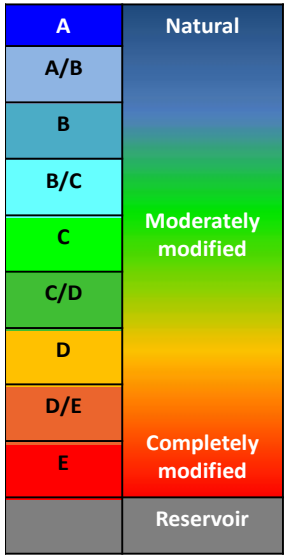
D

E Considerably modified

Scenarios: impacts of development (*or restoration*) on whole ecosystem condition

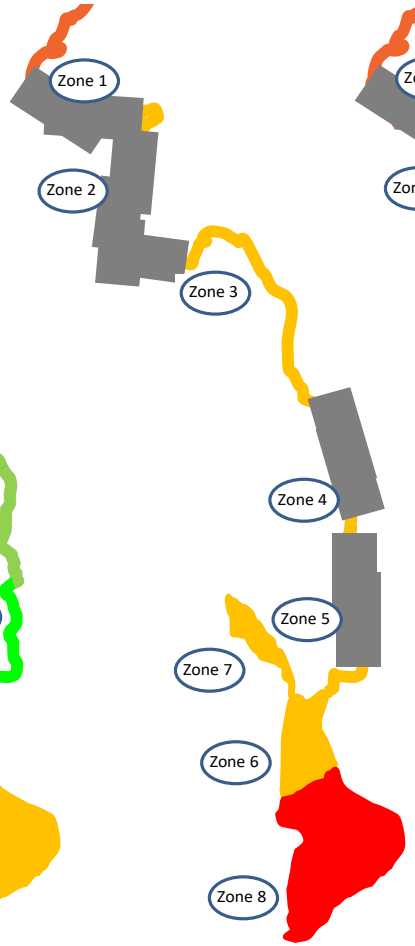
Baseline

Existing and planned development

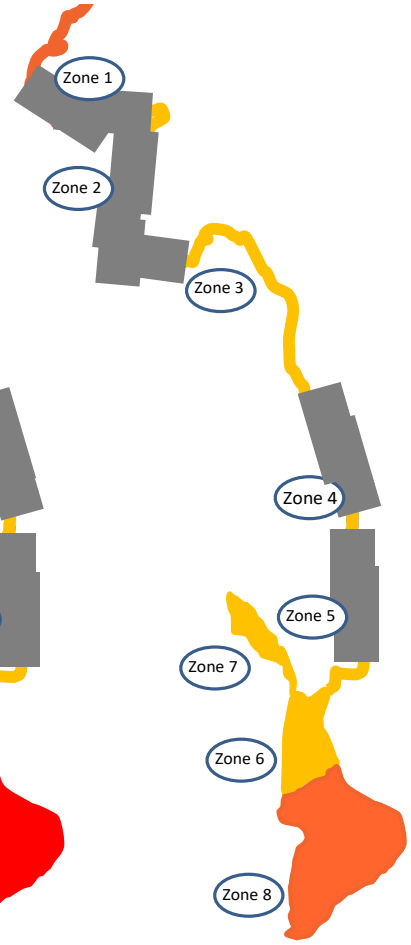


Baseline

MOD

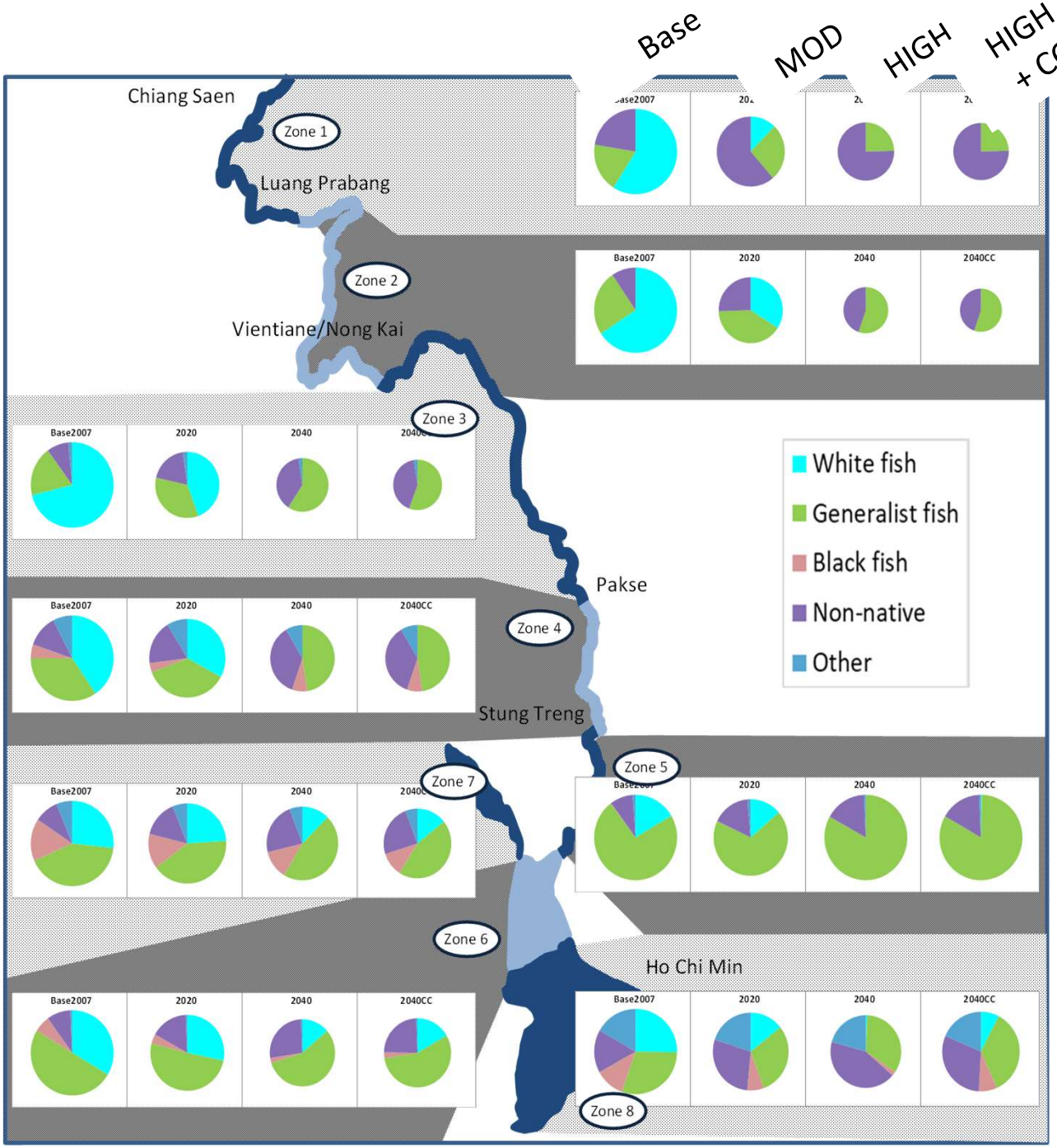


HIGH

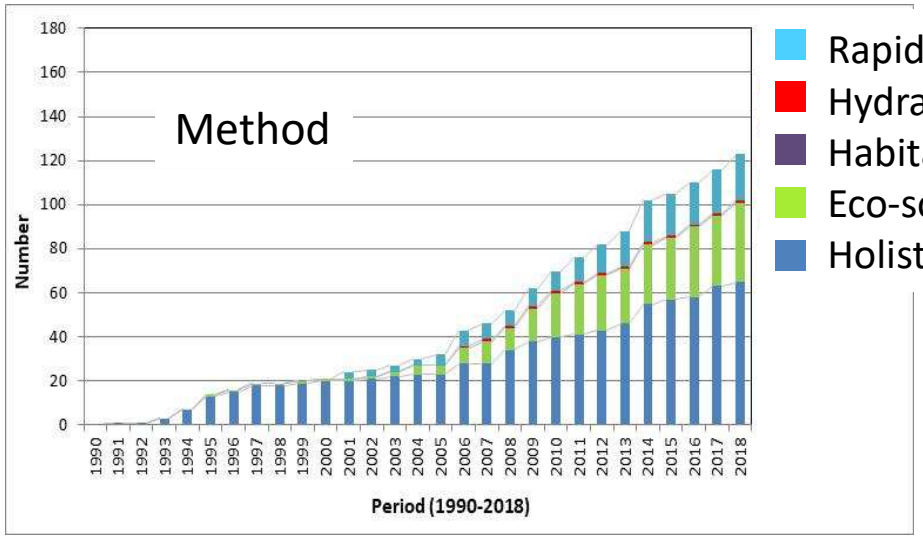


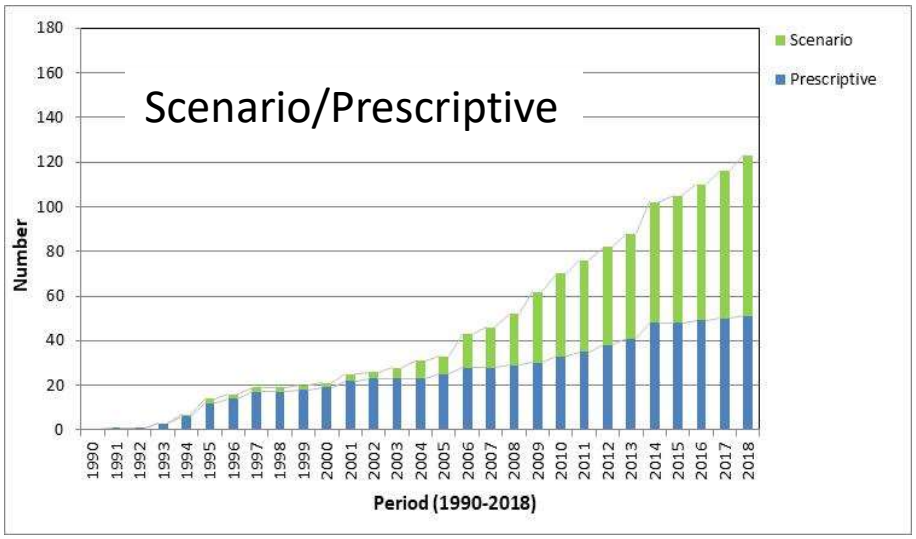
HIGH plus CC

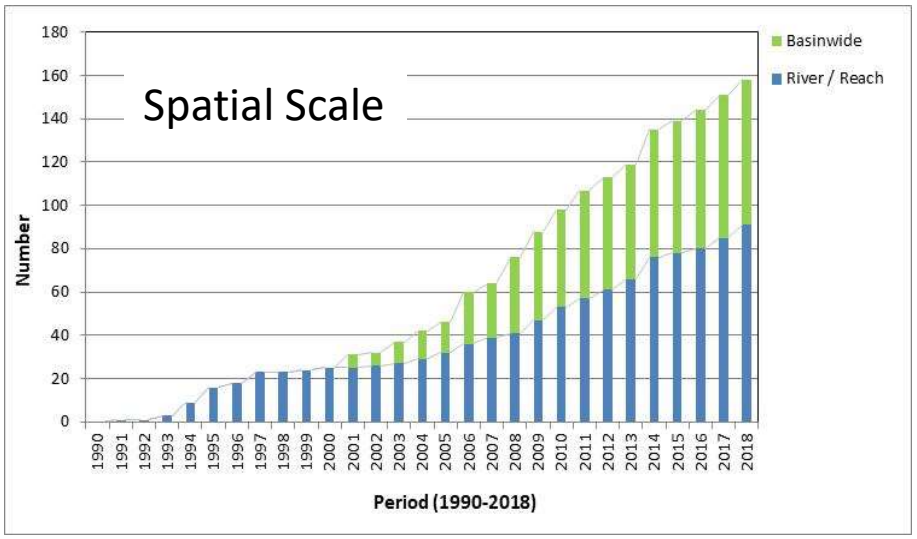
... and on individual resources



Trends in EFlows Assessment in Southern Africa



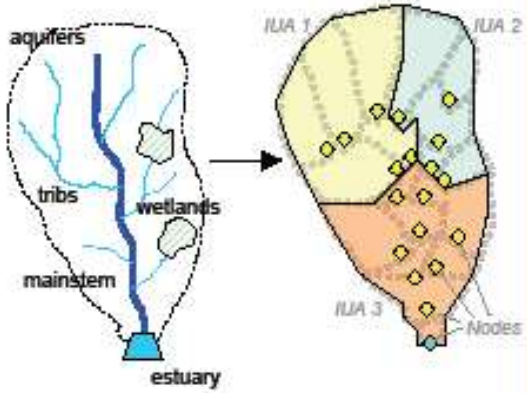




SOUTH AFRICAN WATER RESOURCE CLASSIFICATION SYSTEM (WRCS)

1. Delineate the catchment

'Integrated Units of Analysis' with nested sub-units ('Nodes')

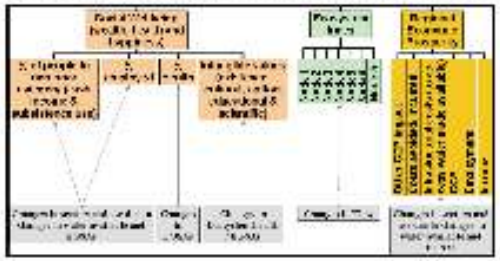


2. Link economic + social value to ecosystem condition and water use

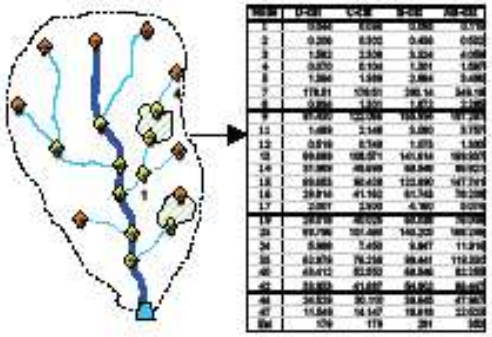
Outcome: a set of quantitative relationships that specify how different levels of

- *water use,*
- *ecological integrity, and*
- *ecosystem goods and services*

*affect **economic value** and **social wellbeing**.*

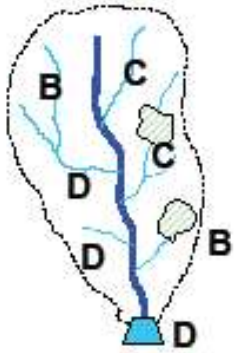


3. Quantify the *Ecological Water Requirements* at each node



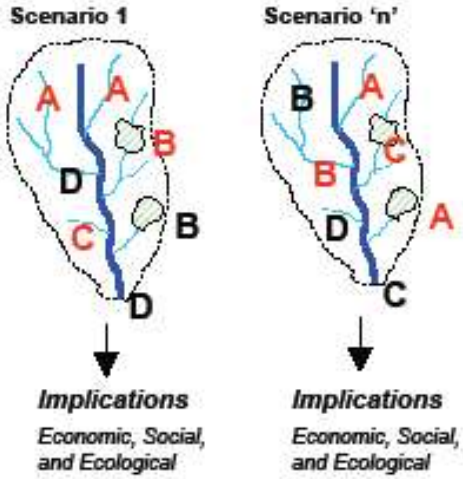
Outcome: Table of EWRs for each node at varying levels of ecological integrity (AB, B, C ,D)

4. Set a 'baseline configuration' for ecological sustainability…



…then generate scenarios.

5. Evaluate scenario implications



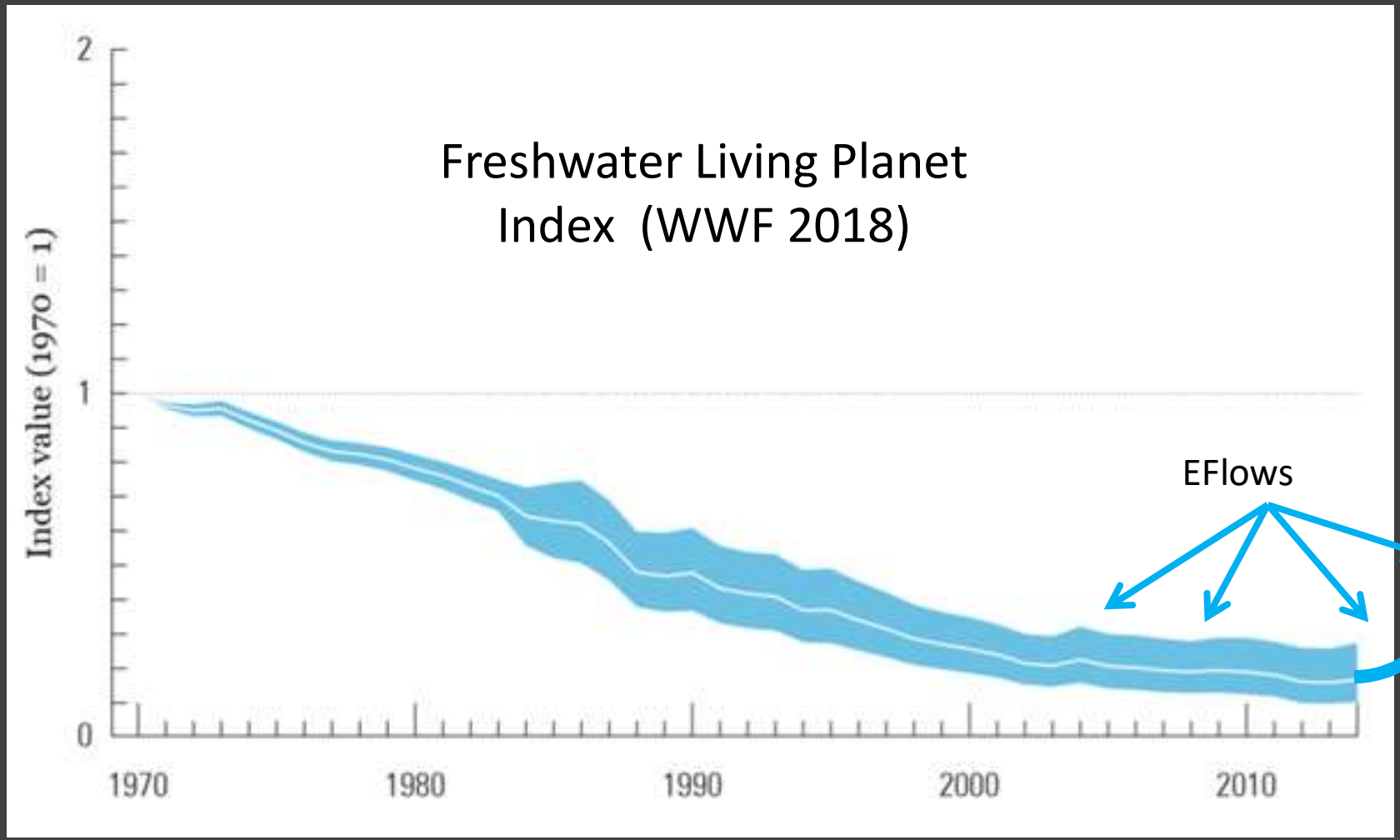
6. Stakeholder workshops

Stakeholders comment on the scenarios and their implications, and may also generate new options for consideration.

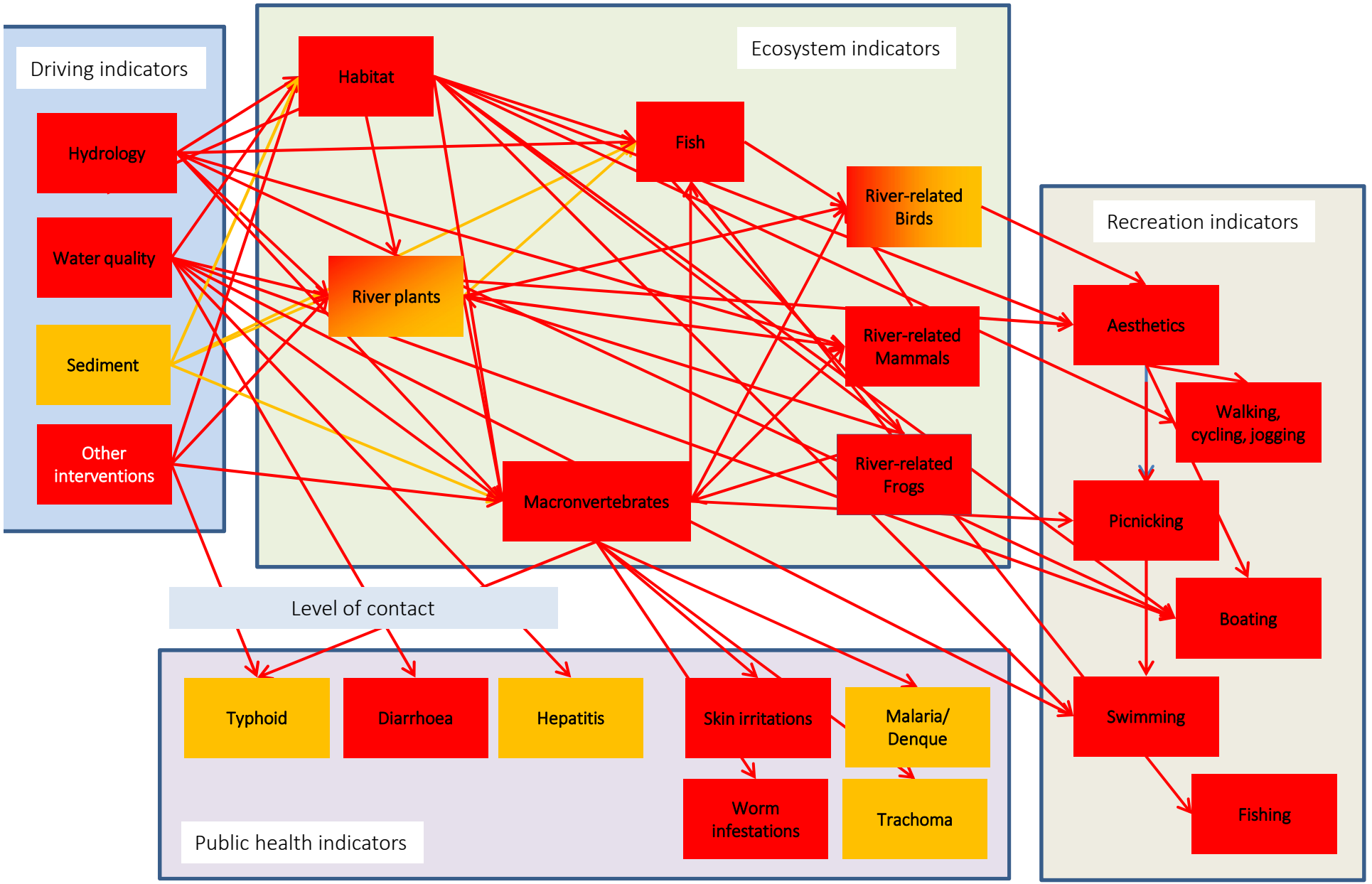
7. Select the preferred configuration of IUA Classes and Node categories

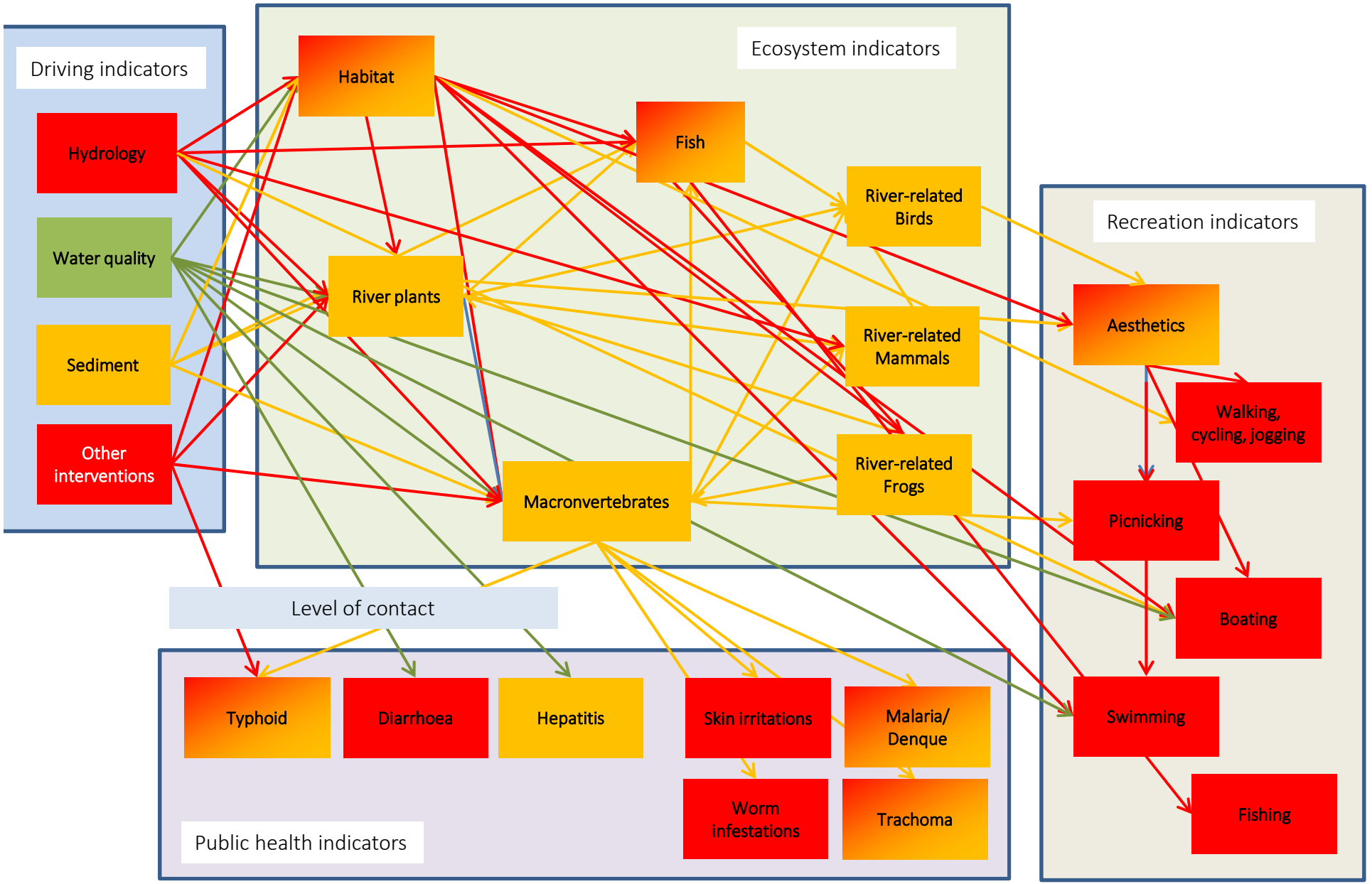
These become legally binding when published in the Government Gazette

Thank you



WWF. 2018. Living Planet Report - 2018: Aiming Higher. Grooten, M. and Almond, R.E.A. (Eds). WWF, Gland, Switzerland.


Driving indicators
Hydrology
Water quality
Sediment
Other interventions
Ecosystem indicators
Habitat
Fish
River-related Birds
River plants
River-related Mammals
Macronvertebrates
River-related Frogs
Recreation indicators
Aesthetics
Walking, cycling, jogging
Picnicking
Boating
Swimming
Fishing
Level of contact
Typhoid
Diarrhoea
Hepatitis
Skin irritations
Malaria/ Denque
Worm infestations
Trachoma
Public health indicators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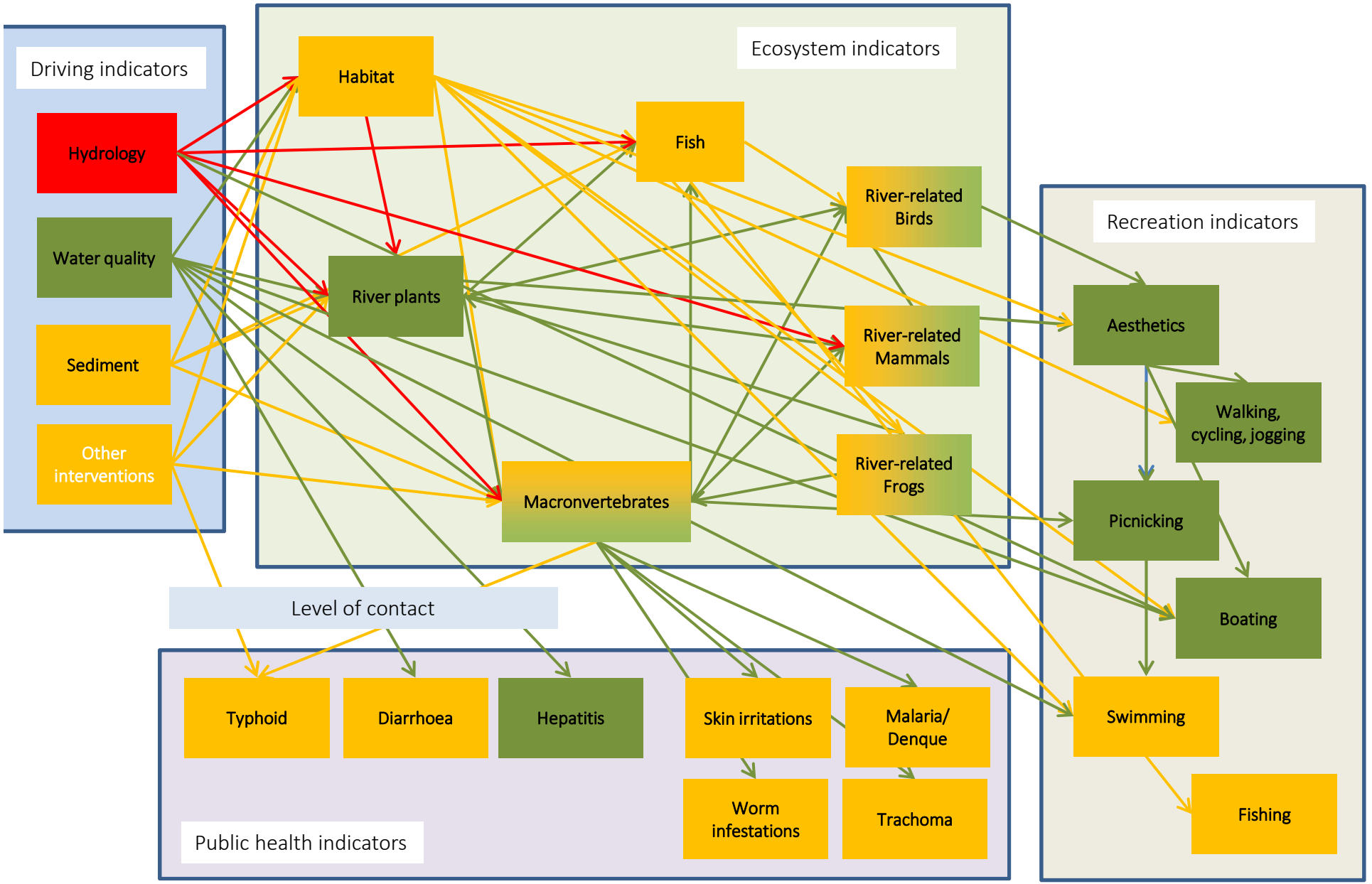
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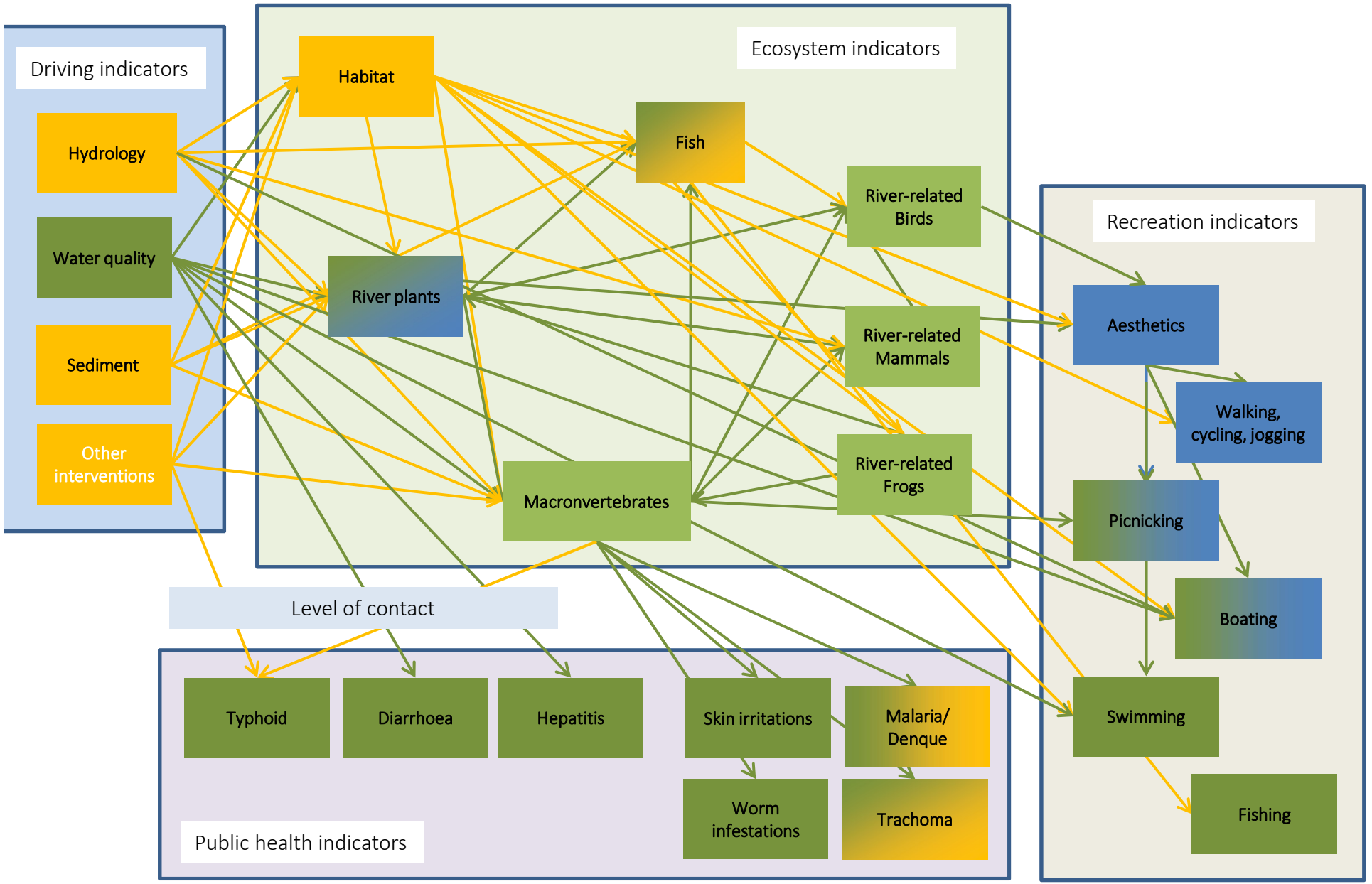
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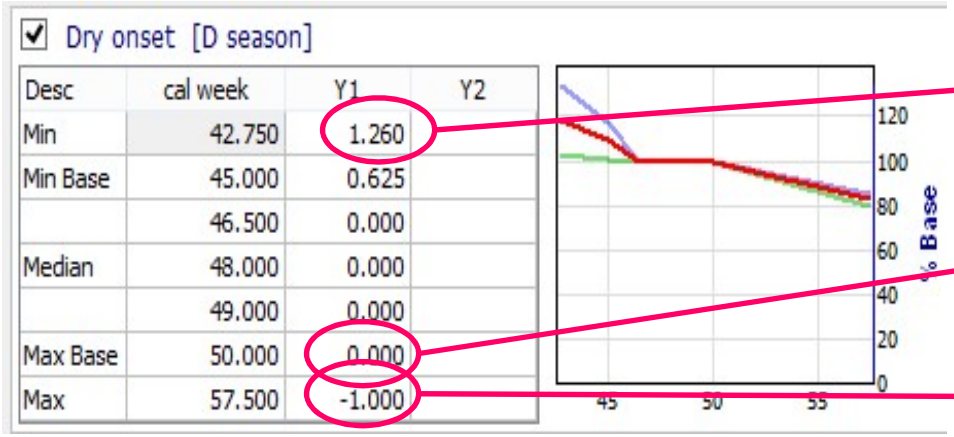
Rhithron fish vs onset of dry season



6 weeks earlier median
c. 15% increase

2 weeks later median
No change

10 weeks later median
c. 15% decrease

The onset of the dry season represents a time rhithron species are able to migrate to shallower areas with suitable substrate for spawning, earlier onset allows the fish greater time to migrate but late onset can disrupt spawning migration and maturation. Also if dry season starts earlier, it beneficial as fish can mature in less stressful conditions prior to spawning.